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Review

# Daily sit-to-stands performed by adults: a systematic review

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**Abstract.** [Purpose] The sit-to-stand (STS) maneuver is a component of everyday mobility. The purpose of this review was to summarize the number of daily STSs performed by adults with or without pathology. [Methods] Four bibliographic databases were searched followed by a consultation with experts and a search by hand to locate articles reporting daily STSs. Information on measurement procedures, tested populations, and daily STSs was extracted. Methodological quality was rated. [Results] Ten articles were identified. The mean number of daily STSs ranged from 33 to 71. The mean number was at least 45 for all groups except patients with congestive heart failure, residents of a hospital ward and one group of older adults. [Conclusion] Individuals performing fewer than 45 daily STSs may be experiencing a work deficit and benefit from additional intentional STS repetitions.
**Key words:** Mobility, Sit-to-stand, Chair-rise

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## INTRODUCTION

The sit-to-stand (STS) transition is a fundamental aspect of mobility[1)]. The maneuver is relatively demanding from a neuromuscular perspective[2)] and is affected negatively by age and pathology[3–6)]. It should not be surprising, therefore, that repeated STSs are a common component of exercise regimens directed at older adults and patients with stroke or other pathologies[7–11)]. Perspective as to how many STSs should be recommended for patients receiving physical therapy might be gained by knowing the number performed daily by apparently healthy adults and by patients with pathology. If individuals are performing a limited number of STSs over the course of a day, they may be experiencing a work deficit that could contribute further to strength impairments and activity limitations. This systematic review was conducted to determine what is known about the number of daily STSs performed by adults-both those who are healthy and those with pathology.

## METHODS

To be included in this review, an article had to describe the number of daily (24 hours or waking day) STSs performed by adult humans. To identify potentially relevant articles, searches of PubMed (from 1950), Science Citation Index (from 1994), Scopus (from 1996), and CINAHL (from 1981) were conducted on January 10, 2013. The search string for PubMed was: ("stand up" OR "standing up" OR "sit to stand" OR "chair rise" OR "chair rises") AND (monitor*[ti] OR "activity monitor" OR "activity monitors" OR "activity monitoring" OR frequency[ti] OR "Monitoring, Ambulatory"[MAJR] OR "ambulatory monitoring" OR "ambulatory monitor" OR "ambulatory monitors") NOT ("heart rate monitoring" OR "blood pressure monitoring" OR "fetal monitoring" OR "memory monitoring"). The search strings for the other databases were similar but adapted as necessary to database specifics. RefWorks was used to consolidate the searches and eliminate duplicates. This process resulted in the identification of 177 potentially relevant unique articles. A search by hand and consultation with 2 experts (Thorlene Egerton and Phillipa Dall) yielded 7 additional articles. After an examination of the full text of these articles, 174 were excluded by the author because they did not report daily STSs. The remaining 10 relevant articles were abstracted for information on: 1) the procedure used to document daily STSs, 2) the population studied (country of residence, residence or health status, age, and number), and 3) the mean and standard deviation of the number of daily STSs performed. Confidence intervals (95%) for daily STSs were calculated using the mean, standard deviation, and sample size for each population. If an article described STSs performed in the context of an intervention, only information from baseline or from the control group was abstracted. Because of the heterogeneity of methods and samples, statistical aggregation and analysis were not conducted. The quality of the 10 included articles was rated using a checklist adapted from applicable items from the Hagströmer-Bowles Physical Activity/Sedentary Behavior Questionnaire Checklist (HBQC) checklist[12)].

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## RESULTS

The 10 identified articles are summarized in Table 1[13–22]. In all but one study, an accelerometer-based activity monitor (most often the activePAL) attached to the anterior thigh(s) and/or chest was used to quantify STS transitions. In the aberrant study, a tally counter was employed[13]. That study required the individuals being monitored to "click" the

**Table 1.** Summary of the 10 studies reporting accumulated daily sit-to-stands (STSs)

| Study | Measurement Procedure | Population | Daily STSs Mean±SD (95% CI) |
|---|---|---|---|
| Bohannon et al.[13] | Talley counter used by participants for 7 days | United States Community-dwelling adults (51±21 years): n= 96 | 46±17 (43–49) Significantly more on weekdays than weekend days. |
| Dall and Kerr[14] | ActivePAL attached to participants' thighs for 3 or 7 days | Scotland Community-dwelling adults (40±9 years): n= 140 | 60±22 (57–64) Significantly more by indoor sedentary workers than outdoor active workers. Significantly more during working days than nonworking days. |
| Grant et al.[15] | ActivePAL attached to participants' thighs for up to 7 days | Scotland Community-dwelling older adults (74±5 years): n = 20 | 71±25 (59–83) |
| | | Scotland Day hospital attendees (75±8 years): n = 20 | 57±23 (46–68) |
| | | Scotland Hospital ward residents (81±6 years): n = 30 | 36±16 (30–42) |
| deBruin et al.[16] | Custom device attached to participants' sternum for 2 consecutive weekdays during 1 week and 1 of the same days the following week | Switzerland Residential care occupants (88±2 years): n = 11 | 60±23 (47–73) [week 1] 56±17 (45–67) [week 2] |
| Van den Berg-Emons et al.[17] | Activity monitor attached to participants' sternum and thighs for 2 consecutive weekdays | The Netherlands Individuals without congestive heart failure or mobility limitations (65±4 years): n = 5 | 54±19 (30–78) |
| | | The Netherlands Patients with congestive heart failure (64±5 years): n = 5 | 33±12 (18–48) |
| De Groot et al.[18] | Activity monitor attached to participants' sternum and thighs for 2 consecutive days | The Netherlands Healthy controls matched with patients scheduled for hip arthroplasty (59±12 years): n = 34 | 61±23 (53–69) |
| | | The Netherlands Healthy controls matched with patients scheduled for knee arthroplasty (60±11 years): n = 37 | 61±23 (54–68) |
| | | The Netherlands Patients with osteoarthritis scheduled for hip arthroplasty (60±13 years): n = 34 | 50±14 (45–55) |
| | | The Netherlands Patients with osteoarthritis scheduled for knee arthroplasty (61±10 years): n = 37 | 47±14 (42–52) |
| Egerton and Brauer[19] | ActivePAL attached to participants' thighs for 3 consecutive days | Australia Individuals living at home (71±4 years): n = 15 | 65±17 (56–74) |
| | | Australia Individuals living in aged care facilities (87±7 years): n = 16 | 47±27 (33–61) |
| Lord et al.[20] | ActivePAL attached to participants' thighs for 7 days | Australia Individuals living independently in community (79±5 years): n = 56 | 39±11 (36–42) |
| Maddocks and Wilcock[21] | ActivePAL attached to participants' thighs for 6 days (2 weekend) | England Patients with end-stage thoracic cancer (66±9 years): n = 84 | 45±17 (41–49) |
| Ryan et al.[22] | ActivePAL attached to thigh for 7 days | Scotland Patients with low back pain (45±11 years): n = 38 | 59±16 (54–64) |

counter every time they completed a STS from the surface of a standard chair height or below. The number of days during which STSs were monitored ranged from 2 to 7. Participants in studies reporting daily STS repetitions were diverse. Most participants were community-dwelling/healthy individuals, but some were residents under hospital, rehabilitation or residential care, and some had health issues. Among the latter were patients with congestive heart failure, cancer, osteoarthritis, or low back pain. Most monitored participants were older adults. The total number of participants monitored was 678, with the number in any one monitored group ranging from 5 to 140.

The mean number of daily STSs varied from 33 to 71. The mean number of daily STSs was at least 45 for all groups except for one group of community-dwelling older adults (mean= 39)[20], patients with congestive heart failure (mean=33)[17], and hospital ward residents (mean=36)[15]. Among community-dwelling adults, the number of STSs was greater on weekdays or working days than on weekend days or nonworking days[13, 14].

Total quality scores on the adapted HBQC ranged from 6 to 12 out of 15 (Table 2). The most common impediments to a high quality score were a failure to report confidence intervals, uncertainty as to the representativeness of the sample, and a lack of blinding of research staff.

## DISCUSSION

The STS maneuver is a key element of everyday activity for most people. However, unlike the number of ambulatory steps accumulated daily[23], the number of STSs performed daily has received much less attention. This review shows, nevertheless, that there is useful information regarding daily STSs to guide physical therapy practice. The literature suggests it is reasonable to expect all but perhaps some older community-dwelling individuals (including those with arthritis, cancer, and low back pain) to perform at least 45 STSs per day[13–15, 17–22]. The literature also suggests that it is

**Table 2.** Assessment of methodological quality using a modification of the Hagströmer et al. Checklist for the 10 included studies

| Item | Bohannon et al.[13] | Dall and Kerr[14] | Grant et al.[15] | De Bruin et al.[16] | Van den Berg-Emons et al.[17] | De Groot et al.[18] | Egerton and Brauer[19] | Lord et al.[20] | Maddocks and Wilcock[21] | Ryan et al.[22] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Objective clearly described | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2. Activity clearly described | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3. Participant characteristics clearly described | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 5. Principal confounders clearly described | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 6. Measurements clearly described | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7. Data reduction clearly described | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8. Characteristics of participants with excluded data noted | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 9. Variability of activity data described | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10. Confidence intervals reported | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11. Representativeness of sample delineated | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 13. Research design comparable to other studies | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 14. Alteration in physical activity minimized | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 15. Research staff blinded | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18. Compliance with protocol acceptable | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19. Reproducibility of measure reported | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 8 | 10 | 11 | 12 | 8 | 6 | 8 | 9 | 9 |

1= yes, addressed; 0= not addressed or unable to determine

reasonable to expect fewer daily STS from adults with some pathologies.

Patients performing a limited number of STSs, relative to a comparable patient group or healthy adults, might be considered to be experiencing a work deficit that may contribute to their muscle weakness and activity limitations. They may benefit, therefore, from educational and procedural interventions focused on intentionally increasing STS activity. Studies of patients with stroke suggest this to be the case. Asberg reported some benefits for patients engaged in additional STS training the first 2 weeks after stroke[24]. Tung et al. also reported positive outcomes for patients receiving additional STS training in a rehabilitation center[25]. Boyn et al. described 2 patients more than 2 years post stroke who were initially dependent on assistance to achieve STS. They achieved independence in STS after performing more than 750 STSs over 8–11 sessions[10].

This study had several limitations. First, although the search was thorough, only 10 studies were found, and their heterogeneous samples precluded mathematical consolidation. A larger population-based study will need to be completed if valid normative values for daily STSs are to be determined. Second, a single individual made decisions as to a study's inclusion and performed all abstracting of article content and quality assessments. Therefore, testing agreement with another rater is not described. Third, the HBQC was designed for assessing articles describing self-report rather than performance-based measures. Nevertheless, the instrument's focus is on physical activity. This emphasis was judged to render the instrument a better choice for quality rating than more generic instruments. Fourth, all of the studies included were quite deficient in quality on the basis of the checklist employed. Higher quality studies may yield different results.

In conclusion, it appears on average that the STS maneuver is completed at least 45 times per day by most community-dwelling individuals. The summary of 10 studies provided herein might serve as a basis for exercise goals aimed at increasing STS activity among individuals with fewer daily STSs.

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