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REVIEW ARTICLE

Sleep Abnormalities, Obesity, Falls, and Bone Fracture Intersectoral Linkages in the Elderly: Review of Salient Peer Reviewed Research Observations and Complementary Medicine Applications

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Abstract

Bone fractures attributable to falls, remain highly common unwanted costly injuries among many elderly, and have not truly abated in their disabling prevalence over time despite years of research, a multitude of preventable risk factors, and numerous intervention program efforts. However, very few reports link the strong falls-fracture link to obesity, rather than frailty, and even fewer allude to possible interacting sleep issues as a possible intervention target in the context of allaying obesity as well as a possible bone fracture risk among at least some elderly. This is despite ample evidence that body metabolism, bone and overall health status, including weight and cognitive status depend on adequate rather than deficient or excess sleep, an emergent epidemic among many aging populations. This review aimed to specifically assess if sleep disturbances do have a possible clinically relevant bearing on the risk of incurring a fracture directly or indirectly, among older obese adults and if so if anything can be done to mitigate this possible attribute. The specific aim was to explore and summarize what we know, and how this might inform future research and practice. Using the PUBMED and Google Scholar data bases representing the topic of sleep in relation to obesity and especially fragility fractures among the elderly [2000-2026], we found that while discordant, rather than uniform, this idea is worthy of both future study, as well as efforts to avert several dire clinical outcomes, including both the direct, as well as the indirect impact of sleep deficits on falls and fracture injury risks as well as on obesity and osteosarcopenia. In this regard, it appears non-medical efforts to foster sleep may not only minimize excess harmful body weight gains, and need to adopt a sedentary lifestyle, but poor cognitive and bone health, injurious falls and a proportion of their overall costs and suffering attributes, quite substantively and safely.

Keywords: Bone, Complementary Medicine, Falls, Fractures, Sleep Deprivation, Sleep Quality, Obesity, Older Adults, Prevention, Treatment

Introduction

The ability to sleep soundly for an adequate time period on a daily basis represents a current theme of high public health import in the context of efforts to foster optimal health and wellbeing in the older population.[1] Indeed sleep disturbances including low quality sleep, a disturbed circadian sleep cycle, too little sleep and a persistent sleep debt, as well as too much sleep is currently deemed a highly impactful health correlate, especially among the older population.[2] Moreover, insufficient sleep as well as untreated sleep disorders are not only detrimental to health, well-being, and public safety, but among the many detrimental health issues associated with aging, sleep deficits alone are strongly implicated in co-morbid health conditions such as obesity, known to heighten falls risk, and possibly poor bone health,[1,3,4,5] as well as fall injuries that may result in one or bone fractures that impose excess morbidity and excess mortality rates among many elderly in their own right, These sleep problems are in fact quite numerous[6] and include deficient as well as lengthy sleep durations[7] that are potential additional falls and fracture risk factors.[8]

Other work indicates that even though there may be no association between measures of bone mineral density and sleep quality or duration,[9,10] many studies have shown that those individuals who consistently experience less than eight hours of sleep may, in turn, suffer from exhaustion as well as the inability to concentrate and pay attention to their health and safety. They may also be more prone to suffer from arterial disease (especially those that sleep less than four hours), which can lead to an increased falls risk in its own right. They may also exhibit higher depression and anxiety rates, perform less well functionally, and suffer more accidents and injuries such as fractures due to their lowered alertness and protective reflexive abilities.[1a] Unsurprisingly, Cauley et al.[6] found poor sleep quality, insomnia, and having more sleep disturbances than desirable increased the subject's odds of incurring recurrent falls, a potential precursor to a life of excess disability. Min et al.[11] further report older adults with sleep problems who take sleep medications show a significantly higher risk of falls than older adults with similar features who do not experience sleep problems or take sleep medications. Sleep problems were also longitudinally associated with an increased falls risk in older community-based adults.[12,13] The combined metabolic damage caused by lower testosterone and higher cortisol levels following sleep restriction may stimulate systemic inflammation and insulin resistance, suppressing pathways for muscle protein synthesis, thus increasing the risk of sarcopenic obesity[14] as well as cognitive and bone health alterations.[15-17]

In this regard, the presence of one or more disabling fractures among the elderly represents a widespread injury that is increasing rather than decreasing in prevalence and incidence, and stresses the importance of doing whatever is possible to prevent these and limit their impacts. For example, removing sleep remedies that provoke falls risks, as well as anti-obesity strategies in the case of the obesity sufferer that may impair bone and muscle health as well as advancing a state of falls vulnerability and thereafter a cycle of adverse sleep duration complications.[7]

Since the literature is non-conclusive in this regard, however, and efforts to prevent fractures, which impose enormous disability and functional consequences are critical to offset no matter where they occur in the older population,[18] it was felt that a closer examination of the possible role of sleep deficits in this regard was warranted, and would be helpful given the observed sleep related epidemic recently discussed, and which may be magnified among the obese elderly who fall, and that represent additional global epidemics in their own right.

In this respect, we focused on the role of intrinsic sleep related associations, such as pain, rather than extrinsic factors that can modify sleep and functional responses such as work schedules. The role of sleep medication as applied to heightening falls, fracture and sarcopenic obesity linkages was however noted as a possible modifiable risk factor for sleep deficits or excesses and duly examined.

Objectives

Our key objectives in this regard were to examine and discern if there is sufficient evidence to guide more focused preventive strategies against bone fractures that address the possible independent or mediating or reactionary role of one or more sleep problems in this regard.

A second aim was to advance ideas for related research and non drug-based practices to minimize sleep related adverse skeletal and metabolic impacts in this realm.

Rationale

Insufficient sleep has been consistently associated with higher indices of fat mass and obesity,[3] a heightened risk of developing metabolic and cardiovascular complications, including type 2 diabetes.[19]

Adequate restful sleep of approximately seven hours is however, often marred by the presence of pain, as well as physiological changes accompanying aging, such as fears, anxieties and depression, common in older adults, as well as those using medications that either over stimulate the individual or confuse them.

This possible sleep challenged group may also be subject to falls due to their age as well as medication derived impacts that may not only slow on demand reflex responses, but may inadvertently foster a state of low muscle mass and physical activity that may not always protect bone or muscle mass and may have a notable adverse gait and balance impact. By reinforcing a state of poor muscle endurance, deficient sleep or excessive sleep, the risk for falling, pain and interference as well as healing processes in some falls injury cases may ensue regardless of cause,[21,22] especially if drug intervention is increased rather than withdrawn.[23] A persistent sleep problem can also engender an unwanted state of reactive depression and thereby worse sleep quality deficits than desired plus a low motivation for activity participation.[24,25] Accordingly, the independent association between disturbed sleep among middle-aged and older adults and falls that may induce one or more fractures may warrant insightful targeting in vulnerable populations and especially if bone density is compromised excessively as may be the case in the obese older adult.[8,20]

Indeed, the link between sleep efficacy and skeletal, metabolic and cognitive health that is increasingly observed suggests:

1) the diurnal variation in bone turnover markers due to endogenous circadian rhythms linked to clock genes in all bone cells may be jeopardized if natural biological evoked sleep patterns are disrupted;
2) cumulative sleep restrictions with concurrent circadian disruptions may negatively alter bone turnover markers in a way that could explain the lower bone mineral density and increased fracture risk identified in some prior night shift work studies[9] and those with poor mood states.[26]

Although Chen et al.[27] who found abnormal sleep durations including sleep deprivation and oversleeping to be linked to a heightened risk of sarcopenia, but not significantly in obese older postmenopausal women who sustained non vertebral fractures, some exhibited several characteristic features of fragility fractures.[28] Other data have shown that at a minimum a decreased sleep quality and state of later sleep timing are risk factors for osteopenia and sarcopenia in middle aged individuals and must hence be considered possible fracture risk determinants.[29]

Methodology

To obtain information on this topic and that might be used to guide future practice or research or both, research data on the current topic were intensively sought. To this end, the author relied primarily on the largest data base in the world known as **PUBMED** as well as **Google Scholar** and **PubMed Central.** **P**ublications housed between January 2000-November 2026 were specifically sought using key words were '*sleep and bone fractures*' or '*sleep deprivation and falls, or fractures*' All articles published in English that appeared relevant were scanned and those that tended to address the review objectives were briefly summarized and documented. With very few available explicit or inclusive studies, only a narrative summary was considered possible. Excluded were proposals, articles on young adults, fracture surgery, obesity and falls prevention studies and those detailing sleep disorders such as insomnia, parasomnias, sleep apnea, and sleep-related movement disorders.

The term sleep problems, poor sleep, or sleep challenges was used to denote any of the associated states found in the literature including: various degrees of difficulty falling asleep, sleep restrictions, chronic partial sleep deprivation, and challenges remaining asleep, as well as impact of sleep duration, sleep deprivation, and poor sleep quality.[16,17]

No pharmacologic approaches were examined and only elderly population applications were examined as sleep disturbances are rife in this group and pharmacological agents can induce s pose side effects such as tolerance and dependence, warranting the exploration of alternative non-pharmacological interventions known to have with few or no adverse effects.[30]

Key Results

Among the data reviewed, the importance of examining sleep issues as possible determinants of falls and obesity risk shows these are likely to occur in at least half of the older population[2,31] and alone or in combination may culminate in a bone fracture event even if not well recognized.[6] In examining the risks of recurrent falls and fracture relative to sleep duration using 7 hours as their referent, as well as other aspects of sleep disturbances, insomnia status, and sleep quality for an average follow-up time of 7.6 years for falls and 12.0 years for fractures those defined as long sleepers (≥10 hours) were found to have an increased odds of recurrent falls. Short sleep periods were further associated with an increased risk of all fracture types, but surprisingly not hip fractures. Although there was little association between other sleep characteristics and fracture occurrences in this study, it was a concluded that both short and long sleep duration and poor sleep quality are independently associated with an increased chance of experiencing recurrent falls, and in a modest way, with an increased fracture risk. The possible bias in only examining hip fracture survivors may explain this observed low hip fracture risk.

Moreover, although somewhat negated as a bone density determinant by Swanson et al.[5,9] Lin et al.[32] who tried to discern how the factors of sleep quality, nutritional status, community participation, cognitive function, depressive symptoms, and falls may interact in the community-dwelling older adult diagnosed with dynapenic abdominal obesity, found almost 14 percent of the 180 cases studied were classified as having a modest to high risk for falls.

In the case of an obese faller, poorer daily living abilities as well fractures that may ensue[33] may yet stem from any persistent sleep issue that can lower bone mineral density,[16] even in the face of sleep medications.[34] As well, longer sleep durations over time expected to impact chronic health attributes including bone mineral density and muscle function unfavorably, may also harm full falls recovery processes if a fracture is eventually manifest.[7,35]

According to Stone et al.[36] self-reported long sleep and daily napping are indeed associated with greater risk of falls and fractures in older women and their recognition thus warrants more attention in our view. As outlined by Rogers et al.[37] in examining the role of dysregulated rest-activity rhythm patterns and falls, the later acrophase sleep stage was found to be associated with a modestly greater risk of falls in elderly men. In this study, the authors used wrist-worn actigraphy to measure sleep rest activity attributes over 4.8 ± 0.8 24-h periods among men older than 67 years who were contacted every 4 months to report occurrence of falls/fractures. Logistic regression was used to estimate the likelihood of recurrent falls in the year after the visit. Proportional hazards models were used to estimate the risk of fractures but follow up may have been too short in this regard.

Indeed, a large earlier study by Holmberg et al.[38] of 22,444 men, mean age 44 years, and 10,902 women, mean age 50 years with a follow-up of to 16 years with regard to occurrence of fracture found 135 women had one low-energy hip fracture each, and 166 in men. Among the significant predictors, were reported sleep disturbances, an observation supported by Bakken et al.[23] for adults who take drugs to reduce sleep disturbances, and Kanis et al.[39] As well, Yoshimura et al.[40] who conducted a prospective study among Japanese adults that examined hip fracture determinants found these to include sleep disturbance, sleeping in a Western-style bed, and drinking more than 3 cups of coffee daily, which could hamper sleep. Short sleep duration (defined as ≤ 5 hours/night) was also found associated with a significantly increased risk of fracture for up to five years in postmenopausal women.[9]

Thus, while remaining somewhat controversial, both long (8 h/day) and short sleep duration have also been repeatedly associated with low bone mineral density and osteoporosis, which is a major risk factor for bone fractures.[3]

Patel et al.[41] further identified that actigraphy-ascertained reduced sleep duration is strongly associated with greater adiposity in older men and women, with those sleeping less than 5 hours per night having a significantly greater average body mass index compared to those sleeping 7–8 hours. This is relevant to fracture understandings as it is apparent obese older women exhibited decreased postural stability, oscillating at a faster center of pressure speed than the normal weight group in both visual conditions where the obese group demonstrated greater sway ranges along the medio-lateral axis than the normal weight group when vision was removed ($p < 0.05$), as well as greater range along both axes without vision. It was found the obese older women spent less time in stability zones and had greater distances between these zones compared to the normal weight group in both visual conditions.[42]

The issue of sleep health and its ramifications is thus not a simple one to unravel; but one strongly related to sarcopenia, characterized by progressive loss of grip strength, gait speed, balance, and muscle mass, that often leads to a higher risk of falls and fractures, as well as a possible increased level of falling fears, sedentary behaviors, plus consumption of hyperpalatable foods that may increase adiposity risk, and osteosarcopenic states of bone vulnerability.[14]

Qian et al.[10] concludes insomnia can be shown to have a causal effect on fracture risk, with participants exhibiting insomnia showing a 6.4% higher risk of fracture in a primary observational analysis. In this regard a U-shape relationship was observed between sleep duration and fracture risk, where the lowest risk was found for those sleeping 7–8 hours per day.

Those deemed to display poor sleep quality as assessed by a composite Sleep Risk Score, were significantly more likely to sustain a fracture.

Huang et al.[43] who examined the relationships between four self-reported sleep characteristics—sleep duration, sleep difficulty, snoring, and excessive daytime sleepiness—and the risk of incident vertebral and hip fracture risk in women using data from two longitudinal cohort studies showed poorer self-reported sleep characteristics were significantly associated with an increased risk of incident vertebral fractures among women. Shorter sleep duration was moderately,

inversely associated with vertebral fracture risk, but not significantly for the shortest category when compared to "7" hours of sleep. The combination of poor sleep symptoms significantly increased the risk of vertebral fracture, particularly in cases with obstructive sleep apnea. Overall, the results did not support a significant association between the four poor sleep characteristics examined and the risk of hip fracture. The conclusions relied however solely on examination of the relationships between four self-reported sleep characteristics—sleep duration, sleep difficulty, snoring, and excessive daytime sleepiness—only in women and using data from two longitudinal cohort studies and other factors were not studied.

Cooper et al.[20] similarly concluded individuals who regularly slept less than 7 hours per night were more likely to have higher average body mass indexes and obesity than those who slept more, while Kim et al.[44] have found falls prevalence is influenced by both short sleep (5 or 6 hours per day) and long sleep durations (8 or hours per day) whether a subject is obese or not.

Lee et al.[45] further agree poor sleep quality is significantly associated with an increased risk of falls, even after adjusting for socioeconomic, physical health-related, and mental health-related confounders and is a situation that may foster an observable fracture risk.[46,47] They further assert a role for healthy sleep management in the future as a means of improving the quality of life of many middle-aged and elderly persons is strongly indicated.

It is also known that difficulty sleeping after a fracture can have negative effects on both mental and physical health and may prolong the recovery process.[48]

CONVERSELY

Efforts to advance sleep health are likely to yield a lower risk of incurring a fall and fracture.[36, 49,50]

In particular, complementary medicine intervention approaches may well improve sleep quality, emotional health, and cognitions and thereby falls and fracture risk as indicated and could include:

Acupuncture[17,51]
Acupressure[52]
Environmental based changes eg., removal of blue light emitting devices
Exercise[53]
Health education to improve sleep hygiene/emotional regulation[4,25,54]
Herbal teas and natural supplements[55-57]
Integrated holistic complementary medicine approaches[24,58-60]
Massage[57]
Melatonin supplementation[61]
Music interventions[62,63]
Vitamin D supplementation[64,65]
Yoga and Tai Chi Meditative Movement Practices[24,66]

Other natural remedies include: aromatherapy, relaxation and imagery, reflexology, bright light exposure, magnesium, and inspiratory muscle training.[49,63] Buford[49] specifically recommend helping clients to:

1) Set a consistent sleep schedule
2) Curate a desirable sleep environment
3) Limit screen time before bed down with intention
4) Watch what is consumed
5) Wind down with intention

To foster more solid conclusions, Gooneratne[67] advocate for an improved research trajectory and one that strongly applies standardized objective measures.

Discussion

In the realm of fostering healthy aging across the lifespan, the very detrimental impact of insomnia as well as the high risk of experiencing one or more fractures that might be linked to this or similar discordant sleep states appears of high import to continue to examine. Not only are these possible sub sleep states very common among older women and men, but they are very impairing if not recognized or treated effectively on a population as well as an individual level basis. However, despite years of research, our present overview implies there is a rather poor understanding of the link between sleep and overall health and safety across the lifespan. In particular, among the less well studied fracture determinants, of particular interest to averting in later life, the lack of attention to sleep and its linkage to osteosarcopenic obesity and fragility fractures that may explain the high rates of both disability as well as mortality among many older adults remain relatively under reported. Impacting recovery rates and health status in the event of a fracture the failure to address sleep issues largely remain limited and poorly applied clinically speaking in our view even when observed.

In particular, sleep, and its association with appetite-regulating hormones, specifically increased levels of ghrelin (an appetite stimulant) and decreased levels of leptin (a satiety hormone) may increase hunger inadvertently, thus heightening an unwanted obesity risk[20] especially in older adults sleeping less than 5 hours compared with a more optimal 7–8 hours and that has enormous ramifications, including those of bone health. Sleep restriction also decreases insulin sensitivity and affects endocrine signaling, as well as possibly impacting multiple behavioral mechanisms negatively that may heighten an undesirable tendency towards falls, recurrent falls, and falls injuries risks.[15] As well, short sleepers may have more opportunities to consume calories and may experience fatigue leading to reduced physical activity and more sedentary inclinations than desirable that may have a link to falls, plus poor bone and muscle health if chronic.

Although we did not conduct a universally inclusive review, the current data point to a need for more substantive verification in many spheres, to justify more preventive efforts to offset sleep disturbances at all life phases.

Nonetheless, it appears if more is done in this regard sooner rather than later, many adverse life events may be obviated including a need for sleep medications. To this end, when focusing on the individual it appears non-pharmacologic solutions that can offset the risk of incurring disability as a result of poor sleep durations or quality are indicated, especially among those older adults at high risk for fracture injuries.

Indeed, increasing numbers of scientific studies confirm that sleep durations of less than six hours for four or more consecutive nights can impair glucose metabolism, immune functions, appetite regulation, cognitive performance, and mood.[68] However, those who use complementary alternative medicine approaches to normalize their sleep profiles tend to agree that their sleep quality improved to some extent after treatment. Acupuncture, has been advocated here due to its measurable impacts on neurochemical modulatory activity involving dopamine, serotonin, and endogenous opioids, which enables it to serve as an effective enhancer of sleep, as well as acupressure and other natural medicine options.

According to the data, removing sleep inhibitors and fostering motivation for exercise appears to be especially beneficial for mitigating falls and fracture risks in later life safely and at low cost. Clinicians can tailor their recommendations accordingly based on the belief much can be done if all avenues of sleep dysfunction mitigation are explored, especially those that may have a bearing on the development of some fractures, such as osteoporosis, obesity, diabetes, stress, falls, and poor muscle health. According to Lucasson et al.[29] decreased sleep quality and a later sleep timing schedule are especially important to combat as they predict osteo- and sarcopenia in middle aged individuals in this regard, a group highly vulnerable to one or more life threatening bone fractures.

Swanson et al. [5,9] too imply that efforts to foster adequate sleep may enable normalization of numerous biological processes plus the functioning of several body systems including optimal bone health. Optimal sleep patterns may also help avert associated poor emotional health that may impact fracture risk as well as fracture healing processes if these occur, plus general personal safety behaviors.[21] However, drugs used to induce sleep where sleep problems prevail should be used judiciously or substituted for by nonpharmacologic interventions where possible.[30,69] As well, if older adults are prescribed Z-drugs they and their caregivers should be warned about the added risk of falls and fractures and counseled as to practical preventive countermeasures against these events. Treves et al.[70] state physicians should consider these potential risks before prescribing these medications to older adults, especially those who are frail or vulnerable, and it seems there are many options to help clients through less toxic measures.

While both short as well as long sleep durations appear to be significantly associated with falls,[47] patients should be carefully questioned about their normal average night's length of sleep as both too little as well as too much sleep can prove equally problematic in increasing falls and fracture risk and each may require differing intervention approaches. The number of days in the week where poor sleep is evident should also be routinely examined, as the falls risk increases with number of sleep related days reported.[8] Min et al.[11] report that even if the association between sleep problems and risk of falls among the elderly are conflicting, some specific sleep problems such as extremely short sleep duration, daytime sleepiness and naps appear to be significantly related to falls in older adults, hence careful assessment of any sleep issue, followed by tailored interventions appear warranted

Indeed, the identification of sleep disturbances and their modification may help identify many high-risk elders who may benefit from fall prevention education, rather than costly pharmacologic and invasive solutions and a life of immense suffering if they survive a fracture.[12] As per Shannon[49] longevity, mood, and life quality may similarly be enhanced significantly.

Conclusion

From this mini overview and not withstanding its limitations as well as immense gaps in the literature-we conclude:

- Sleeping well is essential to good health. People who are healthy, in turn, usually sleep well. However, disruptions in sleep, even if minor can influence one's emotional wellbeing and mental health. If sleep deprivation continues, and actual sleep problems are ignored, poor health, a high risk of accidents, bone fractures, and poor ability to recover may ensue

- Among the older population sufficient data imply sleep may be problematic and that more well targeted preventive efforts to minimize a possible related fracture risk factor in this regard is desirable.

- Complementary medicine can play a beneficial role here and should be studied further.

- More effort is required to establish the range of sleep issues that impact fractures in the elderly and who is susceptible.

- Careful screening may help reduce the chances of excess disability and possible further fractures or poor health due to sleep challenges associated with both aging as well as chronic conditions.

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