Exercise intervention in brain injury: a pilot randomized study of Tai Chi Qigong

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Abstract

Objective: To examine the effects of a brief Tai Chi Chuan Qigong ('Qigong') exercise intervention on individuals with traumatic brain injury.Design: A single-centre randomized controlled trial pilot study.Setting: A registered charity day centre in the community.

Subjects: Twenty individuals with traumatic brain injury.Intervention: Intervention participants attended a Qigong exercise session for one hour per week over eight weeks. Control participants engaged in non-exercise-based social and leisure activities for the same intervention period.Measures: Outcome was assessed at baseline and post intervention using the General Health Questionnaire-12, the Physical Self-Description Questionnaire and the Social Support for Exercise Habits Scale, to measure perceived mood, self-esteem, flexibility, coordination, physical activity and social support.

Results: Groups were comparable at baseline. After the intervention, mood was improved in the exercise group when compared with controls (U 1⁄4 22.0, P 1⁄4 0.02). Improvements in self-esteem (Z 1⁄4 2.397, P 1⁄4 0.01) and mood (Z 1⁄4 –2.032, P 1⁄4 0.04) across the study period were also evident in the exercise group only. There were no significant differences in physical functioning between groups. In view of the sample size, these findings are inconclusive.

Conclusions: This study provides preliminary evidence that a brief Qigong exercise intervention programme may improve mood and self-esteem for individuals with traumatic brain injury. This needs to be tested in a large-scale randomized trial.

Introduction

Traumatic brain injury is considered a prominent cause of death and disabilities in Europe contributing to a range of physical, cognitive and psychological impairments. Disturbances in behaviour and emotion experienced as a result of brain injury may impact on mood and self-esteem, causing problems with engagement and participation in a social environment.[1] Impairments in physical movement, coordination and balance are often present in mild to moderate traumatic brain injury cases that may impact on activities of daily living.[2] Increasing physical activity in the general population and in those with disabilities is important since sedentary lifestyles are associated with deconditioning which increases risk of secondary disease.[3,4] Physical activity is particularly important for individuals with traumatic brain injury since they have been shown to be more deconditioned when compared with non- disabled sedentary individuals[5] and may thus be at even greater risk for cardiovascular disease, diabetes and other preventable diseases although this is yet to be determined in longitudinal studies.[5]

Exercise interventions in brain injury are steadily emerging[6] and a recent Cochrane review identified a small number of randomized trials reporting mixed outcomes of cardiorespiratory fitness training.[7] Aerobic studies are often in hospital or rehabilitation inpatient settings,[8–10] focused on moderate to severe injury[10] or lacking randomization of participants.[11] Psychological outcomes of interventions for people with traumatic brain injury, living in the community, are less available,

although community-based aquatics programmes based on small numbers of participants have shown increases in both functional capacity and physical self-esteem.[12,13] Conventional forms of exercise such as water or gym-based activities have shown promise although may not suit all, yet little is known about less conventional forms of physical activity.

Tai Chi Chuan ('Tai Chi') is gaining popularity in the Western world and has demonstrated potential for both physiological and psychological benefits in those with chronic conditions.[14] However, this ancient Chinese fitness and martial arts form can take several years to master for full benefit. Tai Chi Qigong ('Qigong') is a Chinese mindful exercise, based on similar principles, but is a simpler form requiring less physical and cognitive demands and is therefore proposed as suitable for individuals with traumatic brain injury at varying levels of function. It requires no equipment, can be practised in the home and can be learned over a shorter period of time than Tai Chi, potentially giving participants a more immediate sense of independence, self-esteem and mastery of postures involved. The core components include concentration, relaxation, mind exercises, breathing exercises, body posture and movement. Both Tai Chi and Qigong are suggested to improve indicators of health-related quality of life and psychological health in chronic illness[14,15] and it has been proposed that Qigong may serve to reduce self-perceived functional lim- itation and have an antidepressant effect.[15] Confidence to exercise, coordination and flexibil- ity have all improved with Tai Chi in an older

population.[16] A community Tai Chi intervention in individuals with traumatic brain injury demon- strated improvements in mood, but not self- esteem,[17] although the effects of either Tai Chi or Qigong in neurological samples is still unclear and at present evidence is based mostly on non- randomized studies.[16,18]

Introducing exercise sessions within community day centre activities may help in making exercise more accessible to this group and set exercise within a social context since social support is known to influence physical activity participation.[19] However, it is not yet known whether Qigong as a holistic form of exercise can improve self-perceived physical and psychological function in traumatic brain injury. Therefore, the primary research question for this study was: 'Does participation in a Qigong exercise intervention improve mood, self-esteem, perceived flexibility, coordination, physical activity and social support in people with traumatic brain injury?'

Methods

This was a single-centre pilot randomized controlled trial study, based on an 'intention- to-treat' principle, conducted over an eight-week intervention period at a 'Headway House' community day centre which provides support services for individuals with brain injury and their caregivers. Ethical approval was granted by the local NHS Ethics Committee in May 2008. The exercise group received supervised Qigong instruction (see Appendix) once per week for one hour. This

schedule reflected the level of physical activity intervention that could be offered within a programme of activities provided by the day centre. The control group attended non-exercise social and leisure activities at the centre for one hour per week over eight weeks, which included group discussion, table games, drawing, reading and writing classes.

An opportunity sample was utilized. There were 60 individuals with brain injury registered with the day centre and all registered individuals were considered for inclusion in the study (see Figure 1). Participants were eligible if they were able to attend the day centre once weekly, were 18 years or older, if they had a brain injury occurring one year or more ago and they were able to provide informed consent for the study (n = 10). Of 50 participants eligible to take part, 30 were not interested, leaving a sample of 20 participants.

Recruitment of participants was conducted through the day centre two weeks prior to the start of the intervention. Invitation letters and information sheets were mailed from the day centre, to all participants meeting the study criteria (n = 50). Consenting participants were randomly allocated into either the intervention (n = 10) or control group (n = 10) using a computer-generated random number table where odd numbers were assigned to intervention and even numbers to control condition. Randomization was completed by the principal investigator who was not involved in recruitment, delivery of intervention or data collection.

Each participant's general practitioner (GP) received a letter informing him or her about the voluntary nature of the study and providing contact information for the researchers. Baseline and follow-up data was collected by the study researcher via mail or anonymous collection box situated at the day centre, unless assistance was required with completion of the forms. The exercise intervention was conducted by an independent Qigong instructor who was not involved in the recruitment, randomization or data collection procedures. The control group activities were supervised by day centre staff, who were not involved in the randomization or data collection procedures.

At recruitment, participants provided demographic information and GP details. At baseline and at the end of the eight-week intervention, participants completed the General Health Questionnaire-12,[20] the Social Support for Exercise Habits Scale.[21] and the Physical Self Description Questionnaire.[22] Participant questionnaires contained no personal details but were allocated unique identifier numbers to ensure confidentiality.

Outcome measures

The General Health Questionnaire-12 item[20] was used to assess participant mood. The binary method of scoring (0–0–1–1) was adopted. This measure shows evidence of validity and reliability[23] and has been used previously to assess general health in parents of children and adolescents with traumatic brain injury.[24]

The Physical Self-Description Questionnaire[21] was used to measure participant self-esteem, flexibility, coordination and physical activity. This measure consists of 11 factors, which are specific to how an individual describes himself or herself physically. The scale uses a Likert response scale of '1' for false and '6' for true. Validity and reliability of the Physical Self-Description Questionnaire have been established and the validity of the measure can be maintained if subscales of the measure are used and no total score is given.[25] This measure has recently been used to assess self-esteem and physical self-concept in an aquatics programme for individuals with brain injury.[12]

The Social Support for Exercise Habits Scale[22] was used to assess levels of social support participants received from friends and family. Individuals were asked to rate on a Likert scale (1 'none'; 2 'rarely'; 3 'a few times'; 4 'often'; 5 'very often'; or 'does not apply') the amount of support they received for participating in exercise. A separate score was obtained for family and friends support. This scale has demonstrated reliability and validity[22] and has been used with a brain-injured population.[13]

Data were analysed using Statistical Package for Social Sciences (SPSS) version 15.0. The intention-to-treat carry forward method was used to replace missing data under the assumption that the data collected at baseline remained constant.[26] Mann–Whitney U-tests were conducted to compare the exercise group with the

control group at baseline and eight weeks follow-up.

Further analysis was conducted to compare baseline and follow-up scores on each outcome measure in each group using the Wilcoxon signed rank tests.

Results

There were 60 individuals with brain injury assessed for eligibility (see Figure 1).

Descriptive statistics are provided in Table 1. Gender ratio was comparable with the brain-injured population.[27] No adverse events were reported in either group. The groups were equivalent on demographic and injury indices, and did not differ on baseline outcome measures. With 10 participants in each group and eight sessions there were a possible 80 attendances per group. In the exercise group, there were 58/80 attendances (72.5%). In the control group, there were 64/80 attendances (80%).

Group comparisons at follow-up are presented in Table 2. Mann–Whitney U-test conducted on outcome measures at eight weeks follow-up showed a significant difference between exercise and control groups in mood on the General Health Questionnaire-12. There were no significant differences between exercise and control group on measures of Social Support for Exercise Habits from family or friends, Physical Self Description Questionnaire coordination, self- esteem, flexibility and physical activity. Secondary analyses were conducted using the

Wilcoxon signed rank test to examine changes from baseline to follow-up in the exercise and control groups. There were no significant differences in the control group.

In the exercise group, mood scores were significantly lower at follow-up than at baseline on the General Health Questionnaire-12 (Z 1⁄4 –2.032, P 1⁄4 0.042), indicative of better mood, and self- esteem scores were significantly higher at follow- up compared with baseline on the Physical Self Description Questionnaire self-esteem (Z 1⁄4 2.397, P 1⁄4 0.017), indicative of greater self-esteem. The analysis was corrected for multiple comparisons using Sidak's adjustment, resulting in a critical alpha of 0.02. Thus, the only effect which remained significant following correction was for the Physical Self Description Questionnaire. Spearman's correlations between the change scores for mood and self-esteem with baseline variables found no significant results.

[insert Table 1 and Table 2 here]

Table 1 Demographic details of participants at recruitment and session attendance

	Control group ($n=10$)	Exercise group ($n=10$)
Age (years) range (mean ± SD)	20–63 (46.20) ±11.27)	30–62 (44.5 ±10.52)
Gender, *n* (%)		
Male	6 (60%)	9 (90%)
Female	4 (40%)	1 (10%)
Ethnic groups, *n* (%)		
British	9 (90%)	7 (70%)
Caribbean	1 (10%)	
White and Black Caribbean	1 (10%)	
Any other mixed background	1 (10%)	1 (10%)
Relationship status, *n* (%)		
Single	6 (60%)	7 (70%)
Married	3 (30%)	3 (30%)
Other	1 (10%)	
Time since injury at entry (years), range (mean ± SD)	2–40 (14.89 ±13.62)	5–31 (16.40 ±9.04)
Ambulatory status at entry, *n* (%)		
Non-ambulant	1 (10%)	1 (10%)
Walking aids	1 (10%)	3 (30%)
Ambulant	8 (80%)	6 (60%)
Cause of injury, *n* (%)		
Road traffic accidents	7 (70%)	7 (70%)
Falls	2 (20%)	1 (10%)
Acts of violence	2 (20%)	
Other	1 (10%)	
Injury severity, *n* (%)		
Mild	4 (40%)	3 (30%)
Moderate	4 (40%)	4 (40%)
Severe	2 (20%)	3 (30%)
Attendance, median (IQR)	6.5 (5–8)	5 (4.75–8)

Table 2 Comparison between control and exercise groups

	Control group ($n=10$)			Exercise group ($n=10$)			Eight-week comparison Mann–Whitney U-test[a]	
	Baseline Median (IQR)	Follow-up Median (IQR)	Change Median (IQR)	Baseline Median (IQR)	Follow-up Median (IQR)	Change Median (IQR)	U	P-value (2-tailed)
SSEH family support	20.5 (10)	14 (13.25)	–6.5 (3.25)	23.5 (14)	16 (12.25)	–7.5 (–1.75)	42.5	0.567
SSEH friend support	18 (10.75)	12.5 (4.75)	–5.5 (–6)	21 (14)	14 (13.5)	–7 (–0.5)	35.5	0.266
GHQ-12	3.5 (4.75)	2.5 (2.75)	–1 (–2)	1.5 (3.75)	0 (1)	–1.5 (–2.75)	22	0.026*
PSDQ coordination	3.75 (2.55)	4.25 (2.67)	0.5 (0.12)	3.42 (2.67)	3.42 (2.66)	0 (–0.01)	45.5	0.733
PSDQ self-esteem	2.55 (1.12)	2.88 (1.16)	0.33 (0.04)	2.83 (0.96)	3.44 (1.12)	0.61 (0.16)	37.5	0.344
PSDQ flexibility	3.58 (2.59)	4.17 (3.09)	0.59 (0.5)	3.33 (1.96)	2.92 (1.62)	–0.41 (–0.34)	41	0.496
PSDQ physical activity	1.5 (3.12)	1.67 (3.41)	0.17 (0.29)	3.17 (1.71)	3.50 (2.04)	0.33 (0.33)	34.5	0.240

SSEH, Social Support for Exercise Habits Scale; GHQ-12, General Health Questionnaire-12; PSDQ, Physical Self-Description Questionnaire; IQR, interquartile range, U, Mann–Whitney U statistic.
*Significant at $P<0.05$.
[a]Mann–Whitney U-tests were conducted to compare control group with exercise group on each outcome measure at follow-up.

Discussion

Research on Tai Chi/Qigong exercise in brain injury is very limited.[17,28] The primary aim of this pilot randomized study was to assess whether a brief Qigong exercise programme improves self- perceived physical and psychological functioning in people with traumatic brain injury. This study showed a small but significant difference in mood between the Qigong exercise group and the non-exercising control group at the eight-week follow- up assessment. Secondary analyses also identified improvements in mood and physical self-esteem across the study period in the Qigong exercise group only. Improvements in psychological out- comes are unlikely to be simply a result of the social contacts participants

received in Qigong classes, since both exercise and control groups engaged in social activities. There were no significant changes in physical functioning following the intervention.

These findings are based on a pilot sample, are therefore not conclusive evidence and must be treated with caution. The sample size was small and limited due to constraints of time and funding, which means the study was under-powered. Further investigation would be strongly encouraged in a larger randomized controlled trial. Based on a power calculation for a follow-up study, to detect a moderate effect size of around 0.5 (Cohen's d), a sample size of 51 in each group is required to give 80% power (5% one-tailed significance). Based on recruitment in this pilot study, allowing for 50% refusal rate and ensuring equal sized groups, a total of 204 eligible participants would need to be invited to participate to recruit n1⁄4102. To be adequately powered, a multicentre trial would therefore be required.

The randomized controlled design applied to this pilot study lends some credibility to these results, and there may be positive implications for clinical rehabilitation practice. We are cautiously optimistic regarding the potential for psychological benefits of Tai Chi Chuan and Qigong as has been previously demonstrated in neurological populations.[15,17,18] This study also provides tentative support for the potential bene- ficial effects of other forms of exercise on self- esteem[12,29] and in reducing depression.[30] These preliminary findings are important since low mood

and low self-esteem can affect social adjustment after brain injury.[1] Interventions which have potential to improve psychological outcomes may therefore also help to support social integration and readjustment. Although these findings need to be replicated in a larger population, Qigong may offer an accessible alternative to traditional aerobic physical activity for individuals with disabilities as a means of improving psychological health, and this form of exercise may be further practised in the home environment, without the need for expensive equipment or gym membership, to supplement supervised group sessions. This pilot study therefore raises interesting issues, which are worthy of further investigation.

Aside from the small sample, a number of limitations are evident which have implications for future study design. In the present study, follow-up was restricted to immediately post intervention and so the long-term effects of participation and the potential for further attrition are unclear. A second limitation is that the follow-up assessor was not blind to group allocation. However, care was taken to ensure the randomization and delivery of intervention was not con- ducted by this individual and we are therefore confident that the effects identified in the exercise group were not influenced by the lack of blinding of the assessor. The study was further limited by the use of subjective self-report outcome measures only. Although these were valid and reliable measures and support the aim of the study to determine change in perceived physical and psychological outcomes, supplementing self- report measures with performance-based outcome measures

would extend these findings to more objective ratings of mood and physical function. Day centre management staff identified potential participants without cognitive impairment, however, participants were not screened on neuropsychological measures and it is still possible that some participant responses may have been affected by limited awareness of their thoughts, feelings and behaviour, or difficulties in aggregating the occurrence of behaviours across times and situations.

The duration and intensity of this brief exercise intervention was limited, with only a single hour of exercise per week over an eight-week period. This level of activity reflected that which could be reasonably offered by the day centre at the time of study. However, we feel that this is likely to be a level of group-based physical activity that is most acceptable to sedentary participants when initiating a long-term lifestyle change. Previous Tai Chi Chuan interventions in traumatic brain injury suggest this time-period may be sufficient, with positive psychological outcomes shown after twice-weekly sessions conducted over just six weeks,[17] although the impact on physical function is still unclear. It is possible that a longer intervention period or more regular sessions may improve physical conditioning and, indeed, improved flexibility and coordination has been demonstrated in neurological populations from seven months[16] to four years[28] of practice, although these findings were not based on randomized studies and may be biased towards those who have sufficient motivation to engage in regular, long-

term activities. Although Qigong as com- pared to Tai Chi Chuan requires less time to master,[31] practice may still need to be continued more frequently, and for a longer period of time than this brief intervention offered before substantial health benefits are achieved. The duration and intensity of Qigong required for both physical and psychological benefit still needs to be determined.

This pilot Qigong intervention was well-received by participants, caregivers and service deliverers, and was able to be integrated within a schedule of activities provided for individuals with brain injury at a community day centre. However, due to the small sample size, we do not know whether some participants benefited more than others and if so, the reasons why. Further, attendance was lower in the exercise than control group, and attendance at the Qigong classes was greater for some participants than others. There is therefore a need to explore the determinants and barriers to physical activity participation in traumatic brain injury, to ensure that future exercise interventions better meet the needs of this population. Day centres may consider incorporating caregivers within Qigong sessions to maximize the benefits and increase likelihood of home practice outside of supervised session time. While exercise interventions for people with traumatic brain injuries are on the increase,[6,7] the cost-effectiveness of engaging in alternative forms of physical activity such as Qigong is yet to be assessed, but needs to be determined to inform future service development.

In conclusion, Qigong may have some positive short-term psychological benefits

for individuals with brain injury although more conclusive evidence is needed. Physical and psychological outcomes in both the short and long term need to be further investigated in a large-scale multicentre randomized trial with increased frequency and duration of exercise sessions, objective outcome measures and cost-benefit analysis.

Clinical Messages

- Brief Qigong exercise intervention may improve mood and self-esteem in individuals with brain injury.
- These findings are inconclusive and warrant further investigation in a large-scale randomised trial.

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Conflict of interest

None declared. Headway House were not involved in the interpretation and write-up of

findings.

Author contributions

Study was designed by HB and MB. MB recruited all participants, MB collected data. HB determined data analysis. HB and MB analysed the data. HB is the study guarantor. HB and MB wrote the paper.

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Appendix 1 – Details of Qigong exercise intervention

Tai Chi Chuan Qigong ('Qigong')[31] has many potential health benefits including increased relaxation, flexibility, balance, coordination, strengthening and posture. It is a low-intensity physical activity, and unlike many types of exercise, is accessible to people of all ages and physical conditions. Since this exercise form is not strenuous it carries no potentially harmful side-effects. A certified instructor with seven years' experience in working with individuals with brain injury in the local area conducted the Qigong sessions, which included a combination of both hard and soft martial arts techniques called 'Neigong'. Each session started with chair-based stretching and warm-up followed by work in self-hand massage reflexology. The original 'Shibashi', an 18-style form of Qigong, was adapted for

seated instruc- tion for individuals with a range of physical impairments. The Shibashi Qigong programme combines traditional Qigong breathing and movements with the Tai Chi Yang form.[31] All 18 postures were covered by week 8 of the intervention.

Tai Chi Qigong postures

These postures were taught in a chair. Reproduced with kind permission by Rosie Harrison (http://www.everyday-taichi.com/tai- chi-qi-gong.html).

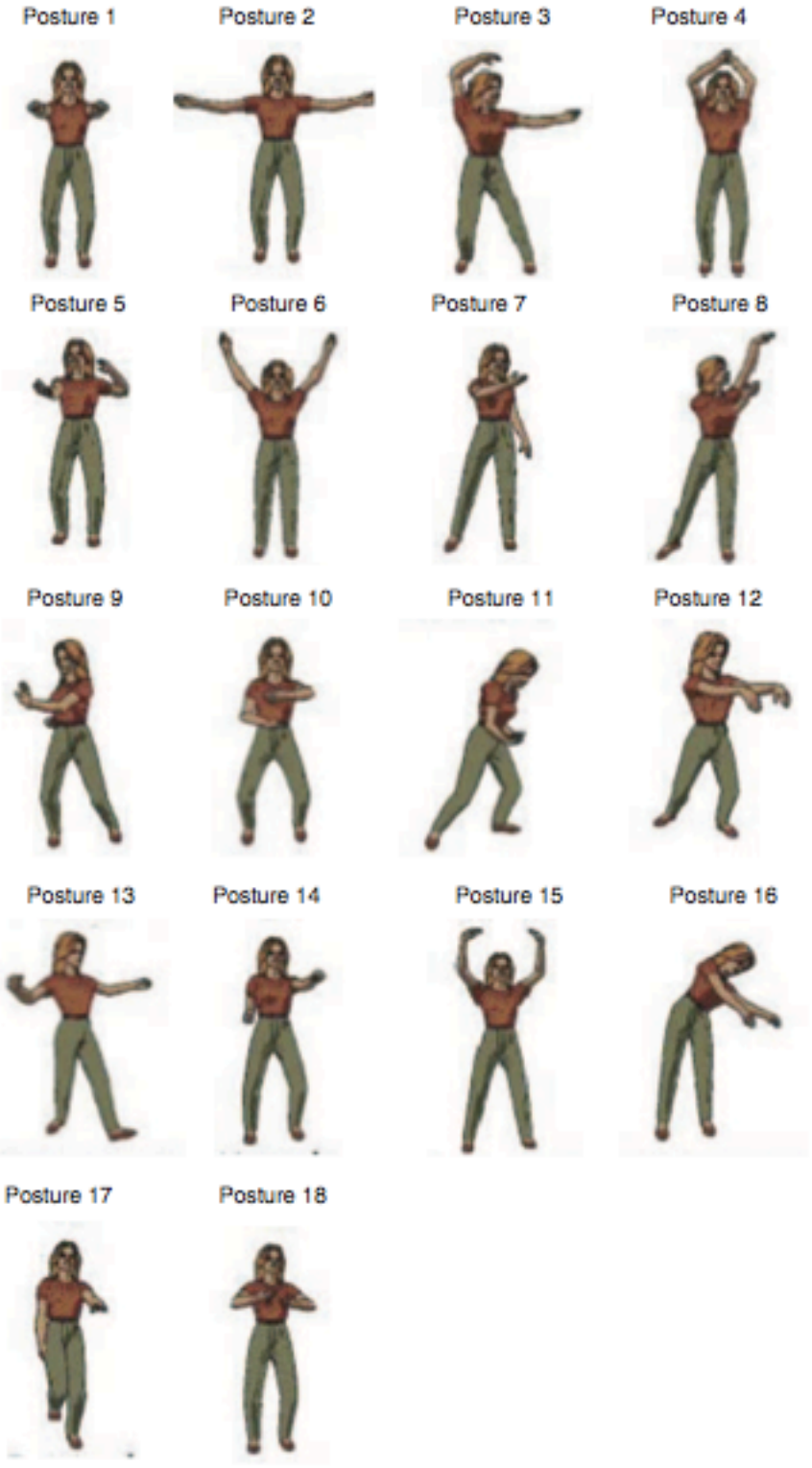

Figure 1. Tai Chi Qigong Postures