

Received: 2019.12.02

Accepted: 2020.01.13

Available online: 2020.02.17

Published: 2020.04.15

Evaluation of Risk Factors for Falls in Patients with Rheumatoid Arthritis

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Source of support: Departmental sources

Background: The aim of our study was to investigate the risk factors for falls in the rheumatoid arthritis (RA) patient population in Poland. This would be a major step towards the development of new fall prevention programs.

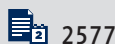
Material/Methods: There were 450 RA patients who met the criteria of the American College of Rheumatology who participated in this study. The average age of patient participants was 54.2 years; the average RA duration was 15.1 years. All patients filled out the study questionnaire regarding falls, medications, and diseases, and they filled out the Polish version of the Health Assessment Questionnaire (HAQ).

Results: Of the 400 patients, 203 patients (51%) experienced falls. Out of the 268 falls experienced by study patients, 113 falls (42%) were due to an environmental cause, the remainder 155 falls were caused by health conditions. The number of falls positively correlated with HAQ scores ($r=0.42$, $P<0.01$) and the duration of RA ($r=0.39$, $P<0.05$). For individuals who had fallen 3 or more times, there was a stronger positive correlation between the number of falls and the total HAQ score ($r=0.61$, $P<0.01$). The main risk factors for falls in the study group were dizziness (odds ratio [OR]=3.42), the use of hypotensive medication (OR=2.82), foot deformities (OR=4.09), and a high HAQ score (OR=2.59). Other factors such as drug use (e.g., glucocorticoids), pain, and duration of RA were measured using a visual analogue scale, and were found not to have increased the risk for falls and fractures ($P>0.05$).

Conclusions: Knowledge about risk factors can help identify high-risk patients to help decrease their risk of falling, thus preventing fall-related injuries.

MeSH Keywords: **Autoimmune Diseases • Dizziness • Foot Deformities • Foot Injuries • Pain**

Full-text PDF: <https://www.medscimonit.com/abstract/index/idArt/921862>



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71



Background

Individuals with rheumatoid arthritis (RA) have been linked with an increased risk for falls [1,2]. Multiple factors work together to provoke non-fatal unintentional falls. These include the environment, body mechanics, and mental status, all of which can be in disbalance in patients with RA [3–7]. RA is a common world-wide chronic autoimmune disease, affecting bone cartilage and predominantly joints, and causing inflammation and pain [8]. In addition to the risk factors for falls observed in healthy patients, RA patients have disease-specific risk factors, including greater impaired balance [9], tender and swollen joints [1–3,10], increased pain perception, and medication side effects [3,11]. Individuals with RA also have lower muscle strength in their lower limbs, fatigability, and impaired mobility, which contributes to a predisposition for falls [1,3,10]. Falls in this group can be traumatizing, especially with decreased bone mass in RA patients, consequently leading to higher bone fracture occurrences after falls [1,11–13]. As an example, RA patients in Finland have a 3-fold increase in hip fractures when compared to the generally healthy population [14].

Within the first year of RA there is an estimated 33% to 54% incidence of falls [2,3,6,15–19]. However, the duration of RA has not been shown to affect the risk of falls [2,15]. One out of every 5 elderly individuals who falls will sustain a serious injury such as a hip or head injury, often requiring hospitalization or surgery [20]. Elderly individuals with RA and other comorbidities constitute a group of poor candidates for surgery and postoperative recovery [21–25]. The mean age onset for RA in people of European descent is 50s and 60s years old, with peak incidence between 70 and 79 years old [26,27]. In Poland, elderly individuals constitute 13% of the population and use 34% of health care funds, some of which include treatment for falls and RA [28,29].

The prevalence of RA in Poland is 0.9%, which is higher than other European countries [30]. RA is prevalent in 0.24% of the world population, between 0.3% and 1% in Western Europe and North America respectively, and it is expected to increase [8,31–33]. Additionally, RA is ranked 74th in terms of burden and 42nd in terms of disability [8]. Although falling commonly increases with age for all individuals, previous studies report RA patients exceeding rates compared to healthy adults [7,19]. However, no association between falls and advanced age in RA patients has been identified [1,2,15–17,19].

The relationship between RA and falls has mainly been studied on North American and a few European countries; little attention has focused on the Polish population [1,16–19,34]. Therefore, the goal of our study was to investigate the risk factors of falls in the RA patient population in Poland. This would be a major step towards the development of new falls prevention programs designed specifically for Polish patients.

Material and Methods

The study was conducted at the J. Dietl Specialistic Hospital in Cracow (Poland) with the inclusion of 400 RA patients who met the criteria of the American College of Rheumatology [35]. All patients filled out the study questionnaire shown in Table 1, regarding falls, medications, and diseases. Furthermore, patients filled in the Polish translation of the Health Assessment Questionnaire (HAQ) regarding their health status [36].

Falls were defined as an unintentional fall to the ground, surface, or a lower level relative to the standing point. This excluded falls that occurred due to other reasons including, but not limited to, stroke, being struck by a car, or tripping by another individual [37].

Out of the 400 patients included in this study, 293 were female (73%) and 107 were male (27%). The average age of patients and RA was 54.2 years and average duration of RA was 15.1 years. The average HAQ score was 1.44 ± 0.81 .

Statistical analysis

All participants were required to fill out the study questionnaire (Table 1) and the HAQ used by Wiland et al. [36]. Statistica 10.0 PL software by StatSoft Polska was used to analyze the data. Statistical analysis (range, mean, standard deviation, percent distribution) was used to extrapolate information of age, medications used, other diseases, joint disorders, activity of disease, daily activities, and other disorders. The Shapiro-Wilk test was used to assess the distribution of data. Then, a *t*-test (for normally distributed data) and Mann-Whitney U test (for non-normally distributed data) were conducted to compare quantitative variables. To determine the relationship between the results of HAQ, the number of falls, duration of disease, and body mass index (BMI), Spearman's correlation analysis was performed. To determine the relationship between falls, fractures and other variables, the logistic regression model was used with the occurrence of fractures or falls successively used as dependent variables. The results are presented using OD and 95% confidence intervals (CI). A *P*-value < 0.05 was assumed to be statistically significant.

Results

Of the 400 patients, 203 patients (51%) experienced falls (Table 2). Out of the 268 falls experienced by patients, 113 falls (42%) were due to an environmental cause, and 155 falls were caused by health conditions. The number of falls per patient can be seen in Table 3.

Table 1. Questionnaire.

1.	Sex (Male/Female):
2.	Age (years):
3.	Height (cm):
4.	Weight (Kg):
5.	How many years have you been suffering from rheumatoid joint inflammation?
6.	Are you taking any of the following medications? (Yes or No)
	Sedatives
	Antidepressants
	Hypotensive drugs (diuretics, beta-blockers, calcium channel blockers, angiotensin converting enzyme inhibitors)
	Analgesics
	Antiarrhythmic
	Antihistamines (allergy medication)
	Nitrates (i.e., nitroglycerine)
	Hypoglycemics (for low blood glucose sugar levels)
	Glucocorticosteroids (i.e., Encorton, Metypred)
7.	Have you had OR do you presently have any of the following conditions? (Yes or No)
	Depression
	Asthma
	Parkinson disease
	Diabetes
	Hypertension
	Osteoporosis
	Arrhythmias
	Infarction/heart attack
	Stroke
	Partial paralysis (paresis) or paralysis of a limb
	Dizziness
	Total number of diseases:
8.	Do you have or had any problems with vision? (Yes or No)
	Myopia (nearsighted)
	Hyperopia (farsighted)
	Astigmatism(s)
	Cataract(s)
	Other (please specify):

Table 1 continued. Questionnaire.

9.	While having RA have you experienced any of the following changes: (Yes or No)
	Shortening of limb(s)
	Deformities of the foot
	Deformed joints (if so, please specify which ones):
	Deviation of the spine
	Functional abnormalities of any limbs i.e., issues with walking or bending of joints
	Other changes please specify:
10.	Do you use any walking aids? (Yes or No)
	Cane
	Crutch(s)
	Walking chair
	Orthopaedic shoe(s)
	Ankle brace(s)
	Other (please specify):
11.	In the last 10 years have you noticed a decrease in height? (Yes or No)
	If yes, how many centimeters have you decreased in height in the last 10 years?
12.	Have you fallen in the last 12 months? (Yes or No)
13.	How many falls have you experienced in the last 12 months?
14.	What caused you to fall? If more than 1 fall, please explain in order the cause of each fall.
	Environmentally caused i.e., difficulty getting out your home, poorly lighting at home, bad weather, being hit by a person or object, wrong shoes, etc.
	Self-caused i.e., dizziness, balance difficulty, muscle weakness, poor vision, etc.
15.	Did you experience any fractures after the fall(s)? (Yes or No)
16.	Did any of the falls or fractures require surgical treatment? (Yes or No)
17.	Please state where the surgical treatment was required?

The number of falls positively correlated with the HAQ scores ($r=0.42$, $P<0.01$) and the duration of RA ($r=0.39$, $P<0.05$). For individuals who had fallen 3 or more times, there was a stronger positive correlation between the number of falls and the total HAQ score ($r=0.61$, $P<0.01$).

A total of 79 falls (29%) resulted in peripheral fractures with the most common locations being proximal femur (39 falls), wrist (20 falls), forearm (9 falls), and ankle (2 falls). The remaining 9 falls were different isolated fractures. Of the fractures, 61 required surgical intervention (21 closed reductions and internal fixations, 18 total joint prostheses). In the group

of individuals who experienced fractures, the number of falls negatively correlated with BMI ($r=-0.52$, $P<0.05$).

The main risk factors for falls in the study group were dizziness ($OR=3.42$), the use of hypotensive medication ($OR=2.82$), foot deformities ($OR=4.09$), and high HAQ score ($OR=2.59$). Other drugs (such as glucocorticoid), pain, and duration of RA were measured using a visual analogue scale and were not shown to increase the risk of falls and fractures ($P>0.05$).

The duration of RA ($OR=1.16$) and age ($OR=1.09$) had a negligible effect on the probability of falls. Factors such as deformed

Table 2. Patient characteristics.

Characteristic	Patients without falls			Patients with falls		
Number of patients	197	(49.3%)		203	(50.8%)	
Number of females	169	(85.8%)		124	(61.1%)	
Age (years)*	53.6	(12.8)	(27.2%)	63.1	(9.1)	(31.1%)
BMI	23.2	(4.8)	(11.8%)	26.1	(5.0)	(12.9%)
Years with RA*	10.8	(7.9)	(5.48%)	18.9	(10.8)	(9.31%)
Medications						
Sedatives*	54.0	(27.4%)		93.0	(45.8%)	
Antidepressants*	21.0	(10.7%)		38.0	(18.7%)	
Hypotensive*	108	(54.8%)		144	(70.9%)	
Hypoglycemic	29.0	(14.7%)		18.0	(8.87%)	
Glucocorticosteroids	161	(81.7%)		175	(86.2%)	
Other diseases						
Hypertension*	104	(52.8%)		143	(70.4%)	
Osteoporosis*	54.0	(27.4%)		127	(62.6%)	
Dizziness*	73.0	(37.1%)		130	(64.0%)	
Joint disorders						
Foot deformities*	110	(55.8%)		177	(87.2%)	
Wrist deformities(s)*	61.0	(31.0%)		38.0	(18.7%)	
Hip deformities(s)	25.0	(12.7%)		39.0	(19.2%)	
Pain VAS (0–100)	46.5	(19.1)	(~23.6%)	50.3	(22.3)	(24.8%)
Activity of disease VAS (0–100)*	51.3	(19.5)	(~26.0%)	61.0	(13.4)	(30.0%)
Sum of HAQ (0–3)*	1.12	(0.69)	(~0.569%)	1.78	(0.48)	(0.877%)
Personal hygiene	1.18	(1.08)	(~0.599%)	1.59	(1.13)	(0.783%)
Lifting	1.31	(0.90)	(0.665%)	1.82	(0.79)	(0.897%)
Grip	1.30	(0.83)	(0.660%)	1.73	(0.87)	(0.852%)
Activity*	1.59	(1.12)	(0.807%)	2.12	(0.91)	(1.04%)
Dressing oneself*	1.07	(0.90)	(0.543%)	1.68	(0.98)	(0.832%)
Standing up*	0.69	(0.68)	(0.350%)	1.26	(0.81)	(0.621%)
Eating*	1.40	(1.12)	(0.710%)	1.91	(0.78)	(0.941%)
Walking*	0.86	(0.71)	(0.437%)	1.40	(0.81)	(0.690%)

Values are as an average (standard deviation) or number (%). * Results that are statistically significant ($P < 0.05$). RH – rheumatoid arthritis; VAS – visual analog scale; HAQ – health assessment questionnaire.

Table 3. Number of falls in the analyzed patient sample.

Number of falls	Number of individuals (%)
0	197 (49.3%)
1	156 (39.0%)
2	34 (8.50%)
≥3	13 (3.25%)

wrists were shown to have a reducing effect on the risk of falls (OR=0.58) (Table 4).

Discussion

This study aimed to identify risk factors for falls and accompanying injuries among RA patients in the Polish population. With the high prevalence of RA in the Polish population, the possibility of identifying important risk factors was probable. This information can then be used to help develop safety programs for this group of patients. Our results indicated that falls are a serious and common problem among individuals with RA.

Approximately 51% of patients participating in this study experienced 1 or more falls within the previous 12 months. However, the percentage of falls could potentially be greater if factors such as the non-accounted “forgotten falls” were considered [2,38–41]. All individuals are capable of experiencing retrieval-induced forgetting, a phenomenon that when trying to recall events can lead to suppression of memories [42]. Therefore, at the time of answering questions for this study, individuals could have forgotten past falls. One study found that in a population of men and women aged 60 and over, 13% of individuals who reported a fall during weekly observations did not report the fall at the end of the 12-month report [38]. In addition, some studies vary in recording reports of incidence of falls (e.g., 6 months versus 12 months) which can lead to some discrepancy between study results [40].

Unfortunately, due to the relatively small population of men in our study, it was not possible to specify which gender experienced more falls. Previous studies of elderly individuals with geriatric diseases [43–45] and studies of individuals with RA [16,46], have suggested that women fall more often than men. However, this is inconsistent with the findings of a systematic review Brenton-Rule et al., which showed falls being independent of gender [40]. Literature supports that women are more likely to seek help and report falls relative to men, especially older men [47]. Additionally, women have been shown to be less physically active compared to men [48]. With lower physical activity comes increased muscle weakness and a higher risk of falling [48]. Less physical activity can also be linked

to a fear of falling or inflicting pain, further resulting in muscle weakness and subsequently more falls [6,11,18].

When using age as a potential risk factor, our results were similar to the findings of Armstrong et al. [16] and Brenton-Rule et al. [40] that found that age did not seem to be a determining factor for increased risk of falls. This age risk finding does not coincide with findings from some other studies conducted on the elderly [43,49,50] and the reason for the difference is not yet clear.

When comparing the incidence of falls in patients with RA between results of studies from Great Britain (33%) [16], the United States (31%) [6], and Poland (43%) (this study), the conclusion can be drawn that falls occurred more frequently in our Polish study population than among the inhabitants of the aforementioned countries. This may be due to the widespread use of fall prevention programs in the United States and Western Europe. Education and installing in-home mobility aids can help to meet patients’ needs by increasing patients’ ability to be mobile and is effective in assisting with balance [6,13,51–53].

The effect of the use of a mobility aid in reducing risk of falls is controversial, as it can help a patient with support and thus be more mobile, but it can also cause a fall [54–57]. It is advised that mobility aids should be properly adjusted to the patient and patient education on the mobility aid and method of use should be provided [57]. To minimize the difference reported between the incidence of falls between countries, several measures could be introduced or developed further. Providing more inpatient physical therapy and occupational therapy, as well as starting enhanced fitness programs could contribute to increased fall prevention. Physical therapy can decrease fatigability in patients with RA, which is a known risk factor for falls [58]. Additionally, it allows for an increase in muscle strength and improves balance [58–61]. These prevention programs should, and sometimes are, recommended in countries with a high prevalence of RA, such as Poland.

When assessing physical activity and mobility as a risk factor, physical function assessments using HAQ have shown that standing up, walking, and getting dressed contributed to an increased risk of falls. These observations are supported by the findings of Armstrong et al. [16] as well as of Kaz et al. [62]. Inferences can be made that stiffness or pain in the joints, or muscle weakness while walking, could contribute to falls as well as lack of balance when getting dressed or being mobile, predisposing a person to a fall [46].

When assessing medication as a risk factor, antidepressants and antihypertensive medication have been shown to be associated with an increased risk of falls. These results have also been seen in studies carried out in elderly populations [40,63–65]

Table 4. Factors influencing risk of falls in rheumatoid arthritis patients.

Characteristics/feature	OR	95% CI	P
Duration of having RA	1.16	1.08–1.20	<0.001
Dizziness	3.42	1.47–5.13	<0.001
Sum of HAQ	2.59	1.56–4.01	<0.01
Antihypertensives	2.82	1.41–3.98	<0.01
Antidepressant medication	2.51	1.12–5.21	<0.05
Foot deformities	4.09	2.46–9.40	<0.01
Wrist deformities	0.58	0.21–0.77	<0.01

RA – rheumatoid arthritis; HAQ – health assessment questionnaire; OR – odds ratio; CI – confidence interval.

as well individuals with RA [16]. Medications used to treat RA, such as methotrexate and psychotropic drugs, have common side effects of dizziness, fatigue, and blurred vision, all of which can result in disorientation or decreased gait steadiness [1,46]. Dizziness complaints have been attributed to various factors such as medication and age; and previous findings using videonystagmography have yet to find a link between dizziness and the vestibular system [66]. More research is needed to better understand the relationship between RA and vertigo. Although not assessed in this study, individuals taking disease modifying anti-rheumatic drugs (DMARD) have been reported to have improved quality of life, physical function, and disease activity. However, risk of falls after consistent administration of DMARD has not yet been assessed; it should be assessed in future studies as a means for fall prevention [67]. Involuntary falls in RA patients can be a result of a combination of the aforementioned factors, which include both mental and physical factors [3].

Foot deformities have been speculated to be a risk factor for falls in individuals with RA. KazKaz et al. [62] and Stanmore et al. [46] reported an increase in falls when there was an increase in pain, edema, or joint pain in the areas of the foot or lower extremities. However, these studies did not investigate the influence of permanently deformed feet on the risk of falls. We took this into consideration and found that permanent foot deformities significantly increase the risk of falling. Foot deformities, including structural deformities, muscle weakness, or decreased flexibility in areas of the foot including reduced toe flexure strength, have been shown to predispose the elderly to falls due to a decrease in balance and coordination [59–61]. Exercises targeted to increasing foot strength to exert steady pressure for increased balance could be implemented to increase muscle strength and help decrease the risk of falls in RA patients who have permanent foot deformities [59–61].

It is known that patients with RA are at a greater risk for osteoporotic fractures, including fractures of the proximal femur [13,68,69]. Osteoporosis includes decreased bone mineral density and the associated risk of fracture. The frequency of fractures as a result of falling in our study (34 fractures; 18.3% of the group) was inconsistent with the Armstrong et al. study (4 fractures; 1.6%) [16]. This difference may be due to the smaller sample size used in the Armstrong et al. study (186 individuals) in comparison to our study sample size or due to population differences (differences in the number and stage of comorbidities, vitamin D deficiencies, etc.).

Surprisingly, our findings showed a decreased risk of falls associated with deformed wrists and poor vision. We are not aware of other studies mentioning such relationships. But we can speculate that these findings might be the result of individuals with wrist deformities being required to take advanced, fall preventing precautions, or their decreased mobility might contribute to preventing injuries [6,18,34,70]. Vision defects have been reported to increase the risk of falls, especially with increasing severity of the vision defect [48]. Vision defects could decrease perception of one's surroundings and the ability to prevent a fall [49,71].

Physical fitness was assessed in our study using HAQ. We acknowledge that some of our study results might have been biased due to poor memory recall by some of the study participants. It is important to note that this was a retrospective study and it had limitations including a causal relationship as to whether a decrease in physical activity can be a cause of a fall.

Conclusions

Falls are a common and significant problem among RA patients. This study showed that the main risk factors for falling among RA patients were joint disorders (wrist and foot

deformities) and medications such as antidepressants or anti-hypertensives. Knowledge about risk factors can help identify high-risk patients and help to decrease their risk for falling, thus preventing injuries (including fractures). Increased care by physical and occupational therapy services can aid in

fall prevention and improve recovery after falls by addressing contributing physical and psychological risk factors. A high incidence in falls reported here emphasizes the importance of educating RA patients about falls, fractures, and fall preventive measures.

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