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# A qualitative study of LoveYourBrain Yoga: a group-based yoga with psychoeducation intervention to facilitate community integration for people with traumatic brain injury and their caregivers

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## ABSTRACT

**Purpose:** To explore participants' experiences in a group-based yoga with psychoeducation intervention designed to facilitate community integration for people with traumatic brain injury and their caregivers.

**Materials and methods:** We conducted semi-structured interviews with 13 people with traumatic brain injury and three caregivers who had completed LoveYourBrain Yoga, a 6-session, manualized, group-based yoga intervention that incorporates breathing exercises, yoga, meditation, and psychoeducation. Interviews were analyzed using content analysis.

**Results:** We identified seven themes: ease of participation, belonging, sustaining community connection, physical health, self-regulation, self-efficacy, and resilience. All participants valued the community-based yoga studio environment and multifaceted structure of the program. Participants reported improvements in strength, balance, flexibility, and attention control, and a greater sense of belonging, community connection, and ability to move forward with their lives. Participants reported ongoing use of tools (e.g., breathing exercises) to cope with negative emotions and stress. About half of participants sustained relationships built during LoveYourBrain Yoga and felt more capable of accessing other activities in their community.

**Conclusions:** LoveYourBrain Yoga successfully promoted community integration for people with traumatic brain injury. It also facilitated diverse and meaningful physical, psychological, and social health benefits, which suggest that it may be an effective mode of community-based rehabilitation.

## ARTICLE HISTORY

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## KEYWORDS

Traumatic brain injury; community integration; yoga; resilience; qualitative; meditation

## ► IMPLICATIONS FOR REHABILITATION

- Traumatic brain injury survivors often struggle to participate in their community, the ultimate goal of rehabilitation
- Yoga is a holistic therapy with many benefits, yet is not accessible to the traumatic brain injury population at the community level
- Participants in a community-based yoga with psychoeducation intervention in six states experienced diverse and meaningful physical, psychological, and social health benefits
- Group-based yoga with psychoeducation may be an effective mode of community integration and community-based rehabilitation for traumatic brain injury survivors

## Introduction

Each year in the United States, about 2.8 million people experience a traumatic brain injury (TBI) [1]. TBI ranges in severity from mild to severe and can lead to a multitude of physical, cognitive, behavioral, and psychosocial deficits that compromise quality of life [2–4]. The impact of TBI can also strain the entire family, who commonly describe a combination of insufficient information and overwhelming care burden that can lead to depression, anger, and fatigue [5]. Across all TBI severity levels, the ultimate goal of rehabilitation is community integration [6], which includes engagement in meaningful and productive activities in social, community, and home contexts [7–9]. Operational definitions of community integration vary, so we adopted the core elements of this construct identified by [10] in their review of approaches to assessing community integration following TBI: relationships with

others, meaningful activities, and independence in one's living situation. Because community integration encompasses activities (e.g., leisure and employment) that can improve key outcomes, such as physical fitness, stress management, self-esteem, companionship, quality of life [11–14], and caregiver distress [15], it plays a critical role as both a means to and end goal of TBI recovery.

People with TBI, however, often face challenges integrating back in their community [16], such as accessing social [17] and leisure activities [12,18]. For example, a prospective evaluation of 160 people with TBI at one year post-injury found that 81% had not returned to preinjury levels of leisure participation, and among this group, 60% were moderately to severely bothered by this outcome [19]. A review of the psychosocial and emotional impacts of TBI found that individuals experienced significantly reduced social support and opportunities to establish new social

contacts [17]. Other research has found that barriers to community integration include struggling to accept a new reality of changed abilities [20], anxiety, lack of motivation, emotional dysregulation, and unsupportive social and family environments [21]. Despite the importance of community integration, interventions designed to achieve this goal can be limited [13,21], fragmented [20], and sometimes produce variable results [22,23].

Some evidence suggests that the most effective strategies to promote community integration are holistic – integrating physical, psychological, social, emotional, and motivational components [24] – and delivered to individuals with TBI and their caregivers within their local environment [21,25]. Yoga is a holistic therapy involving physical movement, breathing exercises, meditation practices, and moral principles that is increasingly being offered in community settings for marginalized populations [26,27] and has facilitated community integration among stroke survivors [28]. While yoga interventions have been shown to improve a range of outcomes from TBI (e.g., quality of life [29], physical functioning [30], emotional regulation [31], and psychological well-being [32]), they are not widely accessible to the TBI population in their communities due to environmental factors (e.g., bright lights, loud music, scents, heat) that may exacerbate sensory sensitivity [33], teaching methods (e.g., pace of movement and instruction is too fast and/or complex) that may worsen mental fatigue [34], and movement patterns (e.g., inversions, rapid head movement) that may aggravate headaches [35] and/or vestibular symptoms [36].

To address this gap, LoveYourBrain Yoga was established to facilitate community integration among people affected by TBI. Designed based on the positive results of a pilot study [29], it involves a 6-session, manualized yoga intervention delivered to groups of people with TBI and their caregivers through community-based yoga studios. One noteworthy innovation is the inclusion of psychoeducation to build community connection and skills in resilience. Psychoeducation includes the delivery of information and activities to enable patients to better understand and cope with their injury [37]. In the brain injury population, group-based programs that integrate psychoeducation have been shown to increase self-efficacy and psychological functioning [38], key precursors to sustained community participation [21,25]. However, a review of the literature revealed no studies have investigated group-based yoga with psychoeducation for community integration following TBI.

The objective of this qualitative study was to explore the experience of individuals with TBI and their caregivers who have participated in LoveYourBrain Yoga. We chose a qualitative methodology because it has been shown to more reliably capture the subjective experience of TBI survivors with deficits in self-awareness [39], and has been used in similar research [40]. Our study explored participants' (1) motivations for joining the program, (2) perceptions of the benefits of participating, and (3) perceptions of any areas for improvement.

## Materials and methods

The study received approval from the Dartmouth College Committee for the Protection of Human Subjects. We adhered to the Standards for Reporting Qualitative Research [41].

### Design

This qualitative study involved in-depth, semi-structured, one-on-one telephone interviews using an interview guide. All study participants completed a self-report demographic questionnaire.

## Participants

People were eligible to participate if they were 18 years and older, were comfortable reading, writing, and speaking English, and had completed the LoveYourBrain Yoga program.

## Intervention

Since 2015, the LoveYourBrain Foundation has implemented a free community-based yoga with psychoeducation intervention for groups of individuals with a TBI and their caregivers. This manualized intervention involves a six-week yoga series designed to promote community integration. To disseminate the yoga intervention, the LoveYourBrain Foundation partners with yoga studios and trains certified yoga teachers to implement the program for their local TBI community across the United States and Canada. The 18-h training is led by a PhD-level, certified yoga teacher who is a Certified Brain Injury Specialist. It includes didactic and experiential learning content designed to increase trainees' knowledge about neuroanatomy and neurophysiology, TBI causes, consequences, and rehabilitation strategies, neuroplasticity, and TBI-specific modifications for yoga postures, meditation, and breathing exercises. It also uses lecture and role plays to build trainees' skills in how to effectively deliver the LoveYourBrain Yoga curriculum, including the provision of TBI-specific information and communication skills for facilitating psychoeducation. Each intervention has from 7 to 13 participants, including both people with TBI and caregivers, and is guided by a primary and assistant yoga teacher. People can participate in the series multiple times at no cost, and people with TBI and caregivers can participate independently or together.

The program offers instruction in gentle movement modified to address various TBI symptoms (e.g., headaches, balance and vestibular challenges, mental fatigue, hypersensitivity to stimuli, poor proprioception, autonomic nervous system dysregulation), breathing exercises (i.e., equal belly breathing, ujjayi breath, three-part breath), meditation techniques (i.e., mindfulness, progressive muscle relaxation, visualization, loving-kindness), and psychoeducation (curriculum available upon request). Figure 1 describes the specific structure of each class and the objectives of each section.

Each class includes a quote that promotes reflection around the theme of the class, which is a factor that has been empirically shown to promote resilience (i.e., physical fitness, mental flexibility, realistic optimism, facing fear, social support, meaning and purpose) [42]. The psychoeducation component includes didactic material, question prompts, and activities that the yoga teacher is

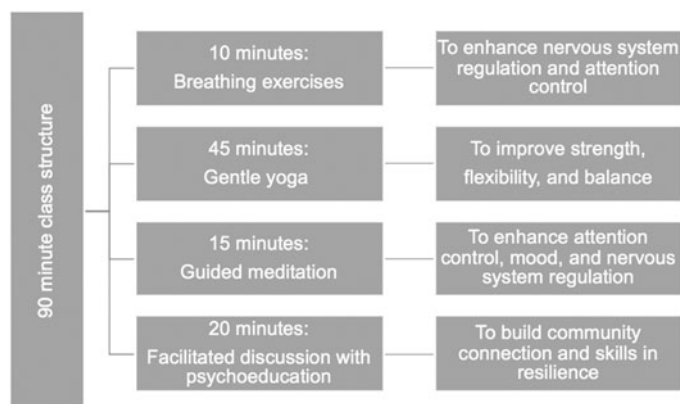


Figure 1. Overview of LoveYourBrain Yoga class structure and section objectives.

**Table 1.** Overview of psychoeducation objectives, questions, and activities by week.

Week	Objective	Question prompt or activity
1	Educate participants about the experience of TBI and being a caregiver and build group cohesion through shared experiences and vulnerability	Why are you here? Who is your superhero (this is a person you admire or has made an influence on your life)?
2	Educate the group about what mindfulness is and build skills in how to apply mindful awareness to support healing from TBI and managing related challenges as a caregiver (e.g., stress)	Activity: Mindfulness eating exercise What was your experience like with this exercise? Any reactions? Does anyone have experience with mindfulness practices? (If yes) How has it helped you with your healing process? (If no) How do you think mindfulness could help?
3	Educate the group about a strengths-based approach to managing the impacts of TBI	What is one positive outcome of your TBI that you maybe didn't expect? What is one challenging outcome, and how are you growing from this challenge?
4	Educate the group about the concept of resilience and how to apply it to the TBI experience	What are people's reactions to the idea of resilience versus recovery? What is one thing that has helped you become more resilient following your TBI?
5	Deepen relationships among group members to strengthen social connection	Activity: Connect and share with a partner Find someone whom you haven't had a chance to talk too much, introduce yourself, share a fun fact, and we'll all report back to the group.
6	Educate the group about the value of gratitude and how to integrate what they have learned from the program into their daily lives	What is one thing you are grateful for or you will take away from this series?

trained to introduce to the group, and subsequently facilitate a discussion around participants' perspectives and questions (see Table 1).

The intervention was developed following a pilot study of an eight-week gentle yoga program, which found significant improvements in quality of life among those who participated in the intervention but not among those in the control group [29]. Learnings from the pilot study were incorporated into the intervention's curriculum, including modifications to postures (e.g., minimal use of inversions, emphasis on slow, simple, and repeated movement) and environmental factors (e.g., use of low lighting, avoiding music with English words), the integration of themes and quotes based on the science of resilience, and, notably, the addition of the psychoeducation component to accommodate preferences for more socializing and discussion about topics relevant to TBI rehabilitation. The curriculum was also vetted by a brain injury rehabilitation specialist at an academic medical center.

### Recruitment

To be eligible for the LoveYourBrain Yoga program, people must self-identify as having experienced a TBI or being a caregiver of someone who experienced a TBI, are 70 years of age or younger, are ambulatory (i.e., do not rely on an assistive device for movement), have not been told by a medical professional to avoid gentle exercise, are open to participating in group discussion, and can follow instructions. The LoveYourBrain Foundation raises awareness about the program through a variety of channels, including by offering in-service presentations at brain injury rehabilitation facilities, presenting at conferences and brain injury support groups, social media, and local press coverage. Participants for this study were recruited via an email list of people, including those who had had a TBI or were caregivers, who had completed the LoveYourBrain Yoga program during May 2016 to May 2017. A LoveYourBrain Foundation staff member sent the email invitation, which included information about the purpose and nature of the study and a link to an online survey where prospective participants could provide their informed consent to participate, complete brief demographic questions, and provide their contact details (i.e., email or phone) to schedule their interview. A two-week reminder email was sent as follow-up.

### Measures and data collection

We developed a brief demographic questionnaire, which assessed age, gender, race, ethnicity, educational attainment [43], employment status, LoveYourBrain Yoga program location and timing, and, for people with a history of TBI, the number of TBIs experienced, year when (most recent) TBI occurred, cause of TBI, and the Centers for Disease Control and Prevention's classification of duration of hospitalization, loss of consciousness, and post-traumatic amnesia [44]. We created a variable to describe TBI severity (i.e., mild, moderate, and severe) based on the duration of post-traumatic amnesia and loss of consciousness from the Centers for Disease Control and Prevention's classification system [44].

An interview guide was developed to facilitate the semi-structured interviews based on the framework outlined by Kallio and colleagues [45]. This interview guide contained prompt questions to solicit participants' perspectives about why they signed up for LoveYourBrain Yoga, what they remembered from each session, what they found most helpful, and what they felt could be improved (see [Supplementary Material](#)). Caregivers were asked a few additional questions about their perceptions about the experience of the person with a TBI whom they accompanied. The interview guide was pilot tested with two people with TBI to ensure comprehension. The semi-structured interview provided flexibility and allowed for the integration of spontaneous follow-up questions [46]. During the interview process, the order of the questions in the interview guide was revised to present more general questions first and then inquire about participants' experiences of each component of each week's class to accommodate memory deficits among people with TBI. One researcher (SG) conducted all interviews from November 2016 to November 2017. The interviewer was not involved in the LoveYourBrain Yoga program and had no relationship to the LoveYourBrain Foundation. Before the interview began, the interviewer re-reviewed the Information Sheet with prospective participants and sought their permission to be audio-recorded. Purposive sampling was conducted to promote variation in terms of participant age, program location, and TBI history. Data collection was conducted until all prospective participants had an opportunity to respond to the request for an interview, the sample demonstrated variation, and data saturation was achieved. Participants who completed the

interview received a \$15 gift card of their choice (e.g., Starbucks, or Amazon gift card, or a donation to the LoveYourBrain Foundation) for their time and effort.

### Analytic strategy

Interviews were de-identified and sent to a professional transcription service to be transcribed verbatim. The interviews were analyzed using inductive content analysis, an approach that classifies the text of the interviews into broad categories or themes [47]. To assess participants' motivations for joining the program, the type and frequency of motivation was documented. The analysis was led by the interviewer (SG), a nurse researcher, and a research team member (KD) whose in-depth knowledge about LoveYourBrain Yoga helped to contextualize the findings. Both researchers immersed themselves in the data and independently generated initial codes and themes. Throughout data collection, they iteratively expanded the coding structure and resultant themes and subthemes based on emerging patterns across the dataset. The researchers met periodically to review and discuss candidate themes and collaboratively define and refine themes.

### Trustworthiness

Lincoln and Guba (1985) proposed criteria for qualitative research rigor or "trustworthiness" including credibility, confirmability, and dependability [48]. To increase credibility, the interviewer wanted to minimize perceptions of the 'distance' between the researcher and research participants to promote open and honest responses [49]. Therefore, the interviewer strove to build rapport with participants by letting them 'set the pace' of the conversation in hopes that they would feel more comfortable with and in control of the interview process [49]. The interviewer also used member checks throughout the interview by summarizing and restating participants' responses and subsequently inviting participants to affirm or correct the accuracy and completeness of the interpretation. Confirmability was achieved by the interviewer maintaining an audit trail to keep notes about her reflections on each interview and decisions made about the interview process (e.g., revisions to the interview guide) and data analysis. To address dependability, two expert qualitative researchers reviewed all transcripts and presented their interpretation and descriptions of the emerging themes to a third researcher not involved in data collection or analysis for an inquiry audit [50].

## Results

### Participant characteristics

Of the 146 people who received the email invitation, 66 people clicked on the link to access the online survey and 53 people consented to participate. While 47 people provided their contact information to schedule the interview, some did not respond to phone or email follow-up communication from the interviewer. The final sample included 16 participants, including 13 people with TBI and three caregivers, all of whom attended the program alongside a relative with a TBI. Data from participants with TBI achieved saturation; however, efforts to recruit more caregivers (i.e., targeted follow-up emails in the later stage of data collection) to achieve saturation were unsuccessful.

Participant characteristics and the TBI history of those who had experienced the injury are described in Tables 2 and 3. Participants had completed the program in Vermont, New

Hampshire, California, Massachusetts, Colorado, or Pennsylvania, and some ( $n=6$ ) had participated multiple times. Interviews lasted from 20 to 45 min with an average of 25 min.

Most people with a history of TBI had experienced the injury once from a fall or work-related event. The average time since injury was 7 years, which ranged from 1 to 24 years.

Table 2. Participant characteristics ( $n = 16$ ).

Characteristic	Freq.
Number of times participated in LoveYourBrain Yoga	
Once	10
Twice	6
Sex	
Female	14
Male	2
Age	
18 to 34 years	5
35 to 54 years	6
55 years or older	5
Currently employed	
Yes	11
No	5
Education	
High school graduate or less	0
College or some college	8
More than a Bachelor's	8
Race	
White	15
Asian	1
Ethnicity	
Non-Hispanic	16

Table 3. TBI history ( $n = 13$ ).

Characteristic	Freq. ( $n = 13$ )
Number of TBIs	
1	11
2	1
3	1
Mean years since TBI (SD)	7 (6.7)
Cause of TBI	
Fall	3
Hit by falling object	1
Motor vehicle accident	3
Assault	2
Work-related	1
Sports	2
Other	1
TBI severity	
Mild	8
Moderate	0
Severe	4
Unclear	1
Duration of hospitalization	
Less than 1 day	1
Between 1 and 7 days	1
More than 7 days	5
Not hospitalized	6
Duration of loss of consciousness	
Less than 30 minutes	7
Between 30 minutes and 1 day	0
More than 1 day	4
None	1
Not sure	1
Duration of post-traumatic amnesia	
Less than 1 day	2
Between 1 and 7 days	0
More than 7 days	4
No, I remember everything	4
Not sure	3

### **Motivations for joining**

Participants commonly shared that they were motivated to sign up because the program was specifically designed to accommodate their injury, was free of cost, and offered an opportunity to address their isolation by connecting with others with a shared experience. A minority of participants had practiced yoga previously and were interested in returning to an activity that they had done before. One participant was also motivated to join the program with her family member so that they could take a break from their caregiver-patient relationship.

And I also liked that it was a way for me to spend time with my mother, who was spending a lot of time taking care of me, but doing something that could benefit her as well and our relationship... So that was part of the motivation, so it was getting back to something I just love, and spending time with my mother in a different dynamic than caregiver and patient. (Participant #57, Female, 25 to 34 years, one-time participant, severe TBI, 1 year post injury)

Participants reported learning about the program through multiple channels, including referral from clinicians and friends who had previously participated, a television segment about the LoveYourBrain Foundation and its co-founder, advertisement through a yoga studio, and participation in a LoveYourBrain Yoga presentation at a Brain Injury Association conference.

### **Emerging themes**

We identified the following emerging themes related to participants' experience of the program's benefits and areas for improvement: ease of participation, belonging, sustaining community connection, physical health, self-regulation, self-efficacy, and resilience, which are described below along with illustrative quotations from the study participants.

#### **Ease of participation**

Participants expressed a unanimous appreciation for the program, and generally felt its design enabled them to successfully participate. For example, the community-based environment in which it was offered was well received.

It offers more than just yoga and that extra piece is really, really valuable, especially this year has been so incredibly hard for me. There are times I really would've loved to be back in that studio - where when you have so many outside things happening to you in addition to your brain injury that it would just be a really comforting place to be. (Participant #23, Female, 55 to 64 years, one-time participant, mild TBI, 1 year post injury)

The structure of the program also resonated with participants, many of whom reflected that having all components was critical to their ability to successfully participate.

So, we had kind of a section where, you know, people greeted each other, and she had a meditation section, and a physical section, then a section where we got together and she had a topic to talk about that we all sat in a circle and talked about. So, it wasn't just all one thing. She broke it down into sections. And people with TBIs - we can't sit so long and we can't do things for long periods of time, so she had it broken down into sections, which was easier to do. (Participant #27, Female, 55 to 64 years, one-time participant, mild TBI, 2 years post injury)

When asked to describe any challenges to participating in the program, the only barrier that was mentioned was scheduling. Specifically, those who worked found it difficult to attend the series if it was offered during working hours, and therefore suggested varying the timing outside of business hours as an area for improvement.

### **Belonging**

It was very common for participants to describe how the group format led them to feel a greater sense of belonging and community connection. Many participants remembered the opening psychoeducation exercise in the first class's group discussion (where people shared their story and their superhero) and reflected how powerful it was to both describe their experience and listen to others' experience. For some, being introduced to a group of others affected by TBI helped them overcome a feeling of isolation and made them more aware of the prevalence and diversity of TBI.

I would say that was probably the biggest beneficial factor of the program for me personally. ... I felt very secluded with this injury. It's a much hidden injury; you don't know people that have TBI. I honestly, honestly really felt like there weren't too many other people with it. When I got in a class there were - you know, it was an awakening because I realized there was actually a lot more people than I thought in a similar situation to myself. (Participant #54, Male, 25 to 34 years, one-time participant, severe TBI, 13 years post injury)

Several participants explained that they were surprised by the positive impact of the group discussion, which is not typically included in yoga classes. One person noted that she appreciated that this group experience felt 'hopeful', which was different from previous experiences of support groups.

I did not realize how profound the support group was going to be for me because in contrast to the previous support group, the group experience there was hopeful... There were people that were struggling with some situations much more dire than mine, but we were all there because we were invested in getting well and working with our new normal. I have to say, [the previous support group] was really sad and painstaking, and I needed to surround myself with some hope. (Participant #42, Female, 55 to 64 years, two-time participant, mild TBI, 2 years post injury)

Given how much participants valued the group discussion for cultivating meaningful social connections, some participants suggested extending the duration of the classes to allow more time for this component as an area for improvement.

#### **Sustaining community connection**

After the program was over, about half of participants shared that they sustained relationships built during LoveYourBrain Yoga and also were more capable of accessing other activities in their community. For example, a small group of participants described that their newfound confidence enabled them to try other yoga classes in their community.

I have [continued to practice yoga] because I found that I could do it... I use the breathing. I go yoga class. I make myself go at least three times a week. I even go on a Sunday morning. There's a really great Sunday morning class that I like. So, I get up early and go on Sunday mornings and it really helps my weekend.

(Participant #27, 55 to 64 years, Female, one-time participant, mild TBI, 2 years post injury)

In contrast, some participants described how they missed the opportunity to engage with the specific group in their program. Notably, one participant described how she felt such a loss of community when the program finished that she had reconsidered whether it was worth it.

And then when I had my injury I became totally isolated like really - and still am. I'm here kind of alone at the house all day again. So it was like really, really nice to meet other people with head injuries and I loved that part of it. The part that was hard for me was that it was real quick. When it stopped it stopped and that was a little sad for me

because I looked forward to every Friday like really looked forward to it.... I just think like I said to have that stronger connection and then to disperse is really tough. I remember once even thinking, 'Maybe I shouldn't have had it because it was so hard to leave it.' (Participant #31, Female, 55 to 64 years, one-time participant, mild TBI, 7 years post injury)

Overall, the most common suggestion for improvement was integrating strategies for maintaining contact with group members after the program was over (e.g., a sharing email and phone numbers) and facilitating more opportunities for ongoing social connection, such as hosting a monthly or quarterly reunion yoga class or social event.

### Physical health

It was common for participants to report that they had improved their strength, flexibility, and balance during the program. In addition, some participants described how they perceived relief from TBI-related symptoms, like headaches, pain, and other complications, from participating in the program.

...it really relieved a lot of the symptoms that I was dealing with, a lot of the physical symptoms, which was completely unexpected for me...had been struggling for months, it was probably a good five months that I wasn't able to walk until I could get to the point where I had enough balance to even participate in the class, so doing the yoga dramatically improved my just physical balance and ability to walk without a limp. I had persistent ringing in my left ear, and I still struggle with that now, but it dramatically decreased the ringing in my left ear. I had visual disturbances, and those improved somewhat. I had physical neck pain, and that completely ceased to exist after starting the program. (Participant #41, Female, 35 to 44 years, two-time participant, mild TBI, 1 year post injury)

### Self-regulation

Participants described using techniques learned from the series to help them regulate their emotions, stress levels, and attention in everyday life. For example, many participants specified that they used the breathing exercises to return to a calmer state when feeling overwhelmed.

The long-term gift...is the breathing piece is the tool that I carry with me and utilize daily. And I do it...to get myself centered, so I added that much more constantly to my meditation in the morning...is the tool that I whip out when I'm in a bad state. So those breathing techniques are the tool for me that help me recalibrate myself when I'm off balance mentally and emotionally. (Participant #42, Female, 55 to 64 years, two-time participant, mild TBI, 2 years post injury)

All three caregivers also reported observing how their loved ones became calmer during the program and were more equipped to cope with challenges in their daily lives. For example, a caregiver described how her loved one was better able to manage stress and anxiety and how her own mental health improved from participating.

I think that's been the biggest thing is just [LoveYourBrain participant] being able to stop and calm down, and work through the anxiety phase. ...So [the participant] is able to kind of, like, instead of getting really anxious and, like, - Oh my gosh I've lost something, and now I'm really stressed, and now I can't think straight - [the LoveYourBrain participant] is taking a step back and being able to have that little bit of mental space...

It's given us something to do together, and now we're both sort of reaping the mental benefits from it. So I think overall it's had a good effect, yeah. (Participant #43, Female, 35 to 44 years, one-time participant)

A majority of participants described how learning how to eat a raisin mindfully (a psychoeducation exercise in week 2) was a

valuable exercise for honing attention and slowing down. One participant described how she uses the concept of mindfulness from the exercise to help her focus on the most salient task.

... the one exercise that I carry with me was the mindfulness piece, where we had worked with the raisins... And the joke kind of in my family is like, - Ooh, okay, let's all take a raisin moment - but I think that that exercise has helped me focus. I've been in some complicated situations where there might be multiple stimuli, and that exercise comes back to where I will ask myself, like what's the raisin here? So what does my focus need to be? What's the thing I need to be paying attention to? (Participant #42, Female, 55 to 64 years, two-time participant, mild TBI, 2 years post injury)

### Self-efficacy

A majority of participants described feeling greater self-efficacy from their experience in the program. For example, successfully practicing the gentle yoga postures led some participants to feel proud of their body's capabilities instead of focusing on their limitations.

Definitely remember bringing awareness throughout my body... I remembered feeling the sense of just being proud of what my body can accomplish rather than being frustrated about what I could no longer do. (Participant #24, Female, 18 to 24 years, one-time participant, mild TBI, 7 years post injury)

A few participants reflected on the unique value of these practices in building a realistic optimism about their capabilities as compared to their traditional therapy.

I also think that, through the breathing and yoga as well, I was very aware of what my body was doing and capable of, so that was valuable as well. So I really enjoyed doing the yoga, because it put me in touch with my challenges and my abilities in a way that just walking in the hospital with a walker did not. So I think it really challenged me in some ways. (Participant #57, Female, 25 to 34 years, one-time participant, severe TBI, 1 year post injury)

Participants appreciated feeling comfortable gradually trying new poses over the course of the series and not feeling judged or pressured to practice in a way that did not feel safe.

I didn't feel rushed or I didn't feel embarrassed that there was something that I couldn't do. (Participant #41, Female, 35 to 44 years, two-time participant, mild TBI, 1 year post injury)

Everyone had support, you know, whatever you came in with. You know, you didn't have to feel like you had to be more. You could just be who you were with what you came in with and they would help you get to, you know, the point that you needed to be at. It was really, really supportive. (Participant #27, Female, 55 to 64 years, one-time participant, severe TBI, 2 years post injury)

Others described that the cross-learning in the group discussion was valuable, and particularly to be able to serve as a resource to others.

...the group support conversations after the yoga, gave us opportunities to be each other's resources... there was a woman talking about how challenging her relationship was at home, and there was a moment from like, 'Oh, I have something to contribute here,' ... And for me that I'm like, 'I might have some answers or something to contribute to other people's recovery.' Yeah, and it was empowering to be able to think of myself as a resource in a place where I was damaged, so it was good. (Participant #42, Female, 55 to 64 years, two-time participant, mild TBI, 2 years post injury)

### Resilience

Participants often described how validating it felt to share their experience with the group and learn from others about their experiences healing from a TBI. This validation catalyzed shifts in

perspective so that participants felt more capable of moving forward with their lives.

... that I wasn't crazy, that I wasn't making these things up, that the struggle was absolutely real, and I saw struggles in other people, and then I also saw people with a lot of hope, so I met people at different stages of their recovery and was able to, you know, gain a lot of insight... and sort of apply it to my life. So it made my experience real, it made me realize yes, this is a real thing that happened to me and yes, there is a way forward. (Participant #41, Female, 35 to 44 years, two-time participant, mild TBI, 1 year post injury)

The group discussion also facilitated reappraisal of perceived limitations to promote resilience. Specifically, of the participants who resisted some of the constraints of their TBI, many described that learning how others accommodated their injury gave them the permission to do the same.

I think that was a little bit of an epiphany... to realize that slowing down is okay in terms of that I don't have to be productive every single second. So, I think it was hearing the other [person] in the class say - in her day, if she has to, she pulls the blinds and she lies on the floor for a while - that that made me say to myself, Okay. It's okay to slow down. (Participant #23, Female, 55 to 64 years, one-time participant, mild TBI, 1 year post injury)

Being invited to discuss a positive outcome of their injury, one of the psychoeducation themes in the third week, was also described as important.

... again, that to me helped - it was about reframing the experience again, because some people talked about well I found gardening as a new passion, and I found that that's a way for me to kind of focus my thoughts and energies and get away from the nagging symptoms, etc., so I think that was a similar question, but in a different way, so I thought it was helpful to build upon how do we look at our lives a little bit differently from this point forward. (Participant #41, Female, 35 to 44 years, two-time participant, mild TBI, 1 year post injury)

Many participants also shared how their experience catalyzed reappraisal of their identity as a brain injury survivor.

The discussions and like the awareness they built around, I just needed to become aware that this, I did suffer a TBI and I needed to take a new approach on life and I was not going to be the same person I was before. (Participant #24, Female, 18 to 24 years, one-time participant, mild TBI, 7 years post injury)

I think that the experience with Love Your Brain yoga helped me to embrace not only - it allowed me to let go of who I was, embrace who I am, and then allowed me to explore who I'm becoming. (Participant #42, Female, 55 to 64 years, two-time participant, mild TBI, 2 years post injury)

A caregiver also observed their partner's change in perspective during the program.

I feel like it has sort of given [my partner] a new perspective that [s/he] can change [her/his] brain for the better even though it was really injured. Because when we first met [s/he] would - like, if we were in an argument a lot of times it would sort of move in to this space where it was, like, 'You don't understand. I have a disability; I'm always gonna have this disability, and this is why I act this way.' And I don't hear that very often, and that kind of stuff doesn't come up in arguments. So I really think it's given [her/him] a new perspective on how [her/his] brain can work. (Participant #43, Female, 35 to 44 years, one-time participant)

## Discussion

This qualitative study describes the experience of people with TBI and their caregivers in LoveYourBrain Yoga, which has important implications on the delivery of holistic, community-based rehabilitation for the TBI community. First, our results suggest that the program was a successful means for promoting relationships with

others and participation in meaningful activities, both core aspects of community integration [51], as demonstrated by the themes of 'ease of participation', 'belonging', and 'sustaining community connection'. Specifically, all participants valued the multifaceted structure of the program, which was accessible to TBI survivors regardless of the time since their injury or severity of impairment, and several people chose to participate multiple times. Other yoga interventions for community-dwelling TBI population have not been designed to support ongoing participation [30,32], despite both patients and caregivers having reported that the short-term focus of community-based services creates anxiety [20]. Participants also felt positively about the community-based yoga studio environment, and many continued to participate in other yoga classes in their community once the program was over. Furthermore, many participants felt accepted and understood by their peers and developed and maintained meaningful relationships with each other, which are among the highest priorities of community integration reported by people affected by TBI [9,12]. Taken together, these findings are important because multiple systems- and patient-level barriers can limit access to holistic services that facilitate community integration for people with TBI and their families [24,51-53].

Second, the diverse and meaningful physical, psychological, and social health benefits engendered by LoveYourBrain Yoga suggest that it may be an effective mode of, or adjunct to, rehabilitation. For example, participants reported improvements in strength, balance, flexibility, emotional regulation, and attention control, and a greater sense of belonging and community connection. Participants ongoing use of yoga-based tools, such as breathing exercises, to cope with negative emotions and stress suggests the program's utility for addressing mental health concerns, which can undermine community integration and wellbeing [16]. Similarly, in a study of three people with TBI who completed one-on-one yoga classes twice a week for eight weeks, participants reported using breathing techniques to regulate emotions and manage stress in their daily lives and developing greater confidence and physical stamina to participate in other activities in their community [31]. A study of 19 veterans with TBI attending weekly group-based mindfulness/yoga classes at an inpatient rehabilitation program also found that many participants perceived deep breathing as helpful for managing stress and mood [54]. In addition, the psychoeducation component of LoveYourBrain Yoga appeared to facilitate resilience and self-efficacy by offering participants the opportunity to relate to and learn from the group [55], serve as a mentor for others [56], and reframe their injury experience from a strengths-based perspective [57]. Enhancing resilience and self-efficacy among TBI survivors have been linked to increased motivation and capacity to manage symptoms and improved functional outcomes [58-60]. The multifaceted structure of LoveYourBrain Yoga is unique and whether it confers greater cost-effectiveness in the long-term than community-based programs designed for a singular objective (e.g., physical fitness [61] or peer support [56]) is an important area of future investigation.

Finally, our results have implications on the delivery of community-based rehabilitation services more broadly. In the era of accountable care organizations, there has been a call for improved collaboration between clinical services and community organizations to more sustainably and holistically address population health [62]. However, there continues to be poor integration between post-acute care and community-based services that address the myriad complications of TBI, including the need for community integration and family support [20,63]. Given the



diverse benefits of LoveYourBrain Yoga and other community-based yoga interventions for brain injury [28,32,40], integrating yoga studios – which are highly prevalent in the US – into models of TBI rehabilitation could offer a more seamless continuum of care and pathway to community integration [64]. Indeed, a growing body of research has shown that integrating yoga for brain injury populations into both rehabilitation [31,54,65] and community-based settings [29] is acceptable and feasible, potentially due to the highly adaptable nature of yoga practices to accommodate the full spectrum of TBI patients' physical, cognitive, and psychosocial needs.

A limitation of this study includes using a convenience sample, which could have introduced selection bias and possibly led people to choose to participate who had a more positive or negative experience of the program. Our sample was also homogenous in terms of gender, race and ethnicity, and educational attainment, therefore the themes that emerged from this study may not apply to other populations. Also, because memory deficits are common following TBI [66], participants may have been more prone to recall bias. Therefore, future qualitative research should consider conducting interviews in closer proximity to the end of the intervention as well as integrating more reliable methods of assessing brain injury severity (e.g., neuropsychological tests, medical chart review), both of which would have been impractical in this study design [67]. In addition, the interview guide was not pilot tested with caregivers, which was a missed opportunity to potentially improve the understandability and appropriateness of the questions for this group. Finally, due to challenges with recruitment, a limited number of caregivers participated in the study. While their responses provided preliminary evidence of potential benefits and useful data for triangulation [50], we suggest further research with a larger sample of caregivers to more reliably understand the implications of LoveYourBrain Yoga on this group [68]. These limitations, however, are balanced by several strengths. First, two researchers independently analyzed the data to prevent subjective bias and strengthen the reliability of data coding and interpretation. Second, this study adds a new dimension to the literature examining group-based yoga with psychoeducation intervention for community integration following TBI. Third, while we did not measure implementation fidelity across locations, the manualized format is an effective strategy for promoting the delivery of the intervention as intended [69] and for furthering knowledge translation in rehabilitation care [70]. Given participants' overall positive experience of LoveYourBrain Yoga, evaluating the intervention in a randomized controlled trial is recommended as an area of future research.

## Conclusions

LoveYourBrain Yoga, a group-based yoga with psychoeducation intervention for people with TBI and caregivers, was a successful means for promoting community integration. The diverse and meaningful physical, psychological, and social health benefits engendered by the intervention suggest that it may be an effective mode of, or adjunct to, rehabilitation. Yoga studios have potential to be integrated into models of TBI rehabilitation to create a more seamless continuum of care and pathway to community integration.

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## Disclosure statement

All authors have completed the ICMJE uniform disclosure form and declare: KD is employed by the LoveYourBrain Foundation, a nonprofit, for whom she led the design of the curriculum for the LoveYourBrain Yoga program. KD is married to the Executive Director of the LoveYourBrain Foundation. KD, DF, and SG received a grant from the Brain Injury Association of New Hampshire to support this research. DF and SG have no other relationships or activities that could appear to have influenced the submitted work. The authors alone are responsible for the content and writing of the paper.

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