

Fear of falling and foot pain, impairment and disability in rheumatoid arthritis: a case-control study

Tricia Morpeth¹ · Angela Brenton-Rule¹ · Matthew Carroll¹ · Mike Frecklington¹ · Keith Rome¹

Received: 21 May 2015 / Revised: 4 October 2015 / Accepted: 17 November 2015 / Published online: 23 November 2015
© International League of Associations for Rheumatology (ILAR) 2015

Abstract Fear of falling, foot pain, impairment and disability are commonly reported in rheumatoid arthritis (RA). However, the relationship between fear of falling and foot pain, impairment and disability has not been investigated in established RA. The aim of the study was to evaluate the relationship between fear of falling and foot pain, walking velocity and foot impairment and disability in women with established RA. A secondary aim was to evaluate differences between fear of falling, foot pain, walking velocity and foot impairment and disability in women with established RA and age- and sex-matched control participants. Twenty-one women with established RA and twenty-one age- and sex-matched controls were assessed for fear of falling, foot pain, foot impairment and disability and walking velocity. Pearson's *r*-correlations were used to examine relationships between fear of falling and the foot measures. Independent samples *t* tests evaluated the differences in fear of falling and foot measures between the two groups. In people with RA, significant correlations were found between fear of falling and foot

impairment ($r=0.53$, $p=0.015$), foot disability ($r=0.77$, $p<0.001$) and walking velocity ($r=0.56$, $p<0.001$). No correlation was found between fear of falling and foot pain ($r=0.36$; $p=0.11$). Significant differences between cases and control participants were found between fear of falling ($p=0.001$), foot impairment ($p=0.004$) and foot disability ($p<0.001$). Foot impairment and disability relates to fear of falling in women with established RA. A better understanding of fear of falling in people with established RA may contribute to more efficient falls assessments in order to identify at risk individuals.

Keywords Fear of falling · Foot disability · Foot impairment · Foot pain · Rheumatoid arthritis

Introduction

Worldwide, falls constitute a significant burden to healthcare resources in both older adults and people with rheumatoid arthritis (RA) [1]. Falls have a multifactorial aetiology that can be resultant from the interaction of behavioural, intrinsic and environmental risk factors [2]. The feet are a common site of pathology in RA [3]. When first diagnosed, 53 % of people with RA may have foot involvement [4], with an increase to between 90 % and 100 % seen as the duration of the disease increases [5, 6]. Foot pathology in RA often results in poor physical functioning due to both structural and functional impairments [7]. Although disease activity can decline in RA, many people still suffer from reduced participation in activities of daily living and disability [8]. RA-related impairments and reduced physical functioning can also lead to an increased fear of falling; subsequently, reducing quality of life and activity participation and increasing disability [9].

✉ Keith Rome
krome@aut.ac.nz

Tricia Morpeth
tmorpeth@aut.ac.nz

Angela Brenton-Rule
abrenton@aut.ac.nz

Matthew Carroll
matthew.carroll@aut.ac.nz

Mike Frecklington
mike.frecklington@aut.ac.nz

¹ Department of Podiatry, Health & Research Rehabilitation Institute, Auckland University of Technology, Private Bag 92006, Auckland 1020, New Zealand

The relationship between fear of falling and foot-specific measures such as foot pain, disability and impairment has not been investigated, even though RA has a significant impact on foot pain [10], function, impairment and disability [11]. Fear of falling has been associated with an increased risk of falls in people with RA [12], with fear of falling incidence between 10 and 60 % in this population [1, 9, 13, 14]. Generalised pain intensity has been associated with fear of falling in people with RA [9]. Foot pain has a negative impact on physical function and is an independent predictor of impairment in people with RA [7]. Previous studies have reported a reduction in walking velocity in people with RA [7, 15, 16], with one study suggesting that walking velocity is a strong determinant of foot impairment and disability [7]. Pain intensity and reduced physical function, evidenced by decreased walking velocity, have been reported to be predictors for fear of falling in RA [17]. The aim of the study was to evaluate the relationship between fear of falling and foot pain, walking velocity and foot impairment and disability in women with established RA. A secondary aim was to evaluate differences between fear of falling, foot pain, walking velocity and foot impairment and disability in women with established RA and age- and sex-matched control participants.

Materials and methods

Twenty-one female participants aged over 18 years old with a history of RA, according to the 2010 ACR/EULAR classification criteria [18], were recruited from a podiatric rheumatology outpatient clinic in Auckland, New Zealand. Twenty-one female age-matched participants with no history of RA, were recruited from a podiatry clinic as the control group. Participants were excluded from the study if they had a history of neuromuscular or cognitive disorders, were diagnosed with diabetes mellitus or were unable to walk more than 10 m unaided. The Auckland University of Technology Ethics Committee approved the study and participants provided informed written consent.

Participant characteristics were recorded including age, gender, ethnicity and body mass index (BMI). Clinical characteristics included disease duration, C-reactive protein level and presence of rheumatoid factor and anti-CCP antibodies from most recent blood tests, current medications and comorbid conditions. A 100 mm visual analogue scale (VAS) was used to measure foot pain in the past week. Patient-reported foot disability and impairment were measured using the Leeds Foot Impact Scale (LFIS), a validated measure of the impact of foot disease in RA [19]. Foot disability was represented by the total score (LFIS_T; range 0 to 51) of the LFIS and foot impairment by the first subscale (LFIS_{IF}; range 0 to 21) [19]. Scores of ≤ 6 were considered mild, from 7–13

were considered moderate and ≥ 14 were considered severe for the LFIS_{IF} [3].

Walking velocity was measured using the GAITRite[®] Electronic walkway (CIR Systems Inc., New Jersey, US), a low profile walkway consisting of 18,432 sensors embedded in a 61-cm-wide and 488-cm-long mat. In their own shoes, participants were instructed to walk at their self-selected walking speed. Three walking trials were conducted. To reduce fatigue, participants rested for 1 min between each walking trial. The GAITRite[®] has been shown to have excellent intra-session reliability for the measurement of walking velocity in participants with established RA [20].

Fear of falling was assessed using the Falls Efficacy Scale-International (FES-I) [21]. The FES-I measures participants' level of concern pertaining to falling during physical and social activities, both inside and outside the home, regardless of whether the participant can perform the activity [21]. The FES-I consists of 16 different activities, scored using a four-point scale (1=not at all concerned, 2=somewhat concerned, 3=fairly concerned and 4=very concerned). The summed scores for the 16 activities for each participant were calculated. Scores of ≥ 23 indicated a high concern of falling [21]. The FES-I has demonstrated excellent internal and test-retest reliability and excellent convergent and predictive validity within the community-dwelling adult population [21, 22].

Statistical analysis

The sample size was calculated to 20 participants per group by power analysis relating to differences in estimates by a previous study on postural stability in people with RA [23]. This presupposes mean (SD) walking velocity of 1.0 (0.18) m/s for the RA group and the mean (SD) of 1.3 (0.14) m/s for the control group. Power was set to 90 % and significance level of 5 %. Descriptive statistics for clinical and demographic characteristics were obtained. All variables were tested for normality by the Kolmogorov-Smirnov statistic. To evaluate the relationship between fear of falling and foot pain, impairment and disability, Pearson's *r*-correlation tests were conducted. To evaluate for significant differences between fear of falling, foot pain, impairment, disability and walking velocity, independent samples *t* tests with 95%CI were calculated. A Bonferroni correction was utilised and the *p* value was set at 0.008. All data was analysed using Statistical Package for the Social Sciences (SPSS) version 21 (IBM, New York, US).

Results

The demographic and clinical characteristics of the cases and controls are presented in Table 1. Participants were middle-aged females with no significant difference in BMI ($p=0.63$). People with RA had a mean (SD) disease duration of 18 (12.5)

Table 1 Clinical characteristics of case and control groups

Variable	Case group	Control group
Age (years), mean (SD)	66 (10)	66 (10)
Body Mass Index (kg/m ²), mean (SD)	28 (6)	27 (3)
Disease duration (years), mean (SD)	18 (13)	NA
Rheumatoid factor positive, n (%)	18 (86)	NA
Anti-CCP antibodies positive, n (%)	13 (81)	NA
Seronegative, n (%)	3 (14)	NA
C-Reactive Protein (mg/L), mean (SD)	16 (27)	NA
Co-morbid conditions, n (%):		
Heart disease	4 (19)	3 (14)
Hypertension	13 (62)	3 (14)
Osteoporosis	3 (14)	1 (5)
Renal disease	1 (5)	0 (0)
Medications, n (%):		
Methotrexate	16 (76)	NA
Other DMARDs	12 (57)	NA
Biologics	2 (10)	NA
Prednisone	8 (38)	NA
NSAIDs	8 (38)	2 (10)
Analgesics	11 (52)	2 (10)
Antihypertensives	9 (43)	3 (14)
Antithrombotic	9 (43)	2 (10)

DMARDs Disease-modifying antirheumatic drugs, NSAIDs Nonsteroidal anti-inflammatory drugs, NA not applicable

years, the majority having rheumatoid factor-positive RA ($n=18$, 86 %) and taking methotrexate ($n=16$, 76 %).

Investigating the relationship between fear of falling and foot measures, the results demonstrated positive correlations between fear of falling and foot impairment ($r=0.53$; $p=0.015$) and disability ($r=0.74$; $p<0.001$) in people with RA. A negative correlation was demonstrated between fear of falling and walking velocity ($r=-0.56$; $p<0.001$). No significant correlation between fear of falling and foot pain ($r=0.36$; $p=0.11$) was found.

Evaluating the differences between cases and controls, people with RA had greater fear of falling ($p=0.001$), foot

Table 2 Descriptive statistics of variables in case and control groups

Variable	Case group Mean (SD)	Control group Mean (SD)	P value
FES-I	32.8 (11.5)	22.2 (5.5)	0.001
VAS foot pain	35.3 (22.9)	20.5 (24.9)	0.052
LFIS _{IF}	9.8 (4.1)	5.9 (4.1)	0.004
LFIS _T	23.9 (12.5)	10.2 (8.7)	<0.001
Walking velocity (m/s)	1.12 (21.7)	1.22 (24.1)	0.118

FES-I Falls efficacy scale-International, VAS Visual analogue score, LFIS_{IF} Leeds foot impact scale impairment/footwear subscale, LFIS_T Leeds foot impact scale total score

impairment ($p=0.004$) and disability ($p<0.001$) (Table 2). No significant differences between foot pain ($p=0.052$) and walking velocity ($p=0.118$) were found between the two groups.

Discussion

Our findings suggest a link between fear of falling and foot-related disability and impairment in people with RA. The findings of a significant correlation between fear of falling and disability are similar to previous studies [9, 16, 24]. Furuya et al. [24] found that increasing disability (measured by the Japanese version of the HAQ) was associated with fear of falling. The current results also concur with a previous study between walking velocity and fear of falling in people with RA [17]. Jamison et al. [17] found that walking velocity was decreased in adults with RA who reported fear of falling. Fear of falling, and self-imposed activity limitation, can result from falls [17] and has also been associated with increased risk of future falls in adults with RA [12]. We found no correlation found between fear of falling and foot pain. Foot pain is the most common problem facing people with RA both generally and specifically related to their feet [25]. However, all participants in the study were part of an ongoing foot care programme where they received regular general podiatric care that included the reduction of foot pain with the use of non-surgical interventions that included foot orthoses and footwear advice.

We found that women with established RA appear to demonstrate a higher propensity in fear of falling compared with age-matched controls. Previous studies have reported similar findings [9, 14, 16, 17]. The women with an increased fear of falling demonstrated greater foot impairment, disability and more co-morbid conditions. The differences in foot-related impairment and disability between cases and controls may have been attributed to factors that include lower limb muscle weakness [26], joint stiffness [25] or postural instability [23]. However, foot pain was not significantly different between the cases and controls. Both groups were women with a moderate level of foot pain. The control participants were all recruited from a podiatry clinic where they may have been seeking treatment for symptomatic foot problems, which may have resulted in the similar levels of foot pain observed in the two groups.

The current findings should be considered in light of some limitations. The study was a case-control study that limits the ability to determine causality. Only women based in Auckland, New Zealand were recruited into the study, therefore the results cannot be generalizable to the wider RA population. To provide an insight into the causative aspect of the relationship between foot impairment, disability and fear of falling, a prospective observational study is required to

include other intrinsic and extrinsic risk factors such as current footwear (indoor and outdoor), current medications and other foot-specific variables such as lower limb muscle strength. In the present study, walking velocity was used as an objective measure of foot-related impairment. A previous study reported that walking velocity is a predictor for fear of falling [17], which itself is a risk factor for falls [12]. Therefore, walking velocity could be measured in clinical practice as part of a falls risk assessment programme. The results of this study have demonstrated the importance of the relationship between fear of falling and foot impairment and disability. Future research may increase the awareness around fear of falling and foot-related impairment and disability which could be used to further develop falls risk assessments in a clinical setting. Appropriate footwear in preventing falls in people with RA should be considered for future studies. Footwear has a role to play in postural stability by facilitating somatosensory feedback to the foot by the proprioceptive system that detects and processes tactile stimulation/information [27].

Acknowledgments TM was supported through a scholarship from ASICS New Zealand.

Compliance with ethical standards The Auckland University of Technology Ethics Committee approved the study and participants provided informed written consent.

Disclosures None.

References

- Bugdayci D, Paker N, Rezvani A, Kesiktas N, Yilmaz O, Sahin M, Ince N (2013) Frequency and predictors for falls in the ambulatory patients with rheumatoid arthritis: a longitudinal prospective study. *Rheumatol Int* 33(10):2523–2527
- Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E (2010) Risk factors for falls in community-dwelling older people: a systematic review and meta-analysis. *Epidemiology* 21(5):658–668
- Hooper L, Bowen CJ, Gates L, Culliford DJ, Ball C, Edwards CJ, Arden NK (2012) Prognostic indicators of foot-related disability in patients with rheumatoid arthritis: results of a prospective three-year study. *Arthritis Care Res* 64(8):1116–1124
- Grondal L, Tengstrand B, Nordmark B, Wretenberg P, Stark A (2008) The foot: still the most important reason for walking incapacity in rheumatoid arthritis: distribution of symptomatic joints in 1,000 RA patients. *Acta Orthop* 79(2):257–261
- MacSween A, Brydson GJ, Hamilton J (1999) The effect of custom moulded ethyl vinyl acetate foot orthoses on the gait of patients with rheumatoid arthritis. *Foot* 9:128–133
- Shi K, Tomita T, Hayashida K, Owaki H, Ochi T (2000) Foot deformities in rheumatoid arthritis and relevance of disease severity. *J Rheumatol* 27(1):84–89
- Turner DE, Helliwell PS, Siegel KL, Woodburn J (2008) Biomechanics of the foot in rheumatoid arthritis: identifying abnormal function and the factors associated with localised disease ‘impact’. *Clin Biomech* 23(1):93–100
- Eppeland SG, Myklebust G, Hodt-Billington C, Moe-Nilssen R (2009) Gait patterns in subjects with rheumatoid arthritis cannot be explained by reduced speed alone. *Gait Posture* 29(3):499–503
- Fessel KD, Nevitt MC (1997) Correlates of fear of falling and activity limitation among persons with rheumatoid arthritis. *Arthritis Care Res* 10(4):222–228
- Lohkamp M, Burrow G, McCarron T, Maclaren W, Granat M (2006) The prevalence of disabling foot pain in patients with early rheumatoid arthritis. *Foot* 16(4):201–207
- Turner DE, Helliwell PS, Emery P, Woodburn J (2006) The impact of rheumatoid arthritis on foot function in the early stages of disease: a clinical case series. *BMC Musculoskelet Disord* 7(1):102–102
- Stanmore EK, Oldham J, Skelton DA, O’Neill T, Pilling M, Campbell AJ, Todd C (2013) Risk factors for falls in adults with rheumatoid arthritis: a prospective study. *Arthritis Care Res* 65(8):1251–1258. doi:10.1002/acr.21987
- Böhler C, Radner H, Ernst M, Binder A, Stamm T, Aletaha D, Smolen JS, Köller M (2012) Rheumatoid arthritis and falls: the influence of disease activity. *Rheumatology* 51(11):2051–2057
- Yamagiwa K, Iijima S, Furuya T, Ikai T, Inoue E, Taniguchi A, Momohara S, Yamanaka H (2011) Incidence of falls and fear of falling in Japanese patients with rheumatoid arthritis. *Mod Rheumatol* 21(1):51–56
- Turner DE, Woodburn J, Helliwell PS, Cornwall MW, Emery P (2003) Pes planovalgus in RA: a descriptive and analytical study of foot function determined by gait analysis. *Musculoskeletal Care* 1(1):21–33
- Duyur Cakit B, Nacir B, Erdem HR, Karagoz A, Saracoglu M (2011) Fear of falling, fall risk and disability in patients with rheumatoid arthritis Turk. *J Rheumatol* 26(3):217
- Jamison M, Neuberger GB, Miller PA (2003) Correlates of falls and fear of falling among adults with rheumatoid arthritis. *Arthritis Rheumatol* 49(5):673–680
- Hawker G, Aletaha D, Silman AJ, Cohen MD, Bykerk VP, Wolfe F, Costenbader KH, Symmons D, Kavanaugh A, Funovits J, Huizinga TWJ, Naden RL, Neogi T, Hobbs K, Tak PP, Vencovský J, Pincus T, Birnbaum NS, Mease P, Emery P, Burmester GR, Ménard HA, Ferraccioli G, Kvien TK, Moreland LW, Kay J, Stanislawski-Biernat E, Combe B, Bingham CO, Smolen JS, Upchurch KS, Hazes JMW, Dougados M, Felson D, Laing T (2010) 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Care Res* 62(9):2569
- Helliwell P, Reay N, Gilworth G, Redmond A, Slade A, Tennant A, Woodburn J (2005) Development of a foot impact scale for rheumatoid arthritis. *Arthritis Rheumatol* 53(3):418–422
- Rome K, Hanchard NC (2005) Within-day reliability of temporal-spatial gait parameters associated with rheumatoid arthritic feet. *Musculoskeletal Care* 3(1):17–23
- Yardley L, Beyer N, Haeur K, Kempen G, Piot-Ziegler C, Todd C (2005) Development and initial validation of the Falls Efficacy Scale-International (FES-I). *Age Ageing* 34(6):614–619
- Delbaere K, Close JCT, Mikolaizak AS, Sachdev PS, Brodaty H, Lord SR (2010) The Falls Efficacy Scale International (FES-I). A comprehensive longitudinal validation study. *Age Ageing* 39(2):210–216
- Rome K, Dixon J, Gray M, Woodley R (2009) Evaluation of static and dynamic postural stability in established rheumatoid arthritis: exploratory study. *Clin Biomech* 24(6):524–526
- Furuya T, Yamagiwa K, Ikai T, Inoue E, Taniguchi A, Momohara S, Yamanaka H (2009) Associated factors for falls and fear of falling in Japanese patients with rheumatoid arthritis. *Clin Rheumatol* 28(11):1325–1330

25. Otter SJ, Lucas K, Springett K, Moore A, Davies K, Cheek L, Young A, Walker-Bone K (2010) Foot pain in rheumatoid arthritis prevalence, risk factors and management: an epidemiological study. *Clin Rheumatol* 29(3):255–271
26. Carroll M, Joyce W, Brenton-Rule A, Dalbeth N, Rome K (2013) Assessment of foot and ankle muscle strength using hand held dynamometry in patients with established rheumatoid arthritis. *J Foot Ankle Res* 6(1):10–14
27. Brenton-Rule A, D'Almeida S, Bassett S, Carroll M, Dalbeth N, Rome K (2014) The effects of sandals on postural stability in patients with rheumatoid arthritis: an exploratory study. *Clin Biomech* 29(3):350–353