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Literature Review

Research on Hip Fracture Risk in Vitamin B12 Deficient Older Adults

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Abstract

Introduction: Bone diseases, such as osteoporosis, as well as falls, when combined are especially prevalent among the older population. Associated with varying degrees of bone thinning, fragility, and increased susceptibility to fracture due to sarcopenia and other neuromuscular factors, preventing hip fractures is of high importance to all populations with aging citizens. Unfortunately, relatively little has been done over time to reduce the degree of bone destruction, or thinning, among other bone and muscle associated pathological changes underpinning one or multiple hip fracture occurrences.

Aim: This mini review focuses on the topic of hip fracture risk and prevention from the viewpoint of vitamin B12, a possible unexplored correlate of clinical relevance.

Methods: Articles of any genre concerning the possible association of vitamin B12 with bone health, muscle mass and function, frailty, and falls were specifically sought.

Results: A limited volume or research both tends to support or negate a role for vitamin B12 in the context of hip fracture risk and occurrences depending on what is studied and how it is studied and interpreted.

Conclusion: Sufficient rationale for a possible moderating or mediating role for vitamin B12 in some cases among the elderly who are malnourished, have malabsorption problems, and certain cardiovascular signs appears warranted.

Keywords: *Bone; Cobalamin; Elderly; Falls; Hip Fracture; Osteoporosis; Sarcopenia; Vitamin B12*

Introduction

Current research shows that the overall rates of hip fracture injuries will rise quite markedly in most countries by 2050. At the same time, very few preventive approaches have been successful, other than those that employ pharmacologic approaches. These however, are not risk free, nor are they universally efficacious.

What is known is that hip fractures occur predominantly in older rather than younger populations, and most result from various falls injuries and observable antecedents of these such as muscular weakness. Indeed, age associated bone loss plus muscle mass and strength loss, collectively known as a condition termed sarcopenia, is being largely held to be responsible for these debilitating and oftentimes life threatening injuries.

Unsurprisingly, a large body of research over many years has thus focused on efforts to foster a comprehensive understanding of bone physiology, as well as elements of muscle function and reaction time, among other factors and how these contribute to falls and possible

hip fractures, and consequently what can potentially be done to offset these anticipated age related declining musculoskeletal states. In terms of nutrition as a possible clinically relevant hip fracture determinant, the topics of malnutrition, calcium and vitamin D, albeit not conclusive are quite well studied, as are other aspects of nutrition such as the influence of vitamin A, C, E and K.

A group of vitamins associated with bone, muscle, and neurological health known as the B vitamins appears however, to be studied less often and with non-conclusive results, even though this group of vitamins appears to have a strong bearing on bone, muscle, and neurological determinants of falls and fractures among the elderly [1,2].

As outlined by Mithal., *et al*. [3] in addition to a moderate relationship between vitamin D status and muscle strength, which has been quite well studied, it appears that specific decreases in vitamin B12 intake or absorption and availability that may indeed play a role in reducing muscle mass and strength during aging is less well studied [4].

Although Swart., *et al*. [5] do not concur with this idea, this group suggested a positive role for vitamin B12 in gait performance, as well as on physical performance among compliant persons > 80 years. Moreover, even though this association may indeed be a weak or an indirect muscle strength mediator [6,7], Bulet., *et al*. [8] found sarcopenia, which commonly results in numerous negative clinical outcomes in the older adult, to be potentially related to lower than desirable levels of vitamin B12 intake, and hand grip strength in women [9]. Macedo., *et al*. [10] who examined 17 related studies on bone mass and fracture and vitamin B12 provides sufficient evidence to support their idea that the role of vitamin B12 on bone mineral density or fracture risk should be further elucidated, although this idea is not truly supported by, He., *et al*. [11] and is disputed by Torbegsen., *et al*. [12] and Gejesdal., *et al* [13].

However, several past studies that have shown that hyperhomocysteinemia caused by the insufficiency of vitamin B12 or folate is a risk for cardiovascular disease, osteoporotic fracture, and cognitive impairment, and possibly osteoporosis, imply more careful examination of this vitamin may have considerable merit [14].

Moreover, cases of geriatric hip fractures, who commonly present with problems related to nutrition may well have underlying deficits in vitamin B12 availability or uptake or both, because vitamin B12 is only available in animal products. Vitamin B12 may also be a factor in fostering sarcopenia, frailty [15] and pain [16], which are all hip fracture risk factors in the elderly. There is also a close link between the presence of poor nutrition, sarcopenia, frailty, adverse functional abilities, falls, cognitive declines, low vitamin B levels as a whole, plus responses to interventions, including hip fracture repair whereby a vitamin B12 deficit cannot be ruled out as a possible mediating or moderating factor [17-19].

Since few medical curricular may focus on nutrition, healthcare professionals may however, not be aware of the possible and specific importance of assessing and ensuring vitamin B12 adequacy among their older clients. They may hence fail to implement regular screening tests, and interventions that could well be effective in offsetting this potentially remediable health risk factor before it becomes irreversible.

In an effort to discern what programs implemented in the present time might help to minimize projected hip fracture occurrences among those older than 65 years of age in the future, this mini review aimed to examine and summarize the degree to which evidence supports a possible role for more concerted efforts to identify, examine and treat vitamin B12 deficiencies in the context of averting several negative clinical outcomes that are known to heighten hip fracture risk in the elderly. These negative outcomes of vitamin B12 deficiency include several age-related chronic diseases, especially those involving the musculoskeletal system, and which arises in general, due to poor nutritional intake, as well as aging.

Aims of the Study

This mini review aimed to examine: 1) if there is a possible need to ensure vitamin B12 is available and being absorbed by aging populations in the case of vulnerable older adults who are at high risk for injuries and tissue declines that result in falls and bone fractures; 2) to offer some recommendations for clinicians and researchers interested in pursuing all possible pathways of prevention in the context of hip fractures and their well established far reaching dire consequences.

Theory

This current review was initiated given that as people age, basic physiological and cognitive changes are possibly exaggerated or hastened in the absence of certain adequate levels of micronutrients or associated nutritional elements. If deficient, these essential nutrients are found to have the potential to adversely impact one or more body systems that tentatively induce physiological alterations that can contribute in diverse ways to an absence of safe locomotion, adequate force attenuation in response to unexpected perturbations, plus poor bone health, among other adverse health correlates [2]. One such element may be vitamin B12 [20], a vital micronutrient with the ability to foster the production of red blood cells, and hence muscle growth, vision, memory, and body coordination [21,22], as well having the ability to reverse elevated homocysteine levels, which is a fracture determinant in its own right. Alternately, the presence of deficient vitamin B levels without any vitamin B12 supplementation could theoretically impair bone health and thereby foster a state of osteoporosis or porous bones that may underpin hip fracture occurrences and disability [2,23] as per figure 1.

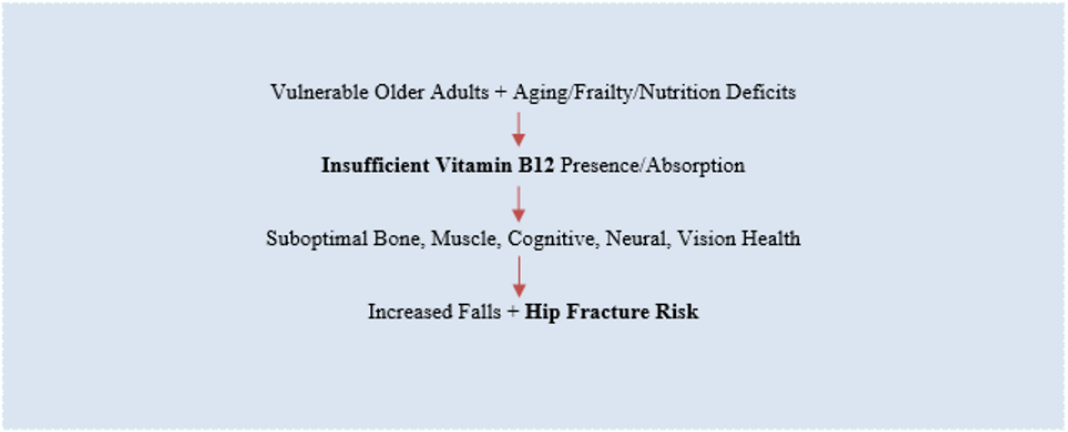

Figure 1: *Possible interactions between vitamin B12 deficiencies and hip fracture risks in older adults.*

Methods

The PUBMED, Web of Science-all databases, Scopus, Science Direct, and GOOGLE SCHOLAR sites were searched for relevant works published over the last 25 years using the key terms "Vitamin B/Cobalamin and Hip Fractures/Falls/Sarcopenia/Fractures Osteoporosis/Malnutrition and Bone, Balance, and Muscle Strength". Articles that addressed the present topic were downloaded and examined accordingly. Excluded were studies of relevance to diseases other than those directly impacting hip fractures, as well as vitamin B12 post surgical impacts for bariatric and other similar surgeries. Preclinical studies were deemed acceptable, as were all research designs.

No foreign language publications or studies discussing hip fracture outcomes, malnutrition and hip fractures, the impact of vitamin B12 deficits in children, and specific health conditions were included.

A general scan of articles referenced as well as a general Google search on this topic were conducted as this may yet reveal information that can be tested in the future, but only the most pertinent are discussed here.

Moreover, only a narrative overview is provided in light of the diverse albeit limited array of studies that focus on the current topic of interest, regardless of electronic data base examined.

Results

Although much time was taken to explore the extent of information on the current topic, it was clear that it is highly understudied and represented in the hip fracture literature as per example from PUBMED listings 1980-September 20, 2021 using key words outlined in box 1 below.

Key Terms and Numbers of Listed Citations

Hip fractures: =41,354 (all years); 10,052 in past 5 years

Hip fracture prevention: =9619 (all years); 2389 in past 5 years

Hip fractures and nutrition: =1,202 (all years); 448 in past 5 years

Vitamin B12 and hip fractures: =43 (all years); 8 in past 5 years

Vitamin D and hip fractures: =1958 (all years); 383 past 5 years

Box 1: *Overview of relative PUBMED listings on salient topics showing limited vitamin B12 focus.*

General findings

Of the 33,966 PUBMED listings for vitamin B_{12} or B12, also known as cobalamin, data from this website and others report vitamin B12 to be a member of the B vitamin group that plays a key role in cellular metabolism, especially as regards DNA synthesis, methylation and mitochondrial metabolism mechanisms. Closely aligned with energy production, antioxidant and neuroprotective effects, and rarely deficient, when present, a clinical B12 deficiency is a serious condition that can be shown to induce several well-established vascular related and neurological conditions, especially in elderly individuals [24,25]. Often caused by an inadequate intake, inadequate bioavailability or mal-absorption, in addition to aging influences, a low vitamin B12 presence can prove harmful if irreversible and prolonged because it can impair the functioning of all cells of the body, including those of the nervous system [26,27]. These aforementioned neurological deficits may include, but are not limited to the presence of resultant nerve demyelination, a variety of neuromuscular conditions, signs of significant damage to nerve fibers, weakness, distal limb numbness, impaired balance, gait ataxia, confusion, and even physical frailty [27]. Vascular, cognitive, bone, fatigue, weakness, joint pain, psychiatric symptoms such as depression and eye health may all depend to some degree on adequate vitamin B12 presence [28,29]. Conversely, although disputed by Stone., *et al*. [30] for women in their middle years who were at risk for cardiovascular disease, vitamin B12 deficiency may yet prove to be one of many hip fracture determinants in

some older adults if one considers that frailty alone is quite strongly associated with recurrent falls, plus fractures, limitations of daily living activities, and cognitive impairments [31]. According to Van Wijngaarden., *et al*. [23], a meta-analysis of four prospective studies including 7475 people showed a modest decrease in fracture risk of 4% per 50 pmol/L increase in vitamin B12 levels, which was borderline significant.

Key reasons why older adults may be at higher risk of a vitamin B12 deficiency than younger adults include:

1. Age
2. Gender
3. Genetics
4. Celiac disease
5. Chronic health conditions
6. Diet and nutrient deficiencies
7. Malabsorption
8. Medications
9. Pernicious anemia
10. Vegetarian diet, excess alcohol intake [2,4,7,29,31].

Specific findings

Muscle related issues

As outlined above, an inadequate intake of micronutrients with antioxidant properties, such as vitamin B12, which may be common among older adults, has been associated with a higher risk of frailty, adverse functional outcomes, and impaired muscle and bone health. In addition, van Dyk., *et al*. [32] who sought to determine the impact of reduced dietary intake of vitamins A/E/B6/B12/folate, selenium, and zinc on muscle mass, oxidative capacity, strength, and physical activity in old mice over time found a link between low vitamin B12 and muscle force production, plus fatigue resistance, among other factors.

In a paper published by Egan., *et al*. [33], the authors describe a 24-year-old female, otherwise healthy, who presented to the Emergency Department with difficulty walking and bilateral leg pain. The patient was a recreational nitrous oxide user, also known as "whippets" or simply nitrous. Neurologic examination demonstrated an unsteady gait and positive Romberg sign along with normal deep tendon reflexes and normal muscle strength in upper and lower extremities. Laboratory results demonstrated macrocytic erythropoiesis, reduced B12, elevated homocysteine, and elevated methylmalonic acid. Outpatient MRI later demonstrated degeneration of the posterior spinal column. While this study was largely about nitrous oxide usage, it showed vitamin B12 depletion and neurological signs may be quite strongly associated.

Bulet., *et al*. [8] found older adults with sarcopenia who are prone to repeated falls, mobility restrictions, depression, frailty, increased mortality and morbidity, tended to show lower levels of lean body mass, total skeletal mass and skeletal muscle mass index in those per-

sons with low vitamin B12 levels compared to those with higher levels. It was concluded that the presence of a sarcopenic state, which commonly results in multiple negative clinical outcomes, especially in older adults, might be related to the presence of a prevailing vitamin B12 deficiency, and if undetected and untreated, could have serious repercussions.

Verlaan., *et al*. [34] similarly concluded that sarcopenia, a fairly well established hip fracture determinant due to its associated impact on muscle mass, strength, and function, may be influenced in part, by reversible factors such as a deficient intake of nutrients containing vitamin B12, in particular, even in non-malnourished older adults. Moreover, older adults with type 2 diabetes, and who have a low vitamin B12 may exhibit excess muscle mass losses, rendering them highly prone to falls and hip fractures [35,36]. Conversely, Ao., *et al*. [37] found that in cases with higher vitamin B12 concentrations exceeding the median, lower limb muscle strength was higher than in less robust cases. Unsurprisingly, Berouzi., *et al*. [38] found greater intakes of vitamin B12 were partially correlated with higher scores on a chair rise test and total physical function, respectively [38]. In addition, frailty, a common feature of hip fracture cases may be caused in part by a lack of adequate B12, among other factors [27], and men with low plasma levels of vitamin B12 may be more vulnerable than not to fractures, even after adjustments are made for body mass, bone mineral density, homocysteine levels, and cystatin C levels [39]. An indirect association between deficient vitamin B12 levels and skeletal muscle dysfunction has also been identified [40], as has the presence of peripheral neuropathy [41].

Falls related issues

As outlined by Mizrachi., *et al*. [42] vitamin B12 deficiency may be an important factor in the progress from cognitive decline to dementia, as well as frailty that can impact hip fracture risk. As such, these authors reported finding that serum vitamin B12 levels ≤ 350 pg/ml were linked to a higher risk of developing cognitive decline in a group of elderly hip fracture patients. They also concluded that their findings concurred with prior observations of a link between vitamin B12 deficiency, dementia, falls, frailty, and fractures.

In addition, Swart., *et al*. [5] argue that a vitamin B12 deficiency appears to be consistently associated with a higher serum homocysteine concentrations, which is a documented risk factor for fractures. This may in turn mediate changes in bone mineral density, bone turnover, bone blood flow, DNA methylation, and/or physical function and fall risk [5].

Bulet., *et al*. [8] highlighted the fact that sarcopenia and dynapenia are related to repeated falls, mobility restriction, depression, frailty, increased mortality and morbidity, and that one or more of these conditions might be related to the presence of a deficient vitamin B12 blood level in the older adult.

Although Berlie., *et al*. [43] found no direct link between metformin and falls in diabetes patients; an indirect association caused by neuropathy secondary to vitamin B12 deficiency was cited to be of some concern. Other reports have found a vitamin B12 deficiency to be associated with the possible falls risk factors of neuropathy, as well as myelopathy [44].

Bone related issues

Whereas Macedo., *et al*. [10] conclude that a real effect of vitamin B12 deficiency in bone health and the mechanisms associated with bone metabolism are not well established, and may have no effect [30], Singh., *et al*. [45] report vitamin B12 deficiency has been shown to affect bone mass in rodents and to negatively impact bone formation in humans.

According to Pawluck., *et al*. [46] who examined vitamin B12 and its possible impact on fracture risk in vegans, the detrimental impact of inadequate B12 status on bone tissue is both direct, via the impairment of the insulin-like growth hormone 1 and taurine synthesis, and indirect, induced through its hyperhomocysteinemic effect, via at least the following mechanisms: 1) reducing bone mineral content and density by accumulating in the extracellular matrix, 2) reducing osteoblasts and increasing osteoclasts function, 3) reducing blood flow

to bone tissue, 4) inducing apoptosis via the reactive oxygen-species-mediated mitochondrial pathway, and 5) obstructing the formation of collagen cross-links, impeding lyslyl oxidase, and hampering insolubility of fibrils. The impact of vitamin B deficiency on red blood cell production may also impact muscle growth, for example during attempts at exercise training, thus explaining the oftentimes lack of change in muscle function in some cases.

As such, even though Meyer., *et al*. [47] noted that excess vitamin B12 intake can actually heighten the risk of hip fractures, among post menopausal women- its adequate presence may yet prove to be an important prophylactic factor or modifiable factor against osteoporosis [14], a bone disease associated with the risk of bone fractures in the elderly. Other benefits may extend to reducing the severity of sarcopenia and dynapenia [8], while failure to do so may induce negative changes in bone turnover and a heightened fracture risk [48,59] as per box 1.

Cognitive related issues

In terms of hip fracture risk, research shows a vitamin B12 deficiency may be linked to the onset of low level cognitive impairments and dementia [49]. A vitamin B12 deficiency may also produce a neurologic syndrome that includes paresthesias, sensory loss and sensory ataxia, and possible brain atrophy [4, 50]. The degree of perceived energy and fatigue, as well as cognitions may be impacted by the presence of adequate vitamin B12 among other factors [60] (Table 1).

Authors	Attributes Assessed	Conclusion
Dai., *et al*. [2]	Bone health	There is an apparent link between bone health and vitamin B12
Macêdo., *et al*. [10]	Bone mineral density	Vitamin B12 may play a role in bone mineral maintenance
Torbergsen., *et al*. [12]	Vitamin A, C, E, B12 and hip fractures	Vitamin B12 is not a risk factor for hip fractures
Pannérec., *et al*. [22]	Frailty	Aging and frailty are associated with vitamin B12 deficits
Verlaan., *et al*. [34]	Nutritional status, body composition, sarcopenia	There may be an association between sarcopenia, physical activity, and vitamin B12 deficiency
Ao., *et al*. [37]	Homocysteine, folate, and physical performance and vitamin B12	Lower leg strength of institutionalized elders was higher at higher vitamin B12 levels
Kalimeri., *et al*. [36]	Muscle strength and bone density	There is a link between vitamin B12 and bone mineral density
Meyer., *et al*. [42]	Vitamin B12 supplementation	Excess vitamin B12 is a hip fracture risk factor
Stone., *et al*. [59]	Hip fractures bone loss	Vitamin B12 deficits are associated with low bone mass increases
Tardy., *et al*. [60]	Vitamins and minerals and energy, cognition, and fatigue	Vitamin B12 contributes to energy

Table 1: *Snapshot of key research related vitamin B12 studies and conclusions in a hip fracture context.*

Discussion

Hip fractures, one of the most serious health conditions affecting older people, are frequently associated with institutionalization and increased premature mortality and excess morbidity rates, and thus with an enormous social and economic burden. In addition, and

despite years of research to examine and test multiple preventive approaches in an effort to counter hip fractures among the elderly, this immense collective burden is expected to increase substantially across the globe in the coming decades, rather than decrease, due to a rise in life expectancy, and possible health challenges that tend to rise exponentially with age. As well, prevailing efforts to counter this burden not only remain very limited in scope and practicality but may fail to impact the substantive numbers of adults living well beyond 90 years of age, an age group rarely studied, and where factors such as poor nutritional status are often excluded as salient in this regard.

Moreover, compared to other hip fracture micronutrients that may have a bearing on hip fracture risk, such as vitamin D, and calcium, as shown in box 1, vitamin B12, essential for DNA synthesis and cellular energy production [22,28] has failed to be extensively studied, despite its potential association with hip fracture risk, as well as possible falls risk due to its role in neural based processes and functions, plus cardiovascular health [19]. Other salient hip fracture correlates found to be linked to hip fractures, such as sarcopenia, low hand grip strength, and walking impairments, which may be markers of vitamin B12 deficiencies, have similarly failed to be extensively explored in this regard. This is not easy to explain, in light of the overall widespread physiological importance of vitamin B12 and the fact aging and frailty may reduce its potency or extent of absorption [22], as may increases in consumption of gastric acid inhibitors [20,22].

As well, in the case where the topic is studied, it is clear there are conflicting conclusions, and hence it is basically impossible to fully understand the implications of any vitamin B12 deficiency. Hence the topic is not only often negated as having any bearing on fracture risk, but may often go unrecognized even if it is important to uncover [51]. This is unfortunate, because some reports highlight the fact that a lower than desirable bone mineral density, as well as vision problems [28], are situations commonly associated to some degree with a higher fracture risk in elderly [23,48]. Moreover, research shows an anticipated age-associated vitamin B12 decline may prevail more readily than not, along with possible limitations in its intake or absorption or both [28], as well as drug interactions or associated health problems such as obesity requiring bariatric surgery. However, even if not a causative factor of hip fractures, it appears a prolonged presence of a state of suboptimal vitamin B12 potentially heightens fracture risk, rather than preventing this, even though an argument has been made for the negative impact of excess vitamin B12, in the context of increasing hip fracture risk.

In light of these aforementioned and divergent non-conclusive viewpoints, and the fact subclinical vitamin B deficiencies are hard to detect readily [28], but could be important to uncover, for example if they have unwanted preventable health impacts, including an observed trend towards to increased pro-oxidant and decreased antioxidant status [64], efforts to pursue this topic are strongly encouraged.

However, in addition to conducting replication studies, samples studied should be more typical of the 'at risk' homebound older adult [8], along with those who have clinically relevant sub-clinical levels of vitamin B12 [28]. Those living in developing countries [2,28] as well as those with mild cognitive impairments, dementia, or multiple health issues implicating deficits in vitamin B12 blood levels should also be studied.

At the same time, prospective studies that do not take into account the fact that vitamin B12 inadequacies may take many years to manifest [28], along with those that do not account for pertinent historical events or maturation factors, and confounding factors such as the use of calcium and/or osteodynamic agents are likely to fail to provide for solid conclusive findings, as may analyses that rely on baseline vitamin B12 records alone [44] and do not account for emergent food insecurity issues [52], and certain gastric surgeries or gastric conditions [28,53]. Failing to account for the optimal use of cut point differences in assays employed to define vitamin B12 status, plus reliance on serum vitamin B12 concentrations rather than on more specific biomarkers [28] will also predictably produce less than desirable outcomes.

To obviate limitations of past research, more careful parallel analyses encompassing dietary practices, interactions between medications and vitamin B12, other vitamin B micronutrients and chronic disease health status, and the use of various supplements and other

approaches, such as biphosphonate intake to offset osteoporosis are essential in efforts to affirm or refute any hypothesized link between low vitamin B12 levels and hip fractures risk, as well as hip fracture mortality, plus the following well established hip fracture antecedents:

- Frailty
- Cognitive disruption/decline
- Increased blood pressure and cardiovascular disease
- Lower immunity, increased inflammation, weakness, pain
- High homocysteine levels
- Neurological symptoms
- Irreversible nerve damage and neuropathy
- Loss of vibration and position sense, as well as loss of motor function often manifested as gait ataxia
- Weakness and fatigue
- Several age-related chronic disease
- Fracture risk due to bone mineral density declines [4,19,20-22,28,53].

Accordingly, an array of clinical assessments may prove especially insightful in this regard and might focus on those balance capacity, bone density, comorbid health conditions, cognitive, kidney, liver and vision health, frailty, nutritional practices, muscle strength, proprioception, sarcopenia, food security, and walking ability [22,54].

Those adults in the higher age groups, those who are older than 75 years of age, depressed, frail, malnourished, food insecure, use metformin for diabetes 2 control, have kidney, liver, and/or vision problems, and those who have associated gastric disturbances should be especially targeted [22,55].

Extending the nature of the samples studied to ensure a broad spectrum of adequately sized sub-groups of various age ranges, carefully specified vitamin B12 levels [normal, low, deficient], health conditions, visual impairments, dietary practices, and the degree to which hip fractures of differing types may occur or not occur would be especially valuable in our view.

Given the highly costly nature of a single hip fracture, and the fact low vitamin B12 levels in this group may predispose to multiple challenges to health and cognitive declines [42,50,57-62], the additional influence of gender, age categories, body mass, medications, bone and health status, and the impact of early versus delayed or suboptimal vitamin B12 supplementation should be carefully examined using multiple validated and sensitive measures.

The fact that a vitamin B12 deficiency tends to emerge slowly overtime, but may have previously unrecognized adverse health implications, but is easy to treat inexpensively and safely, should be borne in mind, both in the research, as well as the clinical realms, despite the initial time and effort involved [21,57-64].

Conclusion

Based on the available data discussed in this review it is the author's view that:

- Many risk factors for hip fractures, which remain devastating events, are clearly closely aligned with several neuromuscular and neurological deficits associated with the presence of chronically suboptimal vitamin B12 levels, as well as possibly excess levels. Thus a mediating, moderating, or independent association of vitamin B12 plasma levels with hip fracture occurrences in certain vulnerable older adults cannot be ruled out.

- To avert the severe degrees of projected disability and tremendous social and fiscal costs anticipated due to the predicted exponential age-associated increases in hip fracture incidence and prevalence by 2050, until more definitive research is forthcoming, routine screening of older vulnerable adults for vitamin B12 status appears important to consider.

- In addition, efforts to identify and intervene upon all common neurological and cognitive features of vitamin B12 deficiency that align with hip fracture risk, as well as the deficiency itself, appears noteworthy and should receive due attention sooner rather than later.

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