

Effects of Extra Training on the Ability of Stroke Survivors to Perform an Independent Sit-to-Stand: A Randomized Controlled Trial

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ABSTRACT

Purpose: Many elderly stroke survivors have difficulty standing up from a seated position. We sought in this study, therefore, to: (1) evaluate whether extra practice increases the likelihood of gaining independence in sit-to-stand (STS); (2) determine the number of repetitions required to achieve a safe, independent STS; (3) assess whether extra STS practice leads to greater patient satisfaction with their general health status and quality of life; and (4) evaluate whether extra STS practice results in fewer falls. **Methods:** Eligible rehabilitation participants were randomly assigned to a conventional or an extra STS practice group. **Results:** There were no statistically significant differences in age, gender, body mass index, time post-stroke, length of stay, duration in study, and motor deficits between the two groups. The difference in the mean daily STS repetitions was significant, 10.6 (inter-quartile range, 8.1-16.5) for the conventional group vs. 14.9 (range, 12.2-20.1) for the extra practice group, $p=0.03$. Sensitivity and specificity were high for the range of mean daily STS repetitions (11.0-13.5). Extra STS practice resulted in 17 out of 25 stroke survivors (vs. 7/23 in the conventional group) standing up safely and consistently from a 16-inch surface without using their hands ($p = 0.02$). Although extra STS practice did not result in fewer falls, those stroke survivors who were able to stand independently expressed greater satisfaction with their quality of life ($p = 0.02$) and physical mobility ($p = 0.003$). **Conclusion:** This study supports the importance of repetitive practice in improving STS performance.

Key Words: stroke, sit-to-stand, exercise, rehabilitation, practice

INTRODUCTION

The process of standing from sitting is a critical precursor to transferring and walking. Past studies have indicated that the ability of stroke survivors to safely transfer impacts on many areas including: their potential for discharge home,¹ fre-

quency of falls,^{2,3} functional capacity,⁴ and burden of care.^{5,6} Consequently, consistent performance of an independent and safe sit-to-stand (STS) maneuver becomes an important rehabilitation objective for stroke survivors and their families.

The STS movement has been well researched in the normal population,⁷⁻¹⁵ in the elderly,¹⁶⁻²⁰ and in the stroke population.^{3,6,21-31} Within our stroke rehabilitation units, stroke survivors tend to practice STS transfers mainly with occupational and physical therapists employing a common protocol. Although many transfers occur on the ward, our nurses had not been trained to follow the same STS protocol, resulting in missed opportunities for stroke survivors to practice STS in a consistent fashion. As the basic biomechanical underpinnings of the STS action have been well described in the literature, we decided that a STS protocol would be relatively easy to teach patients and staff alike.

To date, it is not known how many STS repetitions are necessary before stroke survivors learn to perform the task independently. Moreover, it is unclear whether extra practice of STS, a precursor of transferring and walking, would better enable stroke survivors to perform this task independently. Additionally, there is a lack of normative data by which clinicians could extrapolate a minimum number of STS actions as a target standard for subtask training. The objectives of this study were to: (1) evaluate whether extra STS practice increases the likelihood of patients gaining independence in STS, (2) determine the minimal number of STS actions required for patients to achieve an independent STS during their stay in rehabilitation, (3) evaluate whether extra STS practice resulted in fewer falls, and (4) assess whether extra STS practice leads to greater patient satisfaction with their general health status and quality of life.

METHODS

Subjects

In all, 48 stroke survivors admitted to the Chedoke and Henderson Stroke Rehabilitation Units, Hamilton Health Sciences, Hamilton, Ontario between 2000-2001 were included in the study. Eligible subjects included patients with a complete stroke who: (1) were between the ages of 18-90, (2) were medically stable, (3) had a postural control of stage 3 or greater as measured by the Chedoke-McMaster Stroke Assessment (CMSA),³² and (4) failed the third item of the CMSA Stage 4 Postural Control. For this task, the client sits unsupported on the side of bed, with his or her feet on the floor, and performs a safe, independent rise from sitting to standing (pushing off with hands permissible). Informed consent was obtained from the client or the person responsible for personal care.

On the basis of the flip of a coin, eligible participants who

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were admitted consecutively to the stroke units during the first 4-month period of the study were assigned to the conventional practice group. Eligible participants admitted consecutively to rehabilitation during the next 4 months were assigned to the extra practice group. This sequence of block randomization (ie, assigning participants to either a conventional or extra practice group) was conducted 3 times in total. In the conventional practice group, 23 stroke survivors received daily the regular stroke rehabilitation program that included strengthening exercises with weights and springs, repetitive training, functional training in standing, electrical stimulation, and other therapeutic exercises as well as recreational therapy 3 times a week for 45 minutes. In the extra practice group, 25 stroke survivors received the same daily rehabilitation program as well as 3 weekly 45-minute STS practice sessions in a class setting.

Training Program

Before the study began, 46 full and part-time registered practical nurses (RPNs) and registered nurses were taught the STS protocol (Table 1) to an 85% criterion using videotapes, written instructions, and actual practice.³³ Nurses were given a pre/post-training questionnaire that tested their knowledge of the STS protocol. A physiotherapist, using a standardized checklist, evaluated each nurse's ability to have the stroke survivor stand according to the protocol.

Table 1. Sit-to-Stand Protocol

Encourage client's independence with sit-to-stand (putting on brakes, pushing back footrests, foot placement) whenever possible. Minimize verbal cues and hand gestures as client improves in sit-to-stand performance.	
CHECKLIST	
Action	Instruction
<input type="checkbox"/> brakes on	"Put on your brakes"
<input type="checkbox"/> footrests out of the way	"Push your footrests back"
<input type="checkbox"/> client moves bottom forward in chair	"Scoot your bottom forward"
<input type="checkbox"/> feet shoulder width apart	"Feet apart"
<input type="checkbox"/> toes under the knees	"Toes under knees"
<input type="checkbox"/> interlock the fingers	"Interlock your hands"
<input type="checkbox"/> arms out in front	"Arms out in front"
<input type="checkbox"/> sit tall in the chair	"Sit up tall"
<input type="checkbox"/> nose over knees and stand up in a timely manner	"Nose over your knees and stand up"

Two trained RPNs conducted the extra STS practice sessions in the physiotherapy gymnasium 3 times a week for 45 minutes. The class, usually consisting of 6 to 7 participants, practiced attaining standing from sitting from a variety of different surfaces (wheelchairs, chairs, and benches of varying heights). Each participant attempted to complete 3 practice sets of 5 STS until the class was over. Physical assistance was provided when necessary. After participants were familiar with each other, they were encouraged to provide feedback on each other's STS performance. The conventional group received recreational therapy 3 times a week for 45 minutes in a room in the physiotherapy corridor. The participants remained seated in their wheelchairs. A variety of activities took place that included pet therapy, information sessions about community resources, and interactive word and picture games.

Assessment Procedures

Stroke survivors were supplied with a Sportline hand-held counter that was attached to their wheelchairs. Staff and family members were asked to click each time a STS action was done in therapy, on the ward, or during home visits until the participant either completed the study or was discharged from the hospital. Signs were posted in the participants' rooms and behind their wheelchairs as reminders to record each STS action. A physiotherapist assistant daily recorded the number of STS repetitions. During the study, staff were monitored regularly to ensure that they followed the STS protocol. A research physiotherapist, blind to the study, tested the participants' STS movement once a week. The end points of the study were: (1) when the participants graduated (ie, when they were able to perform 2 independent STS actions from a standardized 16-inch surface [the height of a regular toilet] without using their hands for 2 consecutive days) or, (2) when they were discharged from rehabilitation. Data on the number of falls that occurred during the time of the study were taken from recorded incidence reports.

At the end of the study, 2 measures were administered to evaluate the effect of extra STS practice on the participants' degree of satisfaction with their general health status and quality of life. One of the measures combined a 15-point Likert global rating scale and a 10-point visual analog scale and asked participants to rate their overall satisfaction with their ability to stand and transfer. Potential scores ranged from -20 (totally dissatisfied) to 31 (totally satisfied). The other measure, the Dartmouth Primary Care Cooperative Information Project (COOP charts)³⁴ permits additional 5-point pictorial assessment charts. Participants judged how easily they performed their daily tasks and social activities; their degree of bodily pain; changes in their health, their overall health, feelings, and quality of life; and their ability to perform the STS movement. Potential COOP scores ranged from 8 (no difficulty and positive impact) to 40 (significant limitations and negative impact).

Data Analysis

All data were entered into Microsoft Excel and analyzed using the SAS System for Windows, Release 8.02. The non-parametric test, Mann-Whitney U-test (2-sided), was used to compare participant characteristics of age, body mass index, length of stay, duration of stroke, duration in the study, and the sum of admission CMSA staging of the lower limb and postural control between the extra practice and conventional practice groups since the data were not normally distributed. A chi-square test was used to compare gender, the type of stroke, and the admission leg and foot stage of the affected side between the groups.

Outcome measures were analyzed using the Fisher's exact test (2-sided) to compare the number of participants that fell and the number of graduates per group because the number of incidences was low. The Mann-Whitney U-test (2-sided) was used to compare the mean daily STS repetitions, health status satisfaction (global rating scale/visual analog), and their quality of life (COOP) per group. Sensitivity and specificity for a range of mean daily STS repetitions were calculated; these characteristics examined (1) how sensitive the different

cut-off points were in detecting those stroke survivors who would be able to stand up safely and independently from a 16-inch surface and (2) the adequacy of different cut-off points for rejecting those stroke survivors who would not be able to stand up safely and independently from a 16-inch surface.^{35,36} From these scores, the number of stroke survivors needed to treat (NNT) before seeing a treatment effect from extra STS practice was calculated.³⁶

Continuous results are expressed as medians, inter-quartile ranges (Q1 - Q3), and categorical results are expressed as percentages. Statistical significance was set at 0.05 for all analyses.

RESULTS

Most of the participants were men, elderly, and more than 3 weeks post-stroke. Specifics are presented in Table 2. There were no statistically significant differences in age, gender, body mass index, length of stay, or the time from stroke to first test between the 2 groups. The initial degree of motor deficit in the hemiparetic lower limb, as measured by the CMSA, was similar in both groups; furthermore, there was no difference between the groups in the summed score of the admission CMSA staging of the leg combined with the admission staging of postural control. There was no difference in the degree of neglect, apraxia, and depression between the two groups (data not shown). There were more hemorrhagic strokes in the extra training group than in the conventional group but this was not statistically significant.

Table 2. Characteristics of Participants in the Conventional and Extra Practice Groups

Variable	Conventional Group (n = 23)	Extra Practice Group (n = 25)	P-value
Age (years)*	70.0 (64.0, 78.0)	67.0 (56.0, 72.0)	0.14 [§]
Gender			
Male	14 (60.9)	17 (68.0)	0.61 [†]
Female	9 (39.1)	8 (32.0)	
Body mass index (kg/m ²)*	26.2 (22.9, 30.7)	26.3 (23.4, 28.7)	0.61 [§]
Time from stroke to initial test (days)*	31.0 (18.0, 50.0)	30.0 (21.0, 48.0)	0.93 [§]
Length of stay (days)*	70.0 (56.0, 132.0)	90.0 (58.0 - 115.0)	0.60 [§]
Type of stroke			
Hemorrhage (ICD-9 - (430-432))	4 (17.4)	9 (36.0)	0.15 [†]
Infarction (ICD-9 - (433-337))	19 (82.6)	16 (64.0)	
Side affected			
Right	11 (47.8)	9 (36.0)	0.67 [†]
Left	11 (47.8)	14 (56.0)	
Bilateral	1 (4.4)	2 (8.0)	
Admission leg stage			
I-II	4 (17.4)	2 (8.0)	0.61 [†]
III-IV	16 (69.6)	19 (76.0)	
V-VII	3 (13.0)	4 (16.0)	
Admission foot stage			
I-II	8 (34.8)	6 (24.0)	0.33 [†]
III-IV	13 (56.5)	13 (52.0)	
V-VII	2 (8.7)	6 (24.0)	
Combined admission leg & postural control*	7.0 (6.0, 8.0)	7.0 (6.0, 9.0)	0.42 [§]

All results are expressed as N (%) unless indicated by * which are Median (Q1, Q3)
 Conventional: N = 21 for body mass index
[§]Mann-Whitney U-test (2-sided)
[†]Chi-squareTest

The difference in the mean daily STS repetitions between the two groups was significant (conventional median (IQR): 10.6 (8.1 - 16.5) versus extra practice: 14.9 (12.2 - 20.1); p = 0.03) (Table 3). The median duration of days patients were enrolled in the study was lower in the extra practice group [37.0 (26.0 - 53.0)] when compared to the conventional practice group [57.0 (35.0 - 73.0)] but was not statistically different (Table 3). The sensitivity and specificity of a range of mean number of daily STS repetitions (9.0-14.5) was calculated (Table 4). Figure 1 shows the ROC curve for the mean daily STS repetitions. The mean number of daily STS repetitions where the combined sensitivity and specificity were the highest ranged from 11.0 - 13.5. The number of stroke survivors needed to treat (NNT) before a treatment effect of extra STS practice was observed was 2 (Table 4). Median (IQR) number of 534.0 (386.0 - 758.0) total STS repetitions for the conventional practice group was 599.0 (381.0 - 789.0) for the extra practice group, which was not statistically significant; this finding

Table 3. Comparison of Outcome Measures Between Conventional and Extra Training Groups

Variable	Conventional Group (n = 23)	Extra Practice Group (n = 25)	P-value
Duration in study (days)*	57.0 (35.0, 73.0)	37.0 (26.0, 53.0)	0.09 [§]
Mean daily STS repetitions*	10.6 (8.1, 16.5)	14.9 (12.2, 20.1)	0.03 [§]
Global rating scale*	22.0 (12.0, 28.0)	23.5 (21.0, 27.5)	0.41 [§]
COOP score*	17.0 (14.0, 19.0)	18.0 (15.0, 21.0)	0.66 [§]
Number of participants who fell	4 (17.4)	3 (12.0)	0.70 [†]
Number of graduates [‡]	7 (30.4)	17 (68.0)	0.02 [†]

All results are expressed as N (%) unless indicated by * which are Median (Q1, Q3)
 Conventional: N = 17, 19 for Global rating scale and COOP score, respectively
 Enhanced: N = 20, 21 for Global rating scale and COOP score, respectively
[§]Mann-Whitney U-test (2-sided)
[†]Fisher's Exact Test (2-sided)
[‡]to graduate was measured by the ability to stand up from a 16" surface (the height of a regular toilet) without the use of hands twice for 2 consecutive days

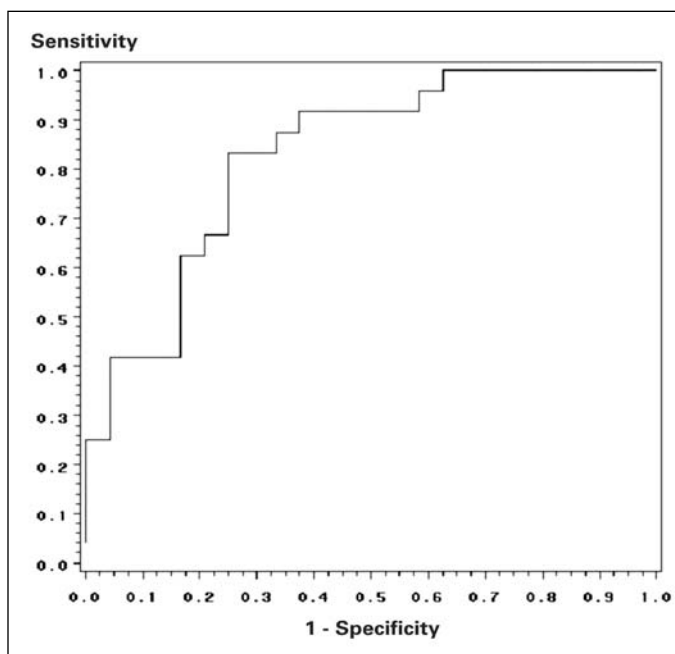


Figure 1. ROC curve for mean daily STS repetitions.

Table 4. Sensitivity and Specificity for Mean Daily Sit-to-stand (STS) Repetitions (total repetitions/number of days in study)

Mean Daily STS	A	B	C	D	Sensitivity	Specificity
≥ 9.0	23	15	1	9	0.958	0.375
9.5	23	14	1	10	0.958	0.417
10.0	22	12	2	12	0.917	0.500
10.5	22	12	2	12	0.917	0.500
11.0	22	10	2	14	0.917	0.583
11.5	21	8	3	16	0.875	0.667
12.0	20	7	4	17	0.833	0.708
12.5	19	6	5	18	0.792	0.750
13.0	18	6	6	18	0.750	0.750
13.5	18	6	6	18	0.750	0.750
14.0	16	6	8	18	0.667	0.750
14.5	16	5	8	19	0.667	0.792

	Graduate	
Mean Daily STS Repetitions	Yes	No
≥ cut-off	A	B
< cut-off	C	D
	A + C	B + D

Sensitivity: A/ (A + C) - the proportion of true positives that are correctly identified by the test
Specificity: D/(B + D) - the proportion of true negatives that are correctly identified by the test
Absolute Risk Reduction: (AR) - graduates over the cut-off minus graduates under the cut-off at 12.5 repetitions 19/25 - 5/23 = 0.760 - 0.217 = 0.543
Numbers needed to treat: (NNT) - inverse of the absolute risk reduction (1/AR) = 1.84

Table 5. Characteristics of Participants who Graduated Compared to those who Failed to Accomplish End Point of Study, Being Able to Stand Up Independently Without the Use of Hands from a 16-inch Surface (the height of a regular toilet)

Variable	Graduate Group (n = 24)	Non-Graduate Group (n = 24)	P-value [§]
Age (years)	24: 66.0 (55.0, 70.5)	24: 70.5 (64.0, 76.0)	0.08
Body mass index	23: 26.2 (23.9, 28.2)	23: 26.9 (22.6, 31.6)	0.88
Time since stroke (days)	24: 28.0 (17.5, 39.5)	24: 33.0 (22.0, 67.0)	0.20
Length of stay (days)	24: 67.0 (50.0, 95.5)	24: 96.0 (62.0, 132.5)	0.08
CMSA (leg & postural control)	24: 8.0 (7.0, 9.0)	24: 6.5 (5.5, 8.0)	0.02
Duration in study (days)	24: 27.5 (18.5, 38.0)	24: 61.0 (56.0, 81.0)	<0.0001
Mean daily STS repetitions	24: 15.9 (13.3, 25.6)	24: 10.2 (8.1, 13.3)	0.0003
Global rating scale	21: 24.0 (22.0, 29.0)	16: 19.5 (10.0, 25.5)	0.03
COOP score	23: 16.0 (11.0, 19.0)	17: 19.0 (17.0, 22.0)	0.02

All results are expressed as N: Median (Q1, Q3)
[§]Mann-Whitney U-test (2-sided)

nongraduates, ie, those participants who were unable to consistently stand up independently from a 16-inch surface.

DISCUSSION

This study demonstrates the importance of repetition in training stroke survivors how to stand from sitting, a subtask of transferring and walking. Participation in the extra STS practice group resulted in significantly more stroke survivors being able to perform a consistent, safe, independent STS from a 16-inch surface (the average height of a regular toilet) without the use of their hands. As the key variables of age, gender, body mass index, time from stroke to first test, type of stroke, and the combined staging of the leg and postural control between the 2 groups were not statistically different, this finding emphasizes the need for stroke survivors to have multiple opportunities to perform a functional activity during rehabilitation. Furthermore, as the length of stay in rehabilitation was similar between the 2 groups, it would appear that extra STS practice not only resulted in more stroke survivors standing up safely and independently from a 16-inch surface, but also they reached the targeted goal in far less time (See Table 3). Although the latter finding was not statistically significant (0.09), there was a median difference of 20 days between the conventional and extra practice groups (57.0 vs. 37.0 days).

As seen in Table 4, we determined a range of mean daily STS repetitions (11.0-13.5) that yielded the highest combinations of sensitivity and specificity for detecting whether a stroke survivor was able to graduate (ie, stand up safely and consistently from a 16-inch surface). This range reflects a trade-off commonly seen in clinical tests between high sensitivity (where the chance of incorrectly saying that a person will not graduate is relatively low) and high specificity (where the accuracy of identifying nongraduates or those persons unable to stand up from a 16" surface is reasonably high).^{35,36} This is demonstrated by selecting a cut-off of 12.5 mean STS repetitions per day which has a sensitivity of 0.79 and a specificity of 0.75. However, a cut-off of 9.0 repetitions per day has a sensitivity of 0.96 and a specificity of 0.38. In other words, we

did not take into account the total number of days the clients were enrolled in the study. The Spearman correlation coefficient was not statistically significant between the mean daily STS and the total STS repetitions ($\rho = 0.05$, $p = 0.74$). There was no difference between the 2 groups on the global rating scale and on the COOP score. There was statistical significance between the 2 groups in the number of stroke survivors who were successful in standing up twice from a 16-inch mat surface, the average height of a regular toilet, without the use of their hands, for 2 consecutive days. In the conventional group, only 7 graduated while in the extra practice group, 17 participants graduated ($p = 0.02$). There was an equal number of falls in both groups. In the conventional group, 3 participants fell once and one individual fell 3 times. In the extra practice group, 3 participants fell twice.

When both groups were combined, post hoc analyses comparing those who did and did not graduate showed no statistical difference in time from stroke to first test, age, and body mass index; however, the combined staging of leg and postural control was higher in the group who graduated, ie, were able to stand up twice from a 16-inch surface without using their hands on 2 consecutive days, $p=0.02$ (Table 5). There was a trend towards significance ($p = 0.08$) with the graduate group staying fewer days in rehabilitation. There was a significant statistical difference in the number of days the graduate group practiced the STS action ($p < 0.0001$). As well, there was a significant statistical difference in the COOP score ($p = 0.02$), mean number of STS repetitions ($p = 0.003$), and the global rating scale ($p=0.03$) between graduates and

are more likely to overestimate the number of graduates, as we are not detecting the nongraduates as well as we did in the first example. A cut-off of 14.0 STS repetitions per day has a sensitivity of 0.67 and the specificity of 0.75. In this last example, we are more likely to underestimate the number of graduates due to the likelihood of there being more false negatives present. From this table of various sensitivities and specificities, we may conclude that the probability of successful graduation within this sample is most accurately measured at practice levels from 11.0-13.5 mean daily STS repetitions. Also important, our results indicate that the minimum number of stroke survivors needed to be treated before an effect of extra STS practice could be detected is 2 individuals. These findings provide strong clinical evidence for providing consistent instructions as well as developing extra opportunities, such as supervised STS classes, where stroke survivors may practice standing up from different types of surfaces that vary in height.

Our total STS repetitions, in the 450-500 range, were similar to the numbers reported by other researchers.^{23,30} However, there was no correlation between the mean number of daily STS and the total number of STS repetitions as the number of days each stroke survivor was in the study varied. Despite our best efforts to accurately record the number of STS movements, we believe that our data may underestimate the total number of repetitions. Although the hand-held counters were easy to click, there was no lock-in mechanism that prevented them from being reset; consequently, stroke survivors reported that their grandchildren sometimes played with the counters. As well, agency nursing staff and/or family often neglected to record STS actions over the weekends. In future, a different type of counter may improve data recording. However, the reality of collecting this type of data on a busy rehabilitation nursing floor continues to be problematic.³⁷

Furthermore, normative data regarding the number of times adults stand and change positions during activities of daily living are lacking. In unpublished studies that recorded the number of STS actions over a 1-week period, a healthy elderly couple performed a daily average of 33.3 STS movements while 4 physiotherapy students performed a daily average of 25.6 STS actions.³⁸ Despite our best efforts at control, the daily number of STS repetitions in the extra practice group was still far less than those of these healthy elderly. It is possible that increased daily repetitions may have resulted in more stroke survivors being able to achieve an independent STS.

Increased nursing awareness of the STS biomechanical parameters has the potential to enhance the number of times stroke survivors received tactile, visual, and verbal feedback during the day. This coordinated effort appeared to help those stroke survivors with multiple sensory, perceptual, and cognitive deficits learn how to perform the correct motor sequence of coming up into standing from sitting. Furthermore, those participants assigned to the extra practice group developed a camaraderie where they encouraged each other and celebrated successful attempts. Consequently, this type of practice environment, combined with consistent feedback from all staff, resulted in more stroke survivors being able to stand independently.

Furthermore, by learning proper positioning of their feet,

trunk, and head, stroke survivors increased weight bearing through their hemiparetic lower limb while decreasing their dependency on their upper limbs. However, ground reaction forces were not measured. Despite more stroke survivors in the extra practice group demonstrating improved functional performance, there was no significant difference in the incidence of recorded falls. Those participants who fell did not successfully learn how to stand independently, regardless of their assigned group. As the falls were not witnessed, we were unable to determine the possible factors that may have contributed to their falling.

Although 68% of the participants in the extra practice group were able to stand up independently from a 16-inch surface (the height of a regular toilet) without the use of their hands, their perceptions about the quality of their lives and their general abilities to move did not differ from the feelings of stroke survivors in the conventional group. Two reasons may account for this lack of a significant finding: (1) missing data (ie, global rating scale and COOP not completed) may have resulted in a sample size too small to detect a clinically important change in the participants' ability to move or in their feelings of self-efficacy; or (2) despite achieving the end point of the study (ie, the ability to stand up consistently from a surface similar in height to a regular toilet) other rehabilitation challenges still confronted them. Even though these stroke survivors were now able to stand safely, it did not necessarily guarantee them independent walking and therefore, greater physical mobility and freedom.

However, when we collapsed the data between the 2 groups and looked at those stroke survivors who graduated versus those stroke survivors who did not succeed in being able to stand up independently from a 16-inch surface without the use of their hands, we found a significant difference in their perceptions about the quality of their lives and improvement in general mobility. Those stroke survivors who were able to stand up consistently from a 16-inch surface (graduated) performed more STS movements and felt better about themselves and their ability to transfer and move. As these participants had a significantly higher stage of motor recovery of their leg and postural control, it may be that those stroke survivors assigned to the conventional group were able to practice more on their own, even without the STS practice class. Whether the increased STS repetitions emanated from class or individual practice, those stroke survivors who learned how to stand up safely and independently from a 16-inch surface without using their hands spent significantly less time in the study. It would appear that once they learned the STS protocol and had opportunity to practice, they reached the targeted goal of an independent STS in far less time than those participants who were unable to perform an independent STS. Again, these results stress the importance of giving stroke survivors' consistent instructions and opportunities to perform task specific training.

CONCLUSIONS

The results of this study strongly support the concept of consistent repetitive practice for relearning the STS action, an important subtask of transferring and walking. Our approach to increasing the number of stroke survivors who became able

to stand up independently and safely from a 16-inch surface included: (1) the implementation of a standardized STS protocol that was followed by the clients, their families, and the nursing and therapy staff; and (2) the provision of extra opportunities to practice the STS action within the rehabilitation setting. Our data also indicate that there may be a minimum range of daily STS repetitions needed for stroke survivors to achieve independence in standing up from sitting.

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