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Intra- and inter-reliability of supine-to-stand performance in older adults

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ABSTRACT

Introduction: Supine-To-Stand task is a basic activity of daily life capable of quickly and simply tracking motor functional competence. Its performance can be assessed quantitatively and qualitatively, respectively, by time and categories identified by checklists. High-reliability levels were founded in studies with time investigation. However, reliability levels are lower in studies with qualitative measures due to the possible evaluator subjectivity. **Objective:** To determine the level of reliability of the Supine-To-Stand task in the elderly. **Methods:** The convenience sample consisted of 49 elderly people (≥60 years), free from dementia or any disease that prevented them from carrying out the Supine-To-Stand task without assistance. The study was based on Reliability Study Reporting Guidelines. The participants were filmed performing the Supine-To-Stand task using a cell phone video camera and the images were decoded by two trained evaluators. The process of collecting and analyzing the videos was carried out from July to November 2019. The intra- and inter-rater reliability was analyzed by the Kappa coefficient ($p \leq 0.05$). **Results:** The coefficients found for intra-rater reliability were K=0.761 and 0.542; 0.744 and 0.525; 0.692 and 0.684 and, inter-evaluators K=0.527, 0.342 and 0.766, respectively, for upper limbs, axial region and lower limbs. **Conclusion:** In general, for the three-body regions described by the checklist used, coefficients from reasonable to substantial reliability were found, both for intra- and inter-rater analyses.

Keywords: aging; motor skills; activities of daily living; data accuracy; geriatric assessment.

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INTRODUCTION

Motor functional competence is a term used to describe an overlap of the concepts functional capacity (ability to perform activities of daily living) and motor competence (ability to perform activities of daily living with coordination and control), starting from gerontological and developmental perspectives, respectively[1-3].

In the aging process, the motor functional competence suffers a decline in the performance for the execution of the activities of daily life (ADL)[4,5]. The ability to rise from the ground or supine-to-stand (STS) is an ADL that can track motor functional competence throughout the life cycle since it is related to physical abilities and health markers[2,6-13].

The STS task performance analysis is performed using quantitative and qualitative measures, respectively, called product and process measures, represented by the time for STS execution and its identification from previously developed motor patterns (motor action checklists). Among the various protocols that process analysis for the analysis of STS[7,11,14-17], VanSant stands out[18].

VanSant[18] pioneered the description of the STS task, performed by children and adults, and as a reference for later protocols that were refined over the years, including with elderly subjects[17]. VanSant[18] proposed movement categories from the motor manifestation of Upper Limbs (UL), Lowe Limbs (LL), and Axial Region (AR). In addition, the possibility of checking the movement combinations, i.e., more frequent developmental sequences allowed the identification of the performance of motor functional competence[18-20].

This protocol for analyzing process performance in the STS was improved by Haywood et al.[21] for the entire life cycle, considering that it is also a task in which balance and postural straightening are extremely required. However, intra- and inter-rater reliability has been investigated only in samples of children and adults[18,20]. The assumption of compensatory strategies to perform the STS has already been demonstrated in the elderly, and they seem to occur more frequently in those with worse body composition conditions (overweight and obese)[13].

The STS advances towards the development of a solid scientific basis for the validation of its use, due to its practicality and because it is a task already contained in the motor repertoire. Among the validity criteria, it is predictive of serious injuries resulting from falls[22] and concurrent for several physical abilities (such as balance and muscle strength), health markers, and frailty in the elderly[7,8]. The high correlation between the performance of the STS and the Timed-to-Up-and-Go (TUG), a test developed to determine the degrees of frailty and sarcopenia in the elderly was also highlighted[23,24].

In addition, reliability studies are important for determining the magnitude of measurement error in diagnostic tests, use of scales, or determination of performance categories, especially when the degree of subjectivity of the evaluator can influence the results[25,26]. From this, we developed the hypothesis that, despite the possibility of the influence of subjectivity and motor compensations in the elderly, previous training will be able to produce satisfactory levels of reliability for categorizing the performance of motor functional competence in the elderly using the STS. Therefore, the objective of this study was to determine the level of intra and inter-rater reliability of the STS performance in the elderly, according to the VanSant protocol[18].

METHODS

This is a study characterized as a methodological study of the reliability of the STS motor competence task in the elderly, approved by the Ethics and Research Committee of the Centro Universitário Euro-Americano - UNIEURO (3.055.980). The study was based on Guidelines for Reporting Reliability and Agreement Studies (GRRAS)[25]. All volunteers signed an informed consent form. The sample was selected by convenience at home and in groups, associations, and institutions that support the elderly living in the Federal District. It consisted of elderly subjects (n=49; ≥60 years old), with no physical, clinical, or mental impediments to performing the STS task, and who self-reported being able to perform the STS, without assistance. The collection and analysis in the period from July to November 2021.

A team of three researchers performed the data collection, with one being responsible for collecting and recording sociodemographic data, a second is responsible for conducting tests (instruction and safety) of hemodynamics, body composition, physical tests (all data determined for sample characterization), and a third who performed the STS filming, in a process that lasted approximately 40 minutes per volunteer.

The individuals initially went through an interview to collect sociodemographic data, such as gender, age, health conditions, medication intake, the occurrence of falls, and fear of falling. Next, hemodynamic aspects were tested[27-29] such as Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Heart Rate (HR), body mass, height, and Body Mass Index (BMI). The BMI classifications were categorized as recommended by the World Health Organization for the elderly, which considers - Low weight: ≤ 22 kg/m²; Normal weight: > 22 kg/m² and < 27 kg/m²; Overweight: ≥ 27 kg/m². Then the physical performance tests were performed (handgrip dynamometry, unipodal balance test with visual restriction, Timed to Up and Go (TUG)[6], and, finally, they performed the STS task[8].

Data Collection Procedures

STS Task[30] - Objective: Get up as quickly as possible from a supine position to a standing position and touch a fixed target on the wall at eye level. Location and procedures:

1) Preparation of the space - a quiet room with a clean, flat floor; there should be a space of approximately eight square meters; 2) Marking of the target - a sticker marking was placed on the wall at eye height of the assessed; 3) Environment preparation - a rubber mat (like those used in yoga classes) was positioned and affixed with adhesive tape 30 cm in front of and longitudinally to the wall where the marking of the target at eye level was made; 4) Image framing - before image collection, the camera was positioned sagittally to the volunteer in dorsal decubitus (the distance from the camera should preserve a frame that captures the subject's image completely and as close as possible); 5) Instruction - the volunteer was instructed to assume the dorsal decubitus position, feet 30 cm away from the wall and Lower Limbs (LL) fully extended, as well as the Upper Limbs (UL) also fully extended and positioned along the trunk. Then he was told to get up as quickly as possible and touch the target mark posted on the wall; 6) Trials - two trials were performed with a minimum interval of two minutes. Both trials were recorded and the faster one was used for analysis.

Data decoding procedures

Video analyses were performed by observing the STS performance using specific movement analysis software Kinovea 0.8.15 from the beginning to the final position and the categorization of the movements was performed by identifying key categories according to the protocol described by VanSant[18]. Two examiners performed the coding of STS performance by process analysis independently. Both participated in previous training to develop the necessary skills for image analysis and to master and distinguish the categories of the VanSant protocol[18].

A blinding process was performed between the video coders, as well as between the coders and evaluators who collected the data and the researchers who performed the statistical analyses. The images were decoded in a random process, as was the distribution of the videos to the encoders.

STS analysis protocol according to VanSant adapted

Lower limbs

A) Half kneel: the lower limbs flex toward the trunk assuming an asymmetrical crossed-leg position (one foot in front of the other), with the outer side of one foot and the thigh in contact with the ground. The body mass is transferred from the thigh to the knee of the same lower limb, as well as the body rotates on the lower limbs and assumes a standing position on one foot and one knee. The body mass is then distributed to the opposite foot and extension of both knees occurs for the assumption of the standing position; B) Asymmetrical squat: the lower limbs are flexed toward the trunk and assume the position with one leg crossed asymmetrically (one foot in front of the other) and with the soles of the feet in contact with the ground. One knee may remain extended or both knees extend for the assumption of the standing position, with the feet resting on the ground. C) Symmetrical squat with balance step: the lower limbs are flexed synchronously and symmetrically, placing the soles of the feet on the ground. The placement of the feet is adjusted before an extension or at the end of straightening by step or hop; D) Symmetrical squat - the lower limbs are flexed symmetrically in inflection with the heels approaching the glutes. Body mass is transferred from the glutes to the feet and the lower limbs then extends vertically.

Upper Limbs

A) Push and reach to symmetrical push: One hand is placed on the ground next to the hips. The other hand crosses the body and supports the ground. Both hands push the ground to the full extension of the elbows. The upper limbs are then lifted and used for balance; B) Push and reach: One hand is placed on the ground beside the hips while the other hand assists in balance; C) Symmetrical push to push and reach: Both hands are placed on the ground, one on each side of the hips. Both hands push against the ground before the point where one arm lifts before the other (asynchrony) for balance; D) Symmetrical push: Both hands are placed on the ground, one on each side of the hips. Both hands push against the ground before the point at which the arms are raised in synchrony and used for balance; E) Symmetrical reach: The arms move forward, lead the torso, and are used to help balance throughout the movement.

Axial region

A) Full rotation, abdomen up the head and trunk flex and rotate to the side. The rotation continues until the ventral surface of the trunk faces the ground, but without contact. The pelvis is then raised to the level of the shoulder girdle or above. The back extends from this position vertically, with or without accompanying trunk rotation; B) Partial rotation: Flexion and rotation of the head and trunk bring the body into a side-facing position, with the trunk tilted slightly forward of the vertical plane. The trunk extends vertically, with or without accompanying rotation; C) Symmetrical, interrupted by rotation: The head and trunk begin to flex forward symmetrically. The symmetrical movement is interrupted by rotation to one side or by extension with rotation. The forward movement then continues until the head and upper body are positioned facing the vertical plane. The trunk may rotate counterclockwise during extension to the vertical position; D) Symmetrical: The head and trunk flex symmetrically (no rotation) past the vertical plane. Then the trunk extends symmetrically to the vertical position (In case of movement not compatible with the categories they must be recorded and described separately).

Statistical Analysis

The descriptive data were presented using relative frequency (%) and non-relative (n), mean and median as measures of central tendency, as well as standard deviation and interquartile range as measures of dispersion, respectively[26]. The intra- and inter-rater reliability of the process performance of the standing up from the ground task was assessed using the Kappa Coefficient (K), with a significance level adopted $p \leq 0.05$[25]. Finally, the classification of the raters' performance according to the following intervals: 0-0.20 (minimal agreement); 0.21-0.40 (reasonable agreement); 0.41-0.60 (moderate agreement); 0.61-0.80 (substantial agreement); >0.81 (perfect agreement)[26].

RESULTS

The sample was composed of 49 elderly subjects predominantly female (61%) as shown in Table 1. Eleven volunteers reported at least one fall in the last year and of these, most were female (82%). Fractures from falls occurred only in females (two at the wrist, one at the tibia, and one at the knee).

The results of the multidimensional questionnaire showed a good perception of motor competence (5±1, median±interquartile range; on a scale ranging from 1 to 7, the higher the value, the better the perception) and a median fear of falling (3±3, median±interquartile range; on a scale ranging from 1 to 5, the higher the value, the greater the fear). In addition, regarding the regular use of medications, only four individuals presented the polypharmacy condition (five medications or more)[31].

In general, satisfactory reliability coefficients were found, that is, classified as at least moderate, for most analyses, except for the inter-rater reliability for the axial region (regular), as shown in Table 2.

DISCUSSION

The objective of the present study was to determine the level of intra and inter-rater reliability of the STS task in elderly subjects, according to VanSant's protocol[18]. The main results showed satisfactory levels of reliability for categorizing the performance of motor functional competence using the STS also in elderly subjects, according to the hypothesis initially proposed.

As expected, the intra-rater reliability levels of the two coders were higher than the inter-rater reliability levels in all body segments analyzed. The Kappa coefficient results for the lower limb region, both for intra- and inter-rater reliability, were more expressive when compared to the other body segments. Hsue et al.[26] in a similar study, however, evaluating children between two and six years of age, showed divergent results, i.e., the worst results were found for the lower limbs. Therefore, one should pay attention to several conditions that can influence the accuracy of the measurement.

Some factors may contribute to altering the raters' performance, such as perception variables related to motor competence, the rater's experience, the rater's body composition[13,] and his/her physical abilities[8].

It should also be pointed out that the motor task analysis was performed by Physical Education students in their final stages of training, with previous training, but with little clinical experience. Similar studies that investigated the clinimetric properties of the STS obtained similar or even better outcomes, but it is more common for this type of diagnosis to be performed by researchers and professionals more experienced in geriatric assessment[7,11,15,16,20]. These findings reinforce the understanding that this type of assessment applies to the context of aging also in a perspective of clinical use, in addition to the scientific approach.

The results of the present study showed a high frequency of volunteers with high BMI, but the sample was homogeneous. On the other hand, the performance of muscle strength and static balance showed peculiar distinctions: men had higher levels of muscle strength than women, and the sample, in general, showed greater heterogeneity in the unipodal support test. However, even with these characteristics, the levels of reliability found were satisfactory.

Qualitative variables of perception related to STS can also interfere with how the movement is performed. The perception of motor competence reveals the individual's feeling of how secure and capable he/she feels when performing a certain motor task. The association between perceived motor competence and performance in the STS has already been shown in experienced elderly people with physical activity programs[32]. However, in the

Table 1: Characterization of the elderly sample in anthropometric, health, and functional variables. Brasília, Brazil, 2020.

	Women (m±sd)	Men (m±sd)	All (m±sd)
Anthropometric variables			
Age (years)	68±6	68±5	68±5
Body Mass (kg)	67±14	75±10	70±13
Height (m)	1.5±0.1	1.7±0.1	1.6±0.1
BMI (kg/m2)	28±5	27±3	27±4
BMI - normal weight (%)	47	42	49
BMI - low weight (%)	6	5	6
BMI - overweight (%)	47	53	45
Health Variables			
SBP (mmHg)	129±17	132±21	130±19
DBP (mmHg)	73±11	77±15	75±13
HR (bpm)	79±16	71±16	76±16
Functional Variables			
TUG (s)	6,10±1,06	5,37±0,88	5,82±1,05
Handgrip dynamometry (kg)	23±6	40±10	29±11
Unipodal Support (s)	4.49±4.47	4.68±2.91	4±3.91
STS - Time (s)	6.17±2.53	3.97±1.76	5.31±2.49

m±sd: mean ± standard deviation; kg: Kilograms; m: meters; BMI: body mass index; SBP: systolic blood pressure; DBP: diastrolic blood pressure; HR: heart rate; mmHg: millimiters of mercury; bpm: beats per minute; s: seconds; TUG: timed up and go; STS = supine-to-stand.

Table 2: Reliability coefficients of each encoder for each body region.

Body Region	Intra-rater		Inter-rater	
	K	p	K	p
UL				
1	0.761	<0.001	0.527	<0.001
2	0.547	<0.001		
AR				
1	0.744	<0.001	0.342	<0.001
2	0.525	<0.001		
LL				
1	0.692	<0.001	0.766	<0.001
2	0.684	<0.001		

UL: upper limbs; LL: lower limbs; AR: axial region; K: Kappa; p: significance level.

present study, the sample proved to be in good condition in terms of perceived motor competence to perform the STS.

Fear of falling is more common in elderly subjects who have experienced a fall[33]. At high levels, the fear of falling can make the individual perform more movement strategies, making it difficult to analyze the codifiers that need to choose a movement category[34]. The fear of falling stood out for presenting itself in a more heterogeneous form since approximately 60% of the sample reported being afraid or very afraid of falling. However, only 22% of the sample reported falling, reinforcing the theory that other factors influence the fear of falling.

There was no report of accident or intercurrence of risk for the application of the STS data collection, as well as no video showed a motor manifestation impossible to be categorized by the coders, according to the VanSant protocol[18]. The application of the evaluation proved to be easy, practical, and safe. Furthermore, it reinforces the proposition of the STS as a useful tool for health professionals, especially those who deal with human movement, to track the functional motor competence of the elderly.

On the other hand, some limitations of the study should be considered and reflect new perspectives. It is speculated that the greater experience and training of the professional evaluators are determinants to raise the levels of reliability of the measurement as well as the number of cameras used. In addition, further methodological studies of translation, adaptation, and validation for the Brazilian context, studies of other clinimetric properties such as agreement rates, and the analysis of other protocols and checklists of the STS certainly foster the validation of the evaluative method.

In another similar investigation, satisfactory levels of reliability were found for STS analysis in the elderly in light of the protocol adapted from Manini et al.[15]. The advance of the present study was due not only to the reliable operational feasibility of the analyses also to VanSant's protocol but especially because the number of categories in VanSant's protocol is almost three times larger than that of Manini et al.[35]. This means that the reliability of the measurements was maintained, even with a higher level of detail of motor actions.

Finally, it is noteworthy that the reliability coefficients for STS analysis using the VanSant protocol were rated as substantial for most analyses, except in the inter-rater condition for the axial region, which was considered reasonable.

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