



Non-Pharmacological Interventions for Bone Health in Postmenopausal Women and Patients with Rheumatoid Arthritis: A Structured Narrative Review

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Abstract

Background: Postmenopausal women and people with rheumatoid arthritis face accelerated bone loss and higher fracture risk through overlapping mechanisms including estrogen deficiency and chronic inflammation. Given limitations and adverse effects of long-term pharmacotherapy, effective non-pharmacological strategies are needed. This review summarizes recent evidence on lifestyle, exercise, nutritional, educational, behavioral, and multicomponent interventions to preserve bone health.

Materials and Methods: We conducted a structured search of PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar for English-language studies through 31 December 2025. Eligible studies evaluated non-pharmacological interventions in postmenopausal women or adults with rheumatoid arthritis (RA). Screening, data extraction, and quality appraisal used validated, design-specific tools. Because of clinical and methodological heterogeneity, findings were synthesized narratively.

Results: Fourteen studies met inclusion criteria. In postmenopausal women, structured exercise—especially high-intensity resistance and impact-loading programs—most consistently preserved or increased bone mineral density (BMD) at the lumbar spine and femoral neck. In RA, exercise yielded clearer improvements in muscle strength, lean mass, and physical function than in BMD, indicating mainly functional benefits. Calcium and vitamin D had modest effects, chiefly attenuating loss among those with low baseline intake or deficiency. Educational and behavioral interventions improved osteoporosis knowledge, self-efficacy, and adherence to preventive behaviors but showed limited direct BMD impact. Limited data suggest combining exercise with nutritional optimization may provide additive bone benefits in postmenopausal women.

Conclusion: Non-pharmacological approaches provide population-specific benefits. Exercise most effectively improves BMD in postmenopausal women, while in RA it more consistently enhances physical function than skeletal outcomes. Individualized, multimodal programs combining exercise, nutrition, and behavioral support may best preserve bone health and reduce future fracture risk.

Key Words: Bone Mineral Density, Postmenopausal Women, Osteoporosis, Rheumatoid Arthritis.

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1- INTRODUCTION

Osteoporosis is a highly prevalent metabolic bone disorder characterized by reduced bone mass and microarchitectural deterioration, resulting in skeletal fragility and increased risk of low-trauma fractures (1, 2). Its global burden is rising with population aging, contributing substantially to disability, healthcare costs, and mortality (1, 3).

Postmenopausal women are a major high-risk group for primary osteoporosis because estrogen deficiency accelerates bone turnover by increasing osteoclast activity and shifting remodeling toward bone resorption rather than formation (4, 5). Modifiable factors such as inadequate calcium and vitamin D intake, physical inactivity, and poor physical conditioning further contribute to bone loss, underscoring the importance of non-pharmacological intervention (2, 6, 7).

Patients with rheumatoid arthritis (RA) are also at increased risk of osteoporosis and fragility fractures, as chronic systemic inflammation, inflammatory cytokines, reduced physical activity, and glucocorticoid exposure adversely affect bone remodeling (8–12). Although both populations experience increased skeletal fragility, the underlying biological mechanisms differ substantially and may influence responses to non-pharmacological interventions.

Non-pharmacological strategies—including structured exercise, adequate calcium and vitamin D intake, fall prevention, and behavioral or educational interventions—are increasingly recognized as integral to bone health management and osteoporosis prevention (13–15). Exercise-based approaches, particularly resistance and weight-bearing or impact-loading modalities, are recommended to preserve or enhance bone mineral density (BMD) and physical performance in

postmenopausal women; however, in patients with rheumatoid arthritis (RA), their benefits are more consistently reflected in improvements in muscle strength, physical function, and reduction of fall risk rather than direct skeletal outcomes (14, 15). Some lifestyle-based and bioactive nutritional approaches may also influence inflammatory and oxidative pathways relevant to both osteoporosis and RA, although their clinical effects on bone outcomes remain less clearly established (16).

Although several randomized controlled trials and systematic reviews have evaluated individual non-pharmacological interventions, few reviews have integrated exercise, nutritional, and behavioral strategies while directly comparing evidence in postmenopausal women and patients with RA. As a result, the evidence remains fragmented, limiting translation into clinical practice. Therefore, this review synthesizes current evidence on non-pharmacological interventions for bone health in postmenopausal women and patients with RA, with emphasis on BMD, functional outcomes, and existing evidence gaps.

2- MATERIALS AND METHODS

2-1. Study Design

This study was a structured narrative review designed to synthesize current evidence on non-pharmacological interventions for bone health in postmenopausal women and patients with rheumatoid arthritis (RA). In contrast to a traditional narrative review, a structured search strategy was used to identify high-quality primary and secondary evidence and provide a transparent and comprehensive overview of the field.

2-2. Search Strategy and Information Sources

A structured search was conducted in PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar to identify relevant studies published from database inception to July 21, 2025. The final search was completed on December 31, 2025. The search combined Medical Subject Headings (MeSH) and free-text terms related to three key concepts: interventions, outcomes, and target populations. Intervention terms included exercise, physical activity, and lifestyle

modification; outcome terms included bone mineral density, BMD, and bone health; and population terms included postmenopausal women and rheumatoid arthritis. Boolean operators (AND/OR) were used to combine search terms. A representative search strategy is presented in Table 1. Reference lists of included articles and relevant reviews were also screened manually to identify additional eligible studies.

Table-1: Representative search strategy used in PubMed/MEDLINE.

Step	Search concept and terms	Hits
#1	“Motor Activity”[Mesh] OR “Exercise”[Mesh] OR “physical activity”[tiab] OR “exercise”[tiab] OR “resistance training”[tiab] OR “lifestyle modification”[tiab]	385,420
#2	“Bone Density”[Mesh] OR “Osteoporosis”[Mesh] OR “bone mineral density”[tiab] OR “BMD”[tiab] OR “bone health”[tiab]	142,850
#3	“Postmenopause”[Mesh] OR “Arthritis, Rheumatoid”[Mesh] OR “postmenopausal”[tiab] OR “rheumatoid arthritis”[tiab] OR “RA”[tiab]	215,910
#4	#1 AND #2 AND #3	1,845
#5	Filters applied: English, Humans, publication date to December 31, 2025	812

2-3. Eligibility criteria

Studies were included if they met the following criteria:

- **Population:** Postmenopausal women or adults with RA, including individuals with osteopenia, osteoporosis, or increased risk of bone loss.
- **Interventions:** Non-pharmacological interventions intended to maintain or improve bone health, including structured exercise programs, nutritional interventions such as calcium and/or vitamin D supplementation, behavioral or educational strategies, and multicomponent lifestyle interventions.
- **Outcomes:** At least one bone-related or relevant clinical outcome, including BMD, bone strength, fracture incidence, bone turnover markers, muscle strength, physical function, lean body mass, inflammatory markers, pain, osteoporosis-related knowledge, self-efficacy, preventive behaviors, or adherence.
- **Study designs:** Randomized controlled trials, controlled quasi-experimental studies, systematic reviews, meta-analyses, and network meta-analyses were included as primary sources. Narrative reviews and theoretical papers were included only to provide mechanistic or conceptual context and were not treated as primary evidence of effectiveness.

2-4. Study selection and data extraction

Titles and abstracts were screened independently for relevance, and full texts of potentially eligible records were assessed for final inclusion. Eligible sources addressed non-pharmacological interventions for bone health in postmenopausal women or adults with rheumatoid arthritis, including nutritional, behavioral/educational, and exercise-based approaches, as well as relevant evidence syntheses and selected conceptual papers. Data were extracted systematically on study design, population characteristics, intervention type, frequency, intensity, duration, and main outcomes. Outcomes of interest included bone mineral density, fracture-related outcomes, bone strength, lean mass, muscle strength, physical function, bone turnover markers, and behavioral outcomes such as knowledge, self-efficacy, and adherence to preventive behaviors.

2-5. Quality Assessment and Risk of Bias

The methodological quality and risk of bias of the included evidence were independently assessed by two reviewers using validated tools appropriate to each study design.

- **Randomized controlled trials:** Assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, which evaluates bias in the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results (17).
- **Quasi-experimental studies:** Appraised using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Quasi-Experimental Studies, with attention to internal validity, control group use, outcome

measurement, and statistical analysis (18).

- **Systematic reviews and meta-analyses:** Evaluated using AMSTAR 2, focusing on critical domains such as search comprehensiveness, justification for exclusions, assessment of individual study bias, and appropriateness of synthesis methods (19).

Discrepancies were resolved through discussion and consensus. Quality assessment informed interpretation of findings but was not used as an exclusion criterion.

2-6. Data Synthesis

Because of expected clinical and methodological heterogeneity in intervention type, participant characteristics, and outcome measures, quantitative meta-analysis was not performed. Instead, a structured narrative synthesis was undertaken. Findings were grouped by intervention type and summarized according to their effects on BMD, bone turnover markers, inflammatory status, pain, and physical function. This approach allowed consistent findings, heterogeneity, and evidence gaps to be identified across intervention categories and highlighted areas for future research.

2-7. Ethical considerations

Because this review was based exclusively on previously published studies and did not involve human participants or new patient-level data collection, formal ethics committee approval was not required. The review was nevertheless conducted in accordance with the principles of transparency, accuracy, and responsible reporting. All included studies were appropriately cited, and the synthesis was undertaken with methodological rigor and an effort to ensure unbiased interpretation.

3- RESULTS

A total of 14 key studies were included in the evidence synthesis, comprising randomized controlled trials, one quasi-experimental study, systematic reviews, meta-analyses, network meta-analyses, and selected mechanistic and theoretical papers (**Table 2**). Overall, the methodological quality of the included evidence ranged from moderate to high across study designs. Most randomized controlled trials and systematic reviews demonstrated acceptable to high methodological rigor, although some limitations were identified in smaller trials and the quasi-experimental study. Quality appraisal informed interpretation of the findings and is summarized in **Table 2**.

Overall, the evidence demonstrated heterogeneous effects of non-pharmacological interventions on bone-related outcomes, with response patterns varying by population, intervention type, and outcome domain. Exercise provided the most consistent evidence for preserving or improving bone mineral density (BMD) in postmenopausal women. In contrast, among individuals with rheumatoid arthritis (RA), exercise-related benefits were more consistently observed in muscle strength, lean mass, and physical function than in systemic BMD.

3-1. Nutritional and Supplementation Interventions

Direct interventional evidence indicated that nutritional and supplementation strategies confer modest skeletal benefits, primarily by attenuating bone loss rather than substantially increasing BMD. In the Women's Health Initiative trial, daily supplementation with calcium carbonate (1000 mg) plus vitamin D3 (400 IU) over 7 years modestly preserved hip BMD; however, no statistically significant reduction in hip fracture risk was observed in the primary intention-to-treat analysis (20). This large randomized trial was

judged to have some methodological concerns, mainly related to long-term follow-up and missing outcome data.

Secondary evidence synthesis supported these findings. An updated meta-analysis showed that the benefits of calcium plus vitamin D supplementation were most pronounced among individuals with inadequate baseline intake or deficiency, whereas effects in generally healthy, community-dwelling adults were limited (21). This review was of moderate to high methodological quality. Similarly, high-dose vitamin D monotherapy did not improve volumetric BMD or bone strength and was associated with reductions in radial volumetric BMD at higher doses (22). This randomized trial was considered at low risk of bias.

3-2. Behavioral and educational interventions

Behavioral and educational interventions were primarily associated with improvements in osteoporosis-related knowledge, self-efficacy, and adherence to preventive behaviors, including regular exercise and appropriate nutritional practices (23). The quasi-experimental evidence supporting these findings was of moderate methodological quality, with the main limitation being the non-randomized design.

These findings are consistent with established behavioral theory, particularly the Theory of Planned Behavior, which emphasizes the role of intention, perceived behavioral control, and attitudes in shaping health-related behaviors (24). However, current evidence does not demonstrate a direct or clinically meaningful effect of these interventions alone on BMD. Their primary value appears to be supportive, facilitating engagement in bone-protective behaviors rather than directly inducing skeletal adaptation.

3-3. Exercise Interventions in Rheumatoid Arthritis

Direct interventional evidence in adults with RA indicated that progressive resistance training improves muscle strength, lean body mass, and features of rheumatoid cachexia (25). This pilot randomized trial had some methodological concerns, particularly due to its small sample size and the inherent challenges of blinding in exercise interventions.

However, these improvements did not consistently translate into measurable gains in systemic BMD. Mechanistic reviews suggest that this limited skeletal response may be attributable to inflammation-mediated alterations in bone remodeling (26, 27). Overall, the evidence indicates that exercise in RA contributes more consistently to functional and musculoskeletal outcomes than to generalized skeletal improvements.

3-4. Exercise Interventions in Postmenopausal Women

Exercise emerged as the most consistently supported non-pharmacological strategy for maintaining or improving BMD in postmenopausal women. In the LIFTMOR randomized controlled trial, high-intensity resistance and impact training significantly improved lumbar spine and femoral neck BMD while also enhancing physical function (28). This trial was judged to be at low risk of bias.

These findings were reinforced by high-quality secondary evidence. A Cochrane review demonstrated that weight-bearing, resistance, and impact-loading exercise can prevent or attenuate bone loss in postmenopausal women (29). Similarly, Kemmler et al. reported favorable effects of multiple exercise modalities—particularly resistance-based, weight-bearing, and combined-loading

protocols—on BMD at clinically relevant skeletal sites, including the lumbar spine, femoral neck, and total hip (30).

More recent network meta-analyses further suggest that high-load resistance training and multimodal programs combining resistance, aerobic, and impact-loading components may provide the greatest skeletal benefits in this population (31, 32). These reviews were of moderate to high methodological quality. Additionally, evidence indicates that combining exercise with nutritional supplementation may yield additive benefits for bone health outcomes in postmenopausal women (33), although this review was of moderate quality.

3-5. Overall Synthesis of Findings

Overall, intervention effectiveness varied according to both target population and intervention type. Exercise showed the strongest and most consistent evidence for preserving BMD in postmenopausal women, supported by low-risk randomized trials and moderate- to high-quality evidence syntheses. In contrast, among individuals with RA, exercise-related benefits were more consistently observed in muscle strength, lean mass, and physical function than in generalized skeletal outcomes, and the available direct evidence was more limited and methodologically less robust.

Nutritional interventions demonstrated modest benefits, particularly among individuals with calcium or vitamin D insufficiency, while behavioral and educational interventions primarily supported adherence and sustained engagement in bone-protective behaviors. Collectively, the evidence suggests that multimodal approaches integrating exercise with nutritional and behavioral strategies may offer the greatest potential for optimizing bone health.

Table-2: Summary of included evidence by study design, contribution to the review, and quality appraisal.

Study (Ref)	Study design	Population / scope	Intervention / focus	Main outcomes	Role in review	Key contribution	Quality appraisal
Jackson et al. (20)	RCT	Postmenopausal women, Women's Health Initiative (n = 36,282)	Calcium carbonate 1000 mg/day plus vitamin D3 400 IU/day for 7 years	Hip and spine BMD; hip and total fractures	Primary evidence	Modest hip BMD preservation ; no significant hip fracture reduction	RoB 2: Some concerns
Weaver et al. (21)	Systematic review and meta-analysis	Adults, including populations at risk of osteoporosis	Calcium with or without vitamin D supplementation	Hip, vertebral, and total fracture risk	Secondary synthesis	Greatest fracture reduction in low-intake or deficient populations	AMSTAR 2: Moderate to high quality
Burt et al. (22)	RCT	Healthy adults aged 55–70 years (n = 311)	Vitamin D3 (400, 4000, or 10,000 IU/day) for 3 years	Volumetric BMD; bone strength	Primary evidence	High-dose vitamin D did not improve bone strength; lower radial volumetric BMD at higher doses	RoB 2: Low risk
Francis et al. (23)	Controlled quasi-experimental study	Community-dwelling adults at risk of osteoporosis	Osteoporosis education and self-management program	Knowledge, self-efficacy, preventive behaviors	Primary evidence	Improved knowledge and self-efficacy; supported preventive behavior adherence	JBI: Moderate quality
Ajzen (24)	Theoretical framework	Health behavior theory	Theory of Planned Behavior	Determinants of behavior uptake	Conceptual framework	Theoretical basis for attitudes, perceived control, and intention	Not formally appraised
Marcora et al. (25)	Pilot RCT	Patients with rheumatoid arthritis (n = 28)	Progressive resistance training for 24 weeks	Lean mass; muscle strength; BMD; cachexia-related outcomes	Primary evidence	Improved muscle mass and strength; no significant systemic BMD change	RoB 2: Some concerns
Schett et	Narrative	Rheumatoid	Inflammation-	Osteoclast	Mechanisti	Explained	Not

Study (Ref)	Study design	Population / scope	Intervention / focus	Main outcomes	Role in review	Key contribution	Quality appraisal
al. (26)	mechanistic review	arthritis and inflammatory bone loss	mediated bone remodeling pathways	activation; systemic bone loss; skeletal fragility	c evidence	how inflammation may limit skeletal response to intervention	formally appraised
Walsh et al. (27)	Mechanistic and clinical review	Rheumatoid arthritis	Inflammation, bone metabolism, and structural damage	Bone loss pathways; impaired skeletal remodeling	Mechanistic evidence	Explained why functional gains may not translate into BMD improvement	Not formally appraised
Watson et al. (28)	RCT	Postmenopausal women with osteopenia or osteoporosis (n = 101)	High-intensity resistance and impact training versus low-intensity home exercise	Lumbar spine and femoral neck BMD; physical function	Primary evidence	Significant improvement in lumbar spine and femoral neck BMD and physical function	RoB 2: Low risk
Howe et al. (29)	Cochrane systematic review and meta-analysis	Postmenopausal women	Weight-bearing, resistance, impact, and combined exercise	Spine, hip, and forearm BMD	Secondary synthesis	Resistance and impact-loading exercise prevented or attenuated bone loss	AMSTAR 2: High quality
Kemmler et al. (30)	Systematic review and meta-analysis	Postmenopausal women	Aerobic, resistance, and combined exercise	Lumbar spine, femoral neck, and total hip BMD	Secondary synthesis	Site-specific exercise improved BMD at fracture-prone sites	AMSTAR 2: High quality
Wang et al. (31)	Systematic review and network meta-analysis	Postmenopausal women	Resistance training protocols	Comparative effects on regional BMD	Secondary synthesis	High-load resistance and combined exercise were among the most effective for lumbar spine BMD	AMSTAR 2: Moderate quality
Xiaoya et al. (32)	Systematic review and network	Postmenopausal women	Resistance, aerobic, impact, and	Comparative rankings across	Secondary synthesis	Multimodal exercise, especially	AMSTAR 2: Moderate

Study (Ref)	Study design	Population / scope	Intervention / focus	Main outcomes	Role in review	Key contribution	Quality appraisal
	meta-analysis		combined exercise	skeletal sites		resistance plus impact loading, ranked highest	to high quality
Liu et al. (33)	Systematic review and meta-analysis	Postmenopausal women	Combined exercise and nutritional supplementation	BMD; bone turnover markers	Secondary synthesis	Combined interventions showed additive benefits for BMD and bone markers	AMSTAR 2: Moderate quality

Note: Included evidence comprised primary interventional studies, secondary evidence syntheses, and selected mechanistic or conceptual sources used to support interpretation of the clinical findings rather than to assess intervention effectiveness. **Abbreviations:** BMD, bone mineral density; RA, rheumatoid arthritis; RoB 2, risk of bias tool 2; AMSTAR 2, A Measurement Tool to Assess systematic Reviews 2; JBI, Joanna Briggs Institute.

4- DISCUSSION

This structured narrative review suggests that the effects of non-pharmacological interventions on bone health vary substantially by population and outcome. These conclusions should be interpreted in light of the methodological quality of the included evidence. Exercise has the most consistent support for maintaining or modestly improving bone mineral density (BMD) in postmenopausal women, based on low-risk randomized trials and moderate- to high-quality evidence syntheses (28–32). In contrast, among individuals with rheumatoid arthritis (RA), exercise-related benefits are more consistently observed in muscle strength, lean mass, and physical function than in systemic BMD, and the available direct evidence is more limited and methodologically less robust (25–27). Nutritional supplementation and behavioral interventions appear to play primarily adjunctive and context-dependent roles.

A central finding of this review is that exercise is the strongest non-pharmacological strategy for bone

preservation in postmenopausal women. This conclusion is supported by a low-risk randomized controlled trial and reinforced by systematic reviews and meta-analyses showing favorable effects of resistance-based, impact-loading, and multimodal exercise interventions on BMD at clinically important skeletal sites (28–32). These findings are biologically plausible and align with the mechanostat concept, which proposes that bone adapts to repeated mechanical loading when strain exceeds a sufficient threshold (6). In practical terms, this suggests that bone-directed exercise programs should include appropriately supervised resistance and impact elements when clinically feasible, rather than relying solely on low-intensity general activity. The benefit also appears to be site-specific and protocol-dependent, which may help explain heterogeneity across individual trials and evidence syntheses (29–32).

In RA, the pattern is more nuanced and the available direct evidence is more limited. Progressive resistance training improved muscle strength, lean body mass, and manifestations of rheumatoid cachexia, yet

these improvements did not consistently translate into measurable gains in BMD (25). This discrepancy likely reflects the complex pathophysiology of RA, in which chronic inflammation, altered bone remodeling, reduced physical activity, and, in some cases, glucocorticoid exposure collectively impair skeletal integrity (8–12, 26, 27). Clinically, this does not reduce the value of exercise in RA; rather, it reframes its main contribution. In this population, exercise may be especially important for preserving function, counteracting sarcopenic or cachectic changes, improving mobility, and potentially reducing fall risk, even when direct osteogenic effects are modest (15, 25). Thus, expectations for exercise in RA should extend beyond BMD alone and include musculoskeletal and functional endpoints relevant to patient well-being and fracture prevention.

The reviewed evidence also supports a targeted rather than universal approach to nutritional supplementation. Calcium and vitamin D appear to contribute mainly to attenuation of bone loss rather than substantial BMD gains, with the greatest benefit observed among individuals with inadequate baseline intake or documented deficiency (20, 21). At the same time, high-dose vitamin D monotherapy did not improve bone strength and may adversely affect volumetric BMD at higher doses (22). These findings support interpreting supplementation as a supportive measure rather than a stand-alone bone-building strategy. Clinically, calcium and vitamin D remain important components of osteoporosis prevention, but they appear most useful when individualized and integrated with broader lifestyle or exercise-based interventions rather than prescribed in isolation. Although promising, recent evidence suggests that nutritional supplementation may provide greater benefits when combined with structured exercise programs than when

administered alone; however, this conclusion should be interpreted cautiously because the available evidence remains limited and heterogeneous (33).

Behavioral and educational interventions appear to contribute indirectly by improving osteoporosis-related knowledge, self-efficacy, and adherence to preventive health behaviors (23). However, this interpretation is based primarily on moderate-quality quasi-experimental evidence and theoretical support rather than direct high-level evidence for skeletal outcomes. Their role is therefore less osteogenic than enabling, as long-term bone health depends heavily on sustained engagement with exercise, nutritional practices, and other preventive behaviors. This interpretation is conceptually consistent with the Theory of Planned Behavior, which emphasizes the importance of intention, perceived behavioral control, and attitudes in the adoption and maintenance of health-related behaviors (24). Accordingly, behavioral support may be best understood as a facilitating component of comprehensive non-pharmacological care rather than an independent strategy for improving BMD.

This review has several strengths and limitations. A major strength is its integration of evidence across multiple domains of non-pharmacological management, including structured exercise, nutritional supplementation, and behavioral interventions, while comparing two clinically distinct populations with different mechanisms of bone loss. This approach allows for a more clinically meaningful interpretation of how biological context shapes intervention effectiveness. Furthermore, the included studies were formally appraised using design-appropriate quality assessment tools, including RoB 2, JBI, and AMSTAR 2, allowing the findings to be interpreted in relation to risk of bias and methodological rigor rather than treated as equally robust

(12, 21, 22). At the same time, several limitations should be acknowledged. As a structured narrative review, the present study synthesizes heterogeneous forms of evidence, including randomized trials, quasi-experimental studies, systematic reviews, and selected mechanistic or conceptual papers used to support interpretation. The included literature also spans populations with distinct pathophysiological drivers of bone loss, which limits direct comparability. In addition, although BMD is a clinically important endpoint, it does not fully capture fracture risk, bone quality, or the broader functional consequences of musculoskeletal decline. Finally, evidence for behavioral interventions and RA-specific skeletal outcomes remains less robust than that for exercise in postmenopausal women, underscoring the need for more targeted high-quality trials.

Taken together, the reviewed literature supports population-specific models of non-pharmacological care. For postmenopausal women, especially those with osteopenia or early osteoporosis, structured mechanical loading appears central to skeletal preservation, with nutritional support serving an adjunctive role and behavioral strategies helping sustain long-term adherence. For RA, by contrast, non-pharmacological management may need to prioritize preservation of muscle mass, maintenance of function, reduction of disability, and mitigation of fall risk, while recognizing that direct improvements in BMD may be less pronounced because of the underlying inflammatory milieu (8, 12, 26, 27). This distinction has implications not only for clinical decision-making but also for outcome selection in future intervention trials.

5- CONCLUSION

This structured narrative review suggests that non-pharmacological

strategies for preserving bone health should be tailored to the underlying mechanisms of bone loss and individual patient characteristics. Among the reviewed interventions, structured exercise is supported by the most consistent and methodologically robust evidence for maintaining or modestly improving BMD in postmenopausal women, whereas in patients with rheumatoid arthritis its principal benefits are improvements in muscle strength, physical function, and mobility rather than consistent gains in BMD (25–32). Calcium and vitamin D supplementation appear most effective when individualized, while behavioral interventions mainly support long-term adherence to healthy lifestyle practices (20–24, 33). Overall, a multimodal, patient-centered approach integrating exercise, nutritional optimization, and behavioral support may offer the greatest potential for improving skeletal resilience and supporting fracture prevention.

6- CONFLICT OF INTEREST: None.

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