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Teste de sentar-levantar: relação com a mortalidade por todas as causas e com a flexibilidade

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2015

Leonardo Barbosa Barreto de Brito

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Dissertação apresentada, como requisito parcial para obtenção do título de mestre ao Programa de Pós-Graduação em Ciências do Exercício e do Esporte, da Universidade do Estado do Rio de Janeiro. Área de Concentração: Aspectos Biopsicossociais de Exercício Físico.

Orientador: Prof. Dr. Claudio Gil Soares de Araújo

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DEDICATÓRIA

Dedico à minha avó Mariana que tanto me incentivou quando entrei no mestrado, mas que infelizmente não pôde me ver concluí-lo.

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RESUMO

BRITO, Leonardo Barbosa Barreto de. *Teste de sentar e levantar:* relação com a mortalidade por todas as causas e com a flexibilidade. 2015. 68 f. Dissertação (Mestrado em Aspectos Biopsicossociais de Exercício Físico) - Instituto de Educação Física e Desportos, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, 2015.

Sabe-se que um estilo de vida sedentário e uma condição aeróbica baixa são associados com uma maior chance de desenvolvimento de doenças cardiovasculares e um maior risco de mortalidade por todas as causas. Contudo, é possível que outros indicadores de aptidão física possam ter significado clínico prognóstico. Originalmente proposto em 1999, o teste de sentar-levantar (TSL) é, simples de executar e possui comprovada reprodutibilidade inter e intra-avaliador. O avaliado inicia o teste com o escore máximo de 5 pontos para cada uma das ações de sentar e levantar, sendo subtraído do mesmo, um ponto para cada apoio extra utilizado (mão, braço e joelho) e meio ponto para cada desequilíbrio corporal perceptível. A pontuação do TSL escore, variando de 0 a 10, é realizada pela soma das ações de sentar e levantar. Considerando o potencial papel da flexibilidade para uma execução mais eficiente de gestos motores, não é surpreendente que o desempenho sobre TSL possa ser influenciado por essa valência. O objetivo desta dissertação foi analisar a relação entre o resultado do TSL e a mortalidade por todas as causas e a flexibilidade. No primeiro estudo, 2002 indivíduos entre 51 e 80 anos (68% homens), realizaram o TSL e os resultados foram estratificados em quatro faixas: 0/3; 3,5/5,5, 6/7,5 and 8/10. Baixos resultados no TSL escore foram associados com um maior risco de mortalidade ($p<0,001$). Uma tendência contínua de maior sobrevivência se refletiu no ajuste multivariado – idade, sexo, índice de massa corporal – em um razão de risco de 5,44 [95%IC=3,1–9,5], 3,44 [95%IC=2,0–5,9] e 1,84 [95%IC=1,1–3,0] ($p<0,001$) dos menores para as maiores faixas de resultados do TSL. Cada aumento de um ponto no escore do TSL significou uma melhora de 21% na sobrevivência. Já o segundo estudo, contou com 3927 indivíduos (67,4% homens) que realizaram o TSL e o Flexiteste. O Flexiteste avalia a amplitude máxima passiva de 20 movimentos corporais. Para cada um dos movimentos, existem cinco escores possíveis, 0 a 4 em uma ordem de mobilidade crescente. A soma dos resultados dos 20 movimentos fornece uma pontuação de flexibilidade global denominada de Flexíndice (FLX). Os resultados do FLX foram estratificados em quartis (6–26, 27–35, 36–44 and 45–77). Os valores do TSL em cada quartil diferiram entre si ($p<0,001$). Além disso, o escore do TSL e o FLX foram diretamente associados ($r=0,296$; $p<0,001$). Os indivíduos com um TSL escore zero são menos flexíveis para todos os 20 movimentos do Flexiteste do que aqueles com escore 10. Portanto, os dados da presente dissertação, indicam que: o resultado do TSL se mostrou um importante preditor de mortalidade por todas as causas para indivíduos entre 51-80 anos de idade e que indivíduos mais flexíveis tendem a ter maiores escores no TSL.

Palavras-chave: Qualidade de vida. Condicionamento músculo esquelético. Avaliação funcional. Sobrevivência. Flexibilidade.

ABSTRACT

BRITO, Leonardo Barbosa Barreto de. Sitting Rising Test and its relationship with mortality from all causes and flexibility. 2015. 68 f. Dissertação (Mestrado em Aspectos Biopsicossociais de Exercício Físico) - Instituto de Educação Física e Desportos, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, 2015.

It is known that a sedentary lifestyle and low aerobic fitness are associated with a greater chance of developing cardiovascular disease and increased risk of mortality from all causes. However, it is possible that other indicators of physical fitness may have clinical significance prognosis. Originally proposed in 1999, the sitting-rising test (SRT) is simple to perform and has proven its reliability. The individual begins the test with the maximum score of 5 points for each of the actions of sitting and rising, and being deducted a point for each extra support used (hand, arm and knee) and half a point for each body imbalance noticeable. The SRT score, ranging from 0 to 10, is performed by the sum of the actions of sitting and rising. Considering the potential role of flexibility for a more efficient execution of motor gestures, it is not surprising that the performance of SRT can be influenced by this valence. The aim of this thesis was to analyze association of SRT score and mortality for all-causes and lexibility. In the first study, 2002 individuals between 51 and 80 years (68% men) underwent the SRT and were stratified into four groups: 0/3, 3.5/5.5, 6/7.5 and 8/10. SRT results in low scores were associated with an increased risk of mortality ($p < 0.001$). A continuous trend for longer survival was reflected by multivariate adjusted – age, sex, body mass index - hazard ratios of 5.44 [95%CI=3.1–9.5], 3.44 [95%CI=2.0–5.9] and 1.84 [95%CI=1.1–3.0] ($p<.001$) from lower to higher SRT scores. Each unit increase in SRT score conferred a 21% improvement in survival. The second study included 3927 individuals (67.4% men) who performed the SRT and Flexitest. Flexitest evaluates the maximum passive range of motion of 20 body joint movements. For each one of the movements, there are five possible scores, 0 to 4 in a crescent mobility order. Adding the results of the 20 movements provides an overall flexibility score called Flexindex (FLX). The results of SRT scores were stratified into quartiles (6-26, 27-35, 36-44 and 45-77) and its FLX results differed between ($p<0.001$). SRT and FLX scores were moderately and positively associated ($r = 0.296$; $p < 0.001$). Besides, subjects with a zero SRT score are less flexible for all 20 Flexitest movements than those scoring 10.Therefore, the data of this thesis, showed that the SRT proved an important predictor of mortality from all causes for individuals between 51-80 years of age and that more flexible individuals tend to have higher scores on the SRT.

Keywords: Health-related quality of life. Musculoskeletal fitness. Functional assessment. Survival. Flexibility.

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INTRODUÇÃO

É sabido que a sensação de bem estar pessoal relaciona-se com a qualidade de vida orientada para a saúde e com a autonomia[1-3]. Há consenso atualmente de que uma boa aptidão física depende não somente de níveis adequados de potência máxima aeróbica, mas também dos padrões apropriados de potência muscular, de flexibilidade, de composição corporal e de estabilidade postural[4, 5]. Historicamente, tem sido dada considerável atenção à influência deletéria de um estilo de vida sedentário e de uma baixa condição física no desenvolvimento das doenças crônico-degenerativas, tais como a doença arterial coronariana, a hipertensão arterial sistêmica, a obesidade e alguns tipos de câncer[6-8]. Entretanto, a literatura é mais escassa no que se refere à análise desses efeitos sobre movimentos e as atividades da vida cotidiana, em indivíduos saudáveis e não saudáveis[9, 10].

Sentar e levantar do solo são atividades relativamente comuns e, particularmente para os idosos, podem representar ações importantes para a independência funcional. O desempenho nessas ações, apresenta uma relação estreita com o risco de queda[10] e, também, com a dificuldade de se levantar do solo, na eventualidade desse evento, mesmo considerando que não tenha ocorrido lesões importantes[11]. Níveis mínimos ou adequados de potência muscular, coordenação motora, composição corporal, equilíbrio[12] e flexibilidade[13] parecem ser necessários para diversas atividades cotidianas e, mais especificamente, para a realização com êxito dessas ações.

Em 1999, objetivando avaliar o desempenho nas referidas ações, Araújo[14] propôs um método simples, denominado de Teste de Sentar-Levantar (TSL), para

quantificar objetivamente a destreza de sentar e levantar do solo. Basicamente sua avaliação consiste em quantificar, separadamente, o número de apoios utilizados e a presença ou a ausência de desequilíbrio para as ações de sentar e levantar do solo.

Outros testes medem a destreza de sentar e de se levantar como o “Get-up and Go”[15] e suas variações[16, 17]. Esses testes implicam que os sujeitos levantem de uma cadeira, andem de 3 a 10 metros, retornem e sentem-se. O TSL, ao contrário desses testes, não necessita de um espaço amplo e livre de obstáculos. Além disso, os resultados dos testes que utilizam uma cadeira para se levantar, sofrem a interferência da altura do assento ou se possuem ou não apoio de braços[18], tornando difícil tanto a padronização do teste quanto a interpretação dos resultados.

O TSL possui uma elevada fidedignidade investigada em recente estudo[19]. A fidedignidade interavaliadores foi abordada através de dois avaliadores, graduando simultaneamente os desempenhos no teste. Para a fidedignidade intravaliador, três avaliadores assistiram a uma fita de vídeo, contendo 100 execuções para cada uma das ações e após 10 meses, um dos avaliadores assistiu à fita novamente. Na determinação da fidedignidade interdias, 10 indivíduos, aparentemente saudáveis, foram avaliados em quatro dias distintos e próximos. Por fim, a fidedignidade intradia, em um dia aleatório para cada indivíduo, 10 avaliações consecutivas foram conduzidas. Nenhuma das abordagens revelou diferenças significativas entre avaliadores ou avaliações, para ambas as ações. Além disso, o TSL é um instrumento citado e aplicado em pesquisas nas áreas de Medicina do Exercício e do Esporte e de Educação Física[4, 14, 19-31].

O American College of Sports Medicine recomenda que para se manter saudável e melhorar o condicionamento físico, toda programação deva conter exercícios que foquem a melhora da força e potência musculares, flexibilidade,

composição corporal e exercícios cardiorrespiratórios[32]. Entende-se que o TSL pode ser considerado um importante instrumento de rastreamento, visto que preenche as características essenciais para tal, pois busca a identificação precoce dos indivíduos que podem ter alguma anormalidade e/ou enfermidade. Desse modo, aqueles que conseguem alcançar os níveis mínimos de corte preconizados são, com grande probabilidade, indivíduos normais ou saudáveis em relação às variáveis medidas, composição corporal[22, 23, 28, 31], força e potência musculares[22], flexibilidade[22] e equilíbrio.

Indivíduos com excesso de peso corporal quando analisados pelo Índice de Massa Corporal (IMC) e pelo Recíproco do Índice Ponderal apresentaram menores escores no TSL, tanto em crianças[28] quanto em adultos[22, 31]. Em elegante estudo, em que os indivíduos vestiam coletes com sobrecargas, os resultados foram semelhantes[23]. Apesar da associação da composição corporal com o TSL já ter sido amplamente estudada, a mesma associação tanto da força e potência muscular quanto da flexibilidade ainda necessita de maiores investigações. Em estudo prévio[22], a força e potência muscular, quando avaliadas pela distância do salto horizontal, assim como, a flexibilidade de membros inferiores e tronco se mostraram relacionadas com o desempenho nas ações de sentar e levantar do solo.

Enquanto numerosos estudos demonstraram claramente que uma menor aptidão cardiorrespiratória, avaliada pelo teste de esforço máximo, significativamente prediz um risco maior de mortalidade por todas as causas em adultos de meia-idade e idosos[33-36], existe um amplo consenso de que outras medidas são necessárias para fornecer um retrato mais abrangente da capacidade funcional. Embora existam poucos dados sobre a relação entre os diferentes indicadores de aptidão músculo-esquelética e mortalidade por todas as causas, a limitada evidência disponível

sugere associações relevantes e positiva entre os níveis mais elevados destes indicadores e sobrevida[37-40]. Além disso, é de extrema relevância clínica desenvolver indicadores prognósticos simples, confiáveis e válidos[41].

Face ao exposto, a presente dissertação é constituída por dois estudos originais, utilizando dados retrospectivos de nosso serviço, a saber: (a) a associação do TSL e a mortalidade por todas as causas e (b) da influência da flexibilidade sobre o desempenho das ações de sentar e levantar do solo.

OBJETIVOS GERAIS

Os objetivos gerais desta dissertação foram apresentar e discutir aspectos relacionados ao poder prognóstico do teste de sentar-levantar, assim como o quanto a flexibilidade pode contribuir nas ações de sentar e levantar do solo.

OBJETIVOS ESPECÍFICOS

1. Avaliar a associação da habilidade de sentar e levantar do solo e a mortalidade por todas as causas;
2. Determinar o papel da flexibilidade no desempenho das ações de sentar e levantar do solo em indivíduos entre 6 e 92 anos de idade.

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1 ESTUDO 1: HABILIDADE DE SENTAR E LEVANTAR DO SOLO COMO PREDITOR DA MORTALIDADE POR TODAS AS CAUSAS

Title: Ability to sit and rise from the floor as a predictor of all-cause mortality

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3852 words

Running title: sitting-rising test scoring and all-cause mortality

Abstract

Background: While cardiorespiratory fitness is strongly related to survival, there are limited data regarding musculoskeletal fitness indicators. Our aim was to evaluate the association between the ability to sit and rise from the floor and all-cause mortality.

Design: Retrospective cohort.

Methods: 2002 adults aged 51-80 years (68% men)performed a sitting-rising test (SRT) to and from the floor, which was scored from 0 to 5, with one point being subtracted from 5 for each support used (hand/knee). Final SRT score, varying from 0 to 10, was obtained by adding sitting and rising scores and stratified in four categories for analysis – 0/3; 3.5/5.5, 6/7.5 and 8/10.

Results: Median follow-up was 6.3 years and there were 159 deaths (7.9%). Lower SRT scores were associated with higher mortality (p<.001). A continuous trend for longer survival was reflected by multivariate adjusted – age, sex, body mass index - hazard ratios of 5.44 [95%CI=3.1–9.5], 3.44 [95%CI=2.0–5.9] and 1.84 [95%CI=1.1–3.0] (p<.001) from lower to higher SRT scores. Each unit increase in SRT score conferred a 21% improvement in survival.

Conclusions: Musculoskeletal fitness, as assessed by SRT, was a significant predictor of mortality in 51-80 year-old subjects. Application of a simple and safe assessment tool such as SRT, that is influenced by muscular strength and flexibility, in general health examinations could add relevant information regarding functional capabilities and outcomes in non-hospitalized adults.

Word count: 226

Keywords: health-related quality of life; musculoskeletal fitness; functional assessment; survival

Introduction

Following a trend for a longer life expectancy in different populations around the world, there has been growing interest in strategies to preserve health-related quality of life and individual autonomy. Middle-aged subjects and those entering seniority represent a growing proportion of the world population [1], and these individuals are known to develop progressively diminished levels of physical fitness and have an increased risk of unfavorable health outcomes [2]. Thus, it is of utmost clinical relevance to develop simple, reliable and valid prognostic indicators [3].

While studies have clearly demonstrated that a lower cardiorespiratory fitness, as evaluated by exercise testing, significantly predicts a higher risk for all-cause mortality in middle-aged and elderly adults[4-6], there is broad recognition that other measurements are needed to provide a more comprehensive depiction of functional capacity. Specifically, body composition, muscle strength and power, flexibility, and postural stability are also relevant for proper health and functioning [7, 8]. Although there are scarce data regarding the relationship between different indicators of musculoskeletal fitness and all-cause mortality, the limited evidence available has suggested relevant and positive associations between higher levels of these indicators and survival [9-13].

Sitting and rising from the floor is an example of a basic functional task required for an autonomous lifestyle. The inability to perform these and similar actions are closely related to the risk of falling, and if a fall has occurred, the capacity to return to an upright position is critical [14]. Minimal levels of muscle power, coordination, body composition, balance [15] and flexibility [16] are required for various daily activities and, more specifically, for a successful transition from standing to a

sitting position as well as rising from the floor [17]. In the late 90's, Araujo [18] proposed a simple method to assess the ability to sit and rise from the floor, termed the sitting-rising test (SRT), which objectively quantifies the number of supports (i.e., hand or knee) needed and the presence or absence of balance stability for these actions. Given the ability of the SRT to reflect an essential aspect of an individual's functional capabilities, we evaluated whether SRT performance predicts all-cause mortality in subjects aged 51 to 80 years.

Methods

Participants

This retrospective single-center cohort study comprised all evaluations carried out in our Exercise Medicine Clinic from 1997 to 2011 in a total of. 2076 subjects aged between 51-80 years old at the time of evaluation. After excluding subjects that met any of the following criteria: a) those regularly competing in sports events; b) presenting with any relevant musculoskeletal limitations or restrictions that could affect SRT; and c) refusal in performing the SRT; a final sample comprising 2002 individuals (1356 men; 67.7%) who were followed from the date of the baseline examination until the date of death or October 31, 2011. Mortality surveillance data were obtained from the official registries of Rio de Janeiro State. All subjects volunteered for the evaluation and signed an informed consent. The evaluation protocol and data analysis were formally approved by an institutional Ethics Committee and the study was conducted according to the Declaration of Helsinki principles.

Sitting-Rising Test (SRT)

The SRT assesses components of musculoskeletal fitness through evaluation of the subject's ability to sit and rise from the floor, assigning a partial score for each of the two required physical actions [18]. SRT was administered on a flat surface that was not slippery, in minimal space of 2x2 m, with the participant standing barefoot and wearing clothing that did not restrict his/her movements. Before the SRT, the evaluator instructed the participant in a very straightforward and structured manner: "Without worrying about the speed of movement, try to sit and then to rise from the floor, using the minimum support that you believe is needed".

SRT partial scores began with a maximum of 5 points, separately for sitting and rising. One point was subtracted for each support utilized, that is, hand, forearm, knee or side of leg, and an additional 0.5 point was subtracted if the evaluator perceived an unsteady execution (partial loss of balance) occurring during the action. In addition, one point was subtracted if the subject placed one hand on the knee to help him/her to sit or rise. Crossing the legs for either sitting or rising from the floor was allowed, while the sides of the subject's feet were not used for support. If a 5 score was not obtained, the evaluator provided some advice that might assist the participant to improve their SRT performance scoring in other trials. In this context, a total of 11 possible separate scores (0 ; 0.5; 1; 1.5; 2; …; 4.5; 5) for sitting and rising from the floor were generated, from at zero to five points, including all intermediate half-point values. A video illustrating SRT performance and scoring is available at http://www.youtube.com/watch?v=MCQ2WA2T2oA.

Independent of the number of attempts performed, the resulting SRT partial scores were considered as the best score for each one of the actions and represented by two numerals (e.g., 4/2), respectively, for the actions of sitting and rising from the floor. In addition, a composite score, hereafter termed the SRT score, was obtained by adding sitting and rising partial scores in which values varied from zero to 10 for a total of 21 (0; 0.5; 1; 1.5; …; 20; 20.5; 21) possible scores. Previous studies have shown that SRT scoring is highly reliable [19] and has been applied in a variety of research contexts[20-23]. Age (5 to 95 years old) and sex-specific norms for SRT scoring – both partial and total scores - are available from our center

Statistical analysis

Results for all subjects were separated and ranked by four categories according to SRT score as follows: C1: 0 - 3, C2: 3.5 - 5.5, C3: 6 - 7.5 and C4: 8 - 10. In order to establish the cutoffs to be used in SRT, we have applied log rank test and ROC curves, however, we felt that minor adjustments in these cutoff values would be more logical and practical in clinical terms. Initially, Kaplan-Meier survival curves were constructed for the four categories and log-rank tests were used to analyze survival time. The relationship between SRT score and all-cause mortality was modeled by Cox univariate and multivariate analyses using adjustments for age, sex and body mass index. Cox regression and proportional hazards analyses were performed (Hazard Ratio = HR), using the highest category score (8 – 10) as the reference. One-way analysis of variance was used for comparing continuous variables, such as age, height, weight and body mass index (BMI) between subjects in the four categories. Statistical significance level was set at 5% and and 95% confidence intervals were used for all results. Calculations were carried out and figures prepared by using either Prism (version 5.01, Graphpad, United States) or SPSS (version 17, SPSS, United States) software.

RESULTS

The descriptive analyses for entire cohort and the four categories ranked according to SRT score ranges - are provided in Table 1. Median follow-up time was 6.3 years (0.1 to 13.9). The median age of 62 years was identical for male and female participants with an overall death rate during follow-up of 7.9%.

Table 1: Major characteristics of the subjects according to SRT scoring (N = 2002) and Cox proportional HR analyses for SRT scoring and all-cause mortality

		SRT Score			
Variables	All	0 - 3	3.5 – 5.5	6 – 7.5	8 – 10
N	2002	311	244	473	974
Age* (years)	63±8.1 (52 - 77)	71±7.0 (56 - 80)	67±7.8 (53 - 79)	63±7.4 (52 - 76)	59±6.3 (51 - 71)
Weight* (kg)	78.4±15.8 (55.0 - 106.0)	81.5±19.9 (53.8 - 121.0)	83.1±17.7 (57.5 - 119.0)	80.2±15.6 (57.3 - 106.0)	75.2±13.1 (54.0 - 97.1)
Height* (cm)	168±9.2 (152 - 182)	164±9.9 (149 - 181)	168±9.4 (152 - 182)	168±9.4 (152 - 183)	170±8.5 (155 -183)
BMI* (kg/m2)	27.5±4.5 (21.3 - 35.7)	30.0±5.9 (22.2 - 41.5)	29.3±4.9 (22.4 - 37.9)	28.2±4.1 (22.0 - 35.4)	25.9±3.3 (20.9 - 31.5)
Hazard Ratios					
Model a**	-	6.56 (4.32 - 9.97)	3.84 (2.37 - 6.20)	1.88 (1.16 - 3.04)	REF
Model b**	-	5.44 (3.11 - 9.53)	3.44 (2.00 - 5.93)	1.84 (1.11 - 3.04)	REF
Follow up	6.3 (0.1 - 13.9)	4.7 (0.04 – 13.1)	5.4 (0.04 – 13.2)	6.4 (0.09 – 13.2)	6.1 (0.09 – 13.5)
Events	159 (7.9%)	60 (19.2%)	32 (13.1%)	32 (6.7%)	35 (3.6%)

* $p<0.001$ for comparisons among the four ranges of SRT score ;** $p<0.05$ $p<0.05$ for comparisons among the hazard ratios; Mean±SD(p5 -p95), except for follow up, that is Median (Range); BMI – body mass index; Model a: unadjusted; Model b: adjusted by age, sex and bodymass index; Events: number of deaths

Distribution of SRT scores in the four categories and according to age at 5-year intervals is displayed in Figure 1. While the vast majority of the deaths were found in those participants with a low SRT scores, just one male, aged 64 years, and one female, aged 54 years, died having an SRT score of 10 during follow-up. On the other hand, no participant older than 70 years scored 10 on the SRT.

Log-rank tests derived from Kaplan-Meier curves (Figure 2) indicate that survival in the four SRT categories differed significantly (chi-square = 107.43; $p < 0.001$). By Kaplan-Meier analyses, there was a 3-year shorter life expectancy among C1 subjects compared to subjects in C4 (Figure 3). Proportional hazards analysis identified that SRT score was a significant predictor of all-cause mortality, with subjects in the lower score range exhibiting a five to six times higher risk as compared to those in the reference (C4). Multivariate analysis adjusting for age, sex and BMI confirmed these findings with similar HR values as those in the unadjusted model shown in Table 2. By proportional hazards analysis, each increment in the SRT score was associated with a 21% reduction in all-cause mortality.

Figure 1: Distribution of SRT scores according to age ranges

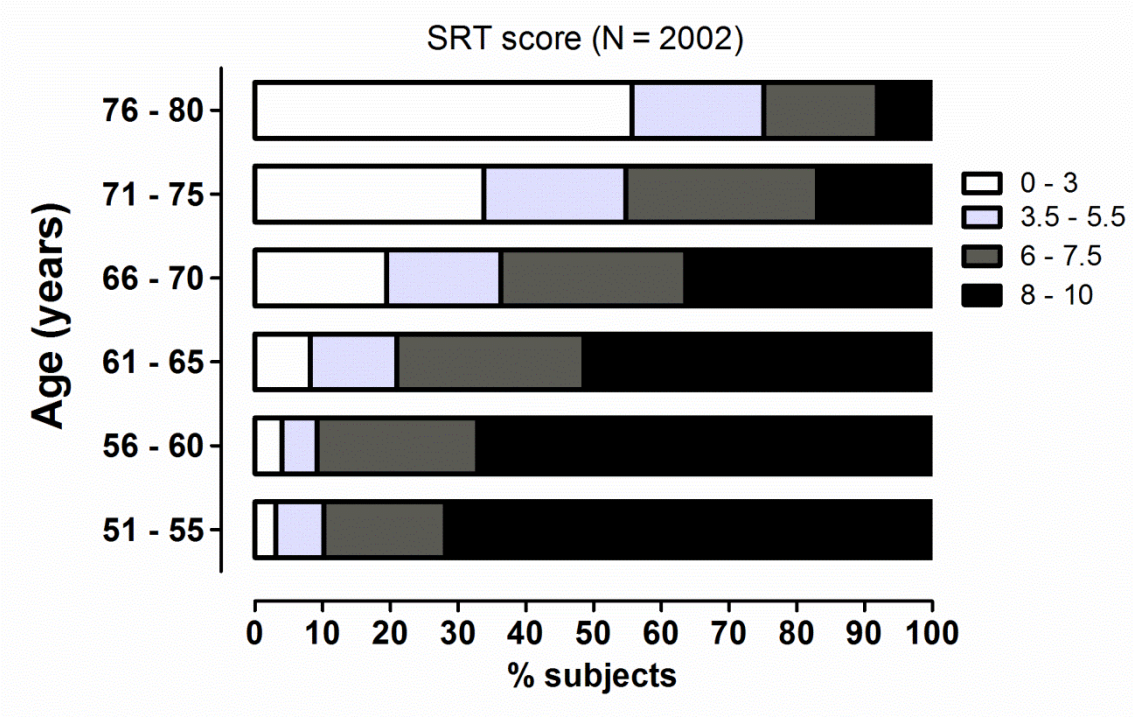


Figure 2: Kaplan-Maier survival analysis for four ranges of SRT scoring in subjects aged 51-80 years

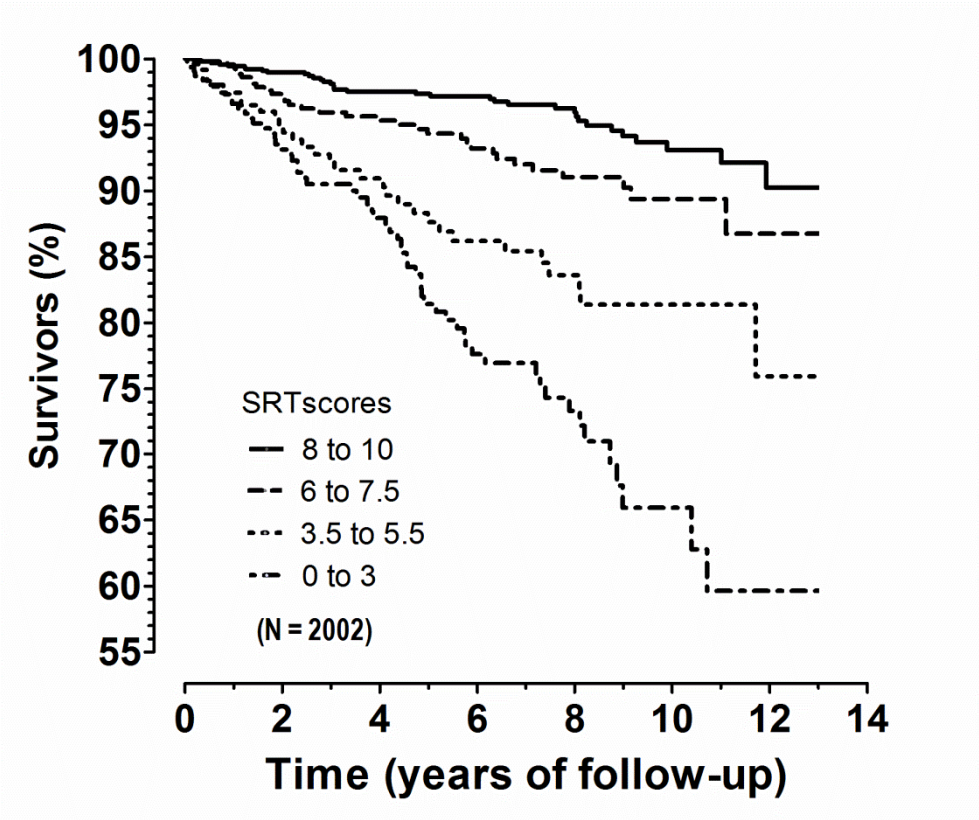
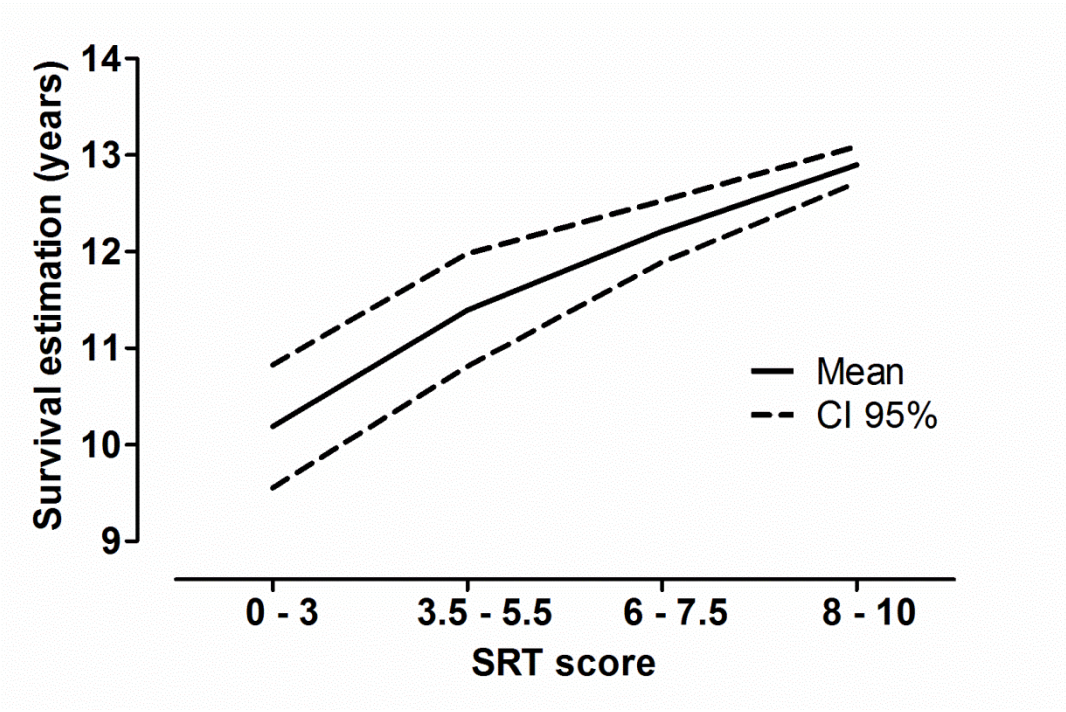


Figure 3: Survival estimation (years) for subjects aged 51 to 80 years based on SRT scores



DISCUSSION

Health-related physical fitness testing has been extensively investigated for much of the last century [24]. For example, approximately 70 years ago, Cureton [25] asserted that flexibility was one of the integral components of physical fitness and stated that "old age is marked by stiffness in the joints and accompanying physical awkwardness". In contrast to other health-related physical fitness or function tests that assess the ability to rise, such as the "Get-up and Go" [26] and its variations [27], the SRT can be applied with no equipment and minimal space. Moreover, commonly-used chair to stand methods tend to be influenced by the height of the chair or by the degree to which armrest support is available [28], which interfere with the standardization of the tests and the interpretation of the results.

In a recent study, the Gait Speed Test was shown to discriminate mortality in elderly community-dwelling subjects (minimal age 65; mean age 73.5 and 5% of the sample older than 85 years of age) [11], however, for subjects aged between 51 and 65 years, this test has very poor discriminatory power. In contrast, our results indicate that SRT scoring is quite useful for discriminating musculoskeletal fitness in a different age range (51 to 80 years). Moreover, in contrast to the gait speed test, SRT requires neither timing nor a corridor to walk, thus minimizing some constraints that could limit its clinical use. By offering 21 possible scores covering a wide spectrum of musculoskeletal fitness profiles, SRT scoring allows sufficient discrimination of performance capabilities, as shown in Figure 1. Thus, as compared to other approaches to functional testing, the SRT does not require specific equipment, is safe, easy to apply in a short time period (<2 minutes) and reliably scored. In our clinical practice, the SRT has been shown to be useful and practical for application to a large spectrum of populations, ranging from pediatric to geriatric [20, 21, 23].

We considered participants who achieved minimum partial scores of 4 in sitting and rising from the floor (SRT scores of ≥ 8) to have preserved functional independence regardless of age. The ability to achieve a high SRT score could reflect the capacity to successfully perform a wide range of activities of daily living, such as bending over to pick up a newspaper or a pair of glasses lying under the bed or table. Moreover, a high SRT score likely indicates a reduced risk of falls [29]. It is also noteworthy that during the application of SRT in our center over a 14-year period, there have been no adverse events, reflecting a high level of safety associated with this simple assessment tool.

Since our study groups somewhat differed both in age and BMI, we have use an adjusted analysis in order to minimize interference of these variables on the interpretation of the SRT score with mortality. Thus in our cohort, we found that the inability to sit and rise from the floor was related to lower survival, irrespective of age, sex and BMI. To our knowledge, this is the first study to demonstrate the prognostic value of the SRT. SRT scores < 8 (that is, requiring more than one hand or knee support to sit and rise from the floor in a stable way) were associated with two to five -fold higher death rates over six years in men and women 51-80 years. SRT scores in the range of 8 to 10 indicated a particularly low risk of death during the tracking period (Figure 2). Even more relevant is the fact that a one-point increment in the SRT score was related to a 21% reduction in mortality. The SRT can be considered a simple screening procedure in which a low score largely reflects the degree of impairment in the components of musculoskeletal fitness – mainly those indicating a reduction in muscle strength and/or joint flexibility.

Despite being regularly recommended as part of an exercise program, there are very few investigations linking flexibility to overall health [16]. One study [30] evaluating overall flexibility (sum of scores obtained from 20 body movements) of 4,711 participants from 5 to 91 years of age confirmed Cureton's classic principle related to the reduction in overall mobility levels with aging [25]. Interestingly, using a more limited flexibility assessment tool, the sit-and-reach test, poor trunk flexibility has been suggested to be a predictor of arterial stiffness [31]. It is reasonable to believe that loss of mobility would adversely influence the ability to sit and to rise from the floor, and therefore results in a lower SRT score; while this is intuitive, this hypothesis requires confirmation.

Regarding muscular fitness, it is clear that muscle wasting and sarcopenia are physiologic attributes closely related to the aging process [32, 33], and likely contribute to the muscle strength decrement in older adults [34]. The primary musculoskeletal changes that occur with aging include decreases in muscle mass, reductions in the number and size of type II fibers, as well as a reduced number of motor units [32]. These changes may lead to impairment in muscle strength determined by maximum voluntary contraction [35], which has been associated with an increased fall risk in the elderly[8]. The loss of strength with aging appears to begin at about 35 years of age.[36]. As previously stated, lack of strength and/or muscle power has also been associated with poor survival [10, 37]. Thus, while not directly assessing muscle power, the SRT may reflect this metric without the need for a cumbersome test that would not be suitable for some older subjects. Evidence demonstrates that the indices of functional status in the elderly are strongly related to lower limb muscle power and strength [38], suggesting the potential use of the SRT as a functional assessment tool in elderly subjects.

There are some limitations to our study. It is possible that some results were negatively influenced by subclinical degenerative changes or recent injuries that were either not reported or identified in the medical history or physical exam prior to the SRT. We were unable to control for physical activity patterns, but it no doubt varied considerably. While it is highly likely that activity level influenced SRT scores, it is unclear whether this influenced the external validity of our data. Our sample was primarily derived from Caucasian subjects, typically from a high socioeconomic status. Thus, it is possible that the results could be different in other populations with more diverse cultural, morphological, physical activity patterns, or other characteristics. We were unable to quantify other health outcomes, such as estimates

of quality of life or ability to carry out daily activities. In addition, we could not determine specific causes of mortality. Since it is well-established that properly designed exercise programs improve musculoskeletal [39] and cardiorespiratory [40] fitness, future studies are needed in order to identify the effect of exercise interventions on SRT scores. Studies are also needed to characterize the association between changes in SRT performance and health-related quality of life and other relevant health outcomes.

In conclusion, a low score on a simple functional assessment tool, the SRT, was associated with a above six fold higher all-cause mortality in men and women. The SRT therefore may be a useful tool for screening, functionally classifying, and risk stratifying large samples of subjects.

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2 ESTUDO 2: A FLEXIBILIDADE PODE INFLUENCIAR A CAPACIDADE DE SENTAR E LEVANTAR DO SOLO?

Does Flexibility Influence the Ability to Sit and Rise from the Floor?

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Disclosures:

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Does Flexibility Influence the Ability to Sit and Rise from the Floor?

ABSTRACT

Objective: The purpose of this study was to establish whether flexibility influences the ability to sit and rise from the floor.

Design: Subjects aged 6 - 92 years [(N = 3927 (2645 men)] performed in the same lab's visit the Sitting-Rising Test (SRT) and the Flexitest. SRT evaluates components of musculoskeletal function by assessing the subject's ability to sit and rise from the floor, which was scored from 0 to 5, with one point being subtracted from 5 for each support used (hand/knee). A final subject's SRT score, varying from 0 to 10, was obtained by adding – sitting and rising – scores. Flexitest evaluates the maximum passive range of motion of 20 body joint movements. For each one of the movements, there are five possible scores, 0 to 4 in a crescent mobility order. Adding the results of the 20 movements provides an overall flexibility score called Flexindex (FLX).

Results: SRT score differed when FLX results were stratified into quartiles: 6 – 26, 27 – 35, 36 – 44 and 45 – 77 ($p<.001$). SRT and FLX scores were moderately and positively associated ($r = .296$; $p < .001$). Besides, subjects with a zero SRT score are less flexible for all 20 Flexitest movements than those scoring 10.

Conclusions: Although a seemingly simple task, the actions of sitting and rising from the floor is also partially dependent of flexibility in male and female subjects of a large age span. Future studies should explore the potential benefit of regular flexibility exercises for these actions.

Key Words: Sitting-rising Test, Flexitest, Fitness, Flexibility, Fitness Testing, Functional Assessment

INRODUCTION

Flexibility is one of the components of physical fitness[1], being considered relevant to the execution of simple or complex movements, to sports performance[2] and to health and quality of life maintenance[3]. Flexibility is, therefore, one of the variables of health-related quality of life and physical performance and has been operationally defined as the maximum physiological passive range of motion of a given joint movement[4]. Exercises aimed on improving flexibility are usually included in any prescription of exercise for both athletes and sedentary individuals, for people with various diseases, and particularly for those older than 65 years of age[5], with some evidence supporting that it may result in improved health-related quality of life[6].

The actions of sitting and rising from the floor are in the motor repertoire of children and adults and most likely require a combination of physiological and psychological processes[7]. Recently, to evaluate the skill to perform these actions, Araujo[8] has proposed a simple procedure, called Sitting-Rising test (SRT). The application of the test is very fast, usually requiring about a minute, and the grading of the actions is extremely simple, since each user support results in reduction of one point from the maximum score, and having perceived imbalance, over half point is subtracted. All the features mentioned, make the SRT suitable for a screening test, especially for situations in which there is a need for prioritizing the identification of low or insufficient results in a large number of individuals in a short period.

The potential role of flexibility is considered for a more efficient execution of motor gestures, it is not surprising that performance on the SRT can be influenced by the pattern of flexibility. Thus, the purpose of this study is to investigate the role of

flexibility in the performance of the actions of sitting and rising from the floor in a large ages pan.

METHODS

Participants

We retrospectively analyzed the evaluations in Exercise Medicine conducted in our Clinic in a 15-year period (1997 and 2012). To better characterize the study sample, we purposely excluded individuals who: a) known to have relevant limitations or restrictions on the locomotor system, able to interfere with SRT or Flexitest (described below) measurements, b) were in an advanced state of pregnancy and c) were unable or denied to performed the SRT and Flexitest testing protocols for proper scoring. After all the exclusion criteria were met, the final sample consisted of 3927 subjects (2645 men; 67.4%). All subjects volunteered for the evaluation, performed at their own request, and signed an informed consent form authorizing the testing and use of the data for research purposes. For minors, a consent form was signed by legal guardian. Both evaluation protocol and data analysis were formally approved by an institutional Ethics Committee and the study was conducted according to the Declaration of Helsinki principles.

Sitting-Rising Test (SRT)

The SRT assesses components of musculoskeletal fitness through evaluation of the subject's ability to sit and rise from the floor, assigning partial scores for each of the two required actions[8]. The SRT was administered on a flat surface that was not slippery, with the subject standing barefoot and wearing clothing that did not restrict his/her movements. As an additional safety procedure, a mat was placed behind the

participant. The evaluator was situated in front or at side of the subject, providing a clear vision, allowing him/her to score the test results. Before the SRT, the evaluator instructed the subject in a very simple and structured manner: "Without worrying about the speed of movement, try to sit and then to rise from the floor, using the minimum support that you believe is needed".

SRT partial scores began with a maximum of 5 points, separately for sitting and rising. One point was subtracted for each support utilized, that is, hand, forearm, knee or lateral side of leg or if the subject placed one hand on the knee to help him or her to sit or to rise. Additionally, 0.5 point was subtracted if the evaluator perceived an unsteady execution (partial loss of balance) occurring during the action. In this sense, a total of 11 possible scores were generated, from at zero to five points, including all intermediate half-point values. Crossing the legs for either sitting or rising from the floor was allowed, while the sides of the subject's feet were not used for support. If a 5 score was not obtained, the evaluator provided some advice that might assist the participant to improve their SRT performance scoring in other trials. A video illustrating SRT performance and scoring is available at http://www.youtube.com/watch?v=MCQ2WA2T2oA.

Independent of the number of attempts performed, typically two, the resulting SRT partial scores were considered the best score for each one of the actions and represented by two numerals separated by a slash (e.g., 4/2, respectively), for the actions of sitting and rising from the floor. In addition, a composite score, hereafter simply named as the SRT score, was obtained by adding sitting and rising partial scores, in which values ranged from zero to 10 (Table 1). Previous studies have shown that SRT scoring is highly reliable[9] and has been applied for answering

different research questions[10-13]. Age (5 to 95 years old) and sex-specific norms for SRT scoring – both partial and total scores - could be requested directly from our Clinic (copa@clinimex.com.br). All SRT testing was performed by specialized physicians and/or other specifically trained health professionals.

Table 1: Graduation of SRT

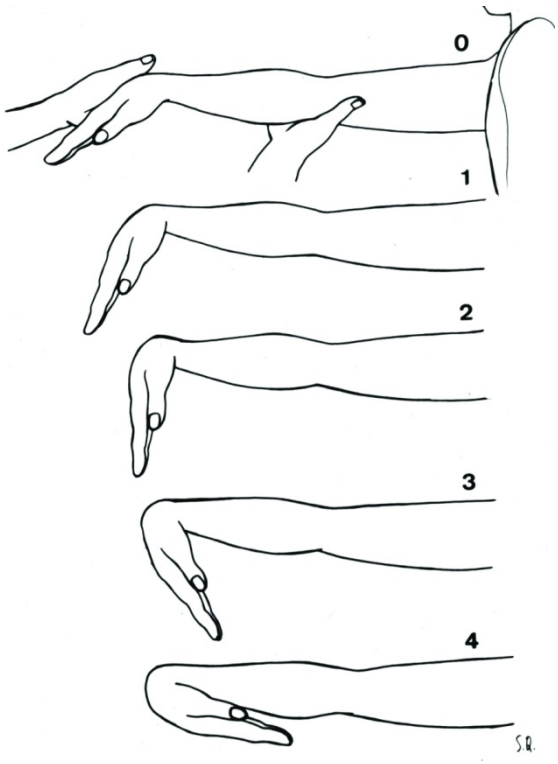
Sitting	Rising
5 – no support	5 – no support
4 – with one support	4 – with one support
3 – with two supports	3 – with two supports
2 - with three supports	2 - with three supports
1 - with four supports	1 - with four supports
0 – with more than four supports or external auxiliary	0 – with more than four supports or external auxiliary
If there is a imbalance, subtract 0.5, point:	If there is a imbalance, subtract 0.5, point:
4.5; 3.5; 2.5; 1.5; 0.5.	4.5; 3.5; 2.5; 1.5; 0.5.
SRT score: sum of individual sitting and rising results	

Flexitest

Passive range of motion in 20 body movements was assessed by Flexitest protocol. This assessment protocol is described in detail elsewhere[4, 14, 15], including age and sex-specific percentiles curves[16]. Briefly, values obtained from the Flexitest are dimensionless, as results are presented as points, with no linear or angular unit featured. It consists of the measurement and assessment of the maximum passive range of motion of 20 joint movements of the body, encompassing ankle (two), knee

(two), hip (four), “trunk” (for simplicity, considered a single joint) (three), wrist (two), elbow (two), and shoulder (five) joints. Eight assessed movements are in the lower limbs, three are related to the trunk, and the remaining nine are in the upper limbs. For each of the movements, there are five scores to rate flexibility measurements, graded from 0 to 4 in a crescent mobility order. The measurement is taken passively, through a slow and gradual performance of the movement to a point of maximal range. Once the maximum tolerable amplitude is reached, it is compared with the evaluation maps (see example in Figure 1). A numerical grade is ascribed whenever the amplitude reached equals that in the standard evaluation map. For instance, when the amplitude reaches position 2 of the map, grade 2 is given until the maximum range of motion reaches the level of score 3. There is no fractional or intermediate grade neither does the scoring take into account the closest grade of the scale. Therefore, only upon actually reaching the specified level for a score is that score given; otherwise, even if the movement is close to the following score, it is rated according to the lower score. When bilateral option exists, right side of body was used for the measurements. In some instances, especially for older subjects or those that were more unfit, there was a partial adaptation in the original Flexitest protocol, avoiding the “lying down in the floor” position, which was replaced with movements either at the orthostatic position or lying down in an examining bed. It is relevant to consider that, for the sake of standardization, no previous warm up is allowed. The time taken to apply the test varies according to the evaluator’s experience and the condition of the subject being assessed, but it typically lasts two to five minutes, which is made feasible by using a modified sequence of movements that minimizes body posture changes.

Figure 1: Example of an evaluation map of Flexitest (wrist flexion)



According to the scale of measurement and the way that each one of the 20 evaluation maps were designed, data following a Gaussian distribution centering on score 2, with scores 1 and 3 less common and the extreme scores, 0 and 4, quite rare. So it is valid to add together the results of each of the 20 movements to obtain an overall flexibility or joint mobility index, called the Flexindex (FLX), which is a major advantage over other methods such as goniometry, where this is not possible. For the FLX, the subject's overall flexibility can be easily compared with his/her centile curves for age and sex owing to the Gaussian nature of the scales for each movement and the global scale. It is also possible to study the entire mobility range, as the maximum extreme values (0 and 80 points) were never actually obtained. Therefore, there are not the so-called ceiling and floor effects often seen with other joint mobility tests, as, for example, the Beighton-Horan joint laxity test[17].

In theory, the same FLX result may be originated from different combinations of scores for each movement. For instance, an FLX of 40 may occur if all movements are rated 2, or if 10 movements are rated 1 and the other 10 are rated 3. Although the FLX is the same in both instances, the passive joint mobility profiles are quite different. Therefore, the assessment of overall flexibility should consider not only the FLX score but also the profile of range of motion of individual movements. Several studies on intra and interobserver reliability conducted with pictures of models or with real measurements in individuals have shown systematically high intraclass correlation coefficients for Flexitest measurements and, in particular, for Flexindex[18].

Statistical Analysis

The results of FLX were stratified into quartiles for all sample`s data. The SRT score for each quartile was compared using an one-way Kruskal-Wallis followed by a Dunn`s multiple comparison test to locate possible differences between these quartiles. Pearson correlation was also calculated to assess the association between FLX and SRT scores. Statistical analysis of the 20 individual Flexitest movements for SRT zero and 10 were performed by t-test. Statistical significance level was set at 5% and confidence intervals of 95% were used for all results. Calculations were carried out and figures prepared by using either Prism (version 5.01, Graphpad, San Diego) or SPSS (version 17, SPSS, Chicago) statistical softwares.

RESULTS

Data regarding subject's characteristics – for the entire cohort and according to the FLX quartiles - are provided in Table 2. Quartiles were generated based on the FLX's results, namely: 6 – 26 (first), 27 – 35 (second), 36 – 44 (third) and 45 – 77 (fourth) and the median of each quartile with percentile 25th and 75th of respective

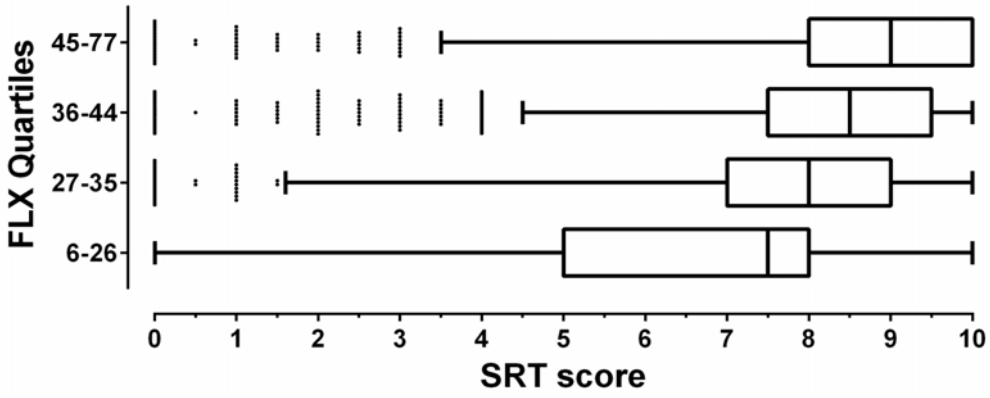
SRT score was 7.5 (5 – 8), 8.0 (7 – 9), 8.5 (7.5 – 9.5) and 9.0 (8 – 10) (Figure 2). All FLX quartiles differed from each other (p<.001). Subjects of the 4th quartile, which presented higher SRT scores, were also younger, taller and lighter than those in the other quartiles (p < .05).

Table 2: Major characteristics of the 3,927 subjects: all sample and by quartiles

		FLX			
Variables	All	**6 to 26**	**27 to 35**	**36 to 44**	**45 to 77**
N	3927	923	983	992	1029
Age (years)	51±17.3	57.8±15.9*	53.3±15.9*	49.8±15.6*	43.9±18.4*
Weight (kg)	76.6±17.7	82.3±18.1*	78.1±16.2**	76.46±15.8$_{\top}$	70.3±18.6
Height (cm)	169.3±10.5	170.8±9.2	170.0±9.9	169.8±9.6	166.7±12.4*

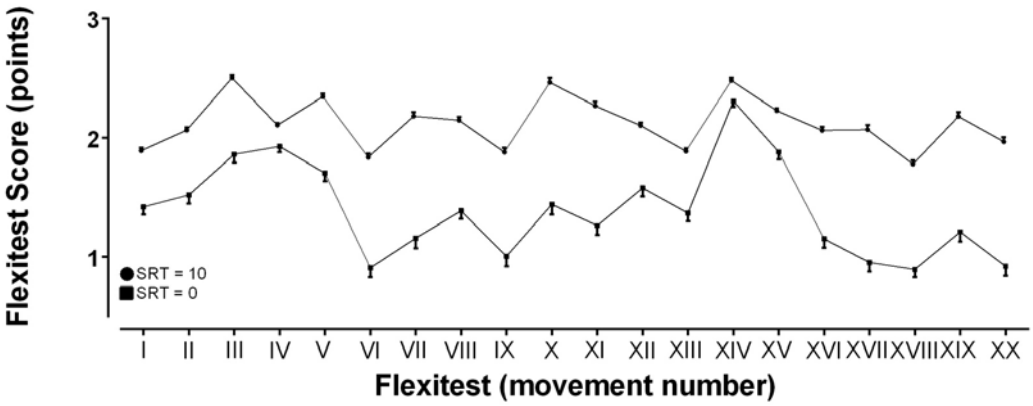
Average ± Standard deviation; * p<0.05;** p < 0.05, between quartiles 27 to 35 and 45 to 77; $_{\top}$ p < 0.05, between quartiles 36 to 44 and 45 to 77.

Figure 2: Whiskers representing the 5th and 95th percentiles. Box line reflects the median and box limits the 25th and 75th percentiles. All quartiles were different between each other (p<0.05).



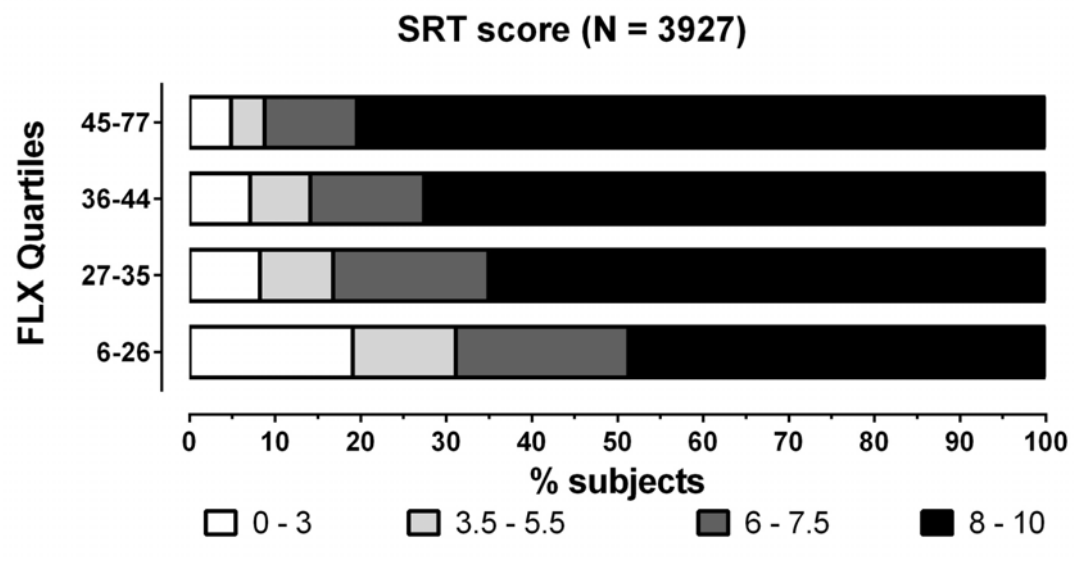
Pearson correlation identified a significant association between FLX and SRT scores (r = .296; p < .001). As for individual movements assessed with the Flexitest, subjects with SRT score 10 presented higher values in all 20 movements compared with SRT score 0 (p<.05) (Figure 3).

Figure 3: Flexitest's individual movement scores for SRT score 10 and 0. For all 20 movements the differences were significantly (p < 0.05).



Distribution of SRT scoring in the four quartiles is displayed in Figure 4. It can be noted that there is a trend for the higher quartiles, to present a larger percentage of cases with SRT scores in the range from 8 to 10. The first quartile has 75 cases of SRT score 0 (8.1%) in comparison with only 15 cases of the fourth quartile (1.5%). In the same line of thinking, there was 92 (10%) and 352 (34.2%) SRT score 10 cases in first and fourth quartiles. In other words, the first quartile presented five times more cases of SRT score 0 and only a quarter of the SRT score 10 in comparison with the fourth quartile.

Figure 4: Distribution of SRT scores according to FLX quartiles



DISCUSSION

At the best of our knowledge, this is the first study to specifically examine the role of flexibility in a basic functional task as sitting and rising from the floor in a large sample of male and female subjects covering a wide age range. Minimum or adequate levels of muscle power, coordination, body composition, balance[19] and flexibility[20] seem to be required for various daily activities and, more specifically, for a successful transition from standing to a sitting position as well as rising from the floor[21]. The ability to rise from sitting position is a prerequisite for a walk and, therefore, independent function[22]. Inability to carry out this essential activity can lead to institutionalization, dependence and even be associated with mortality in the elderly[23].

In the aging process, range of motion in the joints has been shown, by different methods to be reduced[16, 24], as other physical fitness variables, such strength and power [25]. This may limit active lifestyles and even hinder day-to-day, normal movements[26]. Tasks that used to be simple, such as dressing or reaching for

a can off the top shelf, can become extremely difficult and can even increase the risk of falling, which has been pointed out a major concern related to older population[27].

One of the methods to study flexibility, proposed three decades ago, is the Flexitest[4] that has been used in different settings and research studies[14, 28]. Our data clearly establish an association between an overall flexibility index and the ability to perform the actions of sitting and rising from the floor. The significant correlation between FLX e SRT scores, although relatively modest, clearly indicated that flexibility is relevant for the actions of sitting and rising from the floor. In agreement with this association, median SRT score increases when the FLX quartiles are arranged in a growing order, changing from 7.5 to 9 at extremes quartiles. Moreover, in the fourth quartile, only 1.5% of subjects achieved an SRT score 0, and belonging to this quartile means having a probability of approximately 80% of owning an SRT score of 8 to 10. As long as, belonging to the first quartile of FLX decreases the probability of obtaining an SRT score of 8 to 10 to 50%.

The actions of sitting and rising from the floor involve various muscle groups and joints interacting in a specific and complex sequence, as scoring for all movements of Flexitest were higher for the subjects with SRT score 10 as compared to those scoring 0. Interestingly, these results were also observed for the upper limb joints. Although a seemingly simple task, the actions of sitting and rising from the floor require the coordinated interaction of linked body segments that include trunk and hips flexion to bring forward the centre of mass, followed by bilateral extension of the lower limb joints and trunk extension to raise the body mass in a vertical direction over the feet[29].

It is possible that if there was a hypomobility ankle, it can be compensated by a greater flexibility of the knee and /or hip, to sit or rise from the floor. When ankle joint flexibility is compromised, there is a tendency for the heels to rise off the floor at higher degrees of flexion. A good dorsiflexion angle has been shown to be necessary to keep the heels down during both actions[30].

Another interesting result is that subjects from the fourth quartile were lighter than those from the other quartiles. The deleterious effect of excessive body weight in the actions of sitting and rising from the floor have been previously demonstrated in a study in which weight increments by wearing vests with loads were used and shown to hamper these actions[12]. The force of gravity, acting in opposition to the movements required to rise from the floor, determines that such action suffer greater influence of changes in weight.

In conclusion, possessing high values of flexibility can provide the ability to sit and rise from the floor properly Future research should determine if increasing flexibility results by training would induce a concomitant gain in SRT scoring.

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3 DISCUSSÃO GERAL

Testes de aptidão física relacionados à saúde têm sido amplamente investigados no século passado[1]. Por exemplo, aproximadamente 70 anos atrás, Cureton[2] afirmou que a flexibilidade era um dos elementos integrantes da aptidão física e afirmou que "o envelhecimento é marcado pela rigidez nas articulações e dificuldades físicas". Ao contrário de outros testes físicos relacionados com a saúde, como o "Get-up and Go"[3], e variações[4], o TSL é aplicado sem equipamento algum, em um mínimo espaço, seguro e de fácil aplicabilidade. Além disso, testes que utilizam uma cadeira tendem a ser influenciados pela altura do assento ou pela disponibilidade ou não de apoio braço[5], que interferem para uma normatização dos testes e interpretação dos resultados.

Em estudo recente, o "Gait Speed Test" mostrou discriminar a mortalidade em idosos residentes de casas de repouso (idade mínima 65 anos, média de idade 73,5 anos, com 5% da amostra com idade superior a 85 anos de idade)[6], entretanto, para indivíduos entre 51 e 65 anos de idade, este teste possui um baixo poder discriminatório. Em contraste, nossos resultados indicaram que a pontuação do TSL é bastante útil para discriminar a aptidão musculoesquelética em uma faixa etária muito mais ampla (51 a 80 anos). Além disso, ao contrário do Gait Speed Test, o TSL não exige marcação de tempo nem um corredor para andar, minimizando assim algumas restrições que podem limitar a sua utilização clínica. Ao oferecer 21 pontos possíveis que abrangem um amplo espectro de perfis de aptidão músculo-esqueléticas, a pontuação do TSL permite discriminação suficiente do desempenho. Assim, em comparação com outras abordagens de testes funcionais, o TSL não

exige equipamento específico, é seguro e fácil de aplicar em um curto período de tempo (normalmente em 2 minutos). Além disso, os participantes foram capazes de compreender facilmente o sistema de pontuação e o significado dos resultados. Na prática clínica, o TSL se mostrou útil e prático para aplicação a um largo espectro de populações, que vão desde crianças à idosos[7-9].

Na presente dissertação, foi observado que a incapacidade de sentar e levantar do chão foi relacionada à menor sobrevida, independentemente da idade, sexo e IMC. Para nosso conhecimento, este é o primeiro estudo a demonstrar o valor prognóstico do TSL. Pontuações do TSL <8 (ou seja, exigindo mais do que uma mão ou joelho de apoio para se sentar e levantar do chão de uma forma estável) foram associados à duas a cinco vezes maiores taxas de mortalidade ao longo de seis anos em homens e mulheres 51-80 anos. Ainda mais relevante é o fato de que um incremento de um ponto na pontuação do TSL foi relacionado com uma redução de 21% na mortalidade. O TSL pode ser considerado um procedimento de triagem simples, em que uma pontuação baixa em grande parte reflete o grau de comprometimento nos componentes da aptidão músculo-esquelético - principalmente aqueles que indicam uma redução na força muscular e / ou a flexibilidade das articulações.

Quanto à aptidão muscular, é evidente que a perda muscular e sarcopenia são atributos fisiológicos estreitamente relacionados com o processo de envelhecimento[1, 10-12], e, provavelmente, contribuem para o decréscimo da força muscular em adultos mais velhos[13] . As principais alterações músculo-esqueléticas que ocorrem com o envelhecimento além da diminuição da massa muscular, incluem, a redução do número e tamanho das fibras do tipo II, bem como um número

reduzido de unidades motoras[10]. Estas alterações podem conduzir a uma deficiência na força muscular determinada pela contração voluntária máxima[14], que tem sido associada com um risco aumentado queda nos idosos[15]. A perda de força com o envelhecimento parece começar em torno dos 35 anos de idade[16]. Como foi referido anteriormente, a falta de força e / ou potência muscular também tem sido associada com uma menor sobrevida[17, 18]. Assim, embora não avalie diretamente potência muscular, o TSL pode refletir esta métrica sem a necessidade de um teste mais intenso que poderia não ser adequado para alguns indivíduos mais idosos. As evidências demonstram que os indicadores do estado funcional em idosos estão fortemente relacionados com a menor potência de membros e força muscular[19], sugerindo o uso potencial do TSL como um instrumento de avaliação funcional em idosos.

Apesar de ser regularmente recomendado como parte de um programa de exercícios, há pouquíssimas investigações que ligam a flexibilidade com saúde[20]. Um estudo[21], avaliando a flexibilidade global, (soma dos escores obtidos a partir de 20 movimentos do corpo) de 4,711 participantes de 5 a 91 anos de idade confirmou o princípio clássico de Cureton, relacionados com a redução dos níveis globais de mobilidade com a idade[2]. Curiosamente, usando uma ferramenta de avaliação mais limitada de flexibilidade, o teste de sentar-e-alcançar, uma baixa flexibilidade do tronco tem sido sugerida como um preditor da rigidez arterial[22]. Existem várias maneiras de estudar a flexibilidade. Um dos métodos, proposto há três décadas, é o Flexiteste, que é baseado em comparações de mobilidade passivamente obtidos e mapas de avaliação dos 20 movimentos articulares[23]. Este método tem sido utilizado em diferentes contextos e de investigação estudos[24, 25].

Sugiro: no presente documento, a associação da flexibilidade com as ações de sentar e levantar do solo foram claramente observadas pela correlação de Pearson. Em concordância com esta associação, a pontuação mediana do TSL escore aumenta quando os quartis FLX estão dispostos em uma ordem crescente, passando de 7,5 à 9 em quartis extremos. Além disso, no quarto quartil, apenas 1,5% dos indivíduos alcança uma pontuação no TSL escore 0, e uma probabilidade de cerca de 80% de possuir uma pontuação no TSL de 8 a 10. Enquanto que, pertencer ao primeiro quartil do FLX diminui para 50% a probabilidade de obtenção de uma pontuação no TSL escore de 8 a 10. Além disso, a flexibilidade de todos os movimentos do flexiteste foram superiores para os indivíduos que possuíam um TSL escore 10 em relação aos que possuíam um TSL escore 0.

Apesar de uma tarefa aparentemente simples, as ações de sentar e levantar do solo exigem a interação coordenada de segmentos corporais que incluem flexão de tronco e quadris, seguido por extensão bilateral das articulações dos membros inferiores e extensão do tronco para elevar a massa corporal numa direção vertical[26]. É possível que caso haja uma hipomobilidade no tornozelo, esta pode ser compensada por uma maior flexibilidade do joelho e / ou do quadril, para sentar ou levantar do solo. Uma flexibilidade adequada na dorsiflexão parece ser importante para manter os calcanhares no solo durante as ações de sentar e levantar do solo[27]. Tanto a flexão quanto a extensão do joelho são determinantes para sentar e levantar do solo. Uma baixa flexibilidade desta articulação pode resultar em uma queda e/ou desequilíbrio ao se sentar enquanto que para a ação de se levantar do solo, provavelmente pode ser necessário algum apoio. Pode ser especulado que uma flexão do quadril reduzida também possa ter uma influência importante sobre a ação de levantar do solo porque poderia resultar em um movimento para cima com o

tronco ereto e do centro de massa movido posteriormente em relação aos pés, também contribuindo para um desequilíbrio e possível apoio das mãos. Considerando que uma das estratégias utilizadas para sentar e levantar é cruzar as pernas, a flexibilidade dos adutores e abdutores do quadril pode ser fundamental para o sucesso da tarefa. A flexibilidade da extensão do tronco, durante a ação de sentar e levantar de uma cadeira, também se mostrou[28].

Por outro lado há algumas limitações em nosso estudo. É possível que alguns resultados possam ter sido influenciados negativamente por alterações degenerativas subclínicas ou lesões recentes que, ou não foram relatadas ou identificadas na história médica no exame físico antes do TSL. Embora seja altamente provável que o nível de atividade possa influenciar a pontuação do TSL, não está claro se isso influenciou a validade externa dos nossos dados. Nossa amostra foi derivada principalmente de indivíduos da raça branca, tipicamente de um alto nível socioeconômico. Assim, é possível que os resultados pudessem ser diferente em outras populações com características culturais mais diversificadas, morfológicas, padrões de atividade física, ou outros. Não foi possível quantificar os resultados de saúde, tais como estimativas de qualidade de vida ou capacidade de realizar atividades diárias. Além disso, não foi possível determinar causas específicas de mortalidade.

Estudos futuros são necessários para identificar o efeito de intervenções sobre os resultados no TSL, visto que programas de exercícios adequadamente projetados melhoram o condicionamento músculo-esquelético[29] e cardiorrespiratório[30]. Além disso, separar pelo sexo e por faixas etárias os dois estudos, pode trazer uma melhor discriminação dos resultados. Outras

possibilidades para estudos futuros seriam associar a aptidão cardiorrespiratória com o TSL. E apenas os 11 primeiros movimentos do Flexiteste com o TSL.

CONCLUSÕES GERAIS

1. O TSL é um importante preditor de mortalidade por todas as causas para indivíduos entre 51-80 anos de idade;
2. A melhora de um ponto do TSL escore representa uma diminuição do risco de mortalidade em 21%;
3. A flexibilidade global influencia as ações de sentar e levantar do solo;
4. Indivíduos mais flexíveis tendem a ter maiores escores no TSL.

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