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Cognitive Impairments and Depressive Symptoms Did Not Impede Upper Extremity Recovery in a Clinical Repetitive Task Practice Program after Stroke:

A Pilot Study

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Abstract

Objective—We examined whether cognitive impairments or depressive symptoms impeded improvement in upper extremity function in a clinical repetitive task practice program.

Design—Participants had mild to moderate upper extremity impairment after stroke ($n=20$). We characterized baseline cognitive function and depressive symptoms with the Repeatable Battery of Neuropsychological Status and the Hamilton Rating Scale for Depression. We measured upper extremity function at baseline, week 4 and week 24 with the Action Research Arm Test.

Results—Participants with and without cognitive impairments improved significantly over time ($F_{1,17}=84.48$, $p<.001$), regardless of cognitive status ($t_{31}=1.42$, $p=.16$) or time since stroke ($t_{17}=0.7$, $p=.95$). Participants with and without depressive symptoms improved significantly over time ($F_{1,18}=86.29$, $p<.001$), but participants with depressive symptoms demonstrated greater improvement than participants with no depressive symptoms ($t_{31}=3.19$, $p=.003$), regardless of time since stroke ($t_{17}=.06$, $p=.95$).

Conclusions—Preliminary findings suggest that cognitive impairments and depressive symptoms may not impede benefit from repetitive task practice after stroke.

Keywords

Stroke; Repetitive Task Practice; Cognition; Depression

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While repetitive task practice programs improve upper extremity use and function after stroke,¹⁻² there remains some debate among clinicians as to whether clients with comorbid cognitive impairments or depressive symptoms attain benefit from these programs. Repetitive task practice programs facilitate intense task-oriented practice with the affected upper extremity, and frequently include supervised clinic-based practice, as well as prescribed home-based practice components. For these reasons, one may argue that individuals with cognitive impairments or depressive symptoms may not remember to or have the ability to initiate and complete home-based practice, thereby limiting opportunities for practice-based improvements. However, cognitive impairments and depressive symptoms frequently co-occur with upper extremity impairment after stroke,³⁻⁴ and therefore it is important to empirically examine whether cognitive impairments and depressive symptoms influence treatment response attributed to repetitive task practice programs.

Repetitive task practice studies usually exclude individuals with severe cognitive impairments (typically defined by Mini-Mental State Examination <24),² and no studies have reported whether cognitive impairments influenced treatment response. One study has examined whether depressive symptoms influenced treatment response, reporting that depressive symptoms did not appear to limit treatment response to a progressive exercise program focused on strength, balance, endurance and upper extremity function.⁵

Our pilot study examined whether cognitive impairments and depressive symptoms influenced improvement in upper extremity function in an outpatient clinical program using a standardized repetitive task practice protocol. We predicted that clients with cognitive impairments and clients with depressive symptoms would demonstrate less improvement in upper extremity function over time compared to clients without these impairments or symptoms

METHODS

Procedures were approved by the University Institutional Review Board. Participants were recruited from clients referred to a protocol-driven repetitive task practice program at an outpatient occupational therapy clinic affiliated with the academic health center ($n=20$). Inclusion criteria were: 1) unilateral hemiparesis due to stroke (diagnosed at the time of onset using World Health Organization criteria);⁶ 2) mild to moderate upper extremity impairment (at least 15 degrees active elbow flexion, 15 degrees active wrist extension, and 10 degrees active distal interphalangeal flexion); and 3) limited upper extremity use (Motor Activity Log ≤ 3).⁷ Exclusion criteria were: 1) subdural or subarachnoid hemorrhage, 2) stroke location in brainstem or cerebellum, 3) inability to understand and follow one-step directions 4 out of 5 attempts, 4) learning disability or dementia, and 5) progressive neurological condition (i.e., multiple sclerosis).

We characterized baseline cognitive function using the Repeatable Battery of Neuropsychological Status (RBANS).⁸ The RBANS is a valid and reliable battery that assesses cognitive function in 5 domains (immediate memory, attention, visual spatial function, language and delayed memory) and yields an age-adjusted total index score (mean=100, standard deviation=15). We defined the presence of cognitive impairments as a total index score greater than 1 standard deviation below the mean, or a score less than 85.

We measured baseline depressive symptom burden using the Hamilton Rating Scale for Depression (HamD).⁹ The HamD is a standardized interview-based assessment examining the frequency and intensity of 17 depressive symptoms, yielding a total score ranging from 0

to 52. We defined the presence of a clinically meaningful level of depressive symptoms as a total score greater than 7.¹⁰

Upper extremity function was measured at baseline, post-treatment (week 4) and at follow-up (week 24) using the Action Research Arm Test (ARAT).¹¹ The ARAT is a standardized performance assessment of grasp, grip, pinch and gross motor tasks. These tasks address both impairment of voluntary movement functions, and disability of fine hand use, as defined by the International Classification of Functioning, Disability & Health.¹² Nineteen items are rated on a 0 (no movement possible) to 4 (movement performed normally) scale, yielding a total score ranging from 0 to 57. All assessments were administered by trained raters supervised by licensed occupational therapy, neuropsychology and psychiatry personnel.

Upon completion of baseline testing, participants were engaged in a protocol-driven repetitive task practice program that involved both clinic and home practice components. The clinic component provided therapist-supervised repetitive task practice activities 60 minutes per visit, 3 visits per week, for 4 weeks. The home practice component required that participants complete 60 minutes of practice per day, 7 days per week for 4 weeks. Participants documented home-based practice time using structured diaries. In both clinic and home-based programs, repetitive task practice activities were selected in collaboration with each participant based on baseline motor abilities and interests, and focused on grip, grasp, manipulation, and reaching activities using contextually-relevant objects available in the participants' homes (full protocol and compendium of activities available from the corresponding author).

We examined differences in characteristics between individuals based on cognitive function and depressive symptom burden using chi-square and independent *t*-tests. To test the study hypotheses, we conducted 2 separate mixed effects models analyses using an unstructured repeated measure covariance structure to account for the lack of compound symmetry in the residual covariance matrix. In the first analysis, we examined differences in mean total ARAT scores between groups (cognitive impairments, no cognitive impairments) and over time (baseline, week 4, week 24) controlling for covariates identified in the descriptive analyses. In the second analysis, we repeated the same procedures, but changed the groups (depressive symptoms, no depressive symptoms).

RESULTS

Of the 42 clients referred to the clinic for the repetitive task practice program during the study period, 27 provided written informed consent, and 20 met study criteria. Among the 7 ineligible participants, reasons for exclusion were stroke location in the brainstem (2), absence of limited use of impaired upper extremity (2), and co-morbid progressive neurological conditions (3). Eligible and ineligible participants did not differ with respect to age, gender, time since onset, or stroke hemisphere (data not shown). Table 1 provides the characteristics of eligible participants (*n*=20). The mean age of the sample was 60 ($\pm$ 12) years, and 50% were male. Sixty percent sustained stroke in the left hemisphere, and 50% experienced impairment of their dominant upper extremity. All participants completed the intervention program and baseline and week 4 assessments. Furthermore, all participants completed a minimum of 45 minutes of home-based practice 7 days a week over the 4 week program, and there were no differences in average minutes of home-based practice between groups. We added the 24 week assessment after the first 5 participants completed the study, so only 15 participants completed the 24 week assessment.

Comparing participants with and without cognitive impairments, only baseline cognitive function scores were significantly different between groups ($t_{17}=4.34$, $p<.001$). However, we added time since stroke as a covariate in the analyses given the clinically meaningful difference between groups. Participants with and without cognitive impairments improved significantly over time ($F_{1,17}=84.48$, $p<.001$; Figure 1), regardless of cognitive status ($t_{37}=1.42$, $p=.16$) or time since stroke ($t_{17}=.07$, $p=.95$).

Comparing participants with and without depressive symptoms, only baseline depressive symptom levels were significantly different between groups ($t_{18}=6.63$, $p<.001$). Once more, we added time since stroke as a covariate in the analyses. Participants with and without depressive symptoms improved significantly over time ($F_{1,18}=86.29$, $p<.001$), but participants with depressive symptoms demonstrated greater improvement than participants with no depressive symptoms ($t_{31}=3.19$, $p=.003$; Figure 2). Time since stroke did not influence rate of recovery in either group ($t_{17}=.06$, $p=.95$).

DISCUSSION

Preliminary findings suggest that neither cognitive impairments nor depressive symptoms impede treatment response, and that individuals with these deficits are still likely to benefit from repetitive task practice programs. That is, despite cognitive impairments and depressive symptoms, individuals demonstrated improvements in the ability to use the affected upper extremity during grasp, grip, pinch and gross motor tasks, and these improvements were maintained at the week 24 follow-up assessment.

Participants with cognitive impairments and depressive symptoms in this sample were in the subacute phase of neurological recovery (i.e., less than one year). It is possible that cognitive impairments and depressive symptoms resolve over time and therefore are not as likely to be detected among individuals in the chronic phase of recovery. Approximately 30 to 50% of individuals demonstrate cognitive impairments within the first 3 months after stroke, with as much as 50% of these individuals demonstrating improvement in the first year.¹³ Furthermore, the peak incidence of depressive symptoms occurs 3 to 6 months post stroke, and then tapers off by one year.^{4,14} It may also be true that individuals who have persistent cognitive impairments and depressive symptoms are less likely to seek intervention through outpatient clinical programs. Nonetheless, the findings do raise the question as to whether clients in the subacute phase are more likely to show greater improvement in upper extremity function than clients in the chronic phase of recovery with the same severity of cognitive impairments and depressive symptoms. Previous studies have reported accelerated trajectories of upper extremity recovery in the acute and subacute phases of recovery compared to the chronic phase of recovery.¹⁵ The pilot study was not designed to address this question. While time since stroke was not a significant factor in either analysis, we suggest that future studies stratify participants based on chronicity.

Participants with depressive symptoms demonstrated significantly greater improvement in upper extremity function over time than participants with little to no depressive symptoms. This unexpected finding is intriguing, but is similar to findings reported elsewhere.⁵ In the current study, participants with depressive symptoms were in the subacute phase of recovery and therefore may have had more potential for greater improvement in upper extremity function than participants with little to no depressive symptoms who were in the chronic phase of recovery. However, Lai et al. reported greater improvements in upper extremity function among participants with significant depressive symptoms, and all participants (whether experiencing significant or insignificant levels of depressive symptoms) were in the subacute phase of recovery.⁵ It may also be that between our exclusion of potential participants with major depressive disorder (HamD = 16), and our cut off score for

depressive symptoms (HamD >7), we isolated participants with minor depression or with an adjustment disorder with depressive symptoms. Both of these conditions are less severe than major depressive disorder, and are typically not treated with medications. A structured repetitive task practice program that involves activation and socialization may have provided a positive effect on mood that influenced recovery.¹⁶ Nonetheless, given the small sample, we cannot generalize these findings beyond this clinical study.

This pilot study was only an initial clinical examination of the influences of cognitive impairments and depressive symptoms on treatment response. Given the small sample, we were limited in exploring the influences of selected domains of cognitive impairments (i.e., attention, visuospatial function), or selected depressive symptoms (i.e., depressed mood, anhedonia). Nonetheless, preliminary findings suggest that clients with global cognitive impairments and depressive symptoms who have mild to moderate upper extremity impairment do appear to benefit from repetitive task practice programs, and thus should not necessarily be excluded from these clinical programs.

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Figure 1.
Trajectory of Improvement in Upper Extremity Function Scores, by Cognitive Status

Figure 2.
Trajectory of Improvement in Upper Extremity Function Scores, by Depressive Symptoms

Table

Participant Characteristics

	Total Sample (N=20)	Cognitive Impairments (n=13)	No Cognitive Impairments (n=7)	Moderate Mood Symptoms (n=6)	No, Mild Mood Symptoms (n=14)
Male (%)	50	62	29	$\chi^2_f=1.57$	$\chi^2_f=0.00$
Mean Age (years)	60 (12)	56 (11)	65 (12)	$t_{18}=1.64$	$t_{18}=0.41$
Time Since Onset (months)	11 (17)	6 (9)	19 (25)	$t_{18}=1.15$	$t_{18}=1.09$
Left Hemisphere (%)	60	61	57	$\chi^2_f=0.00$	$\chi^2_f=2.54$
Dominant Side Affected (%)	50	54	43	$\chi^2_f=0.43$	$\chi^2_f=0.95$
Cognitive Function (RBANS)	79 (14)	73 (13)	91 (5)	$t_{17}=4.34^*$	$t_{17}=1.59$
Mood Symptoms (HamD)	6 (4)	7 (3)	5 (4)	$t_{18}=1.05$	$t_{18}=6.63^*$
Upper Extremity Function					
Baseline (ARAT)	30 (16)	28 (15)	34 (18)	$t_{18}=0.82$	$t_{18}=0.47$
Week 4 (ARAT)	34 (16)	33 (15)	34 (20)	$t_{18}=0.08$	$t_{18}=1.31$
Week 24 (ARAT)	40 (16)	39 (18)	42 (15)	$t_{13}=0.43$	$t_{13}=1.31$

Note. RBANS=Repeatable Battery of Neuropsychological Status. HamD=Hamilton Rating Scale for Depression. ARAT=Action Research Arm Test.

* $p<.05$