OPEN ACCESS
Freely Available Online

JOURNAL OF AGEING RESEARCH AND HEALTHCARE
ISSN NO: 2474-7785

Special Issue
DOI: 10.14302/issn.2474-7785.jarh-20-3496

Osteoarthritis and Falls: Is there a Link?

Ray Marks[1,*]

[1]Department of Health and Behavior Studies, Teachers College, Columbia University, New York, NY 10027

Abstract

Osteoarthritis, a widespread joint disease, commonly results in considerable pain and functional disability, especially among older adults. At the same time, falls and fall injuries, also common among the older population, may not only contribute to the onset of osteoarthritis, but once established, to falls that lead to fractures and disability in their own right. But what does the research show specifically?

Objective

This report aimed to examine what is known about the interrelationship between falls and osteoarthritis and the implications that can be drawn from this information.

Methods

Using the PUBMED data base, studies describing an association between osteoarthritis and falls were sought. Those fulfilling the eligibility criteria were reviewed and summarized in narrative form.

Results

Consistent support for an osteoarthritis-falls associated linkage is limited and not as robust as one would predict. Whether the observed associations between these health determinants are a cause of osteoarthritis, a consequence or both, or simply spurious findings is hard to decipher.

Conclusion

More numerous and carefully designed research to examine this issue is warranted and may be extremely helpful in preventing, as well as ameliorating a high degree of excess disability and associated fiscal costs due to both falls as well as osteoarthritis among the elderly.

Corresponding author: Ray Marks, Department of Health and Behavior Studies, Teachers College, Columbia University, Box 114, 525W 120th Street, New York, NY 10027, Tel: 1-212-678-3445, Fax: 1-212-678-8259. e-mail: rm226@columbia.edu

Citation: Ray Marks (2020) Osteoarthritis and Falls: Is there a Link?. Journal of Aging Research And Healthcare - 3(2):1-13. https://doi.org/10.14302/issn.2474-7785.jarh-20-3496

Keywords: elderly, falls, fall injuries, hip, knee, osteoarthritis, pain, prevention, treatment

Running tittle: Osteoarthritis and Falls

Received: Jul 23, 2020 **Accepted:** Aug 02, 2020 **Published:** Aug 06, 2020

Introduction

Osteoarthritis, a common disabling progressive joint disease affecting joints such as the knee and hip is frequently associated with various degrees of pain and loss of the ability of the affected person to function physically. Among the challenges noted in cases with knee or hip joint osteoarthritis or both, are varying degrees of oftentimes intractable pain, stiffness, and limited mobility. An additional problem is the strong tendency for one or more affected lower limb joints to 'give way', along with possible further injury due to subsequent falls. In addition, diseases commonly associated with both aging and osteoarthritis such as obesity, diabetes, and cardiovascular diseases, are also all illnesses that can increase the risk serious falls by the affected individual who has osteoarthritis of one or more joints. Other related factors include the strong presence of depression, and lack of sleep, plus possible medications that increase falls risk. Age associated factors, as well as neurological disease correlates such as impaired proprioception, along with a possible decline in balance capacity [1] are additional fall associated factors that might prevail among older adults diagnosed as having osteoarthritis.

In addition, and often less well publicized, are osteoarthritis disease correlates such poor muscle endurance, muscle timing deficits, and muscle weakness, and wasting. Impaired ambulation is an additional falls risk factor [2]. Unsurprisingly, Arnold and Faulkner [3] state that not only does falling account for significant numbers of hospital and long-term care admissions in older adults, but that many adults who are not only advancing in age, but who are also experiencing a decline in their functional ability due to hip or knee osteoarthritis or both, are at an even greater risk.

Moreover, those who are healthy and fall and fracture a hip or another bone, may also develop osteoarthritis that is challenging to treat even if they were previously healthy and mobile, and this situation in turn, can produce a cycle of persistent or recurrent fall-associated injuries.

While all the above issues are somewhat reasonable in predicting that a sizeable number of older adults with osteoarthritis may be at risk for falls, and/or that older adults at risk for falls may sustain joint injuries that lead to osteoarthritis, there is no systematic body of consistently supportive evidence in this respect. Given the great need to foster healthy aging and high life quality for all older adults, and to develop preventive strategies that are empirically sound, rather than being chosen somewhat spuriously, this present overview sought to focus on examining the key findings that have been published in this regard, plus their implications for practitioners and researchers who desire to minimize the enormous health burden among the elderly, as well as society.

One question posed was whether any consensus exists as to the relevance of any observed osteoarthritis-falls linkage, as the literature has been ambiguous as well as limited in scope on this point to date. Another was what is needed to further our understanding of these key risk factors for low life quality among the elderly.

Significance

Both osteoarthritis as well as falls injuries currently pose an enormous challenge to health providers, as well as immense costs. Hence a better understanding of whether there is a clinically significant and robust relationship between these variables that can be predicted, and possibly intervened upon may prove of enormous value in public health efforts to offset the costs of poor health and excess morbidity among current aging population, while promoting life quality.

Methods

To obtain the desired data for the present review, the PUBMED data was selected given its enormous reach and trustworthiness. Appropriate publications listed when applying the key terms: osteoarthritis and falls, falls injuries and hip osteoarthritis, falls injuries and knee osteoarthritis were selected for review. As well, the Web of Science Consolidated and the Google Scholar data bases were reviewed for additional data. Articles pertinent to the current discussion, with the exception of falls relative to older adults in general, and/or total joint replacement surgery follow up studies [eg 4] were sought. Excluded were articles that did not discuss osteoarthritis per se, for example those that discussed falls and pain or falls in healthy older adults, or were study proposals.

Available data extending from Jan 1 1980-July 15, 2020 were examined. Those articles deemed to be relevant were downloaded and scrutinized and summarized and reported in narrative form, given the lack of any uniform focus or diagnostic descriptions in most studies. All forms of study were deemed acceptable.

Results

In general, using the terms below, a modest number of records were identified in the PUBMED database over the years 1987-2020 as follows: Osteoarthritis and falls n=581

Falls injuries and osteoarthritis: n=213; 6=Randomized Controlled Trials Falls injuries and hip osteoarthritis: n=25

Falls injuries and knee osteoarthritis n=37 Osteoarthritis and falls risk n=281

However, although a fair number of postings were profiled from the search using the above terms, an extensive search of both the PUBMED and other data bases reviewed revealed only 50 reasonably relevant papers on the present topic of interest, with all being listed in PUBMED. That is, despite attempts to examine other data bases and to narrow the key words used as outlined above, the data base on the prevailing topics of interest was leaner than anticpated given more than 30 years of effort. As well, many topics that emerged during these searches were clearly irrelevant to this present discussion for various reasons, for example, these included conference abstracts, studies of healthy cohorts, completely unrelated studies, and pilot studies. Surprising too was the very limited number of observational or longitudinal clinical studies other than intervention studies on this general topic.

What was found was that in some cases of studies that met the inclusion criteria for this review, but not all, was that falls and osteoarthritis can co-occur at a modest to a high rate of frequency in some cases with established osteoarthritis. But here again, the differing topics examined, as well as the different samples studied rendered aggregation of these data unfeasible. Issues studied were not only diverse and included, but were not limited to: the possible determinants of falls, the role of Tai Chi and falls, falls in the context of joint replacement surgery, falls and pain, but not osteoarthritis pain per se, among other diverse issues. Diverse measures of falls themselves, plus the differing definitions of osteoarthritis, among other factors, such as joint site studied, and disease duration precluded any meaningful summation of these rates in our opinion.

According to some of this data, for example, although one can predict with reasonable certainty that older adults with lower limb osteoarthritis may be more prone to falling or falls than healthy age-matched adults, Ng and Tan [5] who conducted a review of the existing literature in 2013 found limited evidence in support of this assumption. On the contrary, they argued that that osteoarthritis may actually be protective against falls and related fractures. However, joint arthroplasty surgery appeared to increase the risk of falls in individuals with osteoarthritis according to their observations.

This was not the finding however of Si et al. [6] who reported conclusively that primary total knee arthroplasty is associated with a reduced falls incidence and improved balance-related functions. This group further proposed that the contra-lateral knee should be considered of import in the design of fall-prevention strategies for this group of patients. Foley et al. [7] also concluded that radiographic lower limb osteoarthritis and falls are not linked.

In 2018 meantime, di Laura Frattura et al. [2] who examined falls risk factors in another systematic review, and among knee joint arthroplasty cases, found pre-operative falls prevalence to range from 23- 63%, while post-operative values ranged from 12-38%, suggesting at least some cases, if not all are vulnerable to falls. Moderate evidence indicated no pre operative influence of clinical scales, body mass or joint range of motion differences between "fallers" and "non-fallers", suggested these factors do not determine falls risk. Conflicting evidence was found however, for the variables of sex, history of previous falls, age, kyphosis, muscle weakness, fear of falling, depression, balance, and gait impairment. No evidence was found for the effectiveness of surgical or rehabilitative strategies on falls reduction. It was concluded that cases with osteoarthritis undergoing total knee joint arthroplasty surgery are at high risk of falls, which, though reduced in frequency, are still present post

surgery. Although some risk factors were identified, the authors found no definitive studies demonstrating the possibility of reducing the incidence of this deleterious event. This however, was a systematic review and may not have represented the entire spectrum of available studies, or alternately, what was studied, determined the overall findings, and may have been limited.

Ikutomo et al. [8] who noted fall-induced injuries and potential resultant deaths to be a serious health problem among older adults, and possibly among older adults with muscle weakness, gait and balance deficits, such as patients with end-stage hip osteoarthritis, did note that until 2019 the incidence and risk factors for falls in patients with end-stage hip joint disease had been unclear. What they did find though among 153 women with end-stage hip osteoarthritis, mean age 64 and 112 age-matched healthy women was that the incidence of incurring at least 1 fall in the past year was significantly higher in women with end-stage hip osteoarthritis than in healthy women. Falls among these women with joint disease were most often caused by tripping and falling forward during the daytime, and 65.2% of these resulted in injuries and 13.0%, in fractures. The occurrence of a fall significantly correlated with limping, and knee extensor muscle strength. It was concluded that falls prevention approaches are highly indicated for this group, especially for those with gait challenges such as limping and having reduced lower knee extensor strength. Barbour et al. [9] however, who conducted a community based study, showed knee osteoarthritis was indeed independently associated with an increased risk of injurious falls in older men, but not in older women, which was the reverse in the study by Riddle et al. [10]

An earlier study by Arnold and Faulkner [3] that sought to describe fall and near-fall history, location, circumstances and injuries from falls in a community-dwelling population of adults over aged 65 with hip osteoarthritis and to determine the ability of the timed up and go test to classify fallers and near-fallers found 45% had had at least one fall in the prior year, and 77% reportedly experienced occasional falls or almost falling. The majority of falls in this study occurred during walking and stair climbing, and 40% were found to sustain a falls related injury. The get up and go test was not associated with history of falls, but was associated with near-falls, and higher scores occurred for those who were older, less mobile, and with greater number of co- morbidities. It was concluded that a high percentage of older adults with hip osteoarthritis are likely to experience falls and near-falls.

More recently, Smith et al. [11] examined the question of whether there is an increased risk of falls and fractures in people with early diagnosed hip and knee osteoarthritis using data from the Osteoarthritis Initiative. Identified were persons diagnosed with hip or knee osteoarthritis within a 12 month period, who were then compared to persons without osteoarthritis as to any differences in falls occurrence. Results of 552 hip osteoarthritis cases were compared to 4244 individuals with no hip osteoarthritis; and results of 1350 cases with knee osteoarthritis were compared to 3445 disease free individuals without knee osteoarthritis. Those with knee osteoarthritis were found to have a 54% greater chance of experiencing a fall compared to those without the disease. Those with hip osteoarthritis had a 52% greater chance of experiencing a fall compared to those without hip osteoarthritis. As well, those who had knee or hip osteoarthritis had an 80% greater chance of experiencing a fracture in the first 12 months of their diagnosis compared to those without a hip or knee osteoarthritis diagnosis.

A further study concerning the falling risk among patients with end-stage knee osteoarthritis as studied by Aljehani et al. [12] showed that although 25% of patients with end-stage knee osteoarthritis may report falling, there is limited information about risk factors for falling in this patient group. In studying 259 cases awaiting joint replacement surgery, independent t tests used to examine differences between past fallers and non fallers, those who had fallen, had more low back pain and worse walking endurance. van Schoor et al. [13] however, found opioid and analgesic usage to mediate the associations between clinical osteoarthritis and (recurrent) falls, while physical performance and physical activity did not. It was concluded that individuals with clinical knee osteoarthritis are at increased risk for recurrent falls, and that this relationship is mediated by pain medication, particularly opioids. Lo-Ciganic et al. [14] similarly noted participants with or at risk of knee osteoarthritis who used opioids and antidepressants with/without other analgesics/

nutraceuticals may have an increased risk of recurrent falls after adjusting for potential confounders. The combined role of physical as well as psychological correlates may be implicated in falling, especially among the older osteoarthritis adult, however, as outlined by Byun et al. [15]. As well the role of fear falling is a possible independent falls predictor.

Byun et al. [15] who aimed to describe individual, physical, and psychological characteristics between older adults with and without a fall history and to apply this information to adults with arthritis came to this aforementioned conclusion after analyzing data from the 2014 Korean Survey of Living Conditions and Welfare Needs of Older Adults Their findings suggested that both physical as well as psychological factors, especially the fear of falling, need to be addressed to prevent falls in elderly patients with arthritis.

In another study, Tsonga et al. [16] who investigated the role of the history of falls including their frequency, mechanism and location, plus activities during falling, as well as injuries sustained from falls found a 12 month falls frequency of 63.2% among a cohort of older adults aged 65 years and older suffering from severe knee osteoarthritis. They also found almost 90% of these falls had occurred during walking, and 41% of the cases studied reported stumbling episodes in the past year. Thirty percent of cases experienced a falls-based injury.

Unsurprisingly, Iijima et al. [17] found adults with knee osteoarthritis may well incur repeated falls. However, they found this was not due to leg pain, but rather to mild-moderate low back pain, and possible opioid usage that impairs reflex responses. Nevitt et al. [18] who examined whether knee instability contributes to the increased risk of falls and fractures observed in persons with knee osteoarthritis reported that those who experienced 'buckling' were more likely to incur recurrent falls, significant fall injuries, and fall injuries that limited activity tentatively supporting the findings of Iilima et al. [17]. They also noted that fallers were almost four times more likely than not to have poor balance confidence.

In examining falls risk factors among adults with knee osteoarthritis using a systematic approach, Manlapaz et al. [19] did show that impaired balance, muscle weakness, the presence of comorbidities, and increasing number of symptomatic joints are falls risk factors. However, the strength of evidence was rated as "conflicting" because of the inconsistency of the findings.

Surprisingly, limited evidence was found for knee instability, impaired proprioception, and use of walking aids as falls determinants.

Tasci Barbaz et al. [20] who studied 50 cases with knee osteoarthritis and 50 healthy controls, found the median falling index was 52 in those with knee osteoarthritis, and 31 in the control group. It was determined that primary knee osteoarthritis increased the risk of falling significantly and those with higher disease grades fell more than those with lower grades. Pain and function did not appear to influence the risk of falling in those patients, however.

In another study of lower-extremity osteoarthritis and the risk of falls in a community-based longitudinal study of adults with and without osteoarthritis Doré et al. [21].found the odds of falling to increase with increasing numbers of lower-extremity symptomatic joints. When controlling for covariates, patients with either symptomatic knee or hip osteoarthritis were found to be more likely to report falling. However, both those with symptomatic as well radiographic osteoarthritis appeared to fall to the same degree over time according to Riddle et al [10], and contrary to findings of Levinger et al. [22] to have no muscle strength or proprioception problems sufficient to explain the prevailing falls rate. As well, Mat et al. [23] reported the loss of postural control due to hip/knee osteoarthritis is not a risk factor for falls among community- dwelling older adults. Neither is muscle strength according to de Zwart et al. [24]. While Picorelli et al. [25] state that other factors may be implicated in falls experienced by osteoarthritis cases, this negation of balance observation does not totally align with that of Teder- Braschinkey et al. [26] who found symptomatic hip and knee osteoarthritis are risk factors for falls and related fractures among the elderly population with and without Parkinson's disease in their own right. The inability to walk 500 m appeared to predict an increased risk of falls among the elderly.

One factor noted by Picorelli et al. [25] that could explain why some osteoarthritis cases are prone to falling is muscle weakness, a finding supported by Scott et al. [27] for women with radiographic knee osteoarthritis. As well, even though negated by Mat et al. [23] balance appeared to be a salient falls risk factor for women with lower limb osteoarthritis [28].

In another study, Mat et al. [29] who examined 389 participants, 229 fallers and 160 non-fallers, older than 65 years of age found individuals with radiological defined disease and 'mild' overall symptoms to have a reduced falls risk compared to asymptomatic cases of osteoarthritis.

Individuals with clinical osteoarthritis and 'severe' overall symptoms on the other hand had an increased risk of falls compared to those with 'mild' disease. In individuals with radiological osteoarthritis, mild symptoms appeared protective of falls, while those with clinical osteoarthritis and severe symptoms had an increased falls risk compared to those with mild symptoms.

However, Barbour et al. [9] found symptomatic radiographic osteoarthritis of the knee was independently associated with an increased risk of injurious falls in older men, but not in older women.

In the prospective study conducted by Doré et al. [21] using data from two time points to examine a large group of symptomatic cases with osteoarthritis of the hip and/or knee, the researchers found the odds of falling increased with an increasing number of symptomatic joints. However, as outlined by the authors, the definition of falls, may be open to question due to the subjective nature of the study participants understanding of the question The question used in Doré et al.'s [21] study did not include an indication of the severity of any experienced fall, and any additional falls outside of the 12-month window.

Anderson et al.'s [30] finding of high fall risks in more than one-third of all participants with knee osteoarthritis is consistent with previous reports of a higher risk of falling in this population. These and other data are listed below in Table 1.

Data further reveal the following lower limb osteoarthritis and/or aging related possible preventable falls determinants

- Balance deficits [8,19, 28]
- Cardiovascular disease [19]
- Depression [34]
- Diabetes [19]
- Fear of falling [22, 33]
- Fear of movement [36]
- Gait abnormalities [3,8]
- High levels of narcotic usage [35]
- Impaired mobility/physical performance [41, 44]
- Increasing number of symptomatic joints [19]
- Ligamentous/joint instability [18]
- Muscle weakness [8, 16, 22]
- Neuromuscular factors/asymmetry [38, 43]
- Pain [12, 16, 39, 40]
- Poor walking endurance [12]
- Sarcopenic obesity [37]
- Sleep deficits [42]
- Stiffness [16]

Discussion

Falls among the elderly remain an enormous health concern among aging populations worldwide. While their prevention remains highly challenging, this review examined the possible role of osteoarthritis-related falls, as one possible modifiable excess disease morbidity disabler, as well as hip fracture risk factor. In this regard, all related research efforts were examined, with a fair number indicating a salient role for falls that accompany osteoarthritis as possible risk factors for further injury, as well as low life quality [45]. Work by Hoops et al. [46] among others for example, has affirmed the risk of falling reportedly increases almost 2.5-times in those with lower extremity osteoarthritis compared with age-matched controls even though the mechanisms underlying the increased risk are not clear. However, among the several falls determinants highlighted in this review, Hoop et

Table 1. Examples of key studies examining the theme of osteoarthritis and falls risk or injury

Authors	Sample	Results	Conclusion
Tasci Bozbaz et al. [20]	100 participants, 50 with knee osteoarthritis, 50 healthy controls	Median falling index was 52 in knee osteoarthritis group; it was 31 in control group. Disease status predicted falls Pain and functional status did not appear to influence risk of falling	Primary knee osteoarthritis is a risk factors for falling. Medical attention, proprioception/balance/gait training, muscle strengthen-ing, and home safety arrange-ments may reduce falls risk in those with knee osteoarthritis
Dore et al. [21]	1619 men and women, 45 years of age/older with osteoarthritis	Compared with non fallers, those reporting a fall were more likely to be Caucasian, older, + female Those who fell reported higher narcotics, sleep aids use, lung/ neurologic problems, prior falls The odds of falls increased with numbers of affected symptomatic joints	Individuals with multi-joint lower extremity symptomatic osteoarthritis, and those with symptomatic hip or knee joint disease, are at an increased risk for falls independent of known risk factors
Ikutomo et al. [8]	153 women with end-stage hip osteoarthritis (mean age = 64.0 years) and 112 age- matched healthy women (mean age = 64.1 years)	The incidence of at least 1 fall in the past year was significantly higher in women with end-stage hip osteoarthritis Falls were most often caused by tripping and falling forward during the daytime 65% falls resulted in injuries and 13.0% in fractures The occurrence of a fall correlated with limping and knee extensor strength	Women with end-stage hip osteoarthritis have an increased risk of falls and fall- induced injuries The prevention of falls in this vulnerable population should be a priority among health care practitioners In particular, women who limp + have reduced lower knee extensor strength should ne targeted

Mat et al. [29]	389 participants [from 229 fallers; 160 non-fallers, age (≥65 years)	Individuals with radiological osteoarthritis and 'mild' overall symptoms had reduced risk of falls compared to asymptomatic cases Those with clinically defined disease and 'severe' overall symptoms had an increased risk of falls compared to those with 'mild' osteoarthritis	In individuals with radiological osteoarthritis, mild symptoms appear protective of falls while Those with clinical osteoarthritis + severe symptoms have an increased falls risk compared to those with mild symptoms
Pandya et al. [31]	17 patients with painful osteoarthritis of the knees (age range, 59.6 +/- 8.1 years) and 14 age-matched healthy control subjects (age range, 61.1 +/- 10.0 years)	Patients with knee osteoarthritis had a 37% lower obstacle avoidance success rate, a 54% lower single -leg stance duration	Knee osteoarthritis reduced obstacle avoidance success rates, supporting epidemiologic studies that have found osteoarthritis to be a risk factor for falls
Smith et al. [11]	552 individuals with hip osteoarthritis were compared to 4244 individuals without hip osteoarthritis; 1350 individuals with knee osteoarthritis were compared to 3445 individuals without knee osteoarthritis	People with knee osteoarthritis had a 54% greater chance of experiencing a fall compared to those without; those with hip osteoarthritis had a 52% greater chance Those diagnosed with knee + hip osteoarthritis had an 80% greater chance of experiencing a fracture	There is an increased risk of falls and fractures in early- diagnosed knee and hip osteoarthritis compared to those without osteoarthritis International guidelines on the management of hip and knee osteoarthritis should consider the importance of the management of falls risk
Soh et al. [32]	4796 participants, 2270 (47%) were diagnosed with knee and/or hip osteoarthritis	72% participants with osteoarthritis reported falling and 17% reported fractures Personal factors were strongest predictors of falls and fractures A self-reported history of falls was a significant predictor of both increased falls + fracture risk	Personal factors are more likely to predict falls and fractures than impairments It is important to question patients about their previous falls+ past medical history
Tsonga et al. [16]	68 mean and 58 women scheduled for knee joint replacement	Fall frequency was 63.2% in past year	Patients with severe knee osteoarthritis are at high risk for falling

al. [46] suggest that those with lower limb osteoarthritis who become dynamically unstable, may be less able to perform an appropriate compensatory stepping response compared with people without this health condition or problem.

While this set of ideas appears plausible, data stemming back to 1999 are still confusing however, for example at that time Arden et al. [47] reported that women with radiographic hip osteoarthritis had a reduced risk, rather than an increased risk of recurrent falls in the first year. However, those with self-reported disease had an increased risk of falls. It is possible that those with a clear diagnosis receive education and intervention, and are more careful than those who self-diagnose.

However, this explanation is challenged by findings of Smith et al. [11] who observed a reasonably marked increase in the risk of falls and fractures in early -diagnosed knee and hip osteoarthritis compared to those without osteoarthritis. Tsonga et al. [16] reported that one third of adults over the age of 65 years and half of those over age 80 will fall annually, regardless of the presence of osteoarthritis and patients with severe knee osteoarthritis are likely to be at greater risk of falling, as compared to healthy older adults.

Zasadadka et al. [48] support this aforementioned data and reiterate that it appears these facts should be taken seriously because falling in the elderly results in a significant number of admissions to hospitals and long-term care facilities, especially among patients with lower extremity osteoarthritis. In particular, the elderly population and those with excessive pain and muscle weakness may be most vulnerable. In addition to pain, Tsonga et al. [16] reported that stiffness, limited physical ability, and reduced muscle strength, all consequences of severe knee or hip osteoarthritis or both, can not only restrict a patient's quality of life, but increase their risk for falling and further injury.

As per Tasci Bozbaz et al. [20] falling is among the key causes of excess mortality and morbidity in advanced age, and primary knee as well as hip osteoarthritis are among the key risk factors associated with such falls. Their prevention is thus of high importance, and may need to involve proprioception and balance-gait training, muscle strengthening exercises, and arrangements to prevent domestic injurious falling, regardless of type of osteoarthritis that prevails.

In addition, Nevitt et al. [18] believe that interventions that reduce knee buckling may likewise help prevent falls, fall-related injuries, and adverse psychological consequences of falls in persons with knee osteoarthritis. Those with knee osteoarthritis pain who are at higher risk than those with no pain [40] and with an increased risk of nonvertebral hip fractures should be especially targeted.

Messenger-Rapport and Thaker [49] stress the importance of reducing the risk of injurious falls in osteoarthritis cases given the prevalence of osteoporosis in this population. Interventions that may reduce fall risk include minimizing the use of sedative-hypnotic agents, providing training in transfer skills (balance and gait training), and adapting the home environment

Anderson et al [30] concluded that balance training for individuals with knee osteoarthritis at high risk for falling may be underutilized and should be promoted. Other endorse various forms of exercise, and education, which appears paramount.

More careful delineation of samples, more diverse samples, and consistent approach to defining osteoarthritis related criteria, as well as attention to modes of falls assessment that may not represent actual falls rates (such as self-reports of whether or not an individual fell in the past 12 months, or if the respondent fell during the past 12 months, and had landed on the floor or ground?') or estimates, but not precise numbers, of such falls events (eg falls that are reported as being ≥1 in the previous 12 months, in percent, or as 1, 2, or more falls)[eg., 10, 36]. The use of an interactive balance and coordination device to assess falls risk is also questionable [20].

Ng and Tan [5] indicate that interpretation of such studies is further complicated by the large discrepancy between the symptoms of joint pain and radiographic evidence of osteoarhtritis, and the varying disease indicators used by different researchers. The role of gender also warrants further study [39].

In addition, the precise role of other potentially modifiable risk factors not listed in this report, such as diabetic neuropathy, joint inflammation, assistive device

use, footwear, sedatives, frailty, fatigue, and health beliefs about falling, which have not been studied to any degree clearly undermines the ability to interpret falls mechanisms and to intervene accordingly and warrant exploration given the immense burden of development of exists and that could be exacerbated by one or more preventable falls incidents. The development of inclusive screening tools, and use of electronic records may help practitioners to better assess salient treatment strategies and recommendations. While presently scarce when considering the many being offered and tested with no clear rationale, interventions proposed to reduce falling in the context of osteoarthritis may not be equally effective or optimally effective. As well, some may not be attainable during the COVID-19 pandemic, such as community based exercises.

In the interim, however, and in spite of the lack of solid data, if we accept the premise that adults with lower limb osteoarthritis may fall more often than healthy adults, and that this may lead to worse more costly health outcomes, than not, efforts to carefully assess individual patient's risk in this regard would seem judicious. In addition, the delivery of appropriately tailored and targeted preventive messages and interventions to combat possible falls determinants in the home as well as work environment may prove more efficacious than not in the long term.

Conclusion

This review, which aimed to examine what we know about the linkage of osteoarthritis and falls or falls injuries, and related clinical implications, implies that there may be an increased risk of falls and fractures in some cases of knee and hip osteoarthritis that may be preventable. Those at most risk may be older cases with limited mobility and muscle strength, as well as unrelenting leg or low back pain or both.

Given that many older adults now living in the community who are subject to COVID-19 2020 restrictions of care, are at risk for osteoarthritis as well as comorbid conditions that can lead to falls, more preventive efforts against this possibility are indicated., among others. In this regard, and based on what we do know, the value of efforts to minimize pain, while fostering muscle strength capacity and sleep in older people with osteoarthritis and without osteoarthritis may prove highly beneficial in non fallers, as well as recurrent fallers.

As outlined by Ling and Batton [50] over 20 years ago, although osteoarthritis can result in impaired mobility and lower extremity function, its contribution as a cause of recurrent falls or impaired self-care, relative to other comorbid conditions, remains ill-defined. Further analysis of the determinants of disability, loss of mobility and falls in older adults with osteoarthritis are clearly needed and strongly recommended, however.

In this respect, measures applied by Levinger et al. [22] in their study including the Short Form of the Physiological Profile Assessment used to assess falls risk, and which included tests of vision, lower limb proprioception, knee extension strength, reaction time and postural sway seem highly valuable. Additional measures of physical activity, quality of life, fear of falls and disability appear to hold great promise as well.

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