

Sitting–rising test: Sex- and age-reference scores derived from 6141 adults

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The sitting–rising test (SRT) was developed in the 1990s as a simple and safe tool to simultaneously evaluate all the major non-aerobic components of physical fitness – muscle strength/power, flexibility, balance and body composition.¹ Earlier studies have shown a very high interobserver SRT reliability² and that both body weight³ and mobility of joints⁴ were influential on SRT performance. SRT has also been studied and used by other research groups.⁵ A recent epidemiological study⁶ showed that SRT score is strongly associated with all-cause mortality in subjects aged 51 to 80 years. Over the last years, SRT has become very popular in the media,^{7,8} reaching both health professionals and the general public. However, in order to foster SRT use in clinical practice and considering that SRT scores tend to diminish with aging, reference values according to age are required for the correct interpretation of SRT scoring. The aim of this research letter is to propose sex- and age-reference SRT scores for non-athlete adults.

Data from subjects evaluated following a very comprehensive medical–functional protocol, which included cardiopulmonary exercise testing and several other tests, at our Exercise Medicine Clinic between July 1998 and February 2018 were retrospectively analyzed. All subjects provided written informed consent and both evaluation protocol and data analysis were approved by a research ethics committee. Subjects were either self-referred or referred by their attending physicians and voluntarily participated in the full evaluation. Subjects varied considerably regarding age – six to 99 years old; clinical conditions – very healthy (e.g. Olympic and World Class athletes) to extremely sick patients (e.g. severe congestive heart failure); and aerobic physical fitness – VO₂ maximum ranging from 2 to 24 METs (metabolic equivalents). After purposely and carefully excluding athletes,⁹ children and young adolescents, those that for any personal reason have refused to perform the SRT (less than 1%) and those with any type of locomotor or other clinical limitations that could affect the mechanical ability or the safety to sit and rise from the floor, SRT results from the

remaining 6141 adults (4101 men; 16 to 98 years old) were analyzed for deriving sex- and age-reference scores.

The SRT consists of an evaluation of the subject's ability to sit and to rise from the floor. It should be administered on a non-slippery flat surface, in a space equal to or larger than 2 m × 2 m, and with the subject standing barefoot and wearing clothing that does not restrict his/her movements. In order to standardize the conditions of SRT application, the evaluator should instruct the subject in a very straightforward manner: 'Without worrying about the speed of the movement, try to sit and then to rise from the floor, using the least support that you believe is needed'.

The ability of sitting and rising from the floor is measured according to the number of supports needed to perform each of the movements and the presence or absence of instability when sitting and rising. The score for each of the actions ranges from a minimum of 0 to a maximum of 5, with half-point intervals. Starting from 5, one point is subtracted for each support utilized, that is, for each hand, forearm, knee, or side of the leg used, and an additional 0.5 point is subtracted if the evaluator notices an unsteady execution (partial loss of balance) during the actions. In addition, if the subject places one hand on the knee in order to sit or rise, this is also considered as one support and, therefore, one point is subtracted. Crossing the legs for either sitting or rising from the floor is allowed if the sides of the subject's feet are not used for support. Independently of the number of attempts performed, the best score for each one of the two actions is considered the resulting SRT score for sitting and rising from the floor. Moreover, a composite SRT score – sum of sitting and rising scores – is also calculated

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Figure 1. Sitting–rising test (SRT) (composite score): age-reference values.

and ranges from 0 to 10. A score of 10 indicates the ability to sit and to rise from the floor without using any support – hand or knee – or presenting instability. A video illustrating SRT performance and scoring is available at: <https://www.youtube.com/watch?v=MCQ2WA2T2oA&t=149s>.

Reference scores were obtained separately for sitting on the floor and for rising from the floor and for the composite score. The results are presented for each of the 15 consecutive age ranges with five-year intervals in colored bands of quartiles (Qs), being: Q1 or P1–25 – red, Q2 or P26–50 – yellow, Q3 or P51–75 – green and Q4 or P76–99 – blue. Figure 1 presents a chart showing four (quartiles) colored bands for the composite scores in the 15 defined age-intervals (please refer to the Supplementary Material online for sitting, rising and composite SRT percentile scores charts).

It is worth emphasizing that no relevant clinical events occurred in more than 20 years of the routine SRT use in our clinic. A score of 10 is the most frequently seen in men aged 16 to 25 years old and in women aged 16 to 40 years old. However, less than 8% of men and women aged > 55 years old achieved a composite score of 10. The SRT was highly discriminative – presence of all four colored bands – between 46 and 80 years old in men and between 46 and 75 years of age in women. Nevertheless, it is possible to discriminate at least two bands – favorable (blue/green) and

unfavorable (red/yellow) – across all 15 age intervals analyzed.

While it is highly possible that specific clinical conditions such as advanced heart failure and chronic obstructive pulmonary disease would lead to sarcopenia¹⁰ and so would affect the SRT performance and scoring, no subgroups were analyzed in the current study but ideally should be targeted in future studies. In addition, it would be potentially interesting to study the combination of non-aerobic fitness data, as assessed by the SRT, and aerobic (or cardio-respiratory) fitness regarding clinical prognosis and survival.

The availability of reference scores obtained in a large sample of men and women from a wide age range under controlled conditions enables the application of the SRT in the evaluation of non-aerobic physical fitness in several distinct settings. However, despite the quite diverse clinical characteristics of this large sample, caution should be placed in generalizing these reference data for distinct populations. For instance, Asian populations that are used to a squatting position since childhood could have significantly high SRT scores. Nevertheless, ideally, men and women of all ages should aim to have a SRT score in the green or blue band, that is, equal to or above the median (P50) for his/her sex and age range.

Author contribution

CGSA, CLBC, JFCF and DSMSA contributed to the conception of the work and the analysis and interpretation of the data. CGSA, CLBC and JFCF contributed to the acquisition of data. CGSA drafted the manuscript. CLBC, JFCF and DSMSA critically revised the manuscript. All gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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