Physiological Risk Factors for Falls in Older People with Lower Limb Arthritis

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ABSTRACT. ***Objective.*** To investigate physiological risk factors for falls in people with self-reported lower limb arthritis.

Methods. Six hundred eighty-four community-dwelling men and women aged 75–98 years (mean 80.0, SD 4.4), categorized with and without lower limb arthritis, underwent quantitative tests of strength, peripheral sensation, vision, reaction time, balance, and pain. A 12-month history of falls was also obtained.

Results. Subjects with self-reported lower extremity arthritis performed significantly worse in tests of knee and ankle muscular strength, lower limb proprioception, postural sway, and leaning balance than subjects without lower extremity arthritis, while being comparable in vision, tactile sensitivity, and reaction time. This pattern of specific impairments was also evident when group results for the arthritis subjects were compared with community normative values and presented as a physiological profile. The arthritis group suffered significantly more falls [relative risk (RR) 1.22, 95% CI 1.03–1.46] and injurious falls (RR 1.27, 95% CI 1.01–1.60) in the previous 12 months than the nonarthritis group. Within the arthritis group, reduced knee extension strength and increased sway were identified as significant predictors of falls.

Conclusion. Older people with lower limb arthritis are at increased risk of falling due to deficits in neuromuscular systems. A physiological falls-risk profile based on mean test scores for the arthritis group highlights deficits in muscular strength, knee proprioception, and standing balance, indicating the need for targeted falls prevention interventions for this population. (J Rheumatol 2004;31:2272–9)

Key Indexing Terms:
FALLS ARTHRITIS ELDERLY BALANCE PHYSICAL FUNCTION

Arthritis of the lower limbs is a major cause of disability in older adults[1-4]. Research has found that people with lower extremity arthritis experience difficulties performing activities of daily living, particularly in tasks of mobility and transfer[5]. Arthritis, which is a common healthcare problem and contributing factor to injury, disability, and dependency in older people, has also been identified as a risk factor for falls[6-9].

Impaired strength, proprioception, and balance and increased levels of pain may be important underlying mechanisms for both falls and disability. People with lower limb arthritis commonly experience reduced levels of muscular strength. Quadriceps strength deficits of between 20% and 70% have been reported for people with arthritis affecting the knees[10-14], while strength deficits of 20% to 31% have been reported for musculature about the hip in people with arthritis affecting the hip[15-17]. Proprioceptive deficits have also been described in arthritic populations[12,18-20]. Altered sensory information from the articular surfaces, capsule, and ligaments of arthritic joints may result in impaired perception of limb positions that is necessary for safe movement[21].

Further, because of reduced ability to detect and control postural sway[22,23], deficits in muscle strength and proprioception secondary to arthritis may also result in impaired balance. Muscles have important sensory functions that may be affected by arthritis[12], and deficits in muscle function are likely to affect balance and compromise the safe conduct of daily activities. Indeed, a number of studies have shown that people with lower extremity arthritis perform poorly in tests of postural sway[24-26].

Finally, pain may further compromise muscle function and contribute to falls risk in people with lower limb arthritis[11,27]. Jadelis, *et al*[28] concluded that poorer balance is associated with higher pain scores in patients with knee osteoarthritis (OA) with weak knee strength, and several studies have shown pain to be an important factor in functional impairment[3,5,29-32]. For example, Jordan, *et al*[32] identified knee pain to be independently associated with poor performance on 16 out of 20 functional tasks, while Menz

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and Lord[31] found foot pain to be a significant independent predictor of poor balance and physical functioning.

To date, no study has comprehensively examined the relative contributions of pain and sensorimotor and balance functions on falls risk in people with lower extremity arthritis. We examined the contribution of physiological risk factors for falls in people with lower extremity arthritis using statistical models and a physiological profile approach that compares group scores of those with arthritis to community normative values. It was hypothesized that profiling falls risk in persons with lower limb arthritis would highlight deficits in areas of muscular strength, knee joint proprioception, and composite measures of sensorimotor function, including postural sway and reaction time, and that these deficits would be statistically verified with significantly poorer results in the arthritis group.

MATERIALS AND METHODS

Subjects. Names and addresses of people aged 75 years and older were drawn randomly from a membership database of a private health insurance company as part of a randomized controlled trial for falls prevention[29]. A total of 2468 individuals were contacted by mail and asked to participate in the study. A response was obtained from 700 interested persons, who were subsequently contacted by telephone and invited to the Falls and Balance Laboratory at the Royal North Shore Teaching Hospital in Sydney, Australia. Transportation was provided if required, to maximize participation of individuals with mobility or transportation limitations. Individuals were excluded if they had Parkinson's disease, rheumatoid arthritis (RA), or a Short Portable Mental Status Questionnaire score < 7 indicating a likely cognitive impairment[33], or were blind or had minimal English language skills, resulting in 684 willing and eligible subjects (446 women, 238 men) aged 75 to 98 years (mean 80.0, SD 4.4).

All subjects were asked to indicate whether they had arthritis affecting the lower limbs (hips, knees, ankles, and feet) and were subsequently categorized into an arthritis group (AG) and nonarthritis group (NAG). As people with RA were excluded, it is likely that the majority of the AG would have had OA. Information regarding demographics, anthropometry, cognitive status, other major medical conditions, medication use, physical activity, mobility, and limitations related to activities of daily living was also obtained from each participating subject, and is presented in Table 1. The Human Studies Ethics Committee at the University of New South Wales granted approval for the study, and informed consent was obtained from each subject prior to participation.

Table 1. Demographic, anthropometric, and health characteristics of the arthritis (AG) and no arthritis (NAG) groups.

Variable	AG, n = 283	NAG, n = 401
Female (%)	211 (74.6)	235 (58.6)*
Age, yrs, mean (SD)	80.2 (4.3)	80.0 (4.6)
Height, m, mean (SD)	1.61 (0.28)	1.63 (0.09)
Body mass, kg, mean (SD)	67.9 (13.2)	67.2 (12.3)*
Body mass index, mean (SD)	26.2 (3.6)	25.3 (3.6)*
Health and medical conditions		
Short Portable Mental Status score, mean (SD)	9.1 (0.8)	9.1 (0.9)
SF-12 Physical, mean (SD)	47.5 (9.1)	48.2 (8.6)
SF-12 Emotional, mean (SD)	55.3 (6.6)	55.4 (6.9)
Musculoskeletal medication use (%)	101 (35.7)	60 (15.0)*

* p < 0.01.

Sensorimotor assessments. Subjects underwent assessments of vision, sensation, muscle strength, and reaction time. Detailed descriptions of the apparatus and procedures for these tests and their test-retest reliability scores have been reported[34]. Visual acuity (in logMAR) was measured binocularly using a high (85%) and low (10%) contrast letter chart. Contrast sensitivity was assessed using the Melbourne Edge Test. Depth perception was measured using a Howard-Dohlman depth perception apparatus[35]. Proprioception at the knee was tested using an apparatus based on a design by DeDomenico, *et al*[36]. Vibration sense was measured using an electronic device that generated a 200 Hz vibration to the tibial tuberosity that was applied in a staircase manner to determine a vibration threshold. Tactile sensitivity was measured with a Semmes-Weinstein pressure aesthesiometer applied at the lateral malleolus of the ankle. Knee extension, knee flexion, and ankle dorsiflexion isometric strength were determined as force (kg) produced, measured with a strain gauge linear to direction of force production, normalized to body mass. Strength tests were conducted in a seated position and averaged for both limbs. For knee strength testing, the hip and knee were positioned in 90° of flexion. The test of ankle strength was conducted with the ankle at 30° of plantarflexion. Simple reaction time was assessed in milliseconds with subjects seated using a light as the stimulus and a finger-press and a foot-press as the response.

Balance tests. Balance was evaluated barefoot using tests of postural sway and coordinated stability. Detailed descriptions and the reliability of these tests have been reported[34,37] and both tests have been found to be predictors of falls in populations of older people[37-40]. Postural sway was assessed using a swaymeter that measured displacements of the body at the level of the waist for a 30-second period. Testing was performed in eyes open and eyes closed conditions while subjects stood on (1) a hard floor; and (2) a foam rubber mat (70 × 62 × 15 cm thickness). The coordinated stability test measured the subject's ability to adjust body position in a steady and coordinated way while placing them at or near the limits of their base of support. In this test, the swaymeter was attached to the subject at waist level with the rod extending arteriorly, so that a pen at the end of the rod rested on a piece of paper attached to an adjustable-height table in front. Subjects were then asked to adjust the position of their body without moving their feet so that the pen followed and remained within a convoluted track marked on the piece of paper. To complete the test without errors, subjects had to remain within the track, which was 1.5 cm wide, and therefore be capable of adjusting the position of the pen 29 cm laterally and 18 cm anteroposteriorly. A total error score was calculated by summing the number of occasions that the pen on the swaymeter failed to stay within the path. Where subjects failed to negotiate an outside corner, 5 additional points were accrued. This score was corrected for body height [score × (subject height/average height of sample)]. Subjects attempted the test twice, with the better trial taken as the test result.

Physiological falls profile and falls risk. Each physiological test result was converted to standardized (z) scores, using the reference data from previous population studies[34,39,40]. According to this reference data, a score of zero in each test indicates average performance for people aged ≥ 65 years, positive scores indicate above average performances, and negative scores indicate below average performances. Each unit represents one standard deviation, and as the scores have been standardized, results from different tests can be compared with each other.

In addition to the individual physiological tests, a falls-risk score was computed for each subject using a discriminant function that comprises weighted scores from tests of postural sway, reaction time, strength, proprioception, and vision[34]. This measure has a 75% predictive accuracy for falls in older people[38,39]. Falls-risk scores below zero indicate a low risk of falling, scores between 0 and 1 a mild risk, scores between 1 and 2 a moderate risk, and scores above 2 indicate high risk of falling.

Pain. Bodily pain was assessed using the 12-item Medical Outcomes Study Short Form Health Survey (SF-12)[41]. The pain item of the SF-12 asks, "During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?". Subjects were required to respond on a 5-point Likert scale corresponding to: 0, not at all; 1, a little bit; 2, moderately; 3, quite a bit; and 4, extremely.

Falls. Falls were ascertained retrospectively, as more than half of the sample was randomized to an exercise intervention program and was therefore "contaminated" with respect to the use of prospective falls for a falls risk factor study. A fall was defined as an event that resulted in a person coming to rest unintentionally on the ground or other lower level, not as the result of a major intrinsic event or an overwhelming hazard[42]. Injurious falls were defined as falls that resulted in bruises, strains, cuts and abrasions, back pain, and fractures.

Statistical analysis. The data were analyzed using SPSS[43] and EpiInfo[44] software. Variables that were not normally distributed were transformed using natural logarithm functions before between-group comparisons were made. Comparisons of demographics, health, and lifestyle characteristics were undertaken using a chi-square test for differences in proportions and Student t-tests for differences in means. Analysis of variance tests were conducted to determine between-group differences in subject characteristics, balance tests, and sensorimotor assessments. As a larger proportion of women reported lower extremity arthritis, sex was entered as a covariate. Stepwise discriminant function analysis — a multivariate technique that highlights the variables that are most important in distinguishing 2 or more discrete groups — was used to determine factors predictive of group membership, i.e., AG compared to NAG and fallers compared to nonfallers. Canonical correlations for these analyses (i.e., Pearson correlation coefficients between the discriminant scores and the group variables coded as 0 and 1) are given. These provide an estimate of the degree of discrimination provided by the independent variables between the groups. Using our physiological profile model[34], we were able to constrict the number of variables required for inclusion in the multivariate analysis, i.e., 6 measures representing the domains of vision, sensation, strength, speed, balance, and pain. This represents one variable for more than 100 cases, which is well above the suggested minimum number of 10 cases[45]. Finally, the relative risk of arthritis on falls and injurious falls was calculated with 95% confidence intervals, while adjusting for sex using the Mantel-Haenszel method[44].

RESULTS

Characteristics of the study groups. The AG comprised 283 (41.4%) of the 684 subjects. Information related to demographic, anthropometric, and health characteristics of the AG and NAG groups is presented in Table 1. There was no significant age difference between the AG and NAG. The AG had a significantly higher proportion of women, compared to the NAG. The AG were on average 2 cm shorter, yet not significantly different from the NAG. After adjustment for sex, the AG were significantly heavier in body mass than the NAG ($F_{1,680} = 8.05$, $p < 0.01$) and also had significantly higher body mass index scores (BMI) ($F_{1,680} = 11.29$, $p < 0.001$). The AG participants were also more likely to be taking musculoskeletal medications.

Sensorimotor and balance performance and pain. Table 2 shows the mean scores plus standard deviations for the sensorimotor, balance, pain, and fall-risk measures for the AG and NAG. For the sensorimotor measures, the AG performed significantly worse than the NAG in the tests of lower limb proprioception, knee extension strength, knee flexion strength, and ankle dorsiflexion strength. In contrast, the groups did not differ in any tests that were primarily sensory, i.e., visual acuity, contrast sensitivity, depth perception, tactile sensitivity, and vibration sense. The AG and NAG also performed similarly in the 2 reaction time tasks. With regard to balance, the AG performed worse than the NAG in 3 of the 4 sway tests and in the test of coordinated stability. The AG also reported significantly more bodily pain compared to the NAG.

The effect of closing the eyes on increasing sway differed significantly between subjects in the AG and the NAG. When standing on the firm surface, sway in the NAG increased by a median amount of 45 mm^2 (interquartile range –99 to 244), whereas sway in the AG increased by a median 101 mm^2 (IQR 54–288; MW-U = 51393, z = 2.10, $p < 0.05$). Similarly, when standing on the foam rubber mat, sway in the NAG increased by a median of 1073 mm^2 (IQR 291–3340), whereas sway in the AG increased by a median of 1556 mm^2 (IQR 570–3340; MW-U = 50229, z = 2.60, $p < 0.01$).

Discriminant function analysis revealed knee extension strength, bodily pain, and sway on the floor with eyes closed to be independent predictors of group membership (AG/NAG), as indicated by a final Wilks λ of 0.89 ($p < 0.001$) and a canonical correlation for the discriminant function of 0.33. The standardized canonical correlation coefficients (indicating the relative importance of each variable) were –0.674 for knee extension strength, 0.591 for pain, and 0.274 for sway on floor with eyes closed. These variables correctly classified 64.8% of cases with 62.4% sensitivity and 66.5% specificity.

Falls risk and falls. One hundred thirty-seven subjects (48.4%) in the AG had fallen in the previous year, compared to 57 (39.2%) of the NAG [sex adjusted relative risk (RR) = 1.22, 95% CI 1.03–1.46]. Similarly, the AG reported 94 (33.2%) injurious falls, significantly more than the NAG with 104 (25.9%) injurious falls (sex adjusted RR = 1.27, 95% CI 1.01–1.60).

The physiological falls profile for the AG is presented in Figure 1. This profile indicates that the AG performed poorly in tests of knee and ankle muscular strength, lower limb proprioception, postural sway, and coordinated stability, while being comparable in vision, tactile sensitivity, and reaction time with respect to normative values for community-dwelling people. As indicated in Table 2, the AG had significantly higher falls-risk scores than the NAG.

Predictors of fallers within the AG. Subjects in the AG with a history of falls performed significantly worse in the tests of knee extension strength, knee flexion strength, sway on the floor and foam with eyes closed, coordinated stability, and contrast sensitivity than AG subjects who did not fall (Table 2). There were also trends indicating that the AG fallers had poorer ankle dorsiflexion strength and increased bodily pain, compared to subjects in the AG who did not report a fall.

With the exception of sway on foam with eyes closed, the significant differences found between AG fallers and non-

Table 2. Average (standard deviation) AG and NAG performance in the sensorimotor, balance, pain, and fall-risk tests. High scores in the visual acuity, depth perception, sensation, sway and coordinated stability, pain, and falls-risk tests and low scores in the contrast sensitivity and strength tests indicate impaired performance.

	Fallers, n = 136	AG Nonfallers, n = 145	Total, n = 283	NAG, n = 401	(a)	(b)
Visual acuity: high contrast	1.26 (0.53)	1.24 (0.44)	1.25 (0.49)	1.29 (0.58)		
Visual acuity: low contrast	2.52 (1.37)	2.42 (1.23)	2.47 (1.30)	2.67 (2.35)		
Contrast sensitivity	18.4 (2.2)	18.8 (2.2)	18.6 (2.2)	18.8 (2.7)		†
Depth perception	30.1 (39.9)	28.0 (36.0)	29.1 (38.0)	27.4 (35.8)		
Proprioception	2.1 (1.5)	2.3 (1.5)	2.2 (1.50)	2.0 (1.3)	*	
Tactile sensitivity	4.41 (0.52)	4.39 (0.48)	4.40 (0.50)	4.38 (0.53)		
Vibration sense	42.0 (27.1)	36.6 (23.5)	39.2 (25.5)	39.5 (27.5)		
Ankle dorsiflexion strength	0.09 (0.04)	0.10 (0.05)	0.10 (0.05)	0.11 (0.05)	*	††
Knee extension strength	0.32 (0.14)	0.38 (0.15)	0.35 (0.15)	0.44 (0.17)	***	††
Knee flexion strength	0.19 (0.08)	0.22 (0.08)	0.20 (0.08)	0.24 (0.09)	***	††
Hand reaction time	282 (51)	277 (49)	278 (49)	269 (41)		
Foot reaction time	360 (62)	350 (59)	358 (68)	349 (59)		
Postural sway						
EO floor	517 (652)	467 (464)	491 (562)	434 (435)	*	
EC floor	783 (858)	593 (604)	684 (742)	533 (524)	***	†
EO foam	1470 (1089)	1320 (982)	1396 (1036)	1375 (984)		
EC foam	3569 (1956)	3217 (2348)	3395 (2171)	3114 (2275)	*	†
Coordinated stability	10.9 (9.1)	8.1 (7.6)	9.5 (8.5)	7.6 (8.3)	**	†
Pain	2.01 (1.17)	1.75 (1.02)	1.88 (1.10)	1.42 (0.83)	***	
Fall-risk score	1.63 (1.22)	1.37 (1.16)	1.50 (1.20)	1.31 (1.08)	*	

(a) AG versus NAG comparisons: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. (b) AG faller versus AG nonfaller comparisons: † $p < 0.05$, †† $p < 0.01$. EO: eyes open, EC: eyes closed.

fallers were also observed when comparing AG subjects who experienced an injurious fall and those who did not. The AG subjects who experienced an injurious fall also performed worse than those who did not experience an injurious fall in the assessments of ankle dorsiflexion strength ($p < 0.001$) and bodily pain ($p = 0.007$).

Discriminant function analysis within the AG revealed knee extension strength and sway on foam with eyes closed to be independent predictors of falls, as indicated by a final Wilks λ of 0.946 ($p = 0.001$) and a canonical correlation for the discriminant function of 0.23. The standardized canonical correlation coefficients were 0.827 for knee extension strength and –0.526 for sway on foam with eyes closed. These variables correctly classified 60.0% of AG cases with 60.6% sensitivity and 58.9% specificity.

DISCUSSION

We found that lower limb arthritis was significantly associated with deficits in neuromuscular functioning in older community-dwelling people. Specifically, impairments in knee and ankle strength, lower limb proprioception, and balance, in addition to pain, were significantly more prevalent in older people with lower limb arthritis, compared to a comparison group without arthritis. Such deficits across a diverse range of neuromuscular systems provide insight into why older people with arthritis are at increased risk of falls.

In the general elderly population, reduced lower limb strength is an important risk factor for falls[38,39]. In our study, the AG had reduced knee and ankle strength compared to the NAG. Strength deficits in people with lower extremity arthritis have been suggested to be due to disease-associated pain, joint effusion, articular damage, and secondary muscle atrophy[12,17,46-48]. Further, afferent fibers from affected mechanoreceptors and nociceptive discharge may act on inter-neurons responsible for inhibition of motor neurons and engender deficits in muscular force production[49-52].

The AG also had impaired knee proprioception, as indicated by larger errors in matching lower limb position. OA may affect proprioception via a number of different mechanisms. Mechanoreceptors may be affected by mechanical damage, bony deformities, or joint effusion[53-56], i.e., afferent fibers inhibiting γ-motor neurons important for muscle spindle sensitivity[12]. Histological studies of knee ligaments have also revealed a reduced number of mechanoreceptors in osteoarthritic joints[57]. More indirectly, OA might affect proprioceptive acuity due to a relatively higher level of muscle contractile activity that may saturate afferent sensory units from muscle spindle receptors and reduce their capacity to provide an accurate movement signal[58].

Impaired postural stability is associated with an increased risk of falling in older adults[38,59,60]. The AG performed significantly worse than the NAG in 3 of the 4 postural sway tests, in addition to the coordinated stability test. These findings are in agreement with studies that have

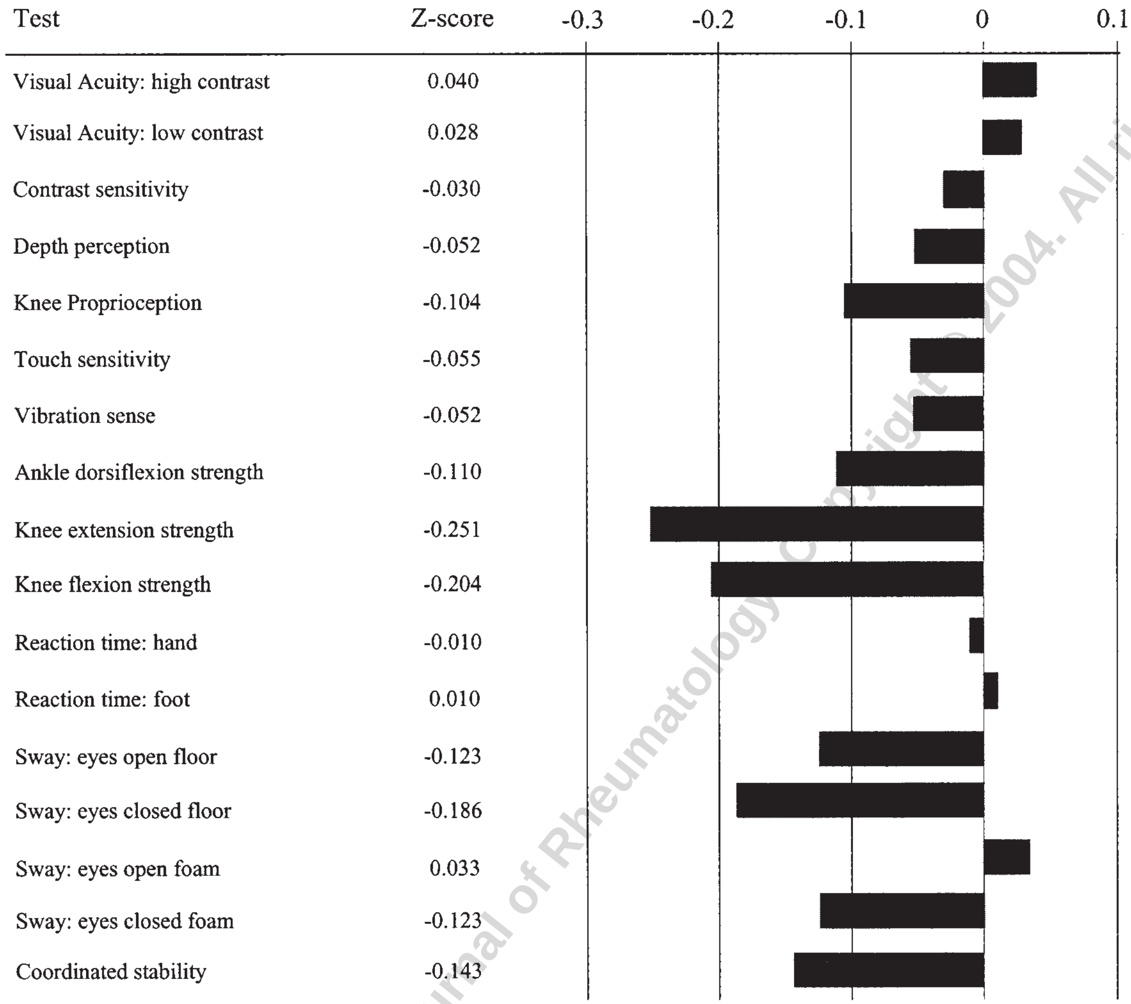

Figure 1. Physiological falls profile of subjects in the arthritis group (AG). Each bar represents a mean Z-score for the AG based on normative data from community-dwelling people aged ≥ 65 years (range 38–40 yrs). Larger positive or negative Z-scores indicate increasing deviation from the general elderly population, with negative scores representing poorer performances.

reported increased sway in people with knee OA[11,25,26] and RA[24,61], which suggested that reduced stability is related to inflammation[61], pain[11,25], and muscle weakness[11,25,28].

The AG demonstrated a greater reliance on vision to account for impaired neuromuscular function in controlling balance. This is supported by the significant increases in postural sway in the AG in the eyes-closed conditions, compared to eyes-open conditions. With no visual reference available in the eyes-closed condition, peripheral sensation is the major source of information for the perception of postural position[62]. The poorer results in the eyes-closed condition suggest that the AG had insufficient sensory information from the periphery to adequately compensate for a lack of visual input and maintain a normal amount of postural sway. The NAG, on the other hand, receiving normal information from unaffected muscle and joint receptors, more sensitively detect changes in postural position and correct postural sway. These findings imply that vision is particularly important in the absence of other sensory information for balance while standing.

Although research has described impaired reaction time in patients with RA[63], we found no differences in foot reaction times between the AG and NAG. This may be due to different effects of OA and/or the testing protocol, as the foot reaction time test required minimal movement and transfer of force through the lower extremity joints.

The discriminant function analysis identified poorer knee extension strength, greater postural sway, and increased levels of pain as independent and significant predictors of AG membership. Of these measures, knee extension strength had the largest standardized discriminant function coefficient, indicating that this measure was most important in determining whether an individual had arthritis. Postural sway was an independent discriminating factor, suggesting that it provided unique information to separate the AG and NAG. Although deficits in proprioception existed in the AG, this variable was not included in the model as an independent factor, which is likely due to its association with postural sway[22]. The inclusion of bodily pain is not surprising, as pain is a major symptom of OA, and complements the other variables entered into the analysis. Increased sway and reduced knee extension strength were also identified as independent discriminating factors of falling status in the AG, suggesting that these particular impairments are important mechanisms underlying the increased risk of falling in older people with lower limb OA.

The physiological falls profile (Figure 1) supports the discriminant function findings and illustrates that the AG were deficient in lower limb strength, balance, and proprioception, while vision, peripheral sensation, and reaction time were similar to average normative values. Poor performances on tests of knee and ankle strength, proprioception, and balance contributed to higher falls-risk scores in the AG. The physiological falls profile provides an indication of areas that should be addressed to reduce the risk of falling in this population. Interventions that address deficit areas have been recommended to optimize falls prevention[64] and the physiological falls profile provides a convenient approach to facilitate this method.

It is acknowledged that this study has certain limitations. First, the classification of subjects into the AG and NAG was based on self-report and was not specific to the affected lower extremity joint/s. It is likely that some subjects who were unaware that they had lower extremity arthritis were categorized in the NAG. Conversely, some subjects who reported lower extremity arthritis may have had no radiographic evidence of joint disease. Previous research has shown that 81% of subjects with self-reported knee OA were correctly categorized following radiographic verification[65], suggesting that most subjects were likely to have been correctly classified. Second, falls incidence was recorded retrospectively because more than half the cohort was prospectively contaminated by a subsequent intervention study. Consequently, there was a probable under-reporting of falls due to the limited accuracy of recalling falls over a 12-month period[66], even when subjects with likely cognitive impairment were excluded. Third, it is acknowledged that although the discriminant function had good predictive accuracy, a considerable proportion of subjects were incorrectly classified. This may be because the physiological measures were too few or indirect for complete discrimination. For example, assessments of other muscle groups such as hip abductor and adductor strength may have added to the predictive accuracy. Measurements of speed of initiating appropriate postural adjustments may have further assisted in correctly classifying the cases. Finally, because falls incidence was recorded retrospectively, the reduced physical performance in the fallers may have been due in part to their history of falling. However, large prospective studies have found strong associations between past falls and subsequent falls[7,67], suggesting that the impairments identified in this study are likely to have implications for future falls.

Our findings suggest that older adults with lower extremity OA experience declines in muscular strength, proprioceptive acuity, and standing balance that result in an increased incidence of falls in this population. These deficits are clearly indicated in the physiological falls profile for AG and the findings of the discriminant function analyses. Strategies to enhance muscular strength and improve proprioceptive acuity are likely to assist in improving balance and preventing falls in people with lower extremity OA.

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