

Brief report: Effects of exercise and self-affirmation intervention after traumatic brain injury

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Abstract.

BACKGROUND: Physical exercise has been proven to be an effective method for improving cognition and mood, but little is known about its benefits among individuals with traumatic brain injury.

OBJECTIVE: This pilot study investigated the feasibility of a combined exercise and self-affirmation intervention (IntenSati) for enhancing cognition and mood in individuals with TBI. It was hypothesized that this intervention would improve individuals' cognition and mood following the completion of the program.

METHOD: This intervention was held at an outpatient rehabilitation department in an urban medical center. A wait-list control design was conducted. Twenty-one adult participants—at least 12-months post-TBI—enrolled in the study. Twelve of them completed the study. Assessment was conducted at three time-points throughout the study using neuropsychological and self-report measures to evaluate participants' cognition and mood. Following initial evaluation, participants were assigned into either the immediate intervention group or the waitlist control group. During the intervention, participants attended the program twice a week over the course of 8 weeks. Debriefing was conducted following the completion of the program.

RESULTS: Both independent *t* tests and paired *t* tests were utilized. Results indicated that the intervention group experienced less depressive symptoms following the completion of the IntenSati program compared to the waitlist control group. Participants also reported having less depressive symptoms, experienced more positive affect, and had a higher quality of life following the completion of the program. Moderate-to-large effect sizes were found on decrease in negative affect. However, results associated with cognitive benefits were mixed. The participants tolerated the program well and reported satisfaction with the program.

CONCLUSIONS: Results from this study indicated that the IntenSati exercise program is a feasible and beneficial intervention for individuals with TBI as supported by the positive impact on their mood and quality of life.

Keywords: Traumatic brain injury, physical exercise, cognition, mood

1. Introduction

Traumatic brain injury (TBI) is an important public health issue in the United States. Besides taking a toll on human lives, the consequence of a TBI-related

injury often leads to extensive short- and long-term impairments in cognition and mood (Albensi, 2001; Ylvisaker, Jacobs, & Feeney, 2003). Reduced cognitive functioning, depression, and diminished quality of life are prevalent in individuals with TBI (Bombardier et al., 2010; Dikmen et al., 2009; Upadhyay, 2007). Additionally, despite improvements in diagnostic and therapeutic interventions, treatment for these disorders and impairments continue to be a challenge for the

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rehabilitation field. A growing body of empirical literature has suggested the benefits of using physical exercise or verbal self-affirmations (positive self-talk) to improve mood and cognition in the general and medical populations (e.g., stroke, Alzheimer's Disease; Creswell, Dutcher, Klein, Harris, Levine, 2013; Legault, Al-Khindi, & Inzlicht, 2012; Quaney et al., 2009; Steinberg, Leoutsakos, Podewils, & Lyketsos, 2009; Wood, Perunovic, & Lee, 2009). Still, research on physical exercise among individuals with TBI is limited and, thus far, no studies have investigated the effects of self-affirmations among this population.

The benefits of physical exercise on cognition among individuals with TBI are unclear and understudied (McDonnell, Smith, & MacKintosh, 2011). Although two studies have shown improvement in objective measures of processing speed, selective attention, and verbal and visual memory, other studies only have found either improvement in self-reported measures of cognition or no significant changes (Grealy, Johnson, & Rushton, 1999; McMillan, Robertson, Brock, & Chrolton, 2002; Mossberg, 2012). Currently there is insufficient evidence regarding whether exercise improves cognitive function in individuals with TBI.

In regards to the impact of exercise on mood among individuals post-TBI, preliminary findings have suggested that an increase in exercise can significantly reduce symptoms of depression (Blake & Batson, 2009). For instance, a randomized controlled trial has shown that those who had TBI and completed a 10-week long aerobic exercise training reported less depressive symptoms, improved sleep, community participation, and quality of life (Hoffman et al., 2010). However, with most studies utilizing only aerobic exercise as the intervention format, there is uncertainty regarding whether other modes of exercise may achieve comparable findings.

Self-affirmations, a common cognitive-behavioral technique, was based on the theory that individuals tend to find ways to protect their integrity when they feel stressed and threatened, and affirming their self-worth and identity is one of the methods to help them feel emotionally contained and relaxed (e.g., McQueen & Klein, 2006). This method has found to be an effective way to improve mood among the general population (Peden, Hall, Rayens, & Beebe, 2000). It assists individuals with appraising situations constructively, reduces negative thinking, and improves affect and mood (Peden et al., 2000). Although no studies have examined this intervention in individuals with TBI, self-affirmations have been shown to be valuable for reducing depres-

sion and maladaptive thoughts among those at risk for depression and breast cancer (Peden et al., 2000; Targ & Levine, 2002).

The "IntenSati" exercise intervention is an innovative form of exercise that combines fitness with verbal self-affirmations (for more details, see <http://www.satilife.com>). Participants recite spoken affirmations (e.g., "I believe I will succeed") simultaneous to executing a specific movement. This program is the first of its kind that aims to improve participants' with brain injury physical health and their psychosocial functioning.

The purpose of this pilot study was to explore the feasibility and effectiveness of the IntenSati program for improving cognition and mood among individuals with TBI. We hypothesized that (1) there would be a significant difference in mood, cognition, and quality of life between the immediate exercise group and the waitlist control group and that (2) participants would report improved mood and cognition and quality of life following completion of the study. Feasibility would be examined based on participants' feedback and any reports of adverse events.

2. Methods

2.1. Participants

Twenty-one participants were recruited through outpatient rehabilitation services at an urban medical center within a three- to four-month recruitment window. Potential participants obtained information about this study either through flyers that were provided by their therapists or posters that were posted on announcement boards at the hospital. After they contacted the research department in-person or through phone regarding their interest in participating in the study, an initial appointment was set-up to determine eligibility. They were eligible for this study if they were 18 years or older, had a TBI occurring a year or more prior to the intervention, had a medically documented TBI, had significant English language skills to complete the intervention and assessments, and agreed to complete measures and take part in the exercise program. Exclusion criteria included those who had medical conditions that contraindicate physical exercise. All participants signed the informed consent for the study, which was granted approval by the Institute of Review Board of the hospital. If any adverse event occurred during the exercise intervention (defined as participants experiencing any form of expected or unexpected medical or physical discomfort or injury

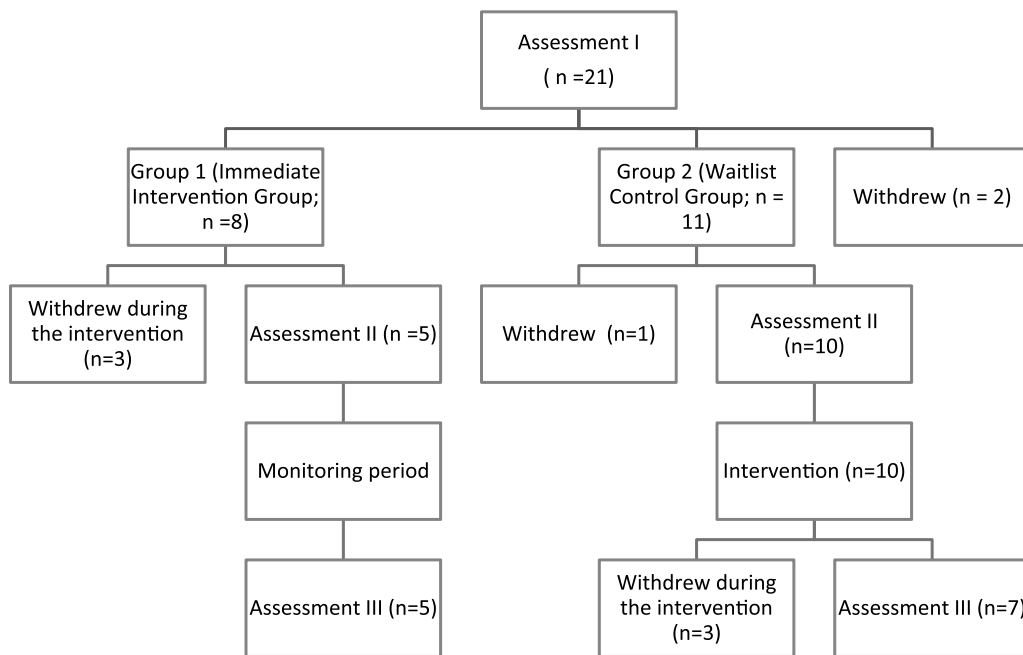


Fig. 1. Flowchart of the study.

during the sessions), the instructor would immediately report this to the principal investigator.

2.2. Procedure

Participants were assessed across three time points (see Fig. 1). During the initial appointment, participants provided consent and completed a demographic information form. If they were eligible for the study, they completed the baseline assessment, which included a set of questionnaires and neuropsychological assessment. This study was a waitlist control design. Following the assessment, participants were assigned into Group 1 (immediate exercise intervention; $n = 8$) or Group 2 (waitlist control group; 8 weeks of monitoring followed by exercise intervention; $n = 11$). Due to participants' personal commitments, they were assigned to the group that best fit their schedule. All participants completed the second assessment once Group 1 completed the program and the final assessment was conducted once Group 2 completed the intervention. Participants from both groups completed the same assessment during the second and third evaluations that were administered at the initial evaluation. All the assessments were conducted by trained research assistants or psychologists. Participants' level of satisfaction and feedback about the program were collected

from their individual debriefing session, which was held immediately after participants completed the final evaluation.

During the exercise phase, participants exercised twice per week, in a group format, guided by a trained and certified IntenSati instructor. Each session lasted 60 minutes. It started with the instructor discussing learned affirmations and asking participants to share their application of affirmations in their daily life. After that the participant began with a 10-minute warm-up and ended with a cool-down period. The program combined movements with spoken affirmations that were repeated during the exercise. Every movement of the IntenSati workout can be modified to any level of fitness and the IntenSati instructors clearly indicated the variations available at every class session, including performing exercises in the seated position. The class was conducted in a group room in the rehabilitation outpatient department. Table 1 shows a timetable of a typical session.

2.3. Measures

Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988). This is a 20-item measure comprised of two mood scales to measure positive and negative emotions. Test-retest reliability for an 8-week period

Table 1
Timetable of a typical session

| Time frame | Content |
|--------------|---|
| 5–10 minutes | Greeting and discussion of affirmations |
| 10 minutes | Warm-up |
| 30 minutes | Cardio session |
| 10 minutes | Cool down (meditation and relaxation) |

ranged from 0.47 to 0.68 for Positive Affect subscale and 0.39 to 0.71 for Negative Affect subscale (Watson et al., 1988). Construct validity is high showing measures of general distress and dysfunction, depression, and anxiety with the Negative Affect subscale (Crawford & Henry, 2004). PANAS has been adapted and used in TBI research (Arenth, Corrigan, & Schmidt, 2006).

Beck Depression Inventory (Beck, Steer, & Brown, 1996). This is a 21-item self-report measure of somatic, cognitive, and affective dimensions of depression. Reliabilities range from 0.77 to 0.90 (Beck et al., 1996). The BDI has been utilized for individuals with TBI (Agency for Healthcare Research and Quality, 2011).

Life-3 (Andrews & Withey, 1976). The widely used Life-3 is a single item in which the participant rates his/her overall quality of life during the past month using a seven-point scale. This item also has been used for TBI research (Cantor et al., 2008).

Digit Span Forward and Backward Subtest of the Wechsler Adult Intelligence Scale – Fourth Edition (Wechsler, 2008). This subtest requires the respondent to recall digits forward and backward and is used to measure immediate attention span and working memory. A reliability coefficient of 0.86 has been found on this subtest and backward span is more sensitive to brain disorders, particularly diffuse damage, which is characteristic of TBI (Chan, 2000).

Stroop Color and Word Test (Golden & Freshwater, 2002). This test assesses individuals' cognitive flexibility and processing speed. It involves three trials that require individuals to read words of color names, identify colors, and finally the inhibition trial. The test is very sensitive and has been widely used among individuals with TBI (Ben-David, Nguyen, & van Lieshout, 2011).

Trail Making Test – Part A and B (Reitan & Wolfson, 1988). These are timed tests focusing on attention, sequencing, mental flexibility, visual search, and motor function. Both parts have been shown to discriminate individuals with brain injury and general population. A test-retest correlation of Part A is 0.75, while Part B is 0.85 (Giovagnoli et al., 1996).

2.4. Statistical analysis

IBM SPSS 20.0 was utilized to analyze the data. Descriptive statistics were calculated. Preliminary analysis was completed to examine whether there were differences between i) those who completed the study and those who dropped out and ii) Group 1 and Group 2. Independent *t* test was used to examine changes in mood, cognition, and quality of life between baseline (evaluation 1) and post intervention (evaluation 2) between the immediate intervention group and the wait-list control group. Paired *t* tests also were conducted to explore any significant changes in overall participants' mood, cognition, and quality of life between baseline and post-intervention. Additionally, due to our small sample size, effect sizes were calculated to aid interpretation of the results. Nonparametric tests were used when data failed to have a normal distribution.

3. Results

Twelve participants completed the program. The average attendance for the study was 71.35%. No adverse events were reported throughout the study. During debriefing, all participants completing the study were satisfied with the program and indicated an interest in continuing the program in the future. A female participant commented on how this program “caused[ed] a ripple effect in [her] recovery.” Another participant described the exercise as “a positive experience, it made me feel very confident [...] I feel like I have a new way to encounter problems.” Overall participants indicated that the program provided a sense of community and a safe environment for them to consolidate skills and strategies that they learned from other rehabilitation services. They also added that the program guided them toward having a more positive outlook on their lives. Following the completion of the program, some of them continued to use verbal affirmations in their daily life and practiced IntenSati or regular exercise at home and/or at free-of-charge community programs. Table 2 presents demographic information about this sample.

Based on preliminary analysis, no significant differences were found within the demographic information, self-report questionnaires, and cognitive assessments between those who completed the study and those who withdrew from the study. Similarly, no significant differences were indicated between Group 1 and Group 2.

Results from the independent *t* test analysis are presented in Table 3. The immediate intervention

Table 2
Participant demographic characteristics

| Variables | Group | Group 1 (N=9) | Group 2 (N=12) | total (N=21) |
|---------------------|----------------------|---------------------------|---------------------------|----------------------------|
| Age (Mean) | | 48.22(<i>SD</i> = 18.19) | 44.50(<i>SD</i> = 12.97) | 46.09 (<i>SD</i> = 15.21) |
| Months since Injury | | 88.11(<i>SD</i> = 83.56) | 27.30(<i>SD</i> = 22.01) | 56.11(<i>SD</i> = 65.71) |
| Gender | Male | 4 | 5 | 9 |
| | Female | 5 | 7 | 12 |
| Marital Status | Married | 2 | 2 | 4 |
| | Single | 6 | 9 | 15 |
| | Divorced | 1 | 1 | 2 |
| Race/Ethnicity | African American | 1 | 1 | 2 |
| | Asian | 0 | 2 | 2 |
| | Hispanic | 2 | 0 | 2 |
| | White | 6 | 9 | 15 |
| Education Level | <8th grade | 1 | 0 | 1 |
| | 9–12th grade | 2 | 2 | 4 |
| | Some College | 3 | 3 | 6 |
| | Bachelors degree | 1 | 0 | 1 |
| | Advanced degree | 2 | 7 | 9 |
| Vocation | Currently employed | 0 | 4 | 4 |
| | Retired | 1 | 1 | 2 |
| | Volunteer activities | 0 | 2 | 2 |
| | On disability | 7 | 6 | 13 |
| | Missing | 1 | 1 | 2 |
| Income Level | \$0–\$25,000 | 8 | 6 | 14 |
| | \$25,001–\$50,000 | 0 | 2 | 2 |
| | >\$100,000 | 1 | 2 | 3 |
| | Missing | 0 | 2 | 2 |
| Subject Status | Dropped Out | 4 | 5 | 9 |
| Attendance Rate | | 63.75% | 77% | 71.35% |

Note. Attendance rate was based on those who completed the study.

group reported experiencing less depressive symptoms following the completion of the IntenSati program ($M = -13.00$, $SD = 14.97$) than the waitlist control group ($M = 1.57$, $SD = 6.90$; $t(10) = -2.28$, $p < 0.05$). No significant improvement in positive affect, negative, and quality of life were found, but a medium effect size was shown for experiencing more positive affect ($d = 0.64$; Cohen 1992) and less negative affect ($d = -0.59$) and a large effect size for reporting having a better quality of life ($d = 0.77$). Regarding cognitive measures, no significant differences were found between the intervention group and control group and the effect sizes among all these measures varied.

Based on the paired t test (see Table 4), results indicated that participants reported experiencing less depressive symptoms following intervention ($M = 23.50$, $SD = 13.1$) than at baseline ($M = 13.00$, $SD = 8.39$). This difference was significant, $t(11) = -3.50$, $p < 0.05$. Participants' positive affect increased significantly, $t(11) = 2.74$, $p < 0.05$, following the completion of the study (baseline $M = 28.36$, $SD = 25.19$; post-intervention $M = 49.08$, $SD = 34.60$). The Life-3 scores showed significant improvements after the exercise

program, $t(11) = 3.36$, $p < 0.01$ (baseline $M = 3.58$, $SD = 1.08$; post-intervention $M = 4.83$, $SD = 1.47$), suggesting improvement in their quality of life. There was no significant decrease in negative affect, but a medium-to-large effect size was indicated ($d = 0.60$). None of the cognitive measures were significantly improved, however, a small-to-medium effect size was indicated in relation to the Stroop word trial ($d = 0.43$).

4. Discussion

This is the first pilot study focusing on the impact of a combined exercise and affirmation (IntenSati) program in individuals with TBI. The results largely supported our hypothesis that the IntenSati program improved depressive symptoms, mood, and quality of life among participants. The benefits of IntenSati exercise on cognitive function were mixed, however a small-to-medium effect size was found in the performance of the Stroop word trial when comparing participants' performance before and after completing the intervention.

Table 3
Comparison of Changes in the Scores of Baseline and Post-Intervention of the IntenSati Exercise Program between Group 1 (Immediate Intervention Group; $n = 5$) and Group 2 (Waitlist Control Group; $n = 7$).

| | ($M \pm SD$) | $T(df)$ | P | Cohen's d |
|-------------|--------------------|--------------|-------|-------------|
| BDI-II | | | | |
| Group 1 | -13.00 ± 14.97 | $-2.29 (10)$ | 0.045 | -1.25 |
| Group 2 | 1.57 ± 6.90 | | | |
| PA | | | | |
| Group 1 | 25.12 ± 34.60 | 1.18 (10) | 0.27 | 0.64 |
| Group 2 | 7.74 ± 16.13 | | | |
| NA | | | | |
| Group 1 | -27.94 ± 42.02 | $-1.07 (10)$ | 0.31 | -0.59 |
| Group 2 | -8.09 ± 22.48 | | | |
| Life-3 | | | | |
| Group 1 | 0.60 ± 1.34 | 0.94 (10) | 0.37 | 0.77 |
| Group 2 | -0.14 ± 1.35 | | | |
| DSF | | | | |
| Group 1 | -1.4 ± 3.13 | $-0.14 (10)$ | 0.89 | -0.09 |
| Group 2 | 1.29 ± 41.37 | | | |
| DSB | | | | |
| Group 1 | -13.22 ± 17.89 | $-0.87 (10)$ | 0.41 | -0.49 |
| Group 2 | -5.0 ± 15.02 | | | |
| Stroop - C | | | | |
| Group 1 | -0.24 ± 4.14 | $-0.12 (10)$ | 0.91 | -0.07 |
| Group 2 | 0.11 ± 5.72 | | | |
| Stroop - W | | | | |
| Group 1 | 2.02 ± 3.70 | 0.85 (10) | 0.42 | 0.54 |
| Group 2 | -7.23 ± 23.93 | | | |
| Stroop - CW | | | | |
| Group 1 | -0.34 ± 18.31 | $-0.12 (10)$ | 0.24 | -0.72 |
| Group 2 | 12.34 ± 16.87 | | | |
| TMT A | | | | |
| Group 1 | -6.36 ± 40.36 | $-0.95 (10)$ | 0.37 | -0.53 |
| Group 2 | 11.61 ± 25.59 | | | |
| TMT B | | | | |
| Group 1 | 10.13 ± 29.55 | 1.08 (10) | 0.31 | 0.69 |
| Group 2 | -13.10 ± 36.55 | | | |

Note. The results from the PA, NA, DSF, DSB, Stroop, and TMTs are measured in percentile. BDI-II = Beck Depression Inventory Second Edition; PA = Positive Affect; NA = Negative Affect; DSF = Digit Span Forward; DSB = Digit Span Backward; Stroop-C = Stroop Color Trial; Stroop-W = Stroop Word Trial; Stroop CW = Stroop Color Word Trial; TMT A = Trail Making Test A; TMT B = Trail Making Test B.

The findings indicated that the IntenSati intervention is a feasible program for individuals with TBI as the program was well-tolerated by individuals, no negative events were reported, and all participants who completed the program were satisfied and hoped to continue with the program.

Our findings indicated that participants reported experiencing less depressive symptoms and more positive affect following the program. Depression has been one of the most frequent psychiatric disturbances for individuals with TBI. The prevalence rate of depression among individuals with TBI has been found to be between 10% and 77% (Bombardier et al., 2010; Ashman et al., 2004). Prior to participating in the intervention, most participants reported feeling moderately depressed. However, following the program, a majority of the participants reported experiencing only

mild mood disturbances. Similar benefits of exercise on mood among this population have been indicated in other studies. Blake and Batson (2009) conducted a pilot study using brief Qigong exercise over an eight-week period showing that self-esteem and mood were improved in the exercise group, but not the control group among individuals with TBI. Similarly, Schwandt and her colleagues (2012) found that an aerobic exercise program improved TBI participants' mood. Our results, as well as previous studies, indicated that physical exercise can be a low-cost and effective method for treating depression.

The results of this study also showed that exercise and affirmations may enhance individuals' quality of life. In general, information related to the impact of exercise on individuals' perception of quality of life in individuals with TBI has been scarce (Hoffman et al., 2010;

Table 4
Comparison of the Baseline and Post-Intervention of the IntenSati Exercise Program Among All Participants

| | Baseline (M \pm SD) | Post-Intervention (M \pm SD) | T(df) | P | Cohen's d |
|-------------|-----------------------|--------------------------------|------------|-------|-----------|
| BDI-II | | | | | |
| Group 1 | 29.60 \pm 18.31 | 16.60 \pm 10.95 | −3.50 (11) | 0.005 | −0.95 |
| Group 2 | 19.14 \pm 6.34 | 10.43 \pm 5.53 | | | |
| PA | | | | | |
| Group 1 | 44.34 \pm 28.16 | 69.46 \pm 40.98 | 2.74 (11) | 0.02 | 0.68 |
| Group 2 | 16.94 \pm 16.41 | 34.53 \pm 21.967 | | | |
| NA | | | | | |
| Group 1 | 84.86 \pm 21.56 | 56.92 \pm 31.98 | −1.63 (11) | 0.13 | 0.60 |
| Group 2 | 57.31 \pm 24.37 | 50.69 \pm 24.81 | | | |
| Life-3 | | | | | |
| Group 1 | 3.60 \pm 0.89 | 4.20 \pm 1.79 | 3.36 (11) | 0.006 | 0.97 |
| Group 2 | 3.57 \pm 1.27 | 5.29 \pm 1.11 | | | |
| DSF | | | | | |
| Group 1 | 33.22 \pm 29.53 | 31.82 \pm 30.69 | −0.21 (11) | 0.83 | −0.02 |
| Group 2 | 44.14 \pm 37.34 | 43.86 \pm 31.67 | | | |
| DSB | | | | | |
| Group 1 | 44.22 \pm 30.20 | 31.00 \pm 27.28 | −0.02 (11) | 0.98 | 0.00 |
| Group 2 | 42.43 \pm 29.09 | 51.66 \pm 30.41 | | | |
| Stroop – C | | | | | |
| Group 1 | 2.58 \pm 2.80 | 2.34 \pm 4.48 | 1.91 (11) | 0.08 | 0.21 |
| Group 2 | 20.06 \pm 19.80 | 27.40 \pm 23.89 | | | |
| Stroop – W | | | | | |
| Group 1 | 1.54 \pm 2.57 | 3.56 \pm 6.26 | 2.10 (11) | 0.06 | 0.43 |
| Group 2 | 22.57 \pm 17.73 | 37.23 \pm 25.42 | | | |
| Stroop - CW | | | | | |
| Group 1 | 12.66 \pm 15.96 | 12.32 \pm 13.34 | −0.60 (11) | 0.56 | −0.08 |
| Group 2 | 63.43 \pm 34.46 | 58.39 \pm 37.99 | | | |
| TMT A | | | | | |
| Group 1 | 25.90 \pm 29.50 | 19.54 \pm 39.12 | −0.35 (11) | 0.74 | −0.06 |
| Group 2 | 71.44 \pm 27.06 | 71.61 \pm 34.13 | | | |
| TMT B | | | | | |
| Group 1 | 25.73 \pm 34.71 | 28.68 \pm 37.20 | 1.41 (10) | 0.19 | 0.32 |
| Group 2 | 50.90 \pm 31.20 | 62.33 \pm 31.08 | | | |

Note. The results from the PA, NA, DSF, DSB, Stroop, and TMTs are measured in percentile. BDI-II = Beck Depression Inventory Second Edition; PA = Positive Affect; NA = Negative Affect; DSF = Digit Span Forward; DSB = Digit Span Backward; Stroop-C = Stroop Color Trial; Stroop-W = Stroop Word Trial; Stroop CW = Stroop Color Word Trial; TMT A = Trail Making Test A; TMT B = Trail Making Test B.

Wise, Hoffman, Powell, Bombardier, & Bell, 2012). Individuals with TBI often find themselves in challenging and unrewarding situations, which can lead them to feel discouraged and negative towards their situations. It is possible that the components of affirmations in this program guide participants to perceive their situations more positively, which helped them improve their mood and appraise their lives with much more satisfaction.

The benefits of the IntenSati program on cognitive functions are mixed, but it appeared to have some positive impact on processing speed among individuals with TBI. However, due to a small-to-medium effect size as well as scarce information in this area among this population, more research is needed in order to indicate strong evidence to support the use of exercise to improve cognition in individuals with TBI.

This study has several limitations. This pilot study was a correlational study which was only based on a small sample and the drop-out rate was moderately high. Due to scheduling conflicts, two participants dropped out following the initial evaluation. Six of them started the program and stopped within 2 sessions and a participant who was in the waitlist group dropped out before beginning the intervention. Thus, interpretation of the results must be approached with caution. Additionally, due to the small sample size, the study groupings could not be divided based on injury severity, which leads to the question of whether this program would be more applicable for those with a certain level of injury severity. We also did not know whether the result was due solely to exercise or due to the combination of the exercise and self-affirmation. Finally, this study did not keep track of treatment

services that individuals received, which can be a confounder for the results.

This study is clinically relevant for current rehabilitation services and healthcare policy. With healthcare system trends moving towards bundled systems, treatment services need to be more integrative and preventive-oriented (Cutler & Ghosh, 2012). Integrative health programs, such as IntenSati, not only improve physical fitness for individuals with TBI, but also may enhance individuals' mental health, cognition, and life satisfaction. Currently, with exercise not considered as part of the standard of care of rehabilitation in addition to the extremely high direct and indirect costs of treating TBI, there is strong need to consider incorporating these low-cost programs to improve overall health among individuals with TBI (Driver, Ede, Dodd, Stevens, & Warren, 2012; Driver, Irwin, Woolsey, & Pawlowski, 2012).

To conclude, this study indicated the feasibility of using the IntenSati program for individuals with TBI. Results indicated its short-term benefits on mood, cognition, and quality of life. Future studies should replicate this study by utilizing a more rigorous methodology such as a randomized clinical trial and recruiting a larger sample. Additionally, studies also should examine the long-term benefits of this program among this population.

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Declaration of interest

None of the authors have any financial and personal relationships with other individuals or organizations that could inappropriately influence their work on this study and paper.

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