

Assessing the Efficacy of Specialized Yoga as a Cost-Effective Intervention for Enhancing Quality of Life in Spinal Cord Injury Patients: A Randomized Controlled Trial

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Abstract

This randomized controlled trial evaluates the efficacy of specialized yoga as an intervention for cost-effectively improving quality of life and mental health in patients suffering from spinal cord injury. Randomly, 60 subjects with chronic spinal cord injury (SCI), aged between 18 to 65 years, were put into two groups: a specialized yoga-based intervention group and a standard rehabilitation care group. The intervention included a 6-week specialized yoga program with twice-weekly sessions, which consisted of physical postures, breathing exercises, and meditation, performed in a manner that is modified to suit the physical limitations of the patients suffering from SCI.

Primary outcomes were assessed through the SF-36 Health Survey, which indicated that the quality of life measurement for the yoga group showed an overall improvement of 20% compared to 10% for the control group, $p < 0.01$. Secondary outcomes included a 30% decrease in depression and anxiety symptoms by the Beck Depression Inventory and Generalised Anxiety Disorder 7-item scale, versus smaller decreases in the control group, $p < 0.01$. Cost-effectiveness analysis demonstrated a lower cost per QALY (Quality-Adjusted Life Year) for the yoga group.

The findings suggest that specialized yoga is an effective, relatively low-cost intervention for significantly improving mental health and quality of life in SCI patients. The study provides a rationale for integrating specialized yoga into rehabilitation practices, with implications particularly in resource-constrained settings.

Keywords: Specialized Yoga, Spinal Cord Injury (SCI), Mental Health, Quality of Life, Rehabilitation, Cost-Effectiveness, Neuroplasticity

1. Introduction

1.1 Background

A spinal cord injury can significantly affect a person's physical and mental well-being and have the ability to change their life. The incidence of SCI fluctuates between 40 and 80 per million years worldwide; most cases are brought on by traumatic events like falls and accidents. The psychological profile of SCI patients, which is characterised by higher-than-average rates of anxiety, depression, and PTSD, has been largely ignored in favour of traditional SCI rehabilitation, which has concentrated on the physical components of recovery (Weathers et al., 2013; Smith et al., 2015; Davis et al., 2018). Consider yoga, which combines meditation with physical postures and breathing techniques (Hernandez et al., 2022; Kim et al., 2023). It has been identified as one of the most successful supplementary therapy for a range of illnesses (Yoganandan et al., 2013; Zhou et al., 2015; Yan & Zhang, 2016). Specialized yoga for SCI patients targets not only aspects of physical but also mental health in rehabilitation. While studies yielded promising results in terms of functional improvement of mobility, reduced pain, and enhancement of mental well-being, so far, its integration into the standard rehabilitation process of SCI is not large (Cramer et al., 2013; Field, 2016; Garland et al., 2013; Lee et al., 2020).

This study aims to establish the efficacy and cost-effectiveness of a specialized yoga program in enhancing the quality of life and mental health of patients suffering from SCI, providing empirical evidence for its broader adoption within rehabilitation practices.

1.2 Rationale

Specialized yoga modified to include traditional pose modifications and use of props has already showed great potential in improving mobility, reducing pain, and enhancing mental health for those affected by SCI conditions (Williams et al., 2017; Johnson et al., 2020; Patel et al., 2020). Moreover, yoga is relatively of low cost, hence, an affordable option for

long-term rehabilitation. The present research, therefore, is an attempt to fill this significant gap in the literature with some empirical evidence on the effectiveness and cost efficiency of specialized yoga in SCI rehabilitation.

1.3 Objective

Therefore, primarily, the research will seek to assess whether the intervention of specialized yoga is effective in improving the quality of life of patients with SCI over a period of six weeks. The secondary objectives are: to assess the effect of the intervention on mental health and physical functioning, as well as to evaluate its cost effectiveness compared to the standard rehabilitation practice.

1.4 Hypothesis

We assume that specialized yoga will significantly improve the quality of life and mental health outcomes in SCI patients and will become more cost-effective intervention compared to standard rehabilitation practices.

2. Literature Review

2.1 Overview of Spinal Cord Injury (SCI) and Rehabilitation

SCI results in severe difficulties—physical and psychological—and is associated with chronic pain, loss of mobility, and consequently, extremely high rates of depression and anxiety (Spitzer et al., 2006; Furlan et al., 2013; WHO, 2013). The conventional rehabilitation approach, consisting of treatment by physical therapy and psychological support, has beneficial effects but is generally inadequate in meeting the extensive needs of a patient with SCI (Hagen et al., 2012; Anderson et al., 2017; Craig et al., 2015).

2.2 Yoga as a Holistic Rehabilitation Approach

Yoga is a holistic practice and is increasingly being applied in rehabilitation practices related to chronic illness and disability (Grossman, 2004; Lubetzky et al., 2016; Cruz-Feliciano et al., 2017; Vancampfort et al., 2017). Studies proved tailored yoga for SCI patients can significantly improve the outcome of physical and mental health. On the contrary, research on its cost and effectiveness, and the long-term benefits are still insubstantial.

2.3 Psychological Health and Quality of Life among Individuals with SCI

There are emotional and mental health challenges that SCI patients face, such as depression, anxiety, and PTSD, which generally lower the quality of life of those concerned (Tran et al., 2010; Miller, 2011a; Miller, 2011b; Tharion et al., 2016). These symptoms are found diminished by practicing yoga, which improves emotional regulation and enhances psychological resilience. and travellers including MacDonald et al. 2012, Field 2016, Craig et al. 2015, Sandford et al. 2014 report reduced symptoms.

2.4 Cost-Effectiveness of Yoga in Rehabilitation

SCI rehabilitation may be very costly; therefore, there is a strict need for cost-effective interventions. The yoga therapy can potentially solve this challenge because it is low cost and generally accessible (Wade, 1992; Sharma & Haider, 2013; Rees, 2009; Kuppaswamy & Whitford, 2020). Literature reports that practice of yoga reduces the overall health care by improving the outcome of the patients and reduces the need for intensive therapies. (Lee et al., 2020; Wiese & Osterberg, 2010).

2.5 Research Gap

Even though there is literature pointing to the benefits of yoga in mental health and physical functioning, there is still a paucity of studies specifically examining the effects of specialized yoga in people with an SCI. Much work has been done in general populations or other groups of chronic illnesses, often overlooking areas of unique rehabilitation needs typical of people with an SCI. Furthermore, robust research investigating the issue of whether yoga has the potential to enhance neuroplasticity and improve cognitive performance within the context of SCI has been lacking to date (Davidson & McEwen, 2012).

Moreover, the cost-effectiveness of yoga as a rehabilitative intervention is relatively unexplored. Provided that the healthcare cost consumed by the processes of rehabilitation for SCI patients is high, there is an urgent need to find low-cost yet effective interventions. While yoga is considered a low-cost therapy, very little empirical evidence has been found to back its economic viability for SCI rehabilitation.

To this effect, the aim of the research is to fill these gaps by investigating, through an RCT design, whether 6 weeks' specialized yoga program can improve the functional ability and reduce pain or severity of cardinal symptoms in patients with SCI. This research will provide invaluable knowledge about how specialized yoga can be integrated into standard rehabilitation practices in subjects with SCI. Still more, it is likely to contribute meaningfully to the development of evidence-based practice and guidelines, specific to SCI outcomes.

3. Methodology

3.1 Study Design

This research had been undertaken in order to assess the effectiveness of specialized yoga in improving the quality of life in patients with SCIs within a duration of 6 weeks, using a randomized controlled trial study design. The participants were randomly divided into two groups—specialized yoga and control receiving regular care.

3.2 Participants

Inclusion Criteria: 18–65-year-old adults diagnosed with SCI, in the chronic phase of injury, and those who can participate in mild to moderate physical activity. Exclusion Criteria: Patients with severe cognitive impairment, severe psychiatric disorders, or absolute medical contraindications to physical activity. Sample Size The sample consisted of 60 participants drawn from Patanjali Wellness Centre, Haridwar. Both groups consisted of 30 participants.

3.3 Intervention

Specialised Yoga Program: The intervention consisted of a 6-week specialized yoga program, conducted twice a week, with 60 minutes per session. The course design took into account the physical limitations of SCI patients and the mental well-being that is fostered by a combination of physical postures, breathing exercises, and meditation techniques. Props such as chairs, straps, and bolsters were used to aid in posing.

Table 1: Yoga Protocol Table for SCI Candidates

Week	Session Focus	Description	Key Asanas/Techniques	Duration
1	Introduction to Yoga & Safety	Introduction to the basic principles of yoga, importance of breath control, mindfulness, and safety measures. Overview of how yoga can benefit SCI patients.	Breathing: Diaphragmatic breathing, Ujjayi breath Asanas: Seated Mountain Pose (Tadasana), Cat-Cow (Marjaryasana-Bitilasana), Seated Forward Bend (Paschimottanasana)	60 mins
2	Gentle Stretching & Mobility	Focus on gentle stretching and improving mobility. Emphasis on slow, controlled movements to enhance flexibility and prevent injury.	Breathing: Nadi Shodhana (Alternate Nostril Breathing) Asanas: Gentle Spinal Twist (Supta Matsyendrasana), Supported Bridge Pose (Setu Bandhasana) using props, Seated Side Stretch	60 mins
3	Strength Building	Introduce asanas aimed at building strength in core and upper body. Use of props to assist in poses.	Breathing: Kapalabhati (Skull Shining Breath) Asanas: Warrior I (Virabhadrasana I) with chair support, Plank Pose (Phalakasana) with knees down, Seated Forward Bend with strap	60 mins
4	Balance & Coordination	Focus on improving balance and coordination through targeted poses. Encourage mindfulness and breath awareness to aid in balance.	Breathing: Bhramari (Bee Breath) Asanas: Tree Pose (Vrksasana) with wall support, Seated Eagle Pose (Garudasana), Table Top Balance (opposite arm and leg lift)	60 mins
5-6	Deepening Flexibility & Integration	Increase the intensity of stretching exercises to further enhance flexibility. Ensure participants are comfortable and use props as needed. Integrate all previous practices into a cohesive routine. Emphasize the importance of	Breathing: Sitali (Cooling Breath), Alternate Nostril Breathing (Nadi Shodhana) Asanas: Seated Forward Bend (Paschimottanasana) with deeper stretch, Reclined Hand-to-Big-Toe Pose (Supta Padangusthasana) with strap, Sun Salutation (Surya Namaskar) sequence with modifications, Legs-Up-the-Wall Pose (Viparita Karani)	60 mins

Control Group: Control group participants, however, received the conventional program of rehabilitation that included standardized physical therapy and psychological support.

3.4 Outcome Measures

Primary Outcome: The health-related quality of life measure was assessed by using SF-36 Health Survey as suggested by Ware & Sherbourne, 1992.

Other outcome measures included the Beck Depression Inventory, or BDI, the Generalized Anxiety Disorder 7-item scale or GAD-7, and the PTSD Checklist or PCL for mental health outcome measures; physical functioning was assessed using mobility; and cost-effectiveness measures were assessed using cost per QALY gained.

Measurements: The control and intervention groups were assessed both at baseline, prior to the intervention, and at the end of the 6-week period, assessing the effectiveness of the yoga intervention on mental health outcomes.

3.5 Data Collection

The data was collected at baseline, immediately post-intervention, and at the 6-month follow-up. This was done through questionnaires, interviews, and physical assessments as outlined by Bovend'Eerd et al. (2009).

3.6 Data Analysis

Statistical analysis was done using SPSS. Descriptive statistics summarized characteristics of participants; inferential statistics — ANOVA and paired t-tests — compared outcomes in both groups. Cost utility analysis, as developed by Wang et al. (2014), was employed for assessing cost-effectiveness.

3.7 Ethical Considerations

Informed consent was sought from all participants. The study was approved by an IRB, and confidentiality was maintained throughout.

4. Results

4.1 Characteristics of participants

Table 2: Demographic Characteristics of Participants

Variable	Yoga Group (n=30)	Control Group (n=30)
Age (Mean ± SD)	45.2 ± 10.5	44.8 ± 11.2
Gender (% Male)	55%	55%
Duration of SCI (Years)	2.5 ± 1.2	2.6 ± 1.3

4.2 Primary Outcome: Quality of Life

In the specialized yoga group, there was a 20% improvement in SF-36 scores, compared to 10% in the control group, $p < 0.01$. These findings clearly point out that if subjects are engaged in interventions including yoga-based exercises and postures, there will be significant improvements in their health-related quality of life and physical functionality.

Table 3: Changes in Quality of Life (SF-36 Scores)

Domain	Yoga Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Physical Functioning	+25%	+10%	<0.05
Mental Health	+30%	+15%	<0.01
Overall Quality of Life	+20%	+10%	<0.01

4.3 Secondary Outcomes

Mental Health: The BDI scores showed a 30% reduction in depression symptoms in the yoga group compared to a 15% reduction in the control group ($p < 0.01$) (Beck et al., 1996).

Table 4: Changes in Mental Health Outcomes

Measure	Yoga Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
BDI	-30%	-15%	<0.01
GAD-7	-30%	-10%	<0.01
PCL	-25%	-12%	<0.05

Cost-Effectiveness: The yoga group demonstrated a cost per QALY of \$3,000, much better than that of the control group for \$6,000 ($p < 0.05$) (Wiese & Osterberg, 2010).

4.4 Follow-Up Results

At the 6-month follow-up, 75% of the yoga group maintained their improvements, while mental health outcomes regressed for the control group (Johnson et al., 2014).

5. Discussion

5.1 Interpretation of Findings

The results show that a 6-week specialized yoga program improves QoL and mental health outcomes significantly in patients with SCI. Even considering the relatively short duration of this program, the overall effects on physical functioning and mental health are remarkable and further support the idea of regarding yoga as a whole and valuable rehabilitation practice.

The findings are in agreement with past research showing benefits of yoga to mental health and physical functioning among populations living with chronic illness, as identified by Field in 2016. In this respect, the significant cost savings in this study further support incorporating yoga into standard care practices, as past research often alluded to financial impediments related to long-term rehabilitation, often referred to in Zhao et al., 2018; Wiese & Osterberg, 2010..

5.3 Implications for Practice

The results obtained from the study prove that specialized yoga can be effectively utilized in a 6-week rehabilitation program, and thus this gives an effective solution for centers with short durations of patient stay. It can also be said that the cost-effectiveness of yoga is likely to easily tempt most health care providers and policy makers who are continuously in efforts to reduce the rehabilitation costs while achieving effective outcomes for the patients involved, Lee et al. (2020).

5.4 Limitations

The relatively small sample size and single-centre design of the study could reduce the generalizability of its findings. Moreover, though the duration was 6 weeks, long-term benefits associated with yoga cannot be claimed through this study, thus there is a need to conduct future studies with a longer period of follow-up and involving larger and more representative populations (Moin & Mohajer, 2012).

5.5 Future Research

Future studies should emphasize increasing the sample size and replication of the study across centers, so that there is an increased generalizability factor. Further, investigations on long-term sustainability of benefits and influence on other rehabilitation outcomes, including social integration and vocational recovery, would be relevant. Studies on the neurobiological mechanisms of yoga, especially its influence on neuroplasticity and biomarkers associated with stress, can further the current understanding of how yoga enables SCI patients to recover (Davidson & McEwen, 2012).

6. Conclusion

Even in a short intervention of 6 weeks, specialized yoga has been evidenced to be an effective and cost-efficient intervention for significantly improving QoL and mental health in people with SCI. The findings should be integrated into mainstream rehabilitation practice, particularly in settings where the length of patient stays is shorter. Therefore, further study into the long-term benefits and broader applications of yoga in SCI rehabilitation is warranted.

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