Innovations

Relationship between Floor Sitting Rising Test and Anti-Gravity Muscle Strength in Normal Healthy Individuals: A Prospective Observational Study Protocol

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Abstract:

Background: *Sitting-rising test (SRT) is a simple means of assessing a person's capacity for sitting and standing up from the ground. It gauges the degree of necessary support (knees or hands) and the presence or absence of balance and stability. Sitting and standing up from the floor are fundamental functional tasks for day-to-day existence. It is customary for people of all ages to participate in events and religious practices such as prayer, ritual performance, and ceremony participation while sitting on the floor. Appropriate degrees of muscle strength/power, coordination, body composition, balance, and flexibility are required for many daily actions. The SRT is a rapid and reliable test that gauges one's capacity to sit and stand up from the ground. The Sitting Rising Test is employed as an outcome measure in a number of articles. However, the relationship between the Sitting Rising Test and the strength of the anti-gravity muscles is still unknown, so the purpose of this study is to clinically observe and relate the same.*

Outcome Measures: *Sitting Rising test, Isometric muscle testing (of Glutei, Quadriceps and Calf muscles) and Sorenson test****Statistical Analysis:*** *The data will be collected and entered in Microsoft excel sheet and descriptive statistic like mean, standard deviation after ensuring the normal distribution and analysis will be done by using SPSS version 21 software by taking the help of a Biostatistician. For checking normal distribution of the data, the Shapiro-Wilk Test will be used. The Pearson correlation coefficient will be used, if the data follow normal distribution and the Spearman Correlation will be used if data does not follow normal distribution to find correlation among sitting rising test with Isometric muscle strength and Sorenson test.* ***Conclusion: Clinical Trial Registration:*** *The study is*

registered with Clinical Trials Registry- India (CTRI), with the registration number for the trial being CTRI/2023/11/060286.
Keywords: *Anti gravity muscles, muscle strength, sitting rising test, Normal healthy individual, sphygmomanometer*

Introduction:

Arajo developed the sitting-rising test (SRT) in the late 1990s as a simple means of assessing a person's capacity for sitting and standing up from the ground. It gauges the degree of necessary support (knees or hands) and the presence or absence of balance and stability. Sitting and standing up from the floor are fundamental functional tasks for day-to-day existence. The risk of falling is closely correlated with the incapacity to perform these and similar duties, and in the event that a fall has already occurred, the capacity to get back up is critical [1]. The primary functional action required to achieve independence is rising from the floor and sitting down [2].

In many developing nations, such as India, it is customary for people of all ages to participate in events while sitting on the floor [2]. It is asserted that floor sitting is important for religious practices such as prayer, ritual performance, and ceremony participation [3, 4]. Appropriate degrees of muscle strength/power, coordination, body composition, balance, and flexibility are required for many daily actions, such as getting up off the ground and shifting from a standing to a seated posture [1].

In addition, the muscles used in floor sitting for crossed ankles, flexed hip's requires powerful abduction, laterally rotated knees, and flexed ankles with their lateral aspects pressed on the floor. When sitting with one leg crossed, the soles of the foot operate as a fixed point from which movement is launched. Eccentric leg flexor and concentric leg extensor contractions control the downward movement. When standing, dorsi-flexors contract concentrically whereas ankle plantar flexors contract eccentrically. The ability to get up from a floor-sitting position without the aid of hands, without wobbling or losing balance, requires a strong lower limb's antigravity muscles, especially the ankle muscles [5].

It is suggested that the SRT, a rapid and reliable test that gauges one's capacity to sit and stand up from the ground, be used in therapeutic settings [6]. The test has extremely good reliability (ICC=0.970-0.999). Inter-rater reliability (ICC=0.872-0.967) was excellent, while test-retest reliability (ICC=0.679-0.863) was deemed adequate. For the sitting test, sensitivity was 90.0% and specificity was 66.7%. Sensitivity and specificity are both at 80.0%, boosting the score [5].

In the study, pressure biofeedback is employed to observe the anti-gravity muscle strength using a modified sphygmomanometer. In order to monitor the isometric quadriceps group of muscles, calf muscles and glutei muscle strength, the conventional sphygmomanometer was shown to be a cost effective and practical alternative [7]. Position-holding time is reliably measured using the Sorensen test for back extensor muscles. Good discriminative validity is included in the test. Additionally, the test is quick to do and requires low-cost tools [7].

The Sitting Rising Test is employed as an outcome measure in a number of articles [1, 3, 8, 9]. However, the relationship between the Sitting Rising Test and the strength of the anti-gravity muscles is still unknown, to the best of our knowledge, so because there is a dearth of literature on the subject, the goal of this study is to clinically observe and relate the same.

A modified sphyg- momanometer is used as pressure biofeedback in this study in training the strength of the quadriceps. This conventional sphygmomanometer was found to be an affordable and use- ful alternative in monitoring and maintaining the isometric quadriceps strength during the acute phase of post- Anterior objective of this study is to observe the influence of an ob-jective training program by using a modified sphygmoma-nometer as a visual biofeedback tool to facilitate quadrice

Objectives of the study are to:

- To see the isometric muscle strength of Glutei, Quadriceps and calves using Sphygmomanometer,
- To see the back extensor endurance using Sorenson Test,
- To see the ability to rise up from the floor using sitting rising test (SRT)
- To analyze association between strength of antigravity muscles and sitting rising test (SRT).

Hypothesis:

The null hypothesis is that there is no statistically significant relation between sitting and rising test and anti-gravity muscle strength.

Ethical Approval:

All the procedures that will be involved in this trial had been taken approval from the Sumandeep Vidyapeeth Institutional Ethics Committee. The approval received from the Sumandeep Vidyapeeth Institutional Ethics Committee had the outward number, SVIEC/ON/Phys/BNMPT22/Oct/23/15 dated on 31/10/2023.

Clinical Trial Registration:

The study is registered with Clinical Trials Registry- India (CTRI), with the registration number for the trial being CTRI/2023/11/060286.

Sample size calculation:

To calculate the Sample size the following formula was used,

$$n' = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)}$$

where n' = Sample size with finite population correction,
N = Population size,
Z = Z statistic for a level of confidence,
P = Expected proportion (If the prevalence is 20%, $P = 0.2$), and
d = Precision (If the precision is 5%, then $d = 0.05$)

After using the above formula for sample size calculation, the final sample size came to be minimum 139 subjects.

Method:

In this cross sectional, observational study, Normal healthy individuals of age group 18 to 45 years from Constituents College's of Sumandeep Vidyapeeth and Dhiraj Hospital will be approached and explained about the study.

Inclusion Criteria:

1. Both genders,
2. Normal healthy individuals of age group 18 to 45 years who are willing to participate.

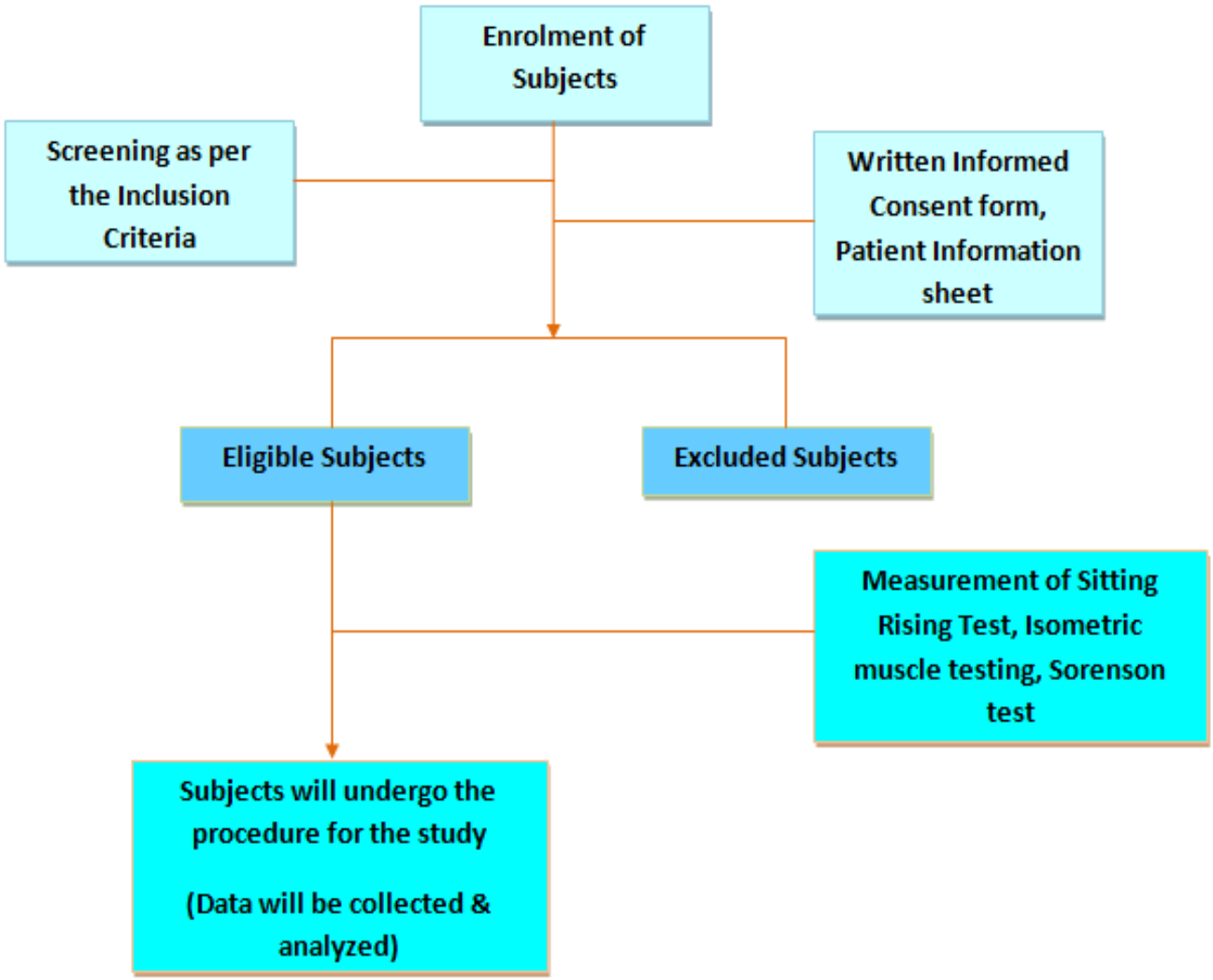
Exclusion Criteria:

1. Subjects with neurological conditions such as Parkinson's disease, multiple sclerosis, or stroke
2. Subjects with recent abdominal or lower limb surgeries
3. Subjects with a history of heart problems or cardiovascular conditions, such as recent heart surgery, uncontrolled hypertension, or a recent heart attack.
4. Subject who is having an active lifestyle (person doing yoga, gym, fitness training etc.)
5. Pregnant women
6. Subject with any musculoskeletal disorder like Osteoarthritis, lower extremity fractures, ankle conditions,

7. Subjects with any non-specific pain of spine or lower limb lasting more than 10 days.

The participants who meet the inclusion criteria will be enrolled in the study. The subjects willing to participate in the study will be requested to fill up written informed consent form. Participants will be selected from the population using convenient sampling technique. Participants will be given to the participant's information sheets. Following this, subjects will be assessed according to the assessment format for the Sitting Rising Test and the strength of the anti-gravity muscles, i.e. Quadriceps group of muscles, gastrocnemius and soleus (calves) and gluteus group of muscles, also endurance of back extensor muscles using Sorenson test will be taken. (Table: 1).

Fig 1: Flowchart summarising the overall trial design



The Test Procedure is as follows:

I. Sitting Rising Test

- The test must be performed on a flat, non-slip surface with the appraised barefoot, without socks and devoid of clothes that limit their movement.
- The evaluator should position oneself close, forward and diagonally to the subject.
- In the first run the evaluator should instruct the subject in a simple and direct way. "Try to sit and get up, using the least number of possible support and without becoming imbalanced"
- The subject starts the test with a maximum score of 5 points for each of the sitting and standing actions, being subtracted from it one point for each extra support used and half a point for each Imbalance Noticeable bodily Resistance.
- Point Deduction: Placing hand, forearm knee or the side of the leg on the floor for support, hand on knee to facilitate Rising or sitting (Refer to Fig 2 a) [5].

Fig 2 a

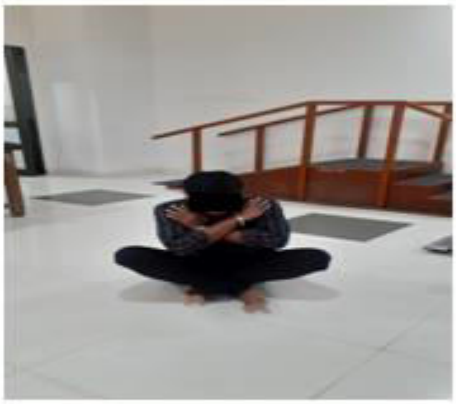


Fig 2 b

Fig: 2 a, and Fig 2 b showing the sitting rising test performance and subject performing Sorenson test.

Fig 3 a

Fig 3 b

Fig 3 c

Fig: 3 a, 3 b and 3 c showing Isometric strength testing for the Quadriceps muscles, Glutei and Calf muscles respectively

II. Isometric strength testing using a sphygmomanometer

A). Quadriceps Strength Testing:

Test procedures involved the following steps:

- Subject's Position- The patient will be in supine position, the knee is flexed to 30 degrees using a Quadriceps board under the Knee Joint. Pressure cuff will be placed between the quadriceps board and the knee.
- The valve will be closed tightly then the cuff will be inflated to remove wrinkles in the sphygmomanometer bladder asking the subject to relax the knee, keeping the pressure at 0 mmHg.
- The subject was instructed to perform maximum isometric quadriceps contraction with a hold time of 5 s
- When a maximum quadriceps contraction is initiated, the cuff measures the pressure proportional to the applied force. Care to be taken to maintain the contact of the hip and ankle to the couch. (Refer fig 3 a)

Three trials will be repeated on both sides, and the average reading will be documented [10].

B). Calf (Gastrocnemius and Soleus) Strength Testing:

Test procedures involved the following steps:

Patient Position - supine position arms crossed, hip, knee and ankle in neutral position.

- The valve will be closed tightly then the system will be inflated to 100mm Hg to remove wrinkles in the bladder,
- The pressure will be reduced to a baseline of 20 mm Hg providing a measurement interval of 20-300 mm Hg, the valve closed tightly again to prevent leakage,
- The cuff or bag will be placed between plantar surface off forefoot, and in contact with the wall.
- The scale will be positioned within full view of the observer,
- The patient is then asked to planter flex the foot slightly, afterwards hold that position and apply pressure gradually, the force recorded on the scale in mm Hg pressure was the maximum the patient was able to sustain without movement. The pressure applied by the observer will be increased gradually, matched at each phase by the patient, reaching a peak at the count of 5 sec, then held there for 2 more sec at which time the scale was read [11].

Maximal resistance is defined as the maximum effort the subject will able to sustain in the position without movement [10]. (Refer fig 3 c)

Table 1: the schedule of enrolment, interventions and assessments in accordance with the Standard Protocol Items: Recommendation for Interventional Trials (SPIRIT) for the Observational Study

Time Point	Study Period			
	Criteria/Particular	Enrolment	Day 1	Later if applicable
Enrolment	Eligibility Screen	×		
	Informed Consent	×		
	Patient Information Sheet	×		
Intervention	Intervention if any		Not applicable	Not applicable
Assessments	Baseline	×		
	Sitting Rising Test		×	
	Isometric muscle testing		×	
	Sorenson test		×	

C). Gluteal (Hip) Strength Testing

Subject's Position- The subject will be tested in Supine, hip and knee in neutral position. The arm cuff of modified sphygmomanometer was placed on the plinth at posterior and distal portion of the leg (heel of the foot).

a) The valve will be closed tightly then the cuff will be inflated to remove wrinkles in the sphygmomanometer bladder asking the subject to relax the leg, keeping the pressure at 0 mmHg.

b) The subject was then instructed to perform maximum hip extension with a hold time of 5 s.

c) When a maximum contraction is reached, the cuff measures the pressure proportional to the applied force.

d) Three trials will be repeated on both sides, and the average reading will be documented [11]. (Refer fig 3 b)

III. Sorenson Test

The patient lies on the examining table in the prone position with the upper edge of the iliac crests aligned with the edge of the table. Three straps are applied around the pelvis, knees and the ankles to fix the lower body. The subject is asked to maintain the upper body in a horizontal position isometrically with the arms folded across the chest. The time for which the subject keeps the upper body horizontally in a straight line is recorded. For those subjects, for whom holding the position finds no difficulty the test is stopped after 240 s. The Sorensen test is the most widely used test in published studies evaluating the isometric endurance of trunk extensor muscles. It has been used either as described initially or with a number of modifications, as listed below.

- Arm position: the test has been used with the arms bent, the elbows held out, and the hands on the ears forehead, or nape of the neck; in another variant, the arms are held along the sides. As the center of gravity is influenced by the arms position, the above changes have influence on the mass moment of the upper body and also the performance of the subject during the test. Location of the edge of the table: in several studies, the anterior–superior iliac spines were placed at the edge of the table, instead of the upper edge of the iliac crests
- Number of straps: two to five straps have been used to hold the lower body to the table; in the Roman chair variant, the feet are fixed to the device and no straps are needed.
- Starting position: in several studies, the test was started with the upper body sloping downward toward the floor so that a concentric contraction of the trunk extensor muscles was needed initially to reach the horizontal position. (refer fig 2 b)
- Hip flexion: in theory, the hips remain fully extended throughout the Sorensen test
- Criteria for stopping the test: in studies that used measurement devices or contact with an object to define the horizontal position, specific test-stopping criteria were used, such as trunk down sloping by more than 5–10° or loss of contact with the object for more than 10 seconds
- Test duration: some individuals can hold the position for longer than 240 s and Jorgenssen and Nicolaisen suggested that the test should be continued beyond

this time [12].

After performing the assessment for Sitting Rising test, Isometric muscle testing (of Glutei, Quadriceps and Calf muscles) and Sorenson test which are also going to be the outcome measures for this study, the obtained data will be recorded.

Statistical Analysis:

The data will be collected and entered in Microsoft excel sheet and descriptive statistic like mean, standard deviation after ensuring the normal distribution and analysis will be done by using SPSS version 21 software by taking the help of a Biostatistician. For checking normal distribution of the data, the Shapiro-Wilk Test will be used. The Pearson correlation coefficient will be used, if the data follow normal distribution and the Spearman Correlation will be used if data does not follow normal distribution to find correlation among sitting rising test with Isometric muscle strength and Sorenson test.

Discussion:

The study will examine the relationship between the sitting rising test and the anti-gravity muscular strength in healthy, normal individuals. A person usually sits on the floor when performing basic activities of daily living (BADLs), such as feeding and bathing. Similarly, instrumental activities of daily living (IADLs) such as laundry and other housework like sweeping; cleaning, cooking, and utensil washing require floor-sitting positions. If a person is performing manual labour, such as farming, packaging, or other manual duties, they might have to work at the floor level [2]. It is also mandatory for people to sit on the floor during social events like weddings and neighbourhood meetings. Reading, watching TV, movies, and taking part in social and cultural events are all very important to older people in India. All of these recreational activities can be done while seated on the floor, especially in rural areas [3]. Thus assessing the level of sitting rising test is important.

On completion of this observational study the results of this study will give more clarity on correlation between sitting rising test and isometric strength of antigravity muscles of lower limb and back. To the best of our knowledge we did not find any review which showed any association among them. The results of this study will also be essential for the persons sitting or not sitting on the floor for performing their BADL's or IADL's during the day. The strength of this study protocol is that it follows the SPIRIT protocol. The study also follows all the recommendations for observational studies considered in the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.

Conclusion: This observational study will be helpful by providing important information and building up essential background for the association between sitting rising test and strength of the anti gravity muscles.

Conflicts of Interest:
The authors hereby state that we have no potential conflicts of interest to declare.

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