ORIGINAL RESEARCH

Yoga and Exercise for Symptoms of Depression and Anxiety in People With Poststroke Disability: A Randomized, Controlled Pilot Trial

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ABSTRACT

Context • Mood disorders are prevalent in people after stroke, and a disorder's onset can exacerbate stroke-related disabilities. While evidence supports the mental-health benefits of participation in exercise and yoga, it is unknown whether such benefits extend to a population with poststroke hemiparesis.

Objective • The study investigated whether supplementing exercise with participation in a yoga program would provide further improvements in self-reported symptoms of depression and anxiety in a chronic poststroke population, and it also assessed trial feasibility for future studies.

Design • The research team designed a randomized, controlled pilot trial that included an exercise-only group (EX, control) and a yoga-and-exercise group (YEX, intervention).

Setting • The study took place at the Centre for Physical Activity in Ageing an exercise rehabilitation and activity center at the Royal Adelaide Hospital in South Australia.

Participants • The participants included 14 individuals with chronic poststroke hemiparesis: eight in the intervention group and six in the control group.

Interventions • The YEX group participated in a 6-week standardized program that included yoga in weekly group sessions and home practice in addition to exercise in a weekly group class. The EX group participated only in the group exercise class weekly for 6 weeks.

Outcome Measures • The research team assessed self-reported symptoms of depression using the Geriatric Depression Scale (GDS15) and symptoms of anxiety and negative affect using the State Trait Anxiety Inventory (STAI). The team based the feasibility evaluation on recruitment outcomes, retention of participants, participants' compliance with the intervention program, and the safety of the intervention.

Results • Changes in depression and state and trait anxiety did not significantly differ between intervention groups (GDS15 $P = .749$, STAI-Y1, $P = .595$, STAI-Y2, $P = .407$). Comparison of individuals' case results indicated clinically relevant improvements in both groups, although members of the intervention group had greater improvements. Participants reported no adverse events, and the study experienced high retention of participants and high compliance in the yoga program.

Conclusions • This pilot study provides preliminary data on the effects of yoga combined with exercise to influence mood poststroke. It is a feasible, safe, and acceptable intervention, and the field requires additional investigations with a larger sample size. (Altern Ther Health Med. 2012;18(3):34-43.)

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Stroke is a leading cause of adult disability worldwide,[1] with an increasing prevalence due to a growing elderly population and poor control of risk factors.[2] Patients typically report many sequelae after a stroke including (1) physical impairment (most typically hemiparesis or one-sided weakness), (2) speech impairment, (3) cognition loss, and ultimately, (4) a reduced quality of life (QOL).[1] Furthermore, an increased risk of mental-health conditions can complicate life further after a stroke.[3-5] Some cases of mental-health conditions, such as depression, can manifest endogenously as a result of brain lesions in the location that the stroke affected, although the nature and extent of this type of mental health condition is unknown, and patients' symptoms should be interpreted cautiously.[3,4] Another more common explanation for the existence of these mood disorders in one-third of all stroke survivors, however, can

be factors such as (1) the initial shock during the early weeks of the stroke incidence, (2) feelings associated with loss of independence, (3) loss of physical function, and (4) lifestyle issues, such as sedentary behavior and social isolation.[4,5] Regardless of their origins, mental-health conditions such as depression and anxiety are potential risk factors for physical disability, and research indicates that management of depression may result in improved physical function.[6]

MENTAL-HEALTH BENEFITS OF PHYSICAL ACTIVITY AFTER STROKE

People who have had a stroke are more likely to experience depression and anxiety relative to the general population.[7] This finding highlights the need to broaden care beyond an emphasis on outcomes related to physical functioning to include interventions that address both physical and mental-health determinants of QOL.[8-10] The focus of care also needs to broaden beyond acute and subacute stages of rehabilitation to long-term and sustainable services and programs that allow individuals to engage in practical, active, creative, and meaningful ways of addressing life after stroke.[11] One approach to supporting health-related QOL for people who have had a stroke involves participation in physical-activity programs. The prevalent sedentary behavior in this population increases the risk of stroke recurrence, death due to stroke, heart disease, diabetes, falling, and mental health comorbidities such as depression.[12] Researchers have shown that participation in physical-activity programs improves gait velocity, mobility, and balance.[13-15]

In terms of mental health, a study by Mead et al has provided support for an exercise-related reduction of depression in the general population.[16] Researchers have paid little attention to the applicability of this finding to a stroke population, and only one randomized controlled trial (RCT) tentatively supports reduced depressive symptoms with physical activity.[17] Although physical activity can provide benefits for the physical health of people with stroke, reduced exercise tolerance resulting from sedentary behavior and diminished movement efficiency due to disability[12] may limit the extent to which exercise garners mental-health benefits for that population. Both of these factors may make it difficult for individuals to reach the exercise intensities and volumes necessary to derive mental-health benefits.[18]

Mental-health Benefits of Yoga Practice

An adjunctive approach involving yoga may increase the mental-health benefits that a stroke population may gain from its participation in exercise. Yoga is a system of self-development that has evolved over many thousands of years since its inception in ancient societies based in southern Asia. Yoga is derived from the Sanskrit root verb yuj, which translates to mean "unite," and this meaning implies an emphasis on the union of mind, body, and spirit. More practically, individuals can interpret that emphasis to mean that they can use their yoga practices holistically to address not only their physical needs (eg, their physical activity) but also their mental (eg, cognitive function) and emotional (eg, positive mood states) needs. The use of movements and postures called asanas, combined with breathing techniques or pranayama, form the most popular style of yoga called hatha yoga. It is common for practitioners to combine hatha yoga with meditation for a complete mind-body approach that achieves the aims of yoga. According to ancient Vedic scriptures, those aims involve calming and focusing the mind to reduce mental turmoil by limiting stress, overstimulation, and excess expectations. Consequently, people widely accept yoga as a means to reduce stress and to prevent or manage mental-health conditions. Consistent with this popular belief, several studies have demonstrated the therapeutic benefits of yoga for depression[19,20] and anxiety.[21]

Researchers have not yet delineated the mechanisms by which yoga supports mental health, but likely they involve a combination of biological, psychological, and social benefits.[22] Most important for individuals who have a physical impairment due to stroke, yoga, unlike strenuous exercise, may not necessarily rely on high levels of physiological challenge to derive mental-health benefits. To justify the potential mechanisms of yoga in improving mental-health conditions, Streeter et al have shown that yoga asanas increase brain levels of gamma-aminobutyric acid, a neurotransmitter for which low levels have been associated with depression and anxiety.[23] In addition, Brown and Gerbarg have shown that pranayama breathing practices are effective in management of mental health conditions such as posttraumatic stress disorder in war veterans and survivors of natural disasters. Possibly the practices encourage neuroplastic changes that downregulate fear and stress responses.[24] Finally, Young has shown that meditation imparts long-term changes in the brain that are associated with the prevention of mental-health conditions, including a decreased density of amygdala grey matter; this decrease is associated with a reduction in levels of stress-signaling molecules and increased levels of dopamine.[25] When individuals combine these yoga practices, the potential for greater relaxation and control over emotions, mood, and anxiety may exist.[19,26]

Two preliminary single-case studies of yoga as a stroke-rehabilitation modality have provided promising, clinically relevant results for improvements in fine motor skills, balance, timed movement, and QOL, as shown in the Stroke Impact Scale[27,28] Researchers have completed no studies, however, that have investigated the mental-health outcomes of yoga in people who have had a stroke, despite the prevalence of mental-health conditions in this population. Saeed et al have shown a reduction in anxiety and depression in a general population through combining exercise and yoga as an integrated approach,[29] suggesting a possible synergy between these treatment modalities. How well researchers can extrapolate this finding to a stroke population remains undetermined.

METHODS

Aims of the Study

The initial aim of this pilot study was the evaluation of changes in self-reported symptoms of depression and anxiety as a result of interventions involving exercise only or a combination of exercise and yoga.

Given the paucity of studies that have investigated exercise and yoga interventions in a population with a stroke-related disability, an additional aim of this study was evaluation of the feasibility of

the intervention in terms of adherence and safety for the purpose of conducting future large-scale studies.

Design and Setting

The research team designed the study as a pilot—a single-blinded randomized controlled trial (RCT)—for individuals with chronic poststroke hemiparesis. The team designed it in accordance with the CONSORT statement for RCT protocols.[30] The Royal Adelaide Hospital's and the University of South Australia's Human Research Ethics Committees both approved the research protocol. In addition, the research team registered this RCT with the Australian New Zealand Clinical Trials Registry (ANZCTR). The research team ensured blinding in the study, with the outcome assessor and the randomization allocator both unaware of the participants' groups.

The research team randomized participants either to an exercise only (EX) group or a yoga and exercise (YEX) group, using a computer-generated randomization process (Microsoft Excel, Microsoft Corporation, Redmond, Washington) and concealed allocation procedures that a person external to the study completed. The team informed participants of their group allocations via mailed letters of notification. The study wait-listed participants in the EX group for participation in a yoga program that commenced after the trial's completion. The Centre for Physical Activity in Ageing (CPAA) conducted the weekly group exercise and yoga classes at its rehabilitation and health facility. The center is affiliated with the Royal Adelaide Hospital, located in South Australia. The center held the exercise classes in the group-exercise activity room and the yoga and meditation classes in a quiet group-activity room located within the facility.

Participants and Recruitment

The research team recruited participants from the CPAA's database of stroke patients (total of 419) who had previously participated in group exercise classes. The research team sent out recruitment announcements and information about the study via posted mailings (317 letters) to those individuals and in some cases contacted individuals directly by phone (62 calls). In addition, the CPAA made verbal announcements to recruit participants in ongoing exercise classes and also placed printed recruitment flyers on notice boards around its facility. The recruitment period lasted for 1 month in total.

After interested individuals made an initial phone contact with investigators, the research team screened them for participation eligibility and scheduled eligible participants for a preintervention assessment held at the CPAA. At the preintervention assessment, participants signed informed-consent forms, and then a physical therapist tested them to determine if hemiparesis was present. Individuals who met all eligibility criteria then completed preintervention, self-reported measures of anxiety and depression. After completion of the preintervention assessment, the research team mailed eligible participants their group-allocation letters.

Inclusion Criteria. Criteria for participants' inclusion included a minimum of 6 months elapsed time since the stroke incidence and the presence of chronic hemiparesis. Hemiparesis was part of the inclusion criteria because this criterion demonstrated physical disability. In addition, individuals must have completed acute and postacute stroke rehabilitation and had to be able to ambulate for 10 m or more with or without the use of an assistive walking device. This criterion would indicate the minimum level of physical ability required for participation in the study.

Exclusion Criteria. The research team excluded individuals if they (1) suffered from other movement disorders in addition to hemiparesis, (2) were unable to follow two-step verbal commands, (3) were currently research participants in any other studies related to physical activity, or (4) were currently practicing any yoga-related activities, including tai chi.

Interventions

Yoga. The yoga program was 6 weeks in duration. It involved six once-a-week, 90-minute group classes and 24 individual home-practice sessions scheduled over the 6 weeks, each lasting approximately 40 minutes. One of the research investigators, Maarten A. Immink, an accredited Satyananda yoga teacher and an accredited exercise physiologist, developed the program. The investigator based the program's yoga practices on hatha yoga and on meditation practices from the Satyananda yoga tradition.[31,32] See Appendices 1 and 2 for the class and home program respectively.

An accredited yoga teacher, with whom the research team signed a contract for the purpose of the study, conducted the group yoga classes. The research team scheduled those classes on an alternate day from the group exercise classes. Each class commenced with a 10-minute didactic activity that the teacher presented on yoga-relevant topics such as safety, practice modification, and aims. After the introduction, the class involved a hatha yoga component with approximately 30 minutes of modified asana practice involving gentle and slow movements and 5 minutes of pranayama practice involving gentle breathing with concentrated attention.

Although the study did not individualize the hatha yoga asana component for individual participants, the research team designed each of the six group classes to introduce new practices progressively, increasing the number of rounds and encouraging awareness of movement and body sensations. Moreover, the yoga asanas maintained the progressive nature of the class through modification of the basic asanas to suit participants' willingness to challenge themselves and their functional capacities. For example, the teacher demonstrated unilateral modification of movement, encouraged visualization for increased range of motion and permitted participants to use chairs and walls as supports during some of the asanas. After the participants were familiar with the asanas, the instructor taught them to combine gentle breathing techniques with the movements to progress awareness and development further.

Following the hatha yoga component, the yoga teacher provided a verbally guided 30-minute meditation practice called Satyananda yoga nidra. Participants could practice this meditation either while seated in a chair or lying in a supine position on a yoga mat on the floor, depending on their preferences. The Satyananda yoga nidra involved a series of verbally guided stages including brief relaxation, mental awareness of body-region sen-

sations, natural-breath awareness, and mental repetition of a personally chosen goal. The end of the class involved a 15-minute group discussion on topics related to the yoga program or personal experiences of it.

The teacher instructed participants to participate in daily home practice on days in which they were not involved in a group yoga class. To support home practice, the research team issued participants a yoga mat, an illustrated instruction manual, and a compact disc with recorded verbal instructions. The 40-minute home-practice session included 10 minutes of hatha yoga and 30 minutes of Satyananda yoga nidra. The home practice progressed by having one set of hatha yoga practices for weeks 1 to 3 and a second set of hatha yoga practices for weeks 4 to 6.

For the purpose of evaluating adherence to the yoga program, the yoga teacher recorded attendance at weekly group classes, and participants self-reported their home practice on a recording sheet that the home-practice instruction manual contained.

Exercise. Participants in the EX and YEX groups both attended six weekly 50-minute exercise classes that the CPAA's clinical exercise physiologist staff delivered. The staff prescribed each participant an individualized exercise program based on results from initial exercise testing. The program consisted of resistance exercises for the upper and lower body on pin-loaded resistance machines and cardiovascular-type exercises on either a bicycle or upper limb ergometer. Foley et al conducted a previous study at the CPAA that describes the exercise program.[33]

OUTCOME MEASUREMENTS

Data Collection

For participants who were eligible for inclusion in the trial, the research team collected information at the preintervention assessment about characteristics, including age, time since stroke, affected hemiparetic side, and hand dominance.

The research team examined participants' mental health preintervention and postintervention, using three outcome measures. The team used the Geriatric Depression Scale-Short Form (GDS15) as a scale of depression.[34] Researchers developed the GDS15 as a tool to screen for the presence of depression in older adults and have reported its internal consistency with Cronbach ($\alpha = .81$) and its high correlations with *The International Statistical Classification of Diseases and Related Health Problems*, 10th revision, *Symptom Checklist for Mental Health Disorders and the Diagnostic and Statistical Manual of Mental Health Disorder*, 4th edition.[35-38] Almeida and Almeida previously interpreted a score between 5 and 7 as a range suggesting mild depression, scores between 8 and 9 as suggesting moderate levels of depression, and a score greater than 10 as suggesting severe depression.[35]

The research team used two forms of the State Trait Anxiety Inventory (STAI, Form Y)[39] to measure state anxiety (STAI-Y1) and trait anxiety (STAI-Y2). These two forms consist of 20 items that respondents rate on a 4-point Likert-type scale depending on how they feel at the moment in time for STAI-Y1 or how they feel generally for STAI-Y2. Although state and trait anxiety are highly correlated,[39] the research team assessed them independently to separate fluctuating vs longer-term changes in anxiety and negative affect. Reported Cronbach's α levels for STAI-Y1 and STAI-Y2 are .86 and .90, respectively against measures of the Attributional Style Questionnaire and Manifest Anxiety Scale for psychological stress.[40] Knight et al have reported a clinically significant cut-off score of 39 on STAI-Y1 for the presence of state anxiety,[41] while Fisher et al have reported a reduction of 8 points on STAI-Y2 as a clinically significant reduction in trait anxiety.[42]

Feasibility outcomes of this pilot study related to (1) participants' recruitment and retention, (2) adherence to the yoga treatment (yoga group–class attendance and home-practice completion), (3) adherence to exercise treatment (exercise-class attendance), and (4) safety of yoga and exercise treatments. The research team based these outcomes on weekly reviews with participants (adverse events).

All analyses of mental-health outcomes due to treatment involved a protocol-based approach and a critical value of $P < .05$ for statistical significance. Due to the small sample size, the research team used a nonparametric statistical approach to compare changes in primary outcomes between the two groups.[43] For this analysis, the team separately rank-transformed data for each outcome measure before it submitted the data to a 2 X 2 [(treatment allocation: YEX, EX) X (time point: pretreatment, posttreatment)] analysis of variance, taking repeated measures on the last factor using SAS version 9.1 (SAS Institute, Cary, North Carolina). The research team summarized participants' data, adherence rates to yoga and exercise treatments, and safety data descriptively for the YEX and EX groups.

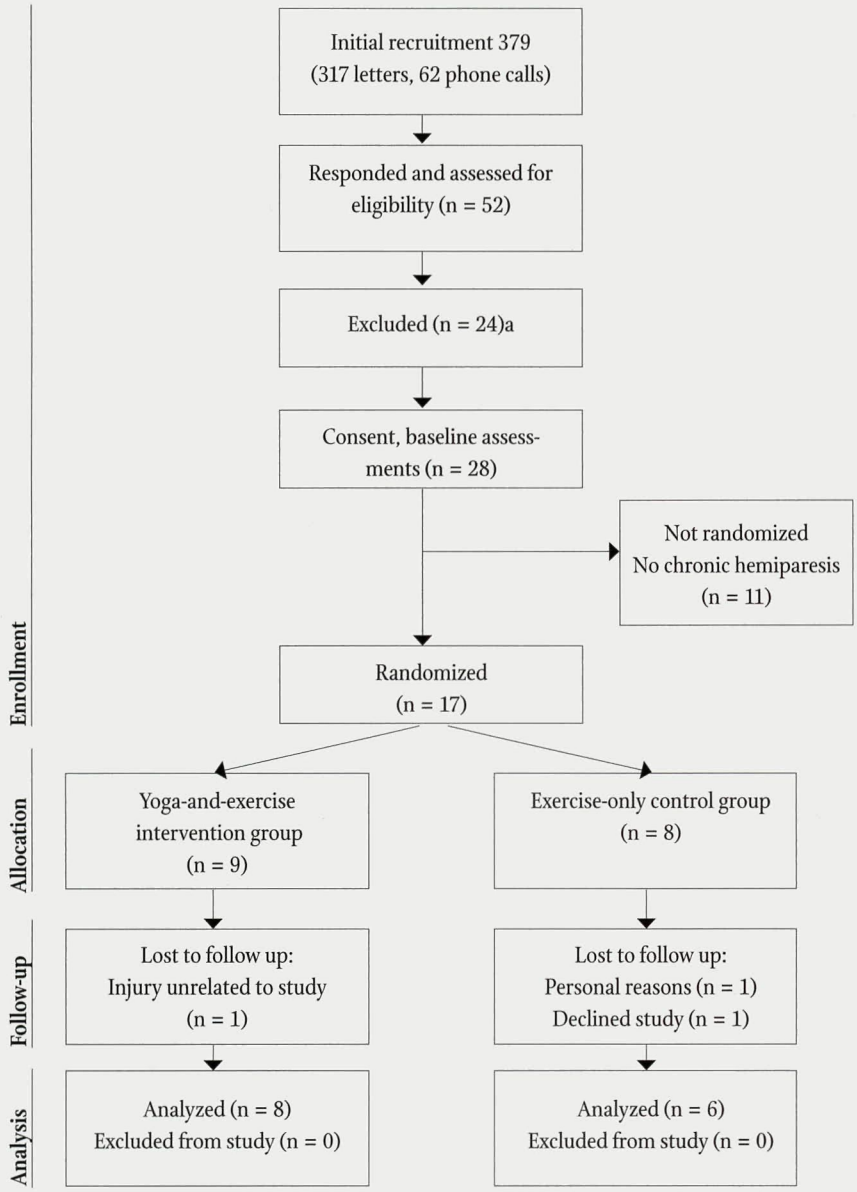
RESULTS

Participants' Recruitment

Over a 1-month recruitment period, 52 individuals responded and indicated an interest in participating in the current study. Of those individuals, the research team excluded 24 individuals during the initial telephone prescreening. Of the remaining 28 individuals who attended an initial assessment, the research team excluded 11 individuals due to a lack of hemiparesis. Thus, the research team included 17 participants in the trial and randomized them to either the YEX (intervention, n = 9) or EX (control, n = 8) group. During the course of the trial, one participant from the YEX group withdrew due to an injury in an incident unrelated to participation in the trial. Two other participants in the EX group also withdrew (one due to an injured and unavailable caregiver and the other due to personal reasons). At the end of the trial, a total of 14 participants, 8 in the YEX group and 6 in the EX group, completed the study and the research team included them in the data analysis. See the Figure for the participants' flow diagram.

The mean age of participants in the YEX group was 67.1 years (standard deviation [SD] = 15.4), while the EX group had participants with a mean age of 71.7 years (SD = 12.7). The mean times since stroke for participants in the YEX group and the EX group was 6.4 years (SD = 3.0) and 11.2 years (SD = 5.8), respectively. Both groups were composed predominantly of male participants, with the YEX group consisting of seven males and one female and the EX group consisting of five males and one female. Three participants in the YEX group were new to having a structured exercise program, while all participants in the EX group already had an existing structured exercise program in the CPAA. A higher

Figure. Participants' Flow Diagram



[a] Reasons for exclusion were as follows: No history of stroke (n = 1); taking part in other forms of structured exercise (n = 3); multiple health conditions (n = 7); and declined participation (n = 13).

proportion of participants in both groups had brain lesions affecting the right side (YEX = 5, EX = 4) rather than the left, and half of participants in each group had hemiparesis affecting the dominant upper limb (Table 1).

Mental-health Outcomes

Across both groups, self-reported scores of depression on the GDS15 decreased from pretreatment (median = 4.0, interquartile range [IQR] = 2, 5) to posttreatment (median = 2.5, IQR = 1, 3), $F(1,12) = 5.28$, $P < .05$. In the analyses, the research team found no other significant effects for GDS15 ($P = .749$), STAI-Y1 ($P = .595$) or STAI-Y2 ($P = .407$). Table 2 presents outcomes for YEX and EX treatment groups at the pretreatment and posttreatment points in time.

Due to the small sample size, the research team evaluated mental health–outcome data descriptively for individual cases in a post-hoc fashion to identify instances where participants in the treatment groups may have experienced clinically relevant changes in mental-health outcomes (Table 3). Overall, participants in both groups exhibited a mixture of decreases, increases, and no changes in GDS15, STAI-Y1, and STAI-Y2 over the course of the trial. For GDS15, two participants in the YEX group had scores in the range indicating a high level of depression at pretreatment (no. 11 and 15). At posttreatment, one of these individuals (no. 11) exhibited a clinically relevant decrease to a moderate level, while the other (no. 15) indicated no change. Two participants (no. 49 and 5) in the EX had GDS15 scores within the mild-depression range, with one of these individuals demonstrating an improvement in depression and the other a worsening at posttreatment.

For STAI-Y1, three participants in the YEX group (no. 11, 8, and 15) and two participants in the EX (no. 18 and 21) scored above the clinically significant score of 39 for state anxiety at pretreatment. Of these, two participants in the YEX group (No. 11 and 8) and one participant in the EX group (no. 18) had clinically relevant reductions in STAI-Y1 scores. For STAI-Y2, one participant in

the YEX group (no. 8) and one participant in the EX group (no. 49) reported clinically relevant reductions in trait anxiety. Overall, two participants in the YEX group demonstrated clinically relevant improvements in two of three outcome measures for depression and anxiety, while two participants in the EX group indicated clinically relevant improvements in only one outcome measure each.

Participant Retention and Adherence

At the conclusion of the 6-week trial, eight participants (88.9%) in the YEX group were still participating in weekly exercise classes, yoga classes, and daily home yoga sessions while six participants (75.0%) in the EX group were still participating in weekly exercise classes. Attendance at the group exercise classes was higher on average for the EX group (mean = 86.0%, SD = 19.5%) than for the YEX group (mean = 77.1%, SD = 30.7%). Participants in the YEX group attended a mean of 97.9% (SD = 6.0%) of the group yoga classes and completed a mean of 76.4% (SD = 26.2%) of the home yoga sessions, equating to 4.9 days of home practice per week. Table 3 presents data for each participant's attendance at exercise and yoga groups for the YEX and EX groups.

Safety

Participants in both the EX group and the YEX group reported no adverse reactions.

DISCUSSION

Prevention and management strategies for mood disorders in people with a disability due to stroke is an area that has attracted little research attention despite the reported prevalence of it and increased risk for it in that population.[7] Previous research has provided initial evidence to support the existence of mental-health benefits from physical activity in a stroke population[17] and from yoga participation in a general population.[21] This pilot study is the first to investigate the additional mental-health benefits that individuals can derive from adding a yoga program to structured exercise. In the current study, supplementing an exercise program with a yoga program did not result in significantly greater improvements in self-reported measures of mental health than participation in an exercise program only. Despite this lack of statistical significance, the data trends still suggest a possible benefit from complementing exercise with yoga for this clinical population. In terms of the YEX and EX groups' results, a larger change in median scores for depression and for state and trait anxiety occurred in the group participating in both the exercise classes and the yoga program compared to exercise only. Within individual case results, the participants demonstrating larger clinically relevant improvements in mental-health scores participated in both exercise and yoga. This finding was particularly important for improvements in state anxiety.

This pilot study was limited by a number of factors. First, this study was most likely underpowered for a between-subject comparative design, particularly given the heterogeneous profile of the participants in terms of mental-health scores and the mixed results from the intervention. Also, no differences existed between participants in terms of ongoing participation in structured exercise prior to involvement in this trial. The study allowed participants taking part in exercise to continue per their usual practice, and if they were not participating, the exercise physiologist in the rehabilitation center prescribed a structured exercise program. All participants in the study were either current or former participants in the rehabilitation center, so they were somewhat familiar with the exercises involved.

For participant no. 8 in the YEX group, the research team found it difficult to determine the activity from which the individual derived the improvements in mental health because of that person's exposure to two new modes of physical activity. Upon further investigation of participation rates, however, the team

Table 1. Baseline Characteristics of 14 Individuals With Chronic Poststroke Hemiparesis Randomized Either to a 6-Week Yoga and Exercise Program (YEX) or an Exercise Only Program (EX)

Variables	YEX Group (n=8)	EX Group (n=6)
Mean (SD) Age (years)	67.1 (15.4)	71.7 (12.7)
Mean (SD) Time Since Stroke (years)	6.4 (3.0)	11.2 (5.8)
Gender, n (%)		
Male	7 (87.5)	5 (83.3)
Female	1 (12.5)	1 (16.7)
Hemiparesis Side, n (%)		
Left	5 (62.5)	4 (66.7)
Right	3 (37.5)	2 (33.3)
Hand Affectedness, n (%)		
Dominant	4 (50)	3 (50)
Nondominant	4 (50)	3 (50)
Usual Exercise Participants, n (%)	5 (62.5)	6 (100)

Abbreviation: SD, standard deviation

Table 2. Median, Interquartile Range Results, Pretreatment and Posttreatment for Yoga and Exercise Program (YEX) and Exercise-only Program (EX) Groups

	GDS15			STAI-Y1 (State)			STAI-Y2 (Trait)		
	Pretreatment	Posttreatment	Group* Time (*p* -value)	Pretreatment	Postreatment	Group *Time (*p* -value)	Pretreatment	Postreatment	Group *Time (*p* -value)
YEX Group (n=8)									
Median (IQR)	4.0 (1.5, 7.5)	2.0 (1.0, 5.5)		31.5 (29.0, 45.4)	30.5 (23.5, 35.5)		35.3 (27.5, 47.5)	33.5 (26.5, 45.0)	
EX Group (n=6)			0.749			0.595			0.407
Median (IQR)	3.5 (2.0, 5.0)	3.0 (2.0, 3.0)		36.0 (33.0, 38.0)	35.5 (32.0, 38.0)		41.5 (40.0, 43.0)		

Abbreviations: GDS15, Geriatric Depression Scale 15; IQR, interquartile range; STAI, State Trait Anxiety Inventory (Y1-State and Y2-Trait).

Table 3. Individual Pretreatment and Posttreatment Results for Individuals Allocated to Yoga and Exercise Program (YEX) and Exercise Only Program (EX) Groupsa

					GDs15			STAI-Y1			STAI-Y2		
YEX Participant	**Usual Exercise Participants (Yes/No)**	**Gym Attendence**	**Home Yoga Practice**	**Yoga Class Attendence**	**Pre**	**Post**	**Change**	**Pre**	**Post**	**Change**	**Pre**	**Post**	**Change**
11	Yes	100%	25%	100%	11	8	-3[b]	49	35	-14[c]	56	50	-6
8	No	50%	69%	100%	4	1	-3	42	31	-11[c]	39	26	-13[c]
33	Yes	100%	61%	100%	1	2	+1	28	22	-6	27	27	0
52	No	17%	100%	83%	4	3	-1	30	25	-5	38	36	-2
48	No	67%	92%	100%	2	1	-1	25	20	-5	28	25	-3
16	Yes	100%	97%	100%	4	2	-2	31	30	-1	33	40	+7
15	Yes	100%	67%	100%	13	13	0	58	59	+1	59	55	-4
35	Yes	83%	100%	100%	0	0	0	32	36	+4	27	31	+4
EX Participant													
18	Yes	83%	-	-	4	3	-1	39	34	-5[c]	49	45	-4
28	Yes	100%	-	-	1	1	0	33	29	-4	26	28	+2
21	Yes	100%	-	-	3	3	0	47	44	-3	41	45	+4
49	Yes	83%	-	-	5	3	-2	34	32	-2	42	31	-11[c]
5	Yes	50%	-	-	5	7	+2	38	37	-1	40	44	+4
9	Yes	100%	-	-	3	2	-1	31	38	+7	43	43	0

a Higher scores on the GDS and STAI indicate a worse state of depression and anxiety respectively. Negative (–) change scores indicate a better performance, while positive (+) change scores indicate a worse performance in the scale of measure.
[b]Clinically relevant change in the GDS15.
[c]Clinically relevant changes in the STAI.
Abbreviations: GDS15, Geriatric Depression Scale 15; STAI, State Trait Anxiety Inventory (Y1-State and Y2-Trait).

found that participant no. 8 had taken part in only 50% of the exercise classes and 69% of the home-practice yoga sessions. These figures fell below the YEX group average of 77.1% for participation in exercise classes and 76.4% of home-practice yoga sessions. Therefore, improvements in the mental-health measures of participant no. 8 may not be due simply to participation in two new modes of physical activity, nor would increased rates of participation in the two different physical activities necessarily affect the mental-health outcomes observed for the rest of the YEX group.

For the current study, it is difficult at this stage to determine whether the YEX group's clinically relevant improvements in mental-health outcomes were due to the exercise program, the yoga program, the combination of the two programs, or even the additional attention and group activity that the combined treatments afforded. Saeed et al suggest a potential synergistic effect for the combination of exercise and yoga, which other researchers need to investigate further.[29]

A second limitation of the current study involves the length of the interventions. Both the exercise and the yoga program were substantially shorter than those programs previously reported to provide mental-health benefits. While some participants in both groups responded to the short treatment, it is quite possible that a study with a longer treatment period would demonstrate clinically relevant mental-health benefits and larger improvements in scores for more participants.

The current study's pretreatment-and-postintervention design presented another limitation because the study captured the highly labile self-reporting of symptoms of depression and anxiety only at two points in time. Finally, the design of this trial meant that the research team could not isolate the mental-health benefits of participation in exercise and yoga from one another and could not compare them to a control group receiving either yoga only or no treatment.

The present study also set out to determine the feasibility of conducting subsequent large-scale studies investigating the mental-health efficacy of exercise and yoga programs in individuals

with a stroke-related disability. Participation in group exercise and yoga programs appears to be safe because participants reported no adverse effects during the trial. In addition, adherence to both treatment modes was high, which may indicate that adding yoga to an existing exercise program is easy and that participants found it enjoyable. For the YEX group, attendance at the exercise classes was slightly lower than for participants who attended only the exercise classes. This finding might be due to the additional burden of traveling to the facility on two occasions rather than one. If that reasoning is correct, it appears that the participants favored attending the yoga classes.

Of particular interest for feasibility purposes was the extent to which participants participated in the home-practice component of the yoga program. Although adherence to home yoga is variable among the YEX group's participants and some issues might exist in terms of reliability in the self-reporting of completion of home practice, the present results indicate that participants generally will adhere about 4 days per week to home practice lasting 40 minutes per day. Anecdotally, participants reported enjoyment of the home practice as it gave them the opportunity to participate in an activity that provided them with a sense of calm. They also reported that the availability of verbally guided instructions supported their participation in home practice.

The present study identified one feasibility issue related to participants' recruitment. Despite numerous mailings and direct recruitment activity, including phone calls and announcements during exercise classes, fewer participants than anticipated responded affirmatively to the study's requests for participation.

Appendix 1. 6-week Standardized Protocol for Group Yoga Classes for Individuals With Chronic Stroke Hemiparesisa

YOGA PRACTICES (Postures, Breathing, and Meditation)	CLASS PROGRESSION OF YOGA PRACTICEW BY WEEKS						Classes with posture
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	
Theme	Introduction, self-care, non-competition, modification of practice	What is yoga?	Value of the breath	Internal awareness	Importance of stillness	Meditation in practice	
Focus	Familiarization with practices, instruction on movement (no breath or direction of awareness)	Feeling direct awareness to body, slow movement for attention but no breath coordination	Movement with breath awareness: inhalation and exhalation	Internalization: closing of eyes, directing practices inward	Movement and stillness: the interplay and counterpose of dynamic and still asamas	Movement and stillness: ther interplay and counterpose of dyname and still asamas	
Postures							
Corpse pose	Yes	Yes	Yes	Yes	Yes	Yes	6
Seated base position (mat or chair)	Yes	Yes	Yes		Yes	Yes	5
Ankle Rotation	Yes	Yes		Yes	Yes	Yes	5
Knee Bending	Yes	Yes					2
Hand-clenching	Yes	Yes	Yes	Yes	Yes	Yes	6
Elbow-bending	Yes			Yes			2
Neck movements	Yes	Yes	Yes	Yes			4
Palmtree post (mat, standing, or chair)	Yes	Yes	Yes	Yes	Yes	Yes	6
Toe Bending							1
Shoulder socket rotation			Yes				2
Waist rotation					Yes		2
Ankle bending			Yes				1
Wrist bending			Yes				1
Squat and raise			Yes	Yes	Yes	Yes	4
Cycling (mat, standing or chair)			Yes	Yes	Yes	Yes	4
Pulling the rope				Yes	Yes	Yes	3
Rowing the boat					Yes	Yes	2
Cat stretch					Yes	Yes	2
One-legged prayer pose (standing and supported)						Yes	1
Breathing							
Natural breath	Yes	Yes		Yes			3
Abdominal breath	Yes	Yes	Yes	Yes	Yes		5
Breath sensing		Yes		Yes	Yes	Yes	4
Thoracic breath			Yes	Yes			2
Tracing of breath to eyebrow center				Yes	Yes	Yes	3
Alternate nostril breath					Yes	Yes	2
Meditation							
Yoga Nida in corpse pose	Yes	Yes	Yes	Yes	Yes	Yes	6

[a] Practices are described in Saraswati (2008, 2001) and were adapted for individuals with hemiparesis.

Out of a total of 379 potential participants, only 52 responded during the month-long recruitment period. Of those who responded, many did not meet the eligibility criteria that the research team had set for investigation of a cohort of individuals who had stroke-related hemiparesis. Significant to the aim of this study was the fact that most of the trial's participants did not indicate clinically significant levels of depression and anxiety that were as high as those reported in previous studies.[4,5,7] Recruitment and subsequent retention of participants with mood disorders is likely to be an issue for future studies involving participation in exercise and yoga programs.

CONCLUSIONS

This initial investigation provided some preliminary support for the notion that individuals with stroke-related disability may achieve additional mental-health benefits from an integrative approach involving participation in a combined exercise and yoga program as opposed to exercise only. Group exercise and yoga classes and yoga home practice are safe, have high levels of compliance, and are tolerated well. The field needs future research that addresses the effectiveness of participation in exercise and yoga classes for the purpose of improving the mental health of the clinical population of individuals with stroke-related disability. Recommendations for future work include (1) larger sample sizes, (2) recruitment of participants with clinically relevant levels of mood disorder, (3) longer intervention periods, and (4) research designs that allow for mental-health assessments at multiple points in time and that provide appropriate comparisons between the intervention and control groups.

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Appendix 2. 6-week Standardized Protocol for Home Yoga Practice for Individuals With Chronic Stroke Hemiparesis[a]

YOGA PRACTICES (Postures, Breathing, and Meditation)	CLASS PROGRESSION OF YOGA PRACTICEW BY WEEKS					
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Theme	Introduction, self-care, non-competition, modification of practice	What is yoga?	Value of the breath	Internal awareness	Importance of stillness	Meditation in practice
Focus	Working alongside the weekly practice and to establish safe home practice.			Progression of home practice inline with weekly classes.		
Postures						
Corpse pose		Yes			Yes	36
Seated base position (mat or chair)		Yes			Yes	36
Ankle Rotation		Yes			Yes	36
Knee Bending		Yes				18
Palmtree post (mat, standing, or chair)		Yes			Yes	36
Swaying palm tree pose					Yes	18
Shoulder socket rotation		Yes				18
Waist rotation		Yes			Yes	36
Wrist bending		Yes				18
Squat and raise					Yes	18
Rowing the boat					Yes	18
Breathing						
Natural breath		Yes				18
Abdominal breath		Yes			Yes	36
Alternate nostril breath					Yes	18
Meditation						
Yoga Nida in corpse pose		Yes			Yes	36

[a] Practices are described in Saraswati (2008, 2001) and were adapted for individuals with hemiparesis.

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