

Yoga after Traumatic Brain Injury: Changes in Emotional Regulation and Health-Related Quality of Life in a Case-Study

Abstract

Purpose: The purpose of this study was to analyze changes in emotional regulation and health-related quality of life (HRQOL) following a yoga intervention for three participants with traumatic brain injury (TBI). Yoga was utilized as a modality to improve HRQOL and emotional regulation.

Methods: A mixed method design was used to analyze changes in emotional regulation and HRQOL. Participants completed an eight-week yoga intervention and assessments were completed before and after the intervention. Outcome measures included the Difficulty in Emotional Regulation Scale (DERS) and Quality of Life after Brain Injury Scale (QOLIBRI), both are reliable and valid after TBI. The Change in score (percent change) were calculated for data from both assessments. Semi-structured interviews were completed, data were transcribed, and qualitative data were analyzed with a focus on emotional regulation and HRQOL.

Results: On average, the three participants had a 16% improvement in DERS scores and 6% improvement in QOLIBRI scores following the yoga intervention. Analysis of the qualitative data indicate that participants identified improvements related to emotional regulation in the mind-body connection, peaceful and calm feelings, concentration and focus, and self-control. In relation to HRQOL participants noted social changes, physical changes leading to life changes, confidence to do things and self-development.

Conclusion: Yoga is a potential intervention to address emotional regulation and HRQOL for individuals with chronic TBI. Emotional regulation and HRQOL are two important factors affected post-TBI that through this study were impacted by yoga as a focused mind-body intervention.

Keywords: emotional regulation, health-related quality of life, traumatic brain injury, yoga, mind-body interventions

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Abbreviations: TBI, Traumatic Brain Injury; HRQOL, Health-Related Quality of Life; MMSE, Mini Mental Status Exam; DERS, Difficulty in Emotion Regulation Scale; RYT, Registered Yoga Therapist

Introduction

A traumatic brain injury (TBI) is a form of acquired brain injury, resulting from damage caused by an external force to the head.¹ The injury can be penetrating or non-penetrating, creating an open or closed head injury. In 2010, it was estimated that 2.2 million emergency room visits in the United States resulted in a TBI diagnosis.² Over three million Americans are living with a residual disability because of a TBI.^{3,4} The effects of TBI permeate the individual's lifespan, potentially creating low life satisfaction and high activity limitations.⁵ Just five years following injury, of those who received TBI-specific rehabilitation, 60% had either died or experienced functional decline.⁶ Due to alterations in brain function, a TBI can result in residual impairments in physical, emotional, cognitive, social, and daily functioning across the lifespan.⁷

The impact of a health condition impairment on an individual's perception of function is known as health-related quality of life (HRQOL).⁸ TBI is associated with multiple long-term impairments in HRQOL,⁹ potentially affecting functioning in physical, emotional, cognitive, and social domains.¹⁰ Individuals with TBI often develop poor coping strategies following the injury, which also negatively

impacts HRQOL.¹¹ When HRQOL domains and coping are interrupted by a TBI, the ability to understand limitations and adjust behaviors, known as emotional regulation, may decline.

This ability to regulate emotions by managing behaviors and making adaptations in social contexts,^{12,13} is important to consider in a TBI-specific population. Given that TBI can affect both psychological (cognitive) and social HRQOL domains, individuals post-TBI are likely to benefit from interventions that directly address emotional regulation.¹⁴ Additionally, emotional regulation can act as a predictor of HRQOL outcomes. Regarding individuals affected by TBI, Henry et al.¹⁵ found that participants with TBI, as compared to controls, had significant difficulty identifying and describing emotions.¹⁵ This identification of emotions can be important to aspects of daily function.¹⁶ Emotions, such as hope and optimism, have been linked to higher scores in HRQOL.¹⁷ In general, the ability to cultivate positive emotions may be fundamental to well-being,¹⁸ and may be particularly important following a TBI if an individual's emotional regulation capabilities are disrupted.¹³

Negative changes in post-TBI HRQOL and emotional regulation indicate a need for interventional research that can address these important outcomes.^{13,7} TBI creates a perceived mind-body disconnect for many individuals.¹⁹ A study by Fernros and Furnhoff (2008) analyzed HRQOL changes following one week of mind-body activities and found significant improvements in the subsets of general health perception, and emotional well-being.²⁰ Therefore, interventions

focused on connecting the mind and body may improve the emotional domain of HRQOL and should be further studied for individuals with TBI in conjunction with emotional regulation. Participants with stroke, another neuropathology, reported an increased sense of connection and specifically noted improvements in psychological, physical and emotional domains following a yoga intervention.²¹ As a mind-body practice focused on physical postures and mental awareness, yoga can lend itself to a neurological population when implemented by trained practitioners.²² Currently, there are a limited number of TBI specific yoga studies targeting HRQOL and none targeting emotional regulation. Silverthorne et al, completed the only TBI-specific yoga study that showed significant improvements in physical functioning and emotional well-being from baseline to nine months following the intervention.²³ In another related population, researchers evaluated an 8-week yoga program for acquired brain injury.²⁴ They found that the yoga intervention group had significant improvements in HRQOL, and participants reported high satisfaction ratings indicating that yoga is potentially feasible for individuals with brain injuries. Other studies examined the effects of mindfulness-based stress reduction (MBSR) for individuals after TBI,^{25,26} and MBSR programs contain a Hatha yoga element but are not designed to be yoga interventions.²⁷ There is however more yoga-specific research available regarding other clinical populations (non-TBI). For example, the physical or HRQOL benefits related to yoga interventions have been demonstrated in other clinical neurological populations,²⁸ such as: multiple sclerosis.²⁹ Parkinson disease;³⁰⁻³² and stroke.^{33,21} Yet, there is currently no research specifically assessing improvements in emotional regulation and HRQOL after yoga for individuals with TBI. Many studies recommend that future research should examine the role of yoga, or other non-pharmaceutical treatment, for individuals with TBI.^{34,35} The purpose of this study was to analyze the participant reported outcomes of emotional regulation and HRQOL, along with their perceptions of an eight-week yoga intervention.

Methods

Design

This was a multi-methods case-study including three participants and was focused on changes in HRQOL and emotional regulation following a yoga intervention. Each participant completed 16 sessions of yoga, twice a week for eight weeks, and outcome data were collected before and after the eight-week yoga intervention.

Participants

All participants were adults, 18 years of age or older, and consented to the study following Institutional Review Board approval. Study participants were classified as having a chronic TBI (greater than six months post injury). All participants received occupational therapy or physical therapy services post-TBI, but had completed all TBI rehabilitation prior to enrollment in this study. In order to qualify for the study, individuals had to score >4/6 on the Short Mini Mental Status Exam (MMSE),³⁶ be able to speak, read, and understand English and be able to stand with or without an assistive device.

Data collection

Demographic data, patient reported outcome data, and qualitative data were collected by a trained research assistant. Age, race, gender, marital/partnership status, and education were all included as demographic data. Date of TBI, years since TBI, and corresponding hemiparesis were also collected. Quantitative assessments occurred before and after the yoga intervention through use of the DERS and QOLIBRI.

Quantitative data collection-Difficulty in Emotion Regulation Scale (DERS)

The DERS is a 36-item questionnaire, consisting of options 1 “almost never” to 5 “almost always”.³⁷ Six subscales are included: lack of emotional awareness; lack of emotional clarity; non-acceptance of negative emotions; lack of strategy building; lack of control of impulsive behaviors; and inability to behave during goal-directed emotions while experiencing negative emotions. There are no established cut-off scores for TBI participants when using the DERS. In this study, items were reverse scored which made a higher total DERS score indicate higher emotional regulation abilities.

Quantitative data collection-Quality of Life after Brain Injury (QOLIBRI)

The QOLIBRI is a 37-item questionnaire that includes a 5-point Likert scale with scoring from 1 “not at all satisfied” to 5 “very satisfied”.³⁸ Part one measures satisfaction level regarding cognition, feelings and emotions, autonomy and daily life, and social relationships. Part two focuses on impact, in regard to negative feelings and restrictions. The total score 0-100 acts as a HRQOL measurement for individuals following TBI, with higher scores indicating better HRQOL.³⁹

Qualitative data collection

Qualitative data were collected post intervention using an 18 question face-to-face semi-structured interview format. All interviews were audio recorded for verbatim transcription. Primary questions included, “What has been your overall experience in the therapy program?” and “What did you expect the yoga program to be like before it started?” Further questions were developed as the interview progressed, and when appropriate participants were probed for further information with phrases like, “expand on that thought.”

Intervention

The intervention consisted of one-hour yoga sessions, provided by a registered yoga therapist (RYT), bi-weekly for eight weeks. Yoga was delivered in a 1:1 fashion and a research assistant was available if needed to assist with postures or moving to and from the floor. The protocol included postures advancing from seated, to standing, then supine, or quadruped on the floor, with the constant option for adjustment per participant and safety needs. Sessions began with breathing techniques to enable awareness. Adjustments throughout the session included posture modifications or the addition of a yoga strap or block for support and ideal biomechanical alignment. Sessions ended with ten minutes of progressive muscle relaxation alongside guided meditation, with the RYT providing eye pillows while participants were supine on their yoga mats. See Table 1 for a full description of yoga postures and progression. Additionally, information on the protocol has been previously published focusing on the physical and balance outcomes.⁴⁰

Data analysis

Quantitative data

Quantitative data were analyzed using SPSS 20.0 (Chicago, IL). Demographic data were described using descriptive statistics: means and standard deviations or frequencies and proportions. Pre and posttest means and standard deviations are included for the DERS and QOLIBRI scores. With the case study format of three participants, researchers calculated a percent change for each outcome measure (Posttest—Pretest/Pretest x100).

Table I Yoga intervention

Position (week estimate)	Description	Yoga practice: select examples
Seated (Weeks 1-8)	Opening breathing Breathing Practices: <ol style="list-style-type: none"> Breath with sound Natural rate breathing Prolonged exhale breathing Alternate nostril breathing Eye Movements, eyes opened or closed: <ol style="list-style-type: none"> Diagonal Horizontal Circles Hourglass Cervical Movements: <ol style="list-style-type: none"> Rotations Lateral flexion Head Movements: <ol style="list-style-type: none"> Mandible flexion and extension Shoulder Movements: <ol style="list-style-type: none"> Shoulder shrugs Shoulder forward rolls Shoulder backward rolls Rotations with shoulders in abducted position Scapular protraction and retraction Torso Movements: <ol style="list-style-type: none"> Side flexion Rotation 	Breathing: <ol style="list-style-type: none"> Ujjayi Pranayama Nadi Shodhana Eye Movements: <ol style="list-style-type: none"> Drishti Bheda Pralokita, Saachi, Alokita Head/Neck/Torso Movements: <ol style="list-style-type: none"> Adapted Ardha Chandrasana Adapted Simhasana Ardha Matsyendrasana
	Using the wall or chair for support: <ol style="list-style-type: none"> Calf stretch/hip extension Supported Toe Balancing Supported One leg balance 	Standing Movements: <ol style="list-style-type: none"> Tadasana Virasana Utkatasana Vrksasana
	Quadruped: <ol style="list-style-type: none"> Spinal extension and flexion Opposing hip and shoulder extension Prone: <ol style="list-style-type: none"> Thoracic extension Tricep extension Hip extension Full body extension 	Movements on all Fours: <ol style="list-style-type: none"> Purvottanasana Marjaryasana Bitilasana Ardha Pincha Mayurasana Movements on Stomach: <ol style="list-style-type: none"> Chakravakasana Bhujangasana Salambhasana
	Supine <ol style="list-style-type: none"> Holding knees to chest Hip flexion with knee extension Pelvic tilts and holds with guided isometric contractions Relaxation <ol style="list-style-type: none"> Guided relaxation Targeting certain muscles and areas with breath 	Movements on Back: <ol style="list-style-type: none"> Pawanmuktasana Ananda Balasana Setu Bandha Sarvangasana Savasana Relaxation: <ol style="list-style-type: none"> Samadhi
Floor (Weeks 3-8)		

Qualitative data

Transcripts were transcribed verbatim by a trained research assistant into a word processing document and then were imported into NVivo for analyses (NVivo 10 QSR International, Victoria, Australia). Transcripts for qualitative data were analyzed and coded by two trained researchers. Two primary themes were identified a priori based on the purpose of these analyses and therefore focused on the

variables of interest: HRQOL and emotional regulation. Secondary themes then evolved with multiple researchers through an iterative consensus building process. Through this process, researchers agreed upon reoccurring subthemes which emerged during analysis of semi-structured interviews (Figure 1). Researchers then used NVivo software to code each theme identified for qualitative analysis and comparison. Qualitative comments that best illustrate each code or theme are included in the results.



Figure 1 Primary and secondary themes derived from participant interviews.

Results

Demographics

Three individuals enrolled and completed the yoga intervention. Two were female, two were more than ten years post TBI, and one was married. See Table 2 for additional demographic and TBI characteristics.

Quantitative data

DERS scores indicated overall improvements, the mean DERS score improved from 94.67 to 109.67, a 16% improvement. Two out

of three participants presented higher scores indicating improved emotional regulation capabilities (Table 3). Participant three showed the largest change, with an increase of 36% following the yoga intervention.

QOLIBRI scores improved for all three participants following the intervention (Table 3). Individually, scores increased from between 5% and 8%, showing an improved perceived HRQOL. The overall mean score increased from 108.33 to 115.33, which is a 6% positive change. Further analysis was then obtained using semi-structured interviews.

Table 2 Demographic Information

Variable	Participant One	Participant Two	Participant Three	Mean n=3
Age	42	48	43	44.33±3.22
Gender	Female	Female	Male	Two female (67%)
Race	White	'Other'	White	Two white (67%)
Years since TBI	21	28	9	19.33±9.6
Corresponding hemiparesis	Yes	Yes	Yes	Hemiparetic (100%)
Age at time of injury (years)	22	21	35	26±7.81
Medication for anxiety (current)	No	No	Yes	No
Medication for depression (current)	Yes	No	Yes	Yes
Partner	Single	Widowed	Married	
Education (any college)	Post-graduate	Some college	Some college	Some college (100%)

Table 3 Emotional regulation and health-related quality of life changes

Outcome Measure	n=3	Baseline Score	8 weeks Score	% Change
Difficulty in Emotional Regulation Scale	Participant 1	82	80	-2%
	Participant 2	118	135	14%
	Participant 3	84	114	36%
	Mean (SD)	94.67±20.23	109.67±27.75	16%
	Participant 1	133	144	8%
Quality of Life After Brain Injury	Participant 2	84	89	6%
	Participant 3	108	113	5%
	Mean (SD)	108.33±24.50	115.33±27.57	6%

Emotional regulation qualitative data

Driven by the research questions, two primary themes were identified from the variables of interest: emotional regulation and HRQOL. Secondary themes were then identified through examination and analysis of the semi-structured interviews. Secondary themes within emotional regulation included: Mind-Body Connection; Peaceful & Calm; Concentration & Focus; and Self-Control (Figure 1). The data showed an improvement in overall self-perceived ability to regulate or manage emotions. Certain quotes from the data have been previously published in a manuscript on the physical effects of yoga for chronic TBI.⁴⁰ A few of these quotes bear repeating due to the powerful nature of the content of the data, and relation specifically to the research questions.

Mind-bodyconnection

Two participants acknowledged how yoga practice facilitated a stronger relationship between the mind and body. Participant One specifically noted the benefits of yoga to individuals with chronic TBI, he stated “I mean mine’s what? 19 years, 20 years after, and I’m noticing different things that...are improving. I mean I think that it would be incredibly valuable to someone with.^a brain injury that was just because of the connection.” Participant Two also noted the connection and simply stated, “I am more mindful”. Whether noting individual changes, or beneficial changes for others with chronic TBI, an increased connection between mind and body surfaced from the interviews.

Peaceful & calm

Two participants identified peaceful and calm thoughts related to emotional regulation. One participant commented on how increased peacefulness during or after yoga had led to calmer feelings throughout daily activities, “It’s more real now...I feel more peaceful.” When asked about the first week of yoga, that participant stated, “it was very peaceful.” Another participant noted his control in the way of revving up or relaxing: “The breathing techniques were huge....ⁱⁿ how to calm myself down or how to ram.^{rev} myself up.” Attention to breath had provided an opportunity to elicit a peaceful awareness.

Concentration & focus

Cognition may be impacted post-TBI, in this study concentration and focus emerged as a noted improvement from yoga by two of the participants. For example, Participant Three compared previous post-TBI treatments and noted how this yoga intervention finally addressed the ability to “now be able to concentrate,” in a way that he had not previously seen improvements, despite specialized TBI interventions. Expanding on the concentration piece, he noted that his attention was more focused on his kids at tee ball and he did “not constantly scan the crowds or you know all the people around it’s just there’s so many things that just made my life better.” Contextually, his statement was in regard to not needing to scan the crowds for terrorists or harm, given he is a veteran with a brain injury, post-traumatic stress, and multiple physical injuries.

Self-control

Another theme which emerged under emotional regulation was self-control. Participant Two did not experience an improvement in DERS scores but described her overall improvement in self-control, stating that for her the yoga intervention was “more mental” with a focus on “getting more self-control.” Participant Three, the veteran, discussed using the breathing techniques and eye movements learned in the program as a method of self-control “to ground you in the here and now,” and as an escape from continuing to perceive the threats of

Iraq in his home, while driving, and elsewhere in his day to day life. He discussed these improvements through daily activities, as well as within an overarching sense of self-control that he received from the yoga intervention.

Health-related quality of life qualitative data

HRQOL was a qualitative primary theme and included the following secondary themes: Social Changes; Physical Changes Leading to Life Changes; Confidence to do Things; and Self-Development (Figure 1).

Social changes

Relating to HRQOL, all participants described an increase in social engagement as the result of this yoga intervention. One participant discussed how social changes had been significantly impacted in the form of “wanting to go out more and to have that confidence to be able to go out and do it.” Increased socialization and engagement due to the yoga intervention emerged as a theme from all three participants.

Physical changes leading to life changes

Participants also identified how physical changes resulting from yoga practice became a vehicle to complete their chosen meaningful activities. Participant One expressed that halfway through the intervention he was engaging in an occupation he had been missing, “I started playing golf...last September - and so probably five weeks into yoga I went out for the first time this year. It was only the second time I’d ever played a full-size course. since my injury.” Participant Two similarly discussed the impact of physical improvements and stated: “I learned...that I could make my body move and accomplish feats that I didn’t think were possible.” Due to the yoga intervention Participant Three highlighted the daily improvements related to strength, “I’ve got more strength in my legs and I’ve got more stamina now...to be able to go out.”

Confidence to do things

People who have experienced TBI often report dissatisfaction in their self-esteem levels, which influence many pieces of performance in life.⁴¹ Two out of three participants indicated that confidence since the time of injury had been a limiting factor, and improvements in confidence occurred during the yoga intervention. This improvement allowed them to complete more desired activities. For example, one participant noted the increased confidence in the form of future goals, “I really want to go back to school and start and complete my degree.”

Self-development

The semi-structured interview revealed statements from all three participants regarding personal growth. One participant noted yoga as a form of self-development, and indicated “I used it more...to...develop myself, that’s what I appreciate more, the self-development.” While another participant stated, “I’m not quite as hard on myself,” in response to how life was different following the program.

Interaction of multiple HRQOL themes

Participant Three importantly identifies the holistic relationship in HRQOL: “I mean it’s rocked my world. It’s changed my life. I mean all the different aspects.” For him, all the HRQOL changes culminated in perceived new capability in his role as a father: “this has changed my world and given me a new life back, because I’ve got a new opportunity now with my two youngest sons to be the Dad that I couldn’t be, in my eyes, to my older kids.” He further commented on several HRQOL domains “physically, emotionally, mentally...it’s given me, you know, my life back. It’s opened up so many doors for me.”

Discussion

These data indicated that an eight-week yoga intervention for people with TBI is potentially an impactful modality to address HRQOL and emotional regulation. The three individuals included in this multi-methods study showed an overall improvement in QOLIBRI and DERS scores, as well as perceived improvements as evidenced by the semi-structured interviews. The QOLIBRI provided a foundation for HRQOL domain analysis, and the data from the DERS elaborated on the “emotions” domain through quantification of emotional regulation. For example, the QOLIBRI assesses emotions, but also includes the additional domains: cognition, general “self”, daily life and autonomy, social relationships, and physical problems.¹⁴ Emotion was then further explored with the DERS through six subsets assessing emotional regulation: “(a) lack of awareness of emotional responses; (b) lack of clarity of emotional responses; (c) non-acceptance of emotional responses, (d) limited access to emotion regulation strategies perceived as effective, (e) difficulties controlling impulses when experiencing negative emotions, and (f) difficulties engaging in goal-directed behaviors when experiencing negative emotions”.³⁷ This three-person format then allowed for in-depth discussion and understanding of each domain through analyses of semi-structured interviews. Researchers focused on the participants’ perspectives and identified potential changes related to HRQOL and emotional regulation for the three participants.

Emotional regulation

Emotional regulation can be viewed as the constant situational adaptation of behaviors to meet social expectations. This study separated four subsets of emotional regulation that emerged in qualitative interviews: mind-body connection, peaceful & calm, concentration & focus, and self-control. Yoga interventions frequently include attention to mindfulness, or moment-to-moment awareness through the development of adaptive techniques to face difficult situations.⁴², which is a part of emotional regulation. Azulay and Mott (2016) implemented a Mindfulness Attention Program and indicated significant improvements in DERS scores for individuals with mixed brain injuries.⁴³ Mindfulness programs may target the disconnect between the mind and body, which is a common theme for individuals with neurological impairments.^{44,19} The current study presented qualitative data which described an increased mind-body connection for three participants following a yoga intervention.

Further, previous research indicates that yoga can trigger the ability to implement a relaxation response,^{45,46} this supports the presented qualitative results regarding increased peaceful and calm feelings. A study done with individuals diagnosed with multiple sclerosis assessed emotional regulation and found that higher emotional regulation correlated to improved scores in psychological and environmental QOL domains.⁴⁷ Participants in the current study highlighted HRQOL domains that were affected in conjunction with emotional regulation changes. In a different study, researchers used the DERS measure and found that, in 50 participants with TBI, global distress strongly related to lower DERS scores.⁴⁸ High negative correlation between emotional regulation and global distress calls for methods specifically addressing emotional regulation. Furthermore, continuous emotional regulation can lead to higher life satisfaction,⁴⁹ reasoning that emotional regulation and quality of life cannot be disentangled, and measurement together is cornerstone to future treatment planning for individuals with neurological impairments. Collectively, these data represent preliminary case study evidence for an individualized yoga intervention and support further exploration of yoga as a treatment intervention post-TBI.

Health-related quality of life

Increased difficulty in emotional regulation has been correlated to decreased ability to sustain meaningful relationships, which leads to a reduction in overall quality of life.¹⁵ This study divided HRQOL into four subsets that emerged during qualitative analysis of the interviews: social change, physical changes leading to life changes, confidence to do things, and self-development. Paralleling the current findings relating to social change, a study by Hawthorne, Gruen, & Kaye (2009) found that lower HRQOL is associated with decreased social interactions.⁵⁰ Individuals with TBI generally report lower HRQOL.⁵⁰ All three participants in this study discussed their increased social participation following the yoga intervention, which was supported by increased HRQOL through their QOLIBRI scores. Related findings were seen in a yoga study for healthy older adults; those who participated in yoga rated HRQOL and social functioning significantly higher than the control or exercise groups.⁵¹ Improvements in social engagement may potentially be related to increase varying categorical developments, for example balance self-confidence, following a yoga intervention.

Regular yoga practice has been connected to increased confidence.⁵² Two participants in this study discussed their increased confidence, often in relation to returning to activities they had avoided since their TBI. In a mindfulness study for a population with mixed (ex. anoxic, traumatic) brain injury, improvements were seen in perceived self-efficacy and perceived QOL measures, emphasizing the connection between confidence and well-being through mindfulness.⁴³ Another part of increased confidence, in the current study, could be attributed to self-reported physical improvements, which allowed for a return to participation. The relationship between physical changes, confidence, and stroke-specific QOL is highlighted in another eight-week yoga intervention study, which revealed increased balance self-efficacy and quality of life outcomes for individuals with chronic stroke.⁵³ The results can be interpreted to show a relationship between the physical component of balance, the perceptual impact of confidence, and resulting overall HRQOL improvements. All three participants in this current study discussed how physical changes had promoted increased life involvement. Participant One, for example, returned to his meaningful activity of golfing on a full-size course halfway through the yoga intervention. Silverthorne et al. (2012) implemented breath-focused yoga, for individuals with severe TBI, and found significant improvements in physical function, emotional well-being, and overall health.²³ Tying together the important factors included in emotional regulation helps to perhaps explain some of the improvements seen throughout HRQOL in this study.

Limitations

Limitations in this study include that there was no control group and a small sample size, which is common in emerging mind-body intervention research and continues to be a limitation especially in neurological populations.²² The size makes it difficult to generalize the results to other individuals with chronic TBI, however the small case study was an important first step in this line of research. In addition, severity of impairment (mild, moderate, severe) and the location of the injury were not included in the demographic data. Therefore, researchers analyzing these data cannot discuss changes following yoga as they relate to specific TBI categorical classifications.

Strengths and implications for future research

Future research could include categorical classifications of TBI. Utilizing these classifications would allow for further comparisons between groups, to determine the best fit or timing for yoga

interventions. This study highlights an intervention strategy that improved emotional regulation and HRQOL scores for individuals with TBI. To generalize the results and prove efficacy, a larger sample size and control comparisons are needed. When considering the benefits of larger sample sizes, it is also important to consider the strengths of a small yoga group. In this study, participants were provided individualized adaptations and adjustments throughout yoga sessions, tailoring each session to meet the participants' needs. Hands-on adaptation and attention to each participant could have been a reason for the positive results seen in HRQOL and emotional regulation. However, a group yoga intervention for people with TBI should be tested to meet social and economic needs.

Conclusion

This study provides preliminary evidence that an eight-week yoga program is a beneficial option to simultaneously improve emotional regulation and HRQOL for individuals with chronic TBI. Improvements were seen with this sample, and this study highlights the importance of assessing emotional regulation along with HRQOL for individuals with TBI. However, further research is warranted because this study was not large enough to be generalizable.

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Conflict of interests

The authors declare that there is no conflict of interests.

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