

RESEARCH ARTICLE

Will Community Dwelling Older Adults Who Sustain a Non injurious Fall Benefit from Prophylactic Vitamin C Supplementation? A Review of Vitamin C and Bone Specific Influences and Observations Past and Present

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Abstract

Fractures and their causative and repair mechanisms have been topics subject to various forms of investigation for several decades and are of particular salience in limiting healthy aging. In both instances, preventing and treating bone fractures - an immense societal concern in all aging populations – is a highly understudied topic. In this paper we discuss a possible role for vitamin C or ascorbic acid in both these processes in the context of secondary fracture prevention post falls, a topic that has received increasing attention in recent years, but with quite limited mainstream practice applications. It explores whether vitamin C is of potential relevance in preventing osteoporosis, a bone thinning disease linked to a high risk of future fractures in recurrent older age fallers, as well as in fostering bone fracture healing. While further investigation of this topic is warranted, ensuring aging adults have sufficient access to fruits and vegetables containing vitamin C as a rule and especially after an injurious fall or fracture appear to have considerable merit. Indeed, findings as of January 20, 2026 show a growing albeit imperfect degree of support for vitamin C in fostering bones mineral density metabolism as well as bone repairs.

Keywords: Adults, Aging, Ascorbic Acid, Bone Healing; Falls, Fractures, Fracture Healing, Osteoporosis, Secondary Prevention, Vitamin C

Introduction

Aging is often accompanied by an increased tendency to fall and sustain various degrees of injury, a high subsequent or recurrent falls risk, and a forthcoming or heightened functional decline, especially in the event of a fracture. At the same time, bone diseases such as osteoporosis, a debilitating chronic bone condition often predating a bone fracture may be important to prevent especially among high age fallers who are susceptible to both even if their initial falls injury is deemed relatively minor. Additionally, even in the absence of osteoporosis, secondary fractures sustained in recurrent older fallers may not only induce immense physical, social, and societal challenges and costs, but bone and perhaps wound healing in the case of fracture surgery repair may heal suboptimally in those of a higher age who already suffer from chronic health challenges plus poor health status.

Thus, we would argue that bone health optimization remains crucial in efforts to avert excess morbidity and premature disablement, not only among independent community based older adults, but especially among those who are frail and undernourished. Often associated independently or collectively with lifestyle factors, corticosteroid therapy, unintended injuries such as falls, plus a genetic predisposition to bone fragility and frailty, ascorbic acid or vitamin C has historically been linked to efforts to maximize bone health status for some time.¹ Yet, despite quite a consistent wealth of favorable evidence, its applied utility has not been well established in the context of either primary, secondary, or tertiary osteoporosis prevention or treatment, nor in the realm of fracture healing or prevention, despite its link to wound healing support and when compared to the guidelines concerning calcium and vitamin D and the extensive research undertaken in this regard.

In this respect we believe as have others over time, that this lack of attention to the many mediating and moderating biological benefits of vitamin C on bone health may account in part for the observed failure of various aspects of bone development as well as bone maintenance and repair across the lifespan among vulnerable youth as well as adults.² Since it is impossible to ensure vitamin C levels can be optimized in the context of all free-living community dwelling elders, we believed it would be helpful to examine if the high rates of vitamin C deficiencies in older adult populations are potential deficient bone health determinants or not. Moreover, this is not simply a research exercise, but one that can provide insight as to whether its sufficient presence may avert highly possible premature death and disability consequent to recurrent falls and a resultant hip fracture for example.

The rationale here is that vitamin C, studied for at least 60 years relative to its bone associations, arguably plays a pivotal

role in fostering optimal skeletal health across the lifespan, including having a favorable influence on collagen formation and normal bone development.² Vitamin C is further linked to bone mineralization processes and outcomes, bone growth plate and trabeculae status, bone resorption, epiphyseal collagen synthesis and osteoblast differentiation, and ultimately to bone density.² Other data reveal vitamin C to have the ability to retard age associated bone mineral density loss rates, along with an ability to foster better outcomes of hormonal treatments designed to improve bone density.² Vitamin C may also impact general health status, as well the recovery phases of a fracture quite favorably, while lowering the risk of older people for developing osteoporosis and/or bone fractures. In particular, several important observations depicting the relationship and identified impacts of vitamin C have shown that relative to reducing osteoporosis prevalence and severity, plus fractures especially among aging adults even though not all findings support a consistent bone vitamin C favorable relationship.^{3,4}

This mini review examines the status of the literature concerning a possible role for vitamin C in reducing fractures in the post fall injured older adult and by extension bone healing after fracture events. The prevailing consensus of whether this can be mediated or moderated by vitamin C in some way, for example by following daily nutrition requirements for this compound and making key vitamin C containing fruits and vegetables available to the elderly, rather than failing to do this was indirectly explored as well. The specific purpose was to carefully examine the current and past research findings documented initially as far back as 30 years ago [1996—2026] to ascertain if this potential osteoporotic and fracture prevention strategy is likely to be more efficacious than not given the scope of knowledge that now extends to studies that show the molecular pathway for vitamin C actions can include direct effects of vitamin C on transcriptional regulation of target genes, transcription factors and by epigenetic modification of key genes involved in skeletal development and maintenance that may be harnessed here to foster its anabolic cycle.⁵ At the same time, nutritional strategies and others designed to optimize vitamin C requirements in the older adult may be essential to achieving or maintaining optimal bone health in some cases as humans are unable to synthesize vitamin C, which must constantly be restored.⁶

Clinical Relevance

Since fractures continue to prove highly prevalent, as well as immensely disabling, and osteoporosis itself can lead to considerable life-long disablement in its own right, especially among older persons, it appears important to continue to examine the evidence base other than calcium and vitamin D as having a possible clinically important role in preventing

osteoporosis associated primary and especially secondary fractures as well as for possibly advancing fracture healing and its intervention surgically or non-operatively where this has occurred.

Simultaneously, we hoped to propose salient lines of endeavor for future research and practice in this regard, including preventive practices against fractures and primary or secondary osteoporosis that are cost-effective, as well as safe, and may foster natural healing processes, and others.

Methods

To achieve the goals of this report, the present search strategy employed the key words *Vitamin C/Ascorbic Acid/Bone Health; Fracture Healing*, and *Frailty/Osteoporosis*, firstly to review all available articles on the topic, and then for those more specifically reported for the time period Jan 1, 1996-Jan 20, 2026 in the **PUBMED, PubMed Central, and Google Scholar** data bases. To provide some clarity as to whether there is clinical evidence that vitamin C can either minimize osteoporosis risk, as well as fracture risk directly or indirectly, articles that addressed these issues and published in the last three decades were selected, carefully scanned, and downloaded as indicated. As well as clinical studies, those discussing the bone healing process, published in the realm of basic pre-clinical studies and non-human substrates were deemed valid. In addition to stand-alone full-length research reports, systematic reviews were deemed acceptable. No abstracts or foreign non-English articles were analyzed, however, and no restrictions were placed on the nature of studies, nor on the health status, or age or gender of the subject.

After completing a comprehensive scan of the relevant literature, salient references as well as those cited in some texts were selected for further reading and discussion. With no substantive well-designed studies on any of the above topics, especially in the realm of the specific topic of vitamin C and its relationship to preventing osteoporosis, or fostering fracture healing, only a narrative review was deemed suitable. However, by including the most up to date findings on this topic, plus an overview of prior work on vitamin C in the context of bone health, a broad picture of the state of the art regarding the topic of this review was anticipated.

To this end, the discussion below first outlines some general findings, followed by some specific clinically relevant observations published in 1996 or since 1996. An attempt was made to categorize findings as either supportive of a possible beneficial bone-fracture-vitamin C link, versus a non-supportive or contrary view, bearing in mind negative studies are less likely to be published than positive studies.

It was decided not to focus on cellular or animal model studies in this effort, or those published prior to 1996 given the problem in translating these data to the current clinical realm and limited access. Other than that, it is believed this ensuing review examined almost all, if not all currently relevant clinical studies and reviews on the topic of vitamin C and bone health along with fracture healing, and related issues. For a summary of prior studies readers are referred to the 2018 review by Malmir.⁷

Results

General vitamin C observations

Research shows a vitamin C deficiency can yield

- An increased risk of bone pain⁵
- Compromises in bone structural health²
- Impairments in bone metabolism⁵
- Reductions in bone mass¹¹
- Delayed fracture healing⁶³

Sufficiency Yields:

- Critical modulation of collagen production^{5,6}
- Ability to regulate bone-based gene transcription⁵
- Ability to reverse bone loss of osteoporosis in animal model⁷
- Positive correlations with bone mass³ and bone mineral density⁸
- Reduced fracture risk⁹
- May reduce risk of complex regional pain syndrome after fractures¹⁰
- More rapid fracture/bone healing^{13,59,62,64}

Most commonly the presence of vitamin C is deemed to serve as important intrinsic mechanisms in the realm of optimizing osteoclast and osteoblast cellular genesis^{2,9} as well as serving as an essential bone mineral density mediator.¹¹

Specific findings

While not well recognized in falls prevention realms to date, possible post fall benefits can be realized in the realm of averting future fractures in at risk recurrent older adult fallers who reside in the community.

Malmir⁷ for example, who examined vitamin C intake impacts in the context of osteoporosis and hip fracture risk did indeed find greater dietary vitamin C intake was associated with a 33% lower osteoporosis risk. Greater dietary vitamin C intake was also associated with a lower hip fracture risk, plus a higher bone mineral density at both the femoral neck and lumbar spine sites.

In assessing the validity of a diverse array of possible vitamin C bone-sparing effects, Chin¹² found cell-based studies tended to depict a dose dependent vitamin C osteoblast and osteoclast influence. Moreover, vitamin C supplementation prevented bone loss in several bone attrition models. As well, human studies generally showed a similar positive relationship between vitamin C and bone health bone mineral density, fracture probability and bone turnover markers despite any study shortcomings. At the same time, the skeletal sites selected for examining bone mineral density were not necessarily comparable across studies or consistent within the skeletal profile of the individual in the studied humans.

Sun¹⁴ concluded dietary vitamin C intake can possibly help to lower the risk of acquiring a hip fracture among older adult populations, even though other supplements may play an additionally favorable role. Kim¹⁵ also agreed dietary vitamin C intake positively influenced bone mineral density among postmenopausal women, and that an inadequate vitamin C intake could increase the risk of osteoporosis, a strong fracture determinant. The significant association between vitamin C intake and bone mineral density was only observed in subjects with a vitamin D deficiency aged 50-59 years or >70 years, however, thus no broad therapeutic or clinically relevant generalizations could be put forth.

Other related research does support a role for optimal fruit or vegetable intake as this may foster more rather than less unwanted age associated bone losses.¹⁶⁻¹⁹ In a parallel study, Torbergsen²⁰ showed low vitamin C among other factors was associated with an increased hip fracture risk, thus stressing the importance of ensuring older adults can maintain adequate vitamin C levels at all times, especially if prone to bone attrition, for example as a result of any persistent suboptimal dietary vegetable intake.²¹ Melaku²² who measured dietary intake via a food frequency questionnaire along with bone mineral density outcomes of their subjects indicated mixed-source dietary patterns may indeed help to prevent bone mineral density losses.

In this regard, Sugiura²³ who strove to examine the role of vitamins alone or in combination with carotenoids in terms of the risk of incurring osteoporosis in a follow-up study of 187 post-menopausal female subject found the combination of β -cryptoxanthin and vitamin C to be inversely associated with the risk of developing osteoporosis in the post-menopausal females, yet one study of several similar reports³ found vitamin C recipients with distal radial fractures did not benefit functionally regardless of whether the fracture was non displaced or displaced. Moreover, time to fracture healing was not accelerated.

Thus, divergent views abound and are hard to unify. Extenuating factors such as levels of daily activity, age,

gender, bone dietary intake, compliance with supplementation if relevant, and its mode of delivery, if used, plus medication interactions, among other fracture healing inhibitors factors may account for this but are often hard to discern or validate specifically. As of 2019 there was however both much more support and potential support for vitamin C supplementation^{14,24,19,20,24,25} than any contrary evidence.³ Moreover, the full scope of vitamin C as a secondary preventive strategy against bone fractures rests on its strong observed promise for promoting many important biological bone building processes, including nerve regeneration; cartilage repair, collagen metabolism, muscle strength and obesity regulation.²⁵⁻³⁷ Its wise usage may hence improve recovery status after fractures treated conservatively or operatively.³⁴

In more recent [2020-2026] research efforts designed to affirm or refute a role for vitamin C as a bone structure mediator or moderator, a more consistent case for a favorable effect of vitamin C on bone mass is apparent. For example, a recent systematic topical review involving 11 studies³⁸ while reiterating what was found earlier in most animal studies, concluded vitamin C does seem to not only accelerate bone formation, but also possible fracture healing in the older adult population. In a very interesting pre clinical study where 80 elderly Osteogenic Disorder Shionogi rats were divided into four groups based on different rates of vitamin C intake and a closed bilateral fracture was made in the middle third of the femur of each rat the groups with the lower vitamin C intake demonstrated a lower mechanical resistance of the healing callus and a lower histological grade. The vitamin C levels in blood during healing correlated with the torque resistance of the callus formed, and indicated the supplementary vitamin C as administered improved the mechanical resistance of the fracture callus in the elderly rats, most significantly and definitively. While these results may not be replicated readily in free living older community dwelling adults, vitamin C supplementation at safe levels appears recommended during fracture healing in the elderly, even though healing studies in humans are limited³⁹ and a common view is not yet evidenced.⁴⁰

Yet a follow-up study of 100 hip fractures subjects in the highest tertile of total vitamin C intake were observed to have a significantly lower rate for hip fractures and non-vertebral fractures compared to subjects in the lowest intake tertile. Dietary vitamin C intake was not associated with fracture risk. These results suggest a possible protective effect of vitamin C on bone health in older adults, as has been reported by others.^{9,34,40,41}

Indeed, it is increasingly implied that an adequate vitamin C presence can potentially accelerate bone regeneration without adverse events in the case of bone attrition or fracture. However, it is not possible to recommend a specific dose or route of administration of vitamin C to advance bone healing as there is great heterogeneity among the related published studies.³⁸ Li⁴² argue that even if the presence of an elevated serum folate, vitamins A and C levels is associated with a higher bone mineral density, other factors such as sex and race/ ethnicity can modify this associations.

Yet others reveal cases with high anti-oxidant levels that can be generated by a consistent vitamin C presence tend to fare more successfully in terms of bone health than those with excess pro-oxidative levels-in the face of any vitamin C insufficiency.³² This line of research specifically showed that after controlling for several potential covariates in the multivariable-adjusted binary logistic regression analysis employed, subjects in the highest tertile of oxidative balance scores had a lower risk of lumbar spine osteoporosis than those in the lowest tertiles. The femoral neck region though was not impacted; thus, results may depend on what is studied as well as who is studied.

At the same time parallel reports have indicated a role for vitamin C in widespread pain relief that could follow a fall and alter mobility as well as reactionary behaviors.⁴⁴ It also appears an intake of fruits rich in vitamin C and potassium may help to decrease risks in middle-aged persons as far as sarcopenia-a falls determinant is concerned.⁴⁵

Additional Findings

Rondanelli⁴⁶ who examined 15 studies in order to evaluate correlations between vitamin C intake and bone mineral density showed eight studies supported a positive correlation between vitamin C dietary intake and bone density. These data were also confirmed starting from adolescence (14,566 subjects). Regarding studies on supplementation, there were six (2671 subjects), of which one was carried out with supplementation exclusively, and where bone density scores were found to be approximately 3% higher in women who took the vitamin C supplements.

Contrary to this Mangano⁴⁷ reported dietary vitamin C is not associated with bone mineral density. Low plasma vitamin C, compared with sufficiency, was associated with lower hip bone mineral density however, particularly among postmenopausal women who were not on estrogen therapy. According to Kim⁴⁸ sufficient intake of vitamin E and C is of import for maintaining bone mineral density and lean mass in young adults, but older adults were not studied.

Lan⁴⁹ who conducted an evaluate designed to examine the association between bone mineral density and four selected circulating nutrients, particularly vitamin C, found that only women with a low a body mass were affected negatively. Plasma vitamin C, categorized as suboptimal (≤ 8.8 mg/L) and sufficient (> 8.8 mg/L), was positively significantly correlated with the lumbar spine bone density measures in men, but there was no association in women. It was concluded plasma vitamin C, categorized as suboptimal and sufficient, was positively associated with the lumbar spine bone mineral density in young and early middle-aged men, not women.

Findings reported by Zhang⁵⁰ suggest a positive association between water-soluble vitamin co-exposure and bone mineral density, but the association was mainly driven by vitamins B12 and C. Zhang⁵¹ indicate vitamin C is an osteoporosis moderator due to its anti-oxidative potential.

Blooin⁵² who examined mice concluded a loss of vitamin C had significantly implications for the skeleton in terms of the bone formation rate, which directly affects mineralization. They proposed that low vitamin C levels may contribute to the higher prevalence of bone-degenerative diseases especially in females and suggest leveraging the role of this vitamin in light of these findings.

In another study,⁵³ it was concluded that a combination of dietary antioxidants would be associated with increasing bone mineral density levels and a decreased osteoporosis risk. Another⁵⁴ showed the combined intake of dietary antioxidants may help reduce the risk of osteoporosis in adults as well as in osteoporotic bone.⁵⁵

Thus, the maintenance of a physiological intake of vitamins including vitamin C should be considered as a key nutritional strategy for the prevention of osteoporosis.⁵⁶ He⁵⁷ recommends vitamin C and D should be routinely measured in clinical practice due to their clinical importance especially in the event of consistently low serum levels of vitamin C that is often the case, bur one not linked to bone health.

Discussion

Fractures and osteoporosis that underlies many of these events remain highly common debilitating occurrences and deterrents to healthy aging, and autonomy, especially among older adults with prevailing chronic health conditions. Their prevention as well the application of treatments to prevent osteoporosis and to optimize fracture healing declines in bone mass are thus topics of high clinical importance in an age of shrinking resources, extended years of life, and limited intervention options.

In this regard, given the documented role of vitamin C in mediating bone status in multiple studies over time, and the failure of various bone building medications to safely offset age associated bone mass declines, the question of whether suboptimal vitamin C intake levels have a strong cumulative impact on the development of osteoporosis, as well as on increasing fracture risk and delayed post trauma or fracture recovery is of growing import.⁵⁸ The specific potential role of ensuring vitamin C sufficiency in secondary fracture prevention efforts among older age fallers who may develop post falls osteoporosis although promising cannot be conclusively determined at present, even though this alone would be highly meaningful to many and advantageous to society.

However, several reasonably favorable investigative reports on this topic generated in both animal and human models,²⁶⁻²⁸ as well as cell-based studies,^{29,30} indicate vitamin C sufficiency is likely to do more good than harm in the context of bone health, preservation, healing and regeneration.¹⁷ Its presence at physiological levels might help avert the widespread finding of osteoporotic fractures in older frail adults,³¹ even if prevailing or past reports remain non-conclusive^{5,14} and report non uniform findings in the context of bone health, fracture healing, and regeneration across the lifespan and in general despite its multiple health affirming benefits.⁶⁵

This may be because limited age groupings are studied along with diverse bone sites that may differ, gender issues, along with studies that do not mention bone associated issues, and few studies that are well designed or well controlled. Establishing if vitamin C exposure reports are valid, bone mineral content and density are repeatable, and if so, in what regard, with what implications cannot be readily discerned to date.⁵

Alternately, both past efforts,⁵⁸ as well as recent genetic as well as epidemiological studies including some contemporary laboratory efforts²⁷ and clinical discussions⁶⁵ imply that the administration of vitamin C as required is more likely to help not only prevent the development of osteoporosis, while increasing bone formation even in the presence of this chronic disease, but will predictably enhance many lives essential body functions and metabolic processes.

Indeed, and notwithstanding the fact that studies designed to specifically examine vitamin C effects on bone health over time in human samples are limited in numbers as well as quality, the topic seems a promising one to pursue³ and is one deemed to have tremendous potential³⁴ by several authors. In particular, not only is it generally agreed that vitamin C

may play a key role in averting enormous degrees of suffering due to its multidimensional impacts on bone as well as other body systems, but may be sufficiently potent to help in preventing or attenuating bone loss in older life and its ramifications. Vitamin C research is further showing new data concerning its beneficial effects on stem cell programming that might hold promise for improving bone healing and bone quality,³² bone degeneration and recovery.³⁵

In this respect, rather than rejecting or overlooking a potentially safe, low cost, effective adjunctive or independent bone health determinant with a number of proven biological physiological properties, it would appear worthwhile to pursue related clinical research efforts and others that employ adequate sample sizes, stringent covariate controls, an array of bone sites, standardized vitamin C measures and dosages, adequate follow up periods and outcome variables despite challenges in doing this. More careful examination of any competing interventions and the impact of health status and age in well-designed longitudinal studies and others is especially indicated⁵ and can perhaps explain to some degree findings not wholly supported by others.³

Until then, since no major safety issues regarding recommendations to consume a diet that will ensure ingestion of optimal levels of daily vitamin C, aging adults can be encouraged to ingest vitamin C containing foods, such as certain fruits, even if knowledge of precise molecular pathways for vitamin C actions in bone cells is not well documented. It is possible moreover that novel therapeutic strategies including nutrition can be developed or existing therapies drawn upon or modified for the treatment and prevention of osteoporotic fractures with excellent bone associated outcomes.⁵

Accordingly, and given the increasing degree of adequate expert support of late, and in particular, that cases that sustain a hip fracture appear to have less than desirable vitamin C levels⁶⁶ appear to offer a novel avenue to help mitigate this devastating injury. In the interim, it seems vitamin C sufficiency is a target that can be measured and raised in order to foster multiple favorable life affirming outcomes by those seeking effective yet potentially cost-effective and highly promising strategies to advance healthy aging and bone health, while mitigating injurious falls. At the very least its possible benefits in protecting against many diseases including scurvy³² imply health practitioners can safely educate their clients about the importance of having an adequate daily vitamin C intake, preferably from natural sources, while ensuring the client's

actual vitamin C plasma levels remain within normal limits. They can also foster those actions required to remedy any vitamin C insufficiency accordingly in the vulnerable as well as the older faller as well as the fracture patient.

At the very least, related research might not only extend our understanding of the mechanisms that foster or hinder bone health status across the lifespan, but can reveal whether vitamin C is a key factor to strongly consider in efforts to optimize bone health and healing in non-surgical and surgical situations involving older age adults, and in the realm of bone biology, maintenance, protection, intervention, and regenerative processes.⁶⁷

Moreover, as in other areas of clinical research, since a lack of conclusive evidence may not imply ineffectiveness, but rather unanticipated research design issues, more effective research attempts to supplement available clinical results will undoubtedly prove especially beneficial in strengthening the credence of the current evidence base.

Conclusion

Although the importance of vitamin C as regards bone health has shown a stronger positive correlation over time, rather than not, and a reasonable case may thus be made for efforts towards ensuring older adults are able to consume the desired daily intake of selected fruits and vegetables that are high in vitamin C content and will not find this problematic economically or challenging for other reasons, this scenario is not a given. This is unfortunate because in our view it can potentially strengthen efforts to promote bone health and healing in aging populations,¹⁸ even if not all articles in the current realm support or test this specific view point thoroughly. However, Hart³⁴ and Lou³⁶ concluded that despite the lack of any clear or definitive proof of concept, given the potential benefits of ensuring minimal vitamin C daily needs are met among vulnerable aging adults in its varied forms must surely warrant consideration by orthopaedic surgeons and allied health personnel involved in the prevention and treatment of a variety of musculoskeletal injuries such as fractures. Initial basic and epidemiologic studies also show a consistent array of positive bone health effects related to vitamin C serum levels. Alternately, serious bone deficits may arise in the face of a vitamin C deficiency and hence what levels of vitamin C are health affirming as well as health negating should be studied with current tools and tested on high age vulnerable adults as well as healthy adults over the long term to convey the ramifications of failing to advance an accurate estimate of desirable vitamin C bone related attributes.⁵ Possibly confounding factors such as the concurrent use of bone building agents or supplements should be controlled for as well. Moreover, whether recommended supplements or dietary vitamin C strategies are actually

adhered to in clinical studies, or not, or whether food recall patterns are accurate measures of vitamin C or not, assuredly adds more confusion to interpreting this line of research than not.¹⁷

In sum, these aforementioned study shortcomings and others related to sample selection, instrumentation, sample size, and study design must be factored into any future clinical study effort designed to establish a link between bone health and vitamin C serum presence. Along with the additional unexplored role of competing therapies, the role of health status, bone site, age, body mass, and gender that may all impact vitamin C requirements and metabolism must be duly accounted for as well. What constitutes an optimal vitamin C serum level and intake in the older age groups must be studied further and more intently in our perspective to avoid current research limitations or generalizations that are not individually relevant or safe.

Additionally, we believe observational studies should be avoided in favor of prospective studies so as to better establish any cause effect relationship between the variables of interest with any degree of confidence. At the same time, meta-analyses should not be conducted on heterogeneous studies that differ in content, as well as conclusions in our view, and should exclude studies that do not examine vitamin C independent effects, use validated measures, and clear unified definition of key terms, and use sophisticated statistical methods in order to collate highly dissimilar or disparate studies.

For a start, documented early observations and others⁶⁰⁻⁶⁸ might be replicated to strengthen the theoretical framework underpinning this line of study and to solidify their conclusions regarding the value of ensuring optimal vitamin C intake levels and measures of sufficiency across the adult lifespan are routinely conducted for purposes of advancing either preventive or therapeutic bone health.

Moreover, and to ensure that a viable cost-effective prophylactic and treatment approach for many, especially the older adult who may suffer from a vitamin C deficit but may be inadvertently overlooked, or treated inappropriately, more carefully designed clinical as well as basic research endeavors are recommended.³⁸ Possible periodic measures of an aging individuals' blood concentrations of vitamin C, as well as their bone quantity and quality that is attached to their medical record may prove especially helpful in efforts to provide tailored recommendations and a clear reason for what is needed and why.

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Conflicts of Interest

The author declares no conflict of interest.

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