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Review article

Assessment of functional capacity in patients with rheumatoid arthritis: implications for recommending exercise



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ABSTRACT

Rheumatoid arthritis (RA) is an autoimmune disease characterized by chronic symmetric polyarthritis of large and small joints and by morning stiffness that may lead to musculoskeletal impairment, with functional impotence. The concept of functionality relates to the ability of an individual to perform effectively and independently daily activities and tasks of everyday life. The aim of this review is to familiarize the rheumatologist with the concept of functional capacity evaluation and with the tests that can be applied in this population, as these are important steps for a proper exercise prescription. From functional tests already used in the elderly population, the Physical Fitness and Rheumatology Laboratory – LAR – Brasília, which is accompanying patients from Brasília Cohort of Early Rheumatoid Arthritis, describes in this article a protocol of tests to assess functional capacity for application in patients with RA, including the description of tests: 1) Sit and Reach; 2) Agility/Dynamic Balance; 3) Manual Dynamometry; 4) Sit Back and Lift; 5) Biceps Curl and 6) Six-minute Walk Test.

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Avaliação da capacidade funcional em pacientes com artrite reumatoide: implicações para a recomendação de exercícios físicos

RESUMO

A artrite reumatoide (AR) é uma doença autoimune que se caracteriza por poliartrite crônica simétrica, de grandes e pequenas articulações, e rigidez matinal que pode levar a comprometimento musculoesquelético, com impotência funcional. O conceito da funcionalidade diz respeito à capacidade de o indivíduo realizar atividades e tarefas da vida diária e cotidiana, de forma eficaz e independente. O objetivo desta revisão é familiarizar o reumatologista com

Palavras-chave:

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o conceito de avaliação da capacidade funcional e os testes que podem ser aplicados nessa população, pois são passos importantes para uma prescrição adequada de exercícios físicos. A partir de testes funcionais já utilizados em população idosa, o Laboratório de Aptidão Física e Reumatologia – LAR – Brasília, que acompanha os pacientes da Coorte Brasília de Artrite Reumatoide Inicial, descreve neste artigo um protocolo de testes para avaliação da capacidade funcional para aplicação nos pacientes com diagnóstico de AR, incluindo a descrição dos seguintes testes: 1) Sentar e Alcançar; 2) Agilidade/Equilíbrio Dinâmico; 3) Dinamometria Manual; 4) Sentar e Levantar; 5) Rosca Bíceps e 6) Teste da Caminhada de Seis Minutos.

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Introduction

Rheumatoid arthritis (RA) is an autoimmune disease characterized primarily by a chronic symmetrical polyarthritis of large and small joints, and by morning stiffness, which can lead to musculoskeletal impairment, with functional incapacity. These factors contribute to physical incapacity and inefficiency of these patients. Among the strategies of non-pharmacological treatment of RA are physical exercises that address the development of range of movement, functionality, cardiovascular capacity and muscular strength stand out.¹ Generally, physical exercises are safe and recommended for patients with RA and other rheumatic diseases.²⁻⁴

Patients with RA are at higher risk of cardiovascular disease. The possible effect of physical activity on the risk of cardiovascular disease and on the inflammatory and immunological profile is of great interest to health professionals. Studies show that constraints of physical exercise for patients with RA are mainly related to a worsening of the joint symptoms, which may contribute both to inactivity and aerobic capacity detraining as to increased cardiovascular risk.⁵

Another factor that may influence the functional capacity is rheumatoid cachexia, which occurs in approximately 66% of RA patients, and is characterized by loss of cell mass, predominantly from skeletal muscle (sarcopenia), and its etiology is multifactorial, including an increased production of proinflammatory cytokines, hormonal changes and the physical inactivity itself.⁵ In this sense, exercises that promote strength and muscle mass gains are associated with improved functionality; moreover, they are also effective as adjuvants in the control of disease activity.^{6,7}

Composite indices to classify the level of activity of RA, for instance, the Disease Activity Score 28 (DAS-28), the Simplified Disease Activity Index (SDAI) and the Clinical Disease Activity Index (CDAI), were created.⁸ However, despite the simplicity, importance and clinical relevance to rheumatologists' use, such instruments are limited, in order to determine the characteristics of a physical exercise program in patients with RA.

Due to the importance of physical activity for patients with RA, it is essential to develop an exercise program that can intentionally contemplate fundamental methodological principles to serve the purpose of preventing, controlling and/or treating this chronic disease. However, the rheumatologist may ask a series of questions about prescription and recommendation/referral for exercise practice: What fitness must

be trained? What exercises? What weekly frequency? What intensity? What volume? For how long?

Therefore, the purpose of this review is to familiarize the rheumatologist with the concept of functional capacity evaluation and with the tests that can be applied to patients with RA, as these are important steps for a proper prescription of physical exercise. We believe that those functional tests already validated in people over 50 years, with a propensity to physical disability and poor mobility,^{9,10} could be used in patients with RA, considering that so far there is no assessment protocols for functional capacity specific for these patients.

Functional tests

The concept of functionality relates to the ability to perform, effectively and independently, daily activities and tasks of everyday life.⁹ An evaluation of functionality, mainly the physical domain, is extremely important to: a) identify patients at risk for functional disability; b) determine priorities in terms of physical abilities and levels of physical training and rehabilitation; c) promote a joint participation and motivation of the patient in terms of adherence and management of therapeutic methods proposed by health professionals.⁶

The tests originally validated for people over 50 years are reliable and feasible, i.e. evaluate each of the physical abilities relating to functionality, have good intra-rater and inter-rater reproducibility and are highly viable, both from an operational standpoint and also in financial terms.¹¹ The cost to purchase the needed equipment is low, the procedures for conducting the tests are simple and, in general, little space is required for to carry out the physical tests.¹¹

Thus, the Physical Fitness and Rheumatology Laboratory – LAR – Brasília, that accompanies patients from Early Rheumatoid Arthritis Brasilia Cohort,¹²⁻¹⁵ suggests the following tests to assess functional capacity of patients with RA: 1) Sit and Reach; 2) Agility/Dynamic Balance; 3) Manual Dynamometry; 4) Sit Back and Stand Up; 5) Biceps Curl and 6) 6-Minute Walk Test.

It is worth noting that for all these tests it is recommended that the evaluator have a sound judgment about the impossibility by the subject to perform the test, due to the degree of joint involvement. Furthermore, it is suggested that the evaluator explain and demonstrate the test; in addition, one practice trial was given to the subject to familiarize him/her with the test:



Fig. 1 – Sit and reach.

1) Sit and Reach (Chair Sit and Reach Test)^{10,11}

Objective – The original purpose of this test was to evaluate the range of motion of the lower limbs' posterior muscle group, as shown in Fig. 1.

Material – One chair with standard seat height (44 cm) and 1 ruler or tape (preferably, metallic).

Unit of measure – Centimeter (cm).

Level of complexity of test run – Low.

Safety level – High. Attention to the subject balance when seated, especially if elderly.

Need to train the evaluator? – Low necessity.

The execution of three attempts at each limb is suggested; the highest value achieved is recorded.

Test description – the subject must:

- sit on the chair with the evaluated knee extended;
- take a deep breath and, while exhaling, bend the trunk, with his/her upper limbs projected forward, elbows extended, and overlapping hands (to prevent trunk rotation) toward the tip of the toes, up to the limit of its joint amplitude;
- maintain the position of maximum reach for at least two seconds, and should not flex the evaluated limb at no time.

2) Agility/Dynamic Balance (Timed to Up and Go)⁹

Objective – As shown in Fig. 2, the agility or dynamic body balance test has its origin in the analysis of the capacity of performing basic motor tasks related to the functionality of the elderly. In RA patients, as well as in the elderly,¹⁶ there is an association between physical performance with the risk of falls and fractures.¹⁷

Material – One stopwatch, 1 chair with standard seat height (44 cm), 1 cone.

Unit of measure – Second(s).

Level of complexity of test run – Low.

Safety level – Moderate. Attention to the floor, which should be flat, with enough adherence to prevent any slipping; and to markings of free space for mobilization of the subject. In this specific case, the chair used in the evaluation must be placed against the wall, to prevent its slipping.

Need to train the evaluator? – Little need.

The execution of three attempts at each limb is suggested; the highest value achieved is recorded.

Test description – The subject starts the test sitting on the chair, and is oriented to:

- At the “Attention, now!” command, rise from his/her chair, turn around the cone at a distance of 3 m away as fast as possible and walk back to sit on the chair. The evaluator should start the stopwatch when the subject's hip leave the chair, stopping the timer when the hip touches the chair again.
- The subject must be warned that he/she should not run; instead should walk with the greatest possible speed. Moreover, the evaluator should warn the subject to avoid contact with the cone, and that at the moment of sitting on the chair (the end of the test), he/she must be careful with the impacts of the hip on the chair and of the head in the wall where the chair is against to.



Fig. 2 – Timed to up and go.

3) Manual Dynamometry (Hand Grip Strength)¹⁸

Objective – The results of manual dynamometry tests are used as a parameter for assessing overall muscle strength. In RA patients, as well as in elderly subjects, the decrease in overall muscle force is associated with decreased functionality of the hands¹⁹ and with the negative effects of chronic inflammation.¹⁸

Material – A handgrip dynamometer.

Unit of measure – Kilogram (kg).

Level of complexity of test run – Moderate.

Safety level – High.

Need to train the evaluator? – Moderate need.

Test description – The subject begins the test in the orthostatic (standing) position.

- The subject must hold the dynamometer in line with the forearm, paralleled to the longitudinal axis of the body. The proximal interphalangeal joint of the test hand must be set under the bar, which is squeezed between the fingers and the thenar region. During handgrip in the orthostatic position, the arm remains motionless, with only flexion of phalangeal and metacarpophalangeal joints.
- Position the hand so that the thumb is around one side of the handle and the other four fingers around the other side.
- An 1-minute interval should be adopted between measurements.
- At the “Attention, now!” command, the subject has to push as hard as possible, or until the dynamometer hand stop climbing.

e) The evaluator should read and record the values obtained. Evaluate the contralateral limb. Repeat this procedure for a total of 6 times (3 on each member).

f) The best of the six measurements will be used for the analysis.

g) Register the dominant hand (left-handed, right-handed, ambidextrous).

4) Sitting and Rising (30s Chair Stand)^{9,10,20}

Objective – The sitting and rising from a chair test was developed to evaluate muscle strength conditioning, as shown in Fig. 3.

Material – One stopwatch and 1 chair with standard seat height (44 cm).

Unit of measure – Number of repetitions (reps). In this particular case, a repetition is defined as the sum of a concentric muscle action and a complete eccentric muscle action.

Level of complexity of test run – Low.

Safety level – High. Attention to the chair that will be used in the test, which must be against the wall to prevent any slipping.

Need to train the evaluator? – Little need.

A previous trial, with about five practice trials, should be given to the subject.

Test description – The subject starts the test sitting on the chair, with his/her trunk straight (without support on the back of the chair), feet flat on the floor and arms folded in the trunk. From this point, the subject is instructed to:



Fig. 3 – Sit and stand up.

- a) To the "Attention, now!" command, run the largest possible number of squats on the chair for 30 seconds;
- b) The evaluator should start counting time on the stopwatch after the "Attention, now!" command, for a timed session of 30 seconds. The number of perfect repetitions of squats on the chair should be counted loud and clear. A perfect repetition is considered when the subject stands, fully extends his/her knees with the torso upright (starting position) and sits with only minimal need of contact of the hips on the chair (final position). That is, there is no need to sit completely and comfortably on the chair. Strong impact on hips when the subject sits on the chair must be avoided.

In this case, only one trial attempt is performed, and the number of perfect and complete repetitions performed is recorded.

5) Biceps curl (30s Arm Curl)^{9,10}

Objective – The unilateral biceps curl test was developed to evaluate the conditioning of upper limbs' muscular strength.

Material – One stopwatch, 1 dumbbell (2 and 4 kg for women and men, respectively) and 1 chair with standard seat height (44 cm).

Unit of measure – Number of repetitions (reps). In this case, a repetition is defined as the sum of a concentric muscle action and a complete eccentric muscle action.

Level of complexity of test run – Low.

Safety level – High. Attention to the chair used in the test, which must be against the wall to prevent any slipping.

Need to train the evaluator? – Little need.

A previous trial, with about five practice reps, should be given to the subject.

Test description – The subject starts the test sitting on the chair, with the torso upright (without support on the back of the chair, nor with the contralateral hand on the edge of the chair), feet flat on the floor. From this point, the subject is instructed to:

- a) To the "Attention, now!" command, perform as many elbow flexions as possible, on the chair, during 30 seconds;
- b) The evaluator should start counting time on the stopwatch after the command "Attention, now!" for a timed session of 30 seconds. The number of perfect repetitions of elbow flexion should be counted loud and clear. A perfect repetition is considered when the subject fully flexes his/her elbow (wrist toward the shoulder) and fully extends the elbow, keeping the torso upright (final position). The contralateral limb stays resting on the thigh to avoid gripping at the chair. In this particular case, only one trial attempt is performed, and the number of perfect and complete repetitions performed is recorded.

6) Six-minute walk test (6MWT)²¹

Objective – The aim of 6MWT is to evaluate the functional and cardiovascular capacity of the subject.²²

Material – One stopwatch, 2 cones, 1 chair, 1 telephone and 1 automatic external defibrillator (AED).²¹

Unit of measure – Meter (m).

Level of complexity of test run – Moderate.

Safety level – Moderate. Attention to the floor, which should be flat, with enough adherence to prevent slipping; and to the markings of free space for mobilization of the subject.

Need to train the evaluator? – Moderate need.

We recommend that a short execution trial (no more than 1 minute) should be given, to get familiar with the walking pace of the subject.

Absolute contraindications:

- a) Unstable angina;
- b) Acute myocardial infarction.
- c) Relative contraindications:
- d) Heart rate at rest > 120 beats per minute (bpm);
- e) Systolic blood pressure > 180 mmHg;
- f) Diastolic blood pressure > 100 mmHg;
- g) O₂ saturation ≤ 90%

Safety Aspects

- a) The test shall be conducted in a suitable location for quick emergency care;
- b) The professional responsible for the application of the test must have cardiopulmonary resuscitation training;
- c) Reasons to stop the test immediately include: chest pain, intolerable dyspnea, leg numbness, or paleness. Health professionals should be trained to recognize these problems.

Test description – The subject begins the test in the orthostatic position (standing):

- a) The course can vary from 20 to 50 metres, depending on the size of the room;
- b) Mark a line across the area demarcated for the course at the start of the test;
- c) If repeats of the test are needed for comparison or evaluation of the evolution of the results, subsequent tests should be performed at the same time chosen for the 1st day of testing;
- d) The subject should sit on a chair placed near the beginning of the test during at least 10 minutes, for measurement of blood pressure, heart rate and O₂ saturation;
- e) At the end of the test, the subject will be asked to walk slowly crosswise to the direction of the test, so that the evaluator can measure the distance travelled. The evaluator must also present a scale of perceived exertion and ask about the intensity of the test;
- f) The evaluator should explain to the subject that the purpose of the test is to walk as far as possible in six minutes, and demonstrate how to perform the test;
- g) The evaluator should ask if the evaluated subject is ready, reminding him/her that the goal is to walk as far as possible for 6 minutes, but without running or jogging;
- h) At every elapsed minute, remind the subject his/her time;
- i) At the command "Attention, now!", the subject start the test;
- j) With 15 seconds remaining to the end of the test, the subject should be advised to be ready for its ending.

Table 1 – Normative table for the performance of functional tests of flexibility, dynamic balance/agility, lower limbs endurance and cardiovascular capacity in the elderly.

Functional Test	Gender	Age groups (years)						
		60-64	65-69	70-74	75-79	80-84	85-89	90-94
Sit and Reach (cm)	M	-6 to +10	-7.6 to +7.6	-8.8 to +6.3	-10.1 to +5	-13.9 to +3.8	-13.9 to +1.2	-16.5 to -1.2
	W	-1.2 to +12.7	-1.2 to +11.4	-2.5 to +10.1	-3.8 to +8.8	-5 to +7.6	-6.3 to +6.3	-11.4 to -2.5
Dynamic Balance (s)	M	5.6 to 3.8	5.7 to 4.3	6.0 to 4.2	7.2 to 4.6	7.6 to 5.2	8.9 to 5.3	10.0 to 6.2
	W	6.0 to 4.4	6.4 to 4.8	7.1 to 4.9	7.4 to 5.2	8.7 to 5.7	9.6 to 6.2	11.5 to 7.3
Sit and Stand Up (reps)	M	14 to 19	12 to 18	12 to 17	11 to 17	10 to 15	8 to 14	7 to 12
	W	12 to 17	11 to 16	10 to 15	10 to 15	9 to 14	8 to 13	4 to 11
6-Minute Walk (m)	M	555 to 668	509 to 637	495 to 618	427 to 582	404 to 550	345 to 518	277 to 455
	W	495 to 600	455 to 577	436 to 559	391 to 532	350 to 491	309 to 464	250 to 400

cm, centimeters; s, seconds; reps, repetitions; m, minutes; M, men; W, women.

Norms for evaluating the results of functional tests in clinical practice

As previously mentioned, there are no regulations for evaluating the results of functional tests described in patients with RA. These tests have been validated for the elderly population,²³ but we can infer its application in patients with rheumatic diseases that also exhibit a decrease in functional ability over time. Tables 1 and 2 list the expected normal values for healthy individuals older than 50 years.

It is therefore suggested that, when applying the functional tests described in patients with RA, and until there is a set of adequate rules for this population of patients, the assessment or judgment of the measures obtained with the tests may be compared with the normal standards of those tests (for the elderly population), or the evaluation may be compared against the individual himself (comparisons of the evolution of results in serial repetitions, over time, for the same subject).

As for the six-minute walk test, in addition to the values shown in Table 1, another possibility for individualization of results is the Enright and Sherrill formula,²⁴ because it offers an estimated value of the cardiovascular capacity by age for this test.

Men:

$$DF = (7.57 \text{ cm} \times \text{height[cm]}) - (5.02 \times \text{age[years]}) \\ - (1.76 \times \text{body mass[kg]}) - 309 \text{ meters}$$

Subtract 153 to get the lower limit of normality

Women

$$DF = (2.11 \text{ cm} \times \text{height[cm]}) - (2.29 \times \text{age[years]}) \\ - (5.78 \times \text{body mass[kg]}) - 667 \text{ meters}$$

Subtract 139 to get the lower limit of normality

DF = Distance foreseen in the 6 – minute walk test

How to use the results of functional tests in clinical practice

From the definitions related to the use of functional assessments, to the values obtained in the tests, and to the judgement of these values, we can establish the process of decision making with respect to physical exercise practice, intentionally prescribed to treat and control the signs and symptoms resulting from AR.

As previously reported, it is possible, for instance, to compare data obtained in functional tests with normative tables available (in the elderly population) and, from this point, checking for any physical capacity in worse condition than another. This information shall assist in the recommendation of the type of physical activity. Moreover, in a practical way, it is not possible to monitor the physical performance of patients in all aspects of physical fitness throughout the treatment, and if some of them come to suffer significant performance degradation, this can be circumvented intentionally with chosen and modulated types of exercises.

Table 2 – Normative table for performance of functional tests of muscular strength and endurance of the upper limbs and static balance in elderly.

Age Groups (years)	50-59			60-69			70-79		
	p25	p50	p75	p25	p50	p75	p25	p50	p75
Manual Dynamometry (kg)									
Right	24	27	30	23	26	29	21	24	27
Left	23	26	29	22	25	28	20	23	26
Biceps curl (reps)	18	22	26	18	22	25	17	20	24
Static Balance (s)	19.6	30	30	14.4	25.5	30	6.5	14.7	26.4

After the choice of modality or physical fitness, parameters such as intensity and volume of exercise should be controlled.² The exercise intensity is related to the level of effort performed for a particular activity and to the exercise volume more temporally related to the amount of exercise performed.² This is important, because the principle of progressive overload says that any physical training proposition requires evolution both of volume and of intensity to escape the plateau effect, very common in people who perform physical activity regularly, but without controlling the dose of exercise.²⁵

The Consensus from the Brazilian Society of Rheumatology for the Treatment of Rheumatoid Arthritis (2012) suggests that the patients perform physical exercises regularly.^{26,27} Most dynamic exercise programs follow the recommendations of the American College of Sports Medicine (ACSM). The ACSM recommends a duration of 20 minutes or more for practising exercise, that it is held at least twice a week, and able to promote an increase of 60% of predicted heart rate for age to be considered as being capable to present positive clinical effects, not being detrimental to the disease, i.e. without worsening RA activity and causing pain. Dynamic exercise, when compared to a conventional joint rehabilitation program, promotes significant improvement in the quality of life of patients with RA.^{28,29}

Currently, the scientific literature is scarce when it comes to determine what kind of dose-response exercise is effective and safe for RA people. Methodological aspects related to dose-response (intensity, duration of sessions, type of exercise, and weekly volume), lack of control of adherence in training, equipment not specified, description of pharmacological treatment (dose and duration of use), level of disease activity, time of diagnosis and level of functional ability in the baseline condition (i.e., initiation of the study), are cited as limitations to the generalization of the findings in the prescription of patients with RA.⁶

Perspectives and concluding remarks

In terms of strategies for prevention, control and non-pharmacological treatment of various chronic and degenerative diseases, in recent years the notorious recognition of the physical exercise has been highlighted, especially in rheumatic diseases, including RA. However, there is lack of exercise protocols or of a discussion of the type of physical activity that should be prescribed.

Recently, researchers involved in the healthcare area have reflected on the importance of conducting long lasting, randomized, controlled clinical trials that assess the impact of overall improvement of fitness in the functional capacity and on the overall health status of physically active patients. Therefore, it is believed that the scientific production involved with physical exercise and AR will be increasingly common, considering the importance of understanding the science of exercise as a therapeutic tool by the rheumatologist.

Finally, there is an urgent need of further research, mainly with regard to the specific physical regulations for the RA patient. The correct assessment of functional capacity can generate subsidies for a precise prescription of the physical

training protocol, with definition of the physical capabilities to be developed and the parameters of volume control and of exercise intensity. Thus, based on the assessment of functional capacity, the physical activity recommendations can be made safer, individualized, precise and intentional, trying to achieve its main goal in patients with RA, i.e. the development of endurance and physical capacity, aimed at improving the quality of life.

Conflict of interests

The authors declare no conflict of interests.

REFERENCES

1. Pinto ALGB, Lima FR, Roschel H. Exercício físico nas doenças reumáticas – efeitos terapêuticos. Sarvier. 2011.
2. Gualano B, Pinto AL, Perondi MB, Roschel H, Sallum AM, Hayashi AP, et al. Therapeutic effects of exercise training in patients with pediatric rheumatic diseases. *Rev Bras Reumatol.* 2011;51:490–6.
3. Cardoso FS, Curtolo M, Natour J, Júnior IL. Avaliação da qualidade de vida, força muscular e capacidade funcional em mulheres com fibromialgia. *Rev Bras Reumatol.* 2011;51:338–50.
4. Silva LE, Valim V, Pessanha AP, Oliveira LM, Myamoto S, Jones A, et al. Hydrotherapy versus conventional land-based exercise for the management of patients with osteoarthritis of the knee: a randomized clinical trial. *Phys Ther.* 2008;88:12–21.
5. Teixeira Vde O, Filippin LI, Xavier RM. Mechanisms of muscle wasting in sarcopenia. *Rev Bras Reumatol.* 2012;52:252–9.
6. Baillet A, Vaillant M, Guinot M, Juvin R, Gaudin P. Efficacy of resistance exercises in rheumatoid arthritis: meta-analysis of randomized controlled trials. *Rheumatology (Oxford).* 2012;51:519–27.
7. Jorge RT, Souza MC, Jones A, Júnior IL, Jennings F, Natour J. Treinamento resistido progressivo nas doenças musculoesqueléticas crônicas. *Rev Bras Reumatol.* 2009;49:726–34.
8. da Mota LM, Cruz BA, Brenol CV, Pereira IA, Fronza LS, Bertolo MB, et al. 2011 Consensus of the Brazilian Society of Rheumatology for diagnosis and early assessment of rheumatoid arthritis. *Rev Bras Reumatol.* 2011;51:199–219.
9. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *J Aging Phys Activ.* 1999;7:129–61.
10. Matsudo S. Avaliação do Idoso – Física e Funcional. 2010; 3 ed.
11. Jones CJ, Rikli RE, Max J, Noffal G. The reliability and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. *Res Q Exercise Sport.* 1998;69:338–43.
12. da Mota LM, Santos Neto LL, Pereira IA, Burlingame R, Menard HA, Laurindo IM. Autoantibodies in early rheumatoid arthritis: Brasilia cohort: results of a three-year serial analysis. *Rev Bras Reumatol.* 2011;51:564–71.
13. da Mota LM, dos Santos Neto LL, Burlingame R, Menard HA, Laurindo IM. Laboratory characteristics of a cohort of patients with early rheumatoid arthritis. *Rev Bras Reumatol.* 2010;50:375–88.
14. da Mota LM, Laurindo IM, dos Santos Neto LL. Prospective evaluation of the quality of life in a cohort of patients with early rheumatoid arthritis. *Rev Bras Reumatol.* 2010;50:249–61.

15. da Mota LM, Laurindo IM, dos Santos Neto LL. Demographic and clinical characteristics of a cohort of patients with early rheumatoid arthritis. *Rev Bras Reumatol.* 2010;50:235-48.
16. Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Phys Ther.* 2000;80:896-903.
17. Bohler C, Radner H, Ernst M, Binder A, Stamm T, Alehata D, et al. Rheumatoid arthritis and falls: the influence of disease activity. *Rheumatology (Oxford).* 2012;9.
18. Beenakker KG, Ling CH, Meskers CG, de Craen AJ, Stijnen T, Westendorp RG, et al. Patterns of muscle strength loss with age in the general population and patients with a chronic inflammatory state. *Ageing Res Rev.* 2010;9:431-6.
19. Cima SR, Barone A, Porto JM, de Abreu DC. Strengthening exercises to improve hand strength and functionality in rheumatoid arthritis with hand deformities: a randomized, controlled trial. *Rheumatol Int.* 2012;8.
20. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exercise Sport.* 1999;70:113-9.
21. Kraemer WJ, Koziris LP, Ratamess NA, Hakkinen K, Triplett-McBride NT, Fry AC, et al. Detraining produces minimal changes in physical performance and hormonal variables in recreationally strength-trained men. *J Strength Cond Res.* 2002;16:373-82.
22. Enright PL. The six-minute walk test. *Respir Care.* 2003;48:783-5.
23. Rikli RE. Reliability, validity, and methodological issues in assessing physical activity in older adults. *Res Q Exerc Sport.* 2000;71:S89-96.
24. Enright PL, Sherrill DL. Reference equations for the six-minute walk in healthy adults. *Am J Respir Crit Care Med.* 1998;158:1384-7.
25. DeLorme TLW. Techniques of progressive resistance exercise. *Arquives of Physical Medicine.* 1948;29:263-73.
26. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc.* 2011;43:1334-59.
27. da Mota LM, Cruz BA, Brenol CV, Pereira IA, Rezende-Fronza LS, Bertolo MB, et al. Brazilian Society of Rheumatology Consensus for the treatment of rheumatoid arthritis. *Rev Bras Reumatol.* 2012;52:152-74.
28. Baillet A, Payraud E, Niderprim VA, Nissen MJ, Allenet B, François P, et al. A dynamic exercise programme to improve patients' disability in rheumatoid arthritis: a prospective randomized controlled trial. *Rheumatology (Oxford).* 2009;48:410-5.
29. Munneke M, de Jong Z, Zwinderman AH, Runday HK, van Schaardenburg D, Dijkmans BA, et al. Effect of a high-intensity weight-bearing exercise program on radiologic damage progression of the large joints in subgroups of patients with rheumatoid arthritis. *Arthritis Rheum.* 2005;15(53):410-7.