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Original article

Disease-related outcomes influence prevalence of falls in people with rheumatoid arthritis

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ABSTRACT

Background: Patients with rheumatoid arthritis (RA) are at increased risk of falls, with potential adverse outcomes. There is a considerable variation across studies regarding the prevalence of falls and its correlation with clinical data, disease-related outcomes and physical performance tests.
Objective: The aim of this study was to evaluate the prevalence of falls and its association with clinical data, disease-related outcomes and physical performance tests.
Methods: In this cross-sectional study, 113 RA patients were divided into 3 groups — "non-fallers", "sporadic fallers" and "recurrent fallers" — and compared in terms of clinical data, Clinical Disease Activity Index (CDAI), lower-limb tender and swollen joint count, disability (Health Assessment Questionnaire-Disability Index [HAQ-DI]), Foot Function Index (FFI), Berg Balance Scale (BBS), Timed-up-and-go Test (TUG) and 5-Time Sit Down-To-Stand Up Test (SST5). Logistic regression analysis was performed to analyze the associations between the studied variables and the occurrence of falls, estimating odds ratios (ORs). We also analyzed the correlation between disease outcome measures (HAQ-DI and CDAI) and physical tests (BBS, TUG, SST5).
Results: Falls and fear of falling were reported by 59 (52.21%) and 71 (64.5%) patients, respectively. Significant associations were found between "recurrent fallers" and vertigo (OR = 3.42; $P = 0.03$), fear of falling (OR = 3.44; $P = 0.01$), low income (OR = 2.02; $P = 0.04$), CDAI (OR = 1.08; $P < 0.01$), HAQ-DI (OR = 3.66; $P < 0.01$), Lower-limb HAQ (OR = 3.48; $P < 0.01$), FFI-pain (OR = 1.24; $P = 0.03$), FFI-total (OR = 1.23; $P = 0.04$), lower-limb tender joint count (OR = 1.22; $P < 0.01$), BBS score (OR = 1.14; $P < 0.01$), TUG score (OR = 1.13; $P = 0.03$) and SST5 score (OR = 1.06; $P = 0.02$). On multivariate analysis, CDAI was the only significant predictor of recurrent falls (OR = 1.08; $P < 0.01$). Physical performance test scores (BBS, TUG, SST5) were correlated with the CDAI and HAQ-DI.
Conclusion: The prevalence of falls in RA is high, most influenced by disease-related outcomes and linked to worse performance on physical tests (BBS, TUG and SST5).

1. Introduction

Rheumatoid arthritis (RA) is an autoimmune disease characterized by persistent synovitis and joint damage [1]. This chronic condition may interfere with mobility, flexibility, gait, musculoskeletal strength and balance [2,3], leading to a high prevalence of falls (10–54%) [4–15], with increased morbidity and mortality and reduced quality of life [4,16].

Some authors found falls correlated with factors commonly seen in older people (such as physical inactivity, impaired vision, previous history of falls and the use of some medications) [12–14] and others found falls most linked to disease activity and related disability [5,7,11,14,15]. The lack of consensus regarding fall predictors in RA [4] may be explained by how the data analysis is performed. Generally, participants are divided into "fallers" and "non-fallers". The dichotomization of fallers as "sporadic fallers" and "recurrent fallers" would better select those at increased risk

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of falls and thus enhance the chance of identifying the main fall predictors in RA. Regarding physical performance tests, although the Berg Balance Scale (BBS) and Timed-up-and-go Test (TUG) are currently used as tools to assess fall risk in older people [17], their relation with falls in RA has been little studied [18,19]. Even the 5-Time Sit Down-To-Stand Up Test (SST5), a proxy measure of lower-limb strength [20], was related to falls in only one study [5].

The aim of this study was to evaluate the prevalence of falls in RA (considering "sporadic fallers" and "recurrent fallers" separately) and its association with clinical data, disease-related outcomes and physical performance tests.

2. Methods

2.1. Design and study settings

This study has a cross-sectional design. It was conducted from June 2017 to November 2017 in the outpatient clinic of the rheumatology department of the State University Campinas (Unicamp), São Paulo, Brazil.

2.2. Ethical considerations

This study was in accordance with the declaration of Helsinki and was approved by the ethics committee of the faculty of medical sciences of the State University Campinas–Unicamp (CAAE-68077517.2.0000.5404). All participants provided written informed consent before the study.

2.3. Participants

Patients were included if they had RA based on the 1987 American College of Rheumatology (ACR) classification criteria [21] and were older than 18 years. They were excluded if they were not able to follow the protocol instructions; had severe visual or hearing impairment; had neurological diseases such as stroke, dementia, and peripheral neuropathies; or had gait impairment due to pathologies not related to RA.

2.4. Procedures

Patients with a diagnosis of RA, currently under follow-up at the outpatient rheumatology clinic were asked to take part in the study during their scheduled appointments. Sociodemographic and clinical data were collected: age, sex, race, marital status, education, income, body mass index (BMI), disease duration, presence of rheumatoid factor, medication (prednisone dose, anti-inflammatory/analgesic drug intake, synthetic and biological disease modifying anti-rheumatic drugs, antidepressants, anti-epileptics, muscle relaxants, antihypertensives and opioids), visual impairment and vertigo. Participants were also asked about the number of falls in the last 12 months, fear of falling, whether they were physically active (30-min exercises, $>$ 2 times/week) and comorbidities (Rheumatic Disease Comorbidity Index [RDCI]) [22].

All participants completed the Health Assessment Questionnaire-Disability Index (HAQ-DI) [23], number of lower-limb tender and swollen joints were assessed and Clinical Disease Activity Index (CDAI) [24] was assessed. Foot tactile sensitivity was assessed by using Semmes-Weinstein monofilaments as previously described [25]. Participants underwent the following physical performance tests: Berg Balance Scale (BBS) [26], Timed-up-and-go Test (TUG) [27] and 5-Time Sit Down-To-Stand Up Test (SST5) [20].

2.5. Outcome measures

2.5.1. Fall occurrence and fear of falling

Participants were asked to report the number of falls in the last 12 months, considering "The Prevention of Falls Network Europe" (ProFaNe) definition for falling: "In the last year, how many times did you fall (considering fall any unexpected event resulting in come to rest on the ground, floor, or other lower level such as a furniture, wall or any other objects)?" [28]. For data analysis, participants were divided into groups considering the occurrence of falls: "non-fallers", "sporadic fallers" (1–2 falls) and "recurrent fallers" ($\geq$ 3 falls). Participants were asked if they were or not fearful of falling (Yes or No).

2.6. Physical performance tests

2.6.1. 5-Time Sit Down-To-Stand Up Test (SST5)

The SST5 is a measure to assess lower-limb strength and functional mobility. In this test, the subject begins sitting on the center of a chair with his/her spine erect, feet separated by a distance equivalent to the distance between the shoulders, and arms folded across the thorax. Then the subject is asked to stand up and sit down on the chair 5 times as quickly as possible, without using the arms. The time required to perform the test is recorded in seconds [20]. This test is a reliable and valid measure of lower extremity function in RA patients [29].

2.6.2. Timed Up and Go Test (TUG)

The TUG test is used to assess the dynamic balance of an individual. It measures the amount of time (recorded in seconds) it takes for the individual to rise from a standard arm chair, walk a distance of 3 m and return to the initial position resting against the back of the chair [27]. It is currently used to assess mobility [27], balance and falls risk in older people [17] and it has also been used in RA [30].

2.6.3. Berg Balance Scale (BBS)

The BBS is a balance assessment test that rates the ability of a subject to maintain balance while performing each of 14 movements required in everyday activities. Scoring is based on an ordinal 5-point scale from 0 to 4, 0 representing inability to complete the task and 4, ability to complete the task unassisted. The maximum possible score is 56 [26]. Testing takes approximately 15–20 min. The test is currently used to assess balance [26] and to identify older people at risk of falling [17]. It has also been used for rheumatic patients [30].

2.6.4. Health Assessment Questionnaire-Disability Index (HAQ-DI)

The HAQ-DI is a self-administered questionnaire with 8 categories, reviewing a total of 20 specific functions that evaluate patient difficulty with activities of daily living over the past week. Each specific activity is assessed on a 4-point Likert scale (0, without difficulty; 1, with some difficulty; 2, with much difficulty; and 3, unable to do). The HAQ score is the average score of all the categories and ranges from 0 to 3. Patients are classified as having mild (HAQ-DI = 0–1), moderate (HAQ-DI $>$ 1–2) and severe disability (HAQ-DI $>$ 2–3) [23].

2.6.5. Lower-limb Health Assessment Questionnaire (LL-HAQ)

The LL-HAQ, developed by Walker et al., is calculated by using 5 sections of the HAQ-DI, 3 with obvious face validity with lower-limb activities — rising, walking and activities — plus the hygiene and dressing sections. The LL-HAQ score is the sum of scores of these 5 sections divided by 5 [31].

2.6.6. Clinical Disease Activity Index (CDAI)

The CDAI is a composite index for assessing disease activity based on the simple summation of the count of swollen/tender joints for 28 joints along with patient and physician global

assessment on a visual analog scale (0–10 cm) for estimating disease activity. Patients are classified as in remission (score < 2.8), low activity (2.8–10), moderate activity (10–22) and high activity (> 22) [24].

2.6.7. Lower-limb joint assessment

The number of lower-limb tender and swollen joints was recorded considering 14 joints: knees, ankles and metatarsophalangeal joints (MTPs).

2.6.8. Foot Function Index (FFI)

The FFI consists of 23 items related to the impact of foot impairments in 3 subscales: foot pain (FFI-pain, 9 items), foot disability (FFI-disability, 9 items) and activity limitation (FFI-activity limitation, 5 items). Each subject is asked to mark on a scale (0–10) the point that best reflects his/her condition on each situation. To obtain a subscale score, the values of each item are summed and divided by the number of items considered applicable by the subject. Calculating the average of the 3 subscale scores produces a total FFI score (FFI-total) [32].

2.6.9. Rheumatic Disease Comorbidity Index (RDCI)

The RDCI is a comorbidity index, ranging from 0 to 9 points, calculated by scoring 11 weighted comorbid conditions (lung disease, heart attack, other cardiovascular diseases, stroke, hypertension, fracture, depression, diabetes, cancer, ulcer and stomach problem). It was found related to physical functioning commitment in people with rheumatic diseases and can be performed by self-reporting or administrative data [22].

2.7. Statistical analysis

For profile analyses, data are presented with descriptive statistics showing the number (%), mean (SD) or median (range) of each variable used. Groups were compared by Chi^2 test, Fisher exact test and Kruskal–Wallis test or Dunn's multiple nonparametric pairwise test with rejection of a Kruskal–Wallis test. To analyze factors associated with sporadic and recurrent falls, logistic regression analysis was used. For univariate analysis, we considered sex, age, marital status, income, BMI, disease duration, rheumatoid factor, medication, vertigo, visual impairment, physical activity, fear of falling, HAQ score, LL-HAQ score, CDAI, lower-limb tender and swollen joint count, BBS, TUG score, FFI and SST5 score. For multivariate stepwise logistic regression analysis, all the above variables were considered except tender and swollen joint count and LL-HAQ score because of its correlation with the CDAI and HAQ. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated. All data were analyzed by using SAS for Windows (v9.4). $P < 0.05$ was considered statistically significant.

3. Results

The flow of participants in the study is in Fig. 1. A total of 190 participants with RA were invited to take part in the study; 52 were excluded for specific reasons and 25 declined to participate. Among the 113 participants analyzed, 59 (52.2%) and 71 (62.8%) reported at least one fall episode in the last 12 months and fear of falling, respectively.

Table 1 shows participants' sociodemographic, clinical and physical test data, considering fall occurrence. Fear of falling ($P = 0.0461$) and use of antidepressants/benzodiazepines ($P = 0.0422$) were more frequent in fallers ("recurrent" and "sporadic fallers") than "non-fallers". CDAI, lower-limb tender joint count, HAQ-DI, and LL-HAQ score were significantly higher in "recurrent fallers" than "sporadic fallers" and "non-fallers". FFI-total, -pain and -disability subscales were higher in "recurrent fallers" than "sporadic fallers". Although the values for FFI were higher for "recurrent fallers" than "non-fallers", the difference was

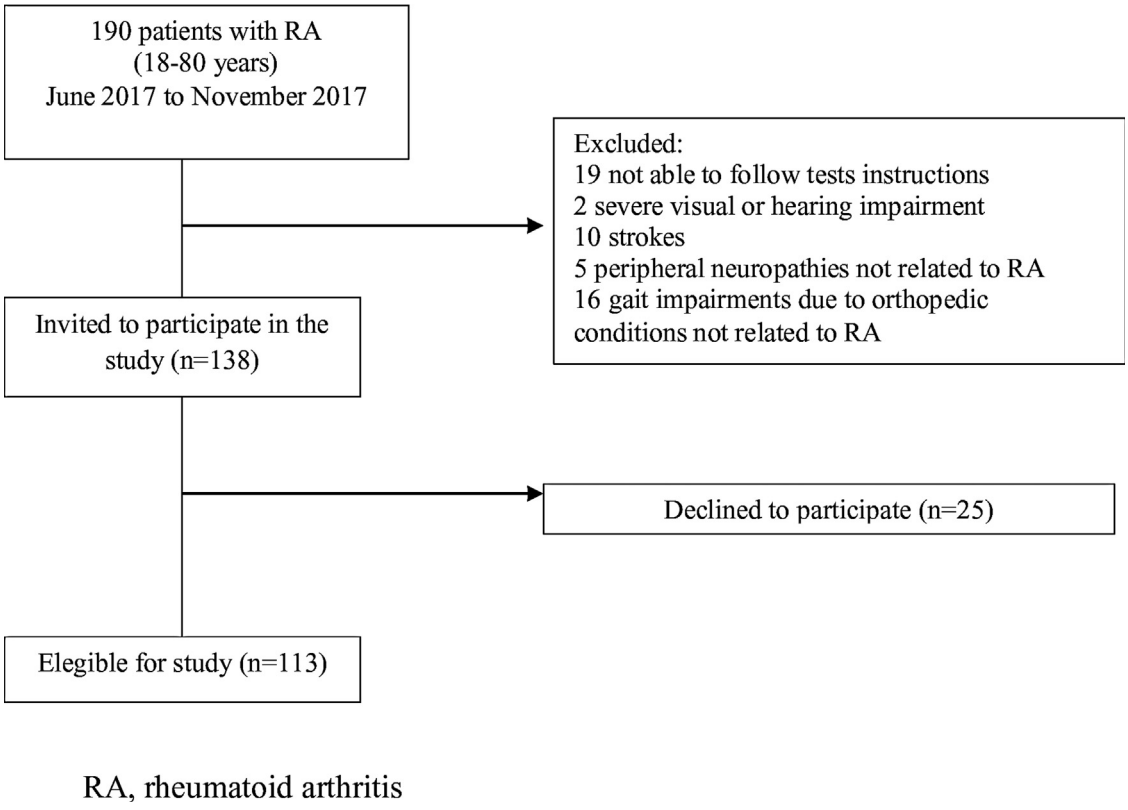

Fig. 1. Flow of participants in the study. RA: rheumatoid arthritis.

Table 1
Sociodemographic and clinical characteristics of "sporadic fallers", "recurrent fallers", and "non-fallers".

Variables	Non-fallers	Sporadic fallers	Recurrent fallers	*P*-value
Number of participants	54 (47.7)	29 (25.6)	30 (26.5)	
Age, mean (SD), years (range)	54.7 (9.7) (32–72)	58.6 (9.8) (33-80)	55.8 (11.5) (32–75)	0.3177[b]
Women	44 (81.5)	27 (93.1)	27 (90.0)	0.2733[c]
Race	White 33 (61.1)	White 16 (55.2)	White 13 (43.3)	0.2919[c]
	Non-white 21 (38.9)	Non-white 13 (44.8)	Non-white 17 (56.7)	
Marital status, with a partner	30 (55.6)	18 (62.1)	15 (51.7)	0.7222[c]
Monthly income, mean (SD) reals[a]	1676.8 (925.9)	1453.1 (743.3)	1277.0 (588.9)	0.1665[b]
Education, mean (SD), years of formal education	8.0 (3.6)	6.5 (3.6)	6.9 (4.3)	0.1837[b]
BMI, mean (SD), kg/m^2	27.6 (5.9)	27.0 (5.0)	30.0 (5.2)	0.0685[b]
Disease duration, mean (SD), years	12.3 (8.4)	10.1 (5.4)	11.4 (7.3)	0.7340[b]
Rheumatoid factor-positive	42 (77.8)	23 (79.3)	23 (76.7)	0.9703[c]
Prednisone, mean (SD), mg/day	4.0 (3.6)	3.5 (3.3)	4.7 (4.0)	0.5482[b]
Synthetic DMARD	39 (72.2)	19 (65.5)	23 (76.7)	0.6319[c]
Biologic DMARD	19 (35.2)	7 (24.1)	14 (46.7)	0.1945[c]
Use of NSAID/analgesics	21 (38.9)	9 (31.0)	9 (30.0)	0.6430[c]
Use of ATD/BDZ	15 (27.8)	5 (17.2)	14 (46.7)	**0.0422**[c,f]
Use of muscular relaxants	7 (13.0)	5 (17.2)	5 (16.7)	0.8376[c]
Use of antihypertensives	21 (38.9)	16 (55.2)	16 (53.3)	0.2609[c]
Use of opioids	5 (9.3)	0 (0.0)	3 (10.0)	0.2244[c]
Vertigo	6 (11.1)	4 (13.8)	9 (30)	0.0752[c]
Visual impairment	42 (77.8)	20 (69.0)	23 (76.7)	0.6597[c]
Physical activity ($>2\times$ /week)	20 (37.0)	9 (31.0)	10 (33.3)	0.8496[c]
RCDI, mean (SD)	1.2 (1.3)	1.2 (1.2)	1.4 (1.3)	0.6859[b]
Fear of falling	29 (53.7)	18 (69.2)	24 (80.0)	**0.0461**[c,f]
CDAI score, mean (SD)	18.8 (10.7)	16.3 (10.1)	30.0 (12.4)	$<$ **0.0001**[b,d]
HAQ-DI score, mean (SD)	0.8 (0.6)	0.9 (0.7)	1.4 (0.5)	**0.0003**[b,d]
LL-HAQ score, mean (SD)	0.8 (0.7)	0.8 (0.7)	1.3 (0.5)	**0.0001**[b,d]
Altered Tactile Sensitivity, *n* (%)	9 (17.0)	3 (10.3)	8 (26.7)	0.2553[c]
FFI – pain, mean (SD)	5.3 (2.7)	4.3 (2.5)	6.4 (2.3)	**0.0059**[b,e]
FFI – disability, mean (SD)	4.7 (2.7)	4.0 (2.6)	5.9 (2.3)	**0.0233**[b,e]
FFI – activity limitation, mean (SD)	2.1 (2.6)	1.6 (2.5)	2.5 (2.8)	0.2062[b]
FFI – total, mean (SD)	4.0 (2.3)	3.3 (2.3)	5.0 (2.0)	**0.0201**[b,e]
TJC of lower limbs, mean (SD)	7.8 (3.5)	6.8 (3.9)	9.9 (2.7)	**0.0040**[b,d]
SJC of lower limbs, mean (SD)	3.8 (2.8)	3.3 (2.8)	4.3 (2.8)	0.3991[b]
TUG, mean (SD), sec	11.5 (3.7)	11.3 (2.6)	13.8 (5.6)	**0.0302**[b,g]
BBS, mean (SD), points	52.5 (4.8)	52.1 (3.5)	48.7 (6.3)	**0.0069**[b,h]
SST5, mean (SD), sec	15.5 (6.6)	13.6 (3.8)	19.4 (9.0)	**0.0165**[b,e]

Data are *n* (%) unless indicated. BMI: body mass index; DMARDs: disease modifying anti-rheumatic drugs; NSAIDs: nonsteroidal anti-inflammatory drugs; ATD/BDZ: antidepressants/benzodiazepines; RDCI: Rheumatic Disease Comorbidity Index; CDAI: Clinical Disease Activity Index; HAQ-DI: Health Assessment Questionnaire-Disability Index; LL-HAQ: lower-limb HAQ; FFI: Foot Function Index; TJC: tender joint count; SJC: swollen joint count; TUG: Timed Up and Go Test; BBS: Berg Balance Scale; SST5: 5-time sit down-to-stand up test. In bold: $P < 0.05$.

[a] R$ 1.00 BRL = 0.26 USD.
[b] Kruskal–Wallis test.
[c] Chi^2 test.
[d] Dunn's multiple test: recurrent > sporadic, non-faller.
[e] Dunn's multiple test: recurrent > sporadic.
[f] Dunn's multiple test: recurrent, sporadic > non-faller.
[g] Dunn's multiple test: recurrent > non-faller.
[h] Dunn's multiple test: non-faller > recurrent.

not significant. Regarding physical performance tests, "recurrent fallers" showed worse performance on the BBS and TUG than "non-fallers". Values for SST5 were increased for "recurrent fallers" and significant differences were noted as compared with "sporadic fallers" but not "non-fallers".

Figs. 2 and 3 present forest plots of the association of the occurrence of falls ("sporadic fallers" and "recurrent fallers", respectively) with sociodemographic, clinical data, disease activity, disability and physical performance tests (univariate logistic regression). No significant associations were noted between "sporadic fallers" and the studied variables.

Significant associations were found between "recurrent fallers" and vertigo (OR = 3.42; $P = 0.0363$); fear of falling (OR = 3.44; $P = 0.0199$); low income (2.02-fold increased odds for each Brazilian real 1000.00/US$ 260.00 income reduction); CDAI (1.08-fold increased odds for each additional index point); HAQ-DI (3.66-fold increased odds for each additional score point); LL-HAQ (3.48-fold increased odds for each additional score point); FFI-pain and FFI-total (1.24-fold and 1.23-fold increased odds for each additional score point, respectively); lower-limb tender joint count (OR = 1.22; $P = 0.0088$); worse performance on the SST5 (1.06-fold increased odds for each additional second in the test), TUG (1.13-fold increased odds for each additional second in the test) and BBS (1.14-fold increased odds for each point decrease in the final score) (Appendix A). On multivariate analysis, CDAI was the only significant predictor of recurrent falls (OR = 1.08 for each 1-point increase in CDAI, 95% CI 1.03–1.13, $P = 0.0007$). Although not significant, CDAI appeared to be also associated with sporadic falls (OR 0.97, 95% CI 0.92–1.02, $P = 0.3563$) (Appendix A).

We found significant correlations between physical performance tests (TUG, BBS and SST5) and HAQ-DI and CDAI ($P < 0.0001$) (Table 2). Performance in all physical tests was worse for participants with moderate and high versus low disease activity and for participants with moderate and severe versus mild disability.

4. Discussion

In this study, we evaluated the prevalence of falls in RA and its relation to sociodemographic and clinical data, disease activity,

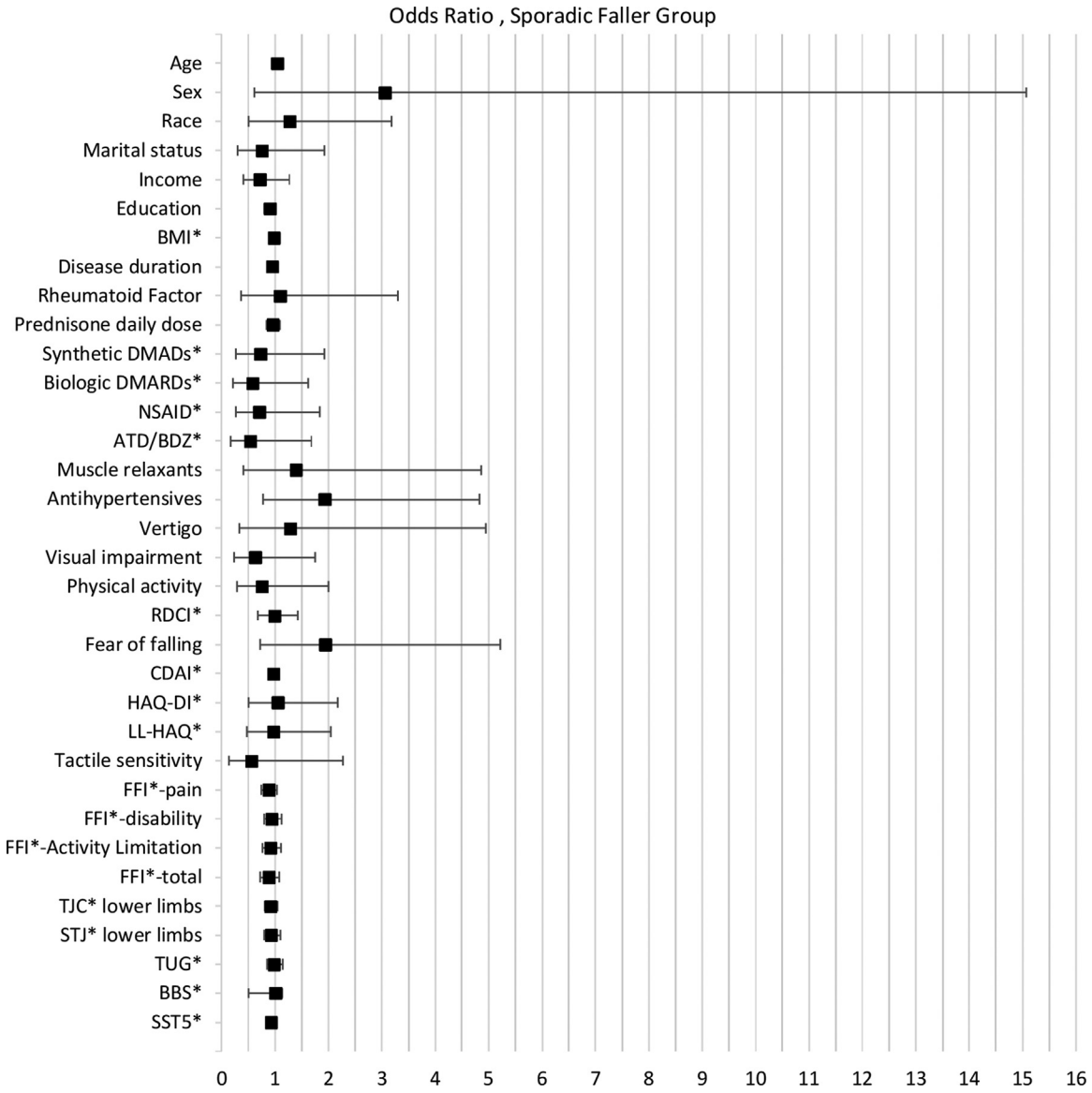

Fig. 2. Forest plot of univariate analysis of the association between variables and sporadic falls. Data are odds ratios and 95% confidence intervals. *BMI: body mass index; DMARDs: disease modifying anti-rheumatic drugs; NSAIDs: nonsteroidal anti-inflammatory drugs; ATD/BDZ: antidepressants/benzodiazepines; RDCI: Rheumatic Disease Comorbidity Index; CDAI: Clinical Disease Activity Index; HAQ-DI: Health Assessment Questionnaire-Disability Index; LL-HAQ: lower-limb HAQ; FFI: Foot Function Index; TJC: tender joint count; SJC: swollen joint count; TUG: Timed Up and Go Test; BBS: Berg Balance Scale; SST5: 5-time sit down-to-stand up test.

disability and physical performance tests. The prevalence of falls was high, mostly linked to disease-related outcomes, foot function and worse performance in physical tests.

Half of the participants referred to a previous fall in the last year, one quarter with 3 or more episodes. This prevalence was greater than that reported in other retrospective studies [6–8,10,11,13] and may be explained by the wide definition of falls used in this protocol, based on Prevention of Falls Network Europe recommendations [28]. The fear of falling was also high, especially in recurrent fallers (80%). These data reinforce the need to ask about the past history of falls and the fear of falling in clinical practice. These factors have been previously reported as significant fall predictors [5,16].

Factors commonly related to falls in older people such as age, race, marital status, education, BMI, visual impairment, and physical activity were not related to falls in this sample. The lack of association between RA and sociodemographic factors has been reported [4,5,7–10,12,13]. Only the use of antidepressives/benzodiazepines, vertigo and low income were related to recurrent falls in our RA participants. Income was lower for "recurrent fallers" than "sporadic fallers" and "non-fallers" although not significantly. People with low income are known to have high disease activity and morbidity [33] and are likely to have a high fall incidence. In contrast, people with high disease activity are also expected to have lower chances of high income than those with controlled disease.

The comorbidity index (RDCI) did not show a direct relation to falls. This finding needs to be interpreted with caution because a large number of participants supposed to have a high comorbidity index — those with stroke and orthopaedic conditions — were excluded from the protocol.

Regarding disease indexes, the HAQ-DI (even when analyzing LL-HAQ), lower-limb tender joint count and CDAI were higher in "recurrent fallers" than "non-fallers" and "sporadic fallers"; all scales were considered recurrent-fall predictors (HAQ-DI and lower-limb tender joint count on univariate analysis and CDAI on both univariate and multivariate analysis). In previous studies, the HAQ-DI was also found increased in fallers [5,7,8,12–14] and was

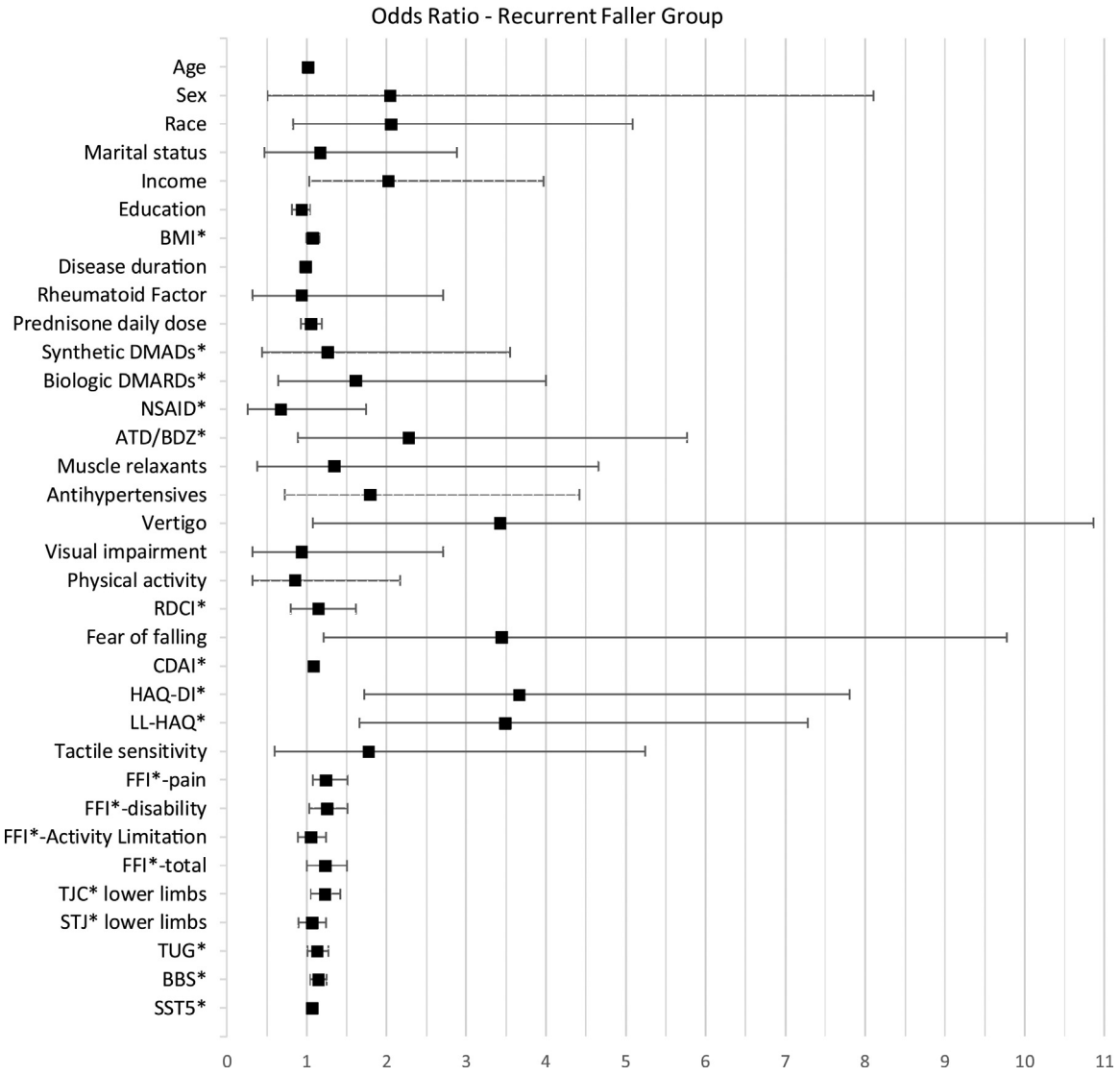

Fig. 3. Forest Plot of univariate analysis of the association between variables and recurrent falls. Data are odds ratios and 95% confidence intervals. *BMI: body mass index; DMARDs: Disease Modifying Anti-Rheumatic Drugs; NSAID: anti-inflammatory drugs; ATD/BDZ: antidepressants/benzodiazepines; RDCI: Rheumatic Disease Comorbidity Index; CDAI: Clinical Disease Activity Index; HAQ-DI: Health Assessment Questionnaire-Disability Index; LL-HAQ: lower-limb HAQ; FFI: Foot Function Index; TJC: tender joint count; SJC: swollen joint count; TUG: Timed Up and Go Test; BBS: Berg Balance Scale; SST5: 5-time sit down-to-stand up test.

described as a fall predictor [5,7,13,14]. Some authors found disease activity indexes associated with increased risk of falls [5,7,11,14,15,34] but not others [7,9,19,35]. This divergence may be attributed to sample characteristics and how fall frequency is analyzed. In samples with high disease activity, falls are supposed to be related better to disease outcomes than in samples with a predominance of participants with low disease activity indexes. Also, the separate analysis of "multiple fallers" or "recurrent fallers" may better identify those at increased risk of falls than the simple dichotomization into "fallers" and "non-fallers".

The FFI was high among "recurrent fallers" and was considered a recurrent fall predictor on univariate analysis. The foot is

Table 2
Associations between physical performance tests (SST5, TUG, BBS) and HAQ-DI and CDAI.

	Disability (HAQ-DI)			*P*-value[a]	Disease activity (CDAI)			*P*-value[a]
Physical Performance Tests	Mild ($n=63$)	Moderate ($n=44$)	Severe ($n=6$)		Low ($n=23$)	Moderate ($n=48$)	High ($n=42$)	
SST5	13.57 (4.48) Mild < moderate/severe[b]	18.57 (8.06)	22.70 (11.07)	0.0002	13.03 (3.64) Low < moderate/high[b]	16.45 (7.43)	17.15 (7.69)	0.0002
TUG	10.57 (2.13) Mild/moderate < severe[b]	13.48 (5.30)	16.99 (4.18)	< 0.0001	10.63 (2.71) Low < moderate/high[b]	11.62 (3.01)	13.34 (5.50)	< 0.0001
BBS	53.54 (2.62) Mild > severe[b]	49.39 (5.78)	43.33 (7.50)	< 0.0001	53.95 (2.32) Low > moderate/high[b]	50.98 (5.55)	50.45 (5.51)	< 0.0001

Data are mean (SD). CDAI: Clinical Disease Activity Index; HAQ-DI: Health Assessment Questionnaire-Disability Index; SST5: 5-time sit down-to-stand up test; TUG: Timed Up and Go Test; BBS: Berg Balance Scale.
[a] Kruskal–Wallis test.
[b] Dunn's multiple comparison test

commonly affected in RA and it may also affect the occurrence of falls. A few studies addressed this issue, but it seems that foot function [34] rather than foot deformity may be linked to falls [9,36].

Many tools have been proposed to screen people at high risk for falls, such as the BBS, TUG and SST5 [17]. The TUG, BBS and SST5 values were worse for "recurrent fallers" than others and were considered significant fall predictors on univariate analysis. To our knowledge, only 3 other studies evaluated the correlation between falls and the TUG, BBS and SST5 in RA. The first study [18] found significant differences between "fallers" and "non-fallers" with the BBS and TUG, but none was considered a fall predictor. The second study [19] did not observe any association of falls with the BBS and TUG score. Finally, the SST5 score was associated with falls and considered a fall predictor in a prospective protocol [5]. In this study, these tests were also significantly correlated with disease activity (CDAI) and disability (HAQ-DI). Other authors described similar results [6,35,37]. The positive correlation of physical performance test results (as well as FFI) with recurrent falls reinforces the importance of physical activity and rehabilitation in balance. Physical rehabilitation has been reported as a feasible intervention to improve balance in RA [38].

This study has several limitations. Data concerning falls were based on self-reports over the last 12 months. Retrospective studies have been shown to underestimate falls occurrence due to poor recall [4]. Also, because the occurrence of falls was retrospective, we cannot determine the temporal nature of the observed associations. The fear of falling was assessed as a categorical variable (yes or no), which may not be adequately sensitive. Some authors suggest the use of efficacy scales for falls, or balance confidence scales [39]. In our analysis, we did not include some factors related to falls in older people such as sarcopenia, body mass composition, aerobic capacity, upper- and lower-limb strength by using motor function measures or isometric or isokinetic dynamometers [40]. Moreover, participants were recruited from a tertiary outpatient clinic, with disease generally more severe than those in primary care; thus, our results should not be extrapolated outside this setting. Our protocol might also have excluded some participants at high risk of falling, such as those with a previous stroke and who had fractures or injuries after a fall and could not attend the outpatient clinic, which could represent a selection bias. Finally, we did not include a control group of healthy participants to clarify whether RA per se represents a risk factor for falls.

In summary, we observed a high prevalence of falls in RA, most linked to disease-related outcomes (mainly CDAI). BBS, TUG and SST5 findings were also related to recurrent falls and these can be used as fall risk assessment tools in rheumatoid individuals.

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Author contributions

J.Z.G.: study design, data collection, drafting the manuscript; M.B.B.: study design, final article revision; C.deM.B.: study design, participant recruitment, article revision. C.S.N.: study design, participant recruitment, article revision; Z.S.: study design, final article revision; M.D.: study design, final article revision; and E. de P.M.: study design, participant recruitment, drafting the manuscript. All authors read and approved the final manuscript.

Disclosure of interest

The authors declare that they have no competing interest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org.10.1016/j.rehab.2018.09.003.

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