DIVYAYATAN
A JOURNAL OF LAKULISH YOGA UNIVERSITY

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A JOURNAL OF LAKULISH YOGA UNIVERSITY
Peer Reviewed Journal
E-ISSN: 3048-4928

ANALYTICAL STUDY ON THE IMPACT OF SIX-MONTH HATHA YOGA TRAINING ON FUNCTIONAL CAPACITY AND MENTAL WELL-BEING IN POST-COVID ADULTS

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Abstract

Background: *The COVID-19 pandemic has left many adults experiencing prolonged symptoms, including reduced functional capacity and mental health challenges. Rehabilitation approaches that incorporate holistic physical and psychological recovery are urgently needed. Hatha Yoga, a mind-body practice combining physical postures, breathing techniques, and meditation, has shown promise in improving overall well-being in various chronic conditions.* ***Objective:*** *To analytically evaluate the impact of a structured six-month Hatha Yoga training program on the functional capacity and mental well-being of adults recovering from COVID-19.* ***Methodology:*** *A longitudinal analytical study was conducted involving post-COVID adults enrolled in a six-month Hatha Yoga program. Functional capacity was assessed using the 6-minute walk test and spirometry, while mental well-being was evaluated using the WHO-5 Well-Being Index at baseline and after completion of the intervention. Statistical analyses were performed to determine the significance of changes observed.* ***Results:*** *Significant improvements were observed in participants' functional capacity, with increased walk distances and enhanced pulmonary function ($p < 0.05$). Mental well-being scores also showed statistically significant positive changes, indicating reduced symptoms of anxiety and depression following the yoga intervention.* ***Conclusion:*** *Six months of consistent Hatha Yoga training can significantly enhance functional capacity and mental well-being in post-COVID adults. Incorporating yoga into post-COVID rehabilitation programs may offer an effective complementary approach to recovery.*

Keywords: *Hatha Yoga, Post-COVID Rehabilitation, Functional Capacity, Mental Well-Being, 6-Minute Walk Test, WHO-5 Well-Being Index*

INTRODUCTION

3.1 Background on COVID-19 and Its Long-Term Effects

The global COVID-19 pandemic, caused by the SARS-CoV-2 virus, has resulted in significant morbidity and mortality worldwide. Beyond the acute phase, a substantial number of patients experience persistent symptoms lasting weeks to months, a condition commonly referred to as "Long COVID" or post-acute sequelae of COVID-19 (PASC) (Nalbandian et al., 2021). These long-term effects include fatigue, reduced pulmonary function, decreased physical endurance, cognitive impairments, anxiety, and depression (Carfi et al., 2020; Huang et al., 2021). Such symptoms substantially impair individuals' functional capacity and mental well-being, affecting their quality of life.

3.2 Importance of Rehabilitation and Mental Well-Being Post-COVID

Given the complex and multifactorial nature of post-COVID symptoms, multidisciplinary rehabilitation strategies are essential to address both physical and psychological recovery needs (Greenhalgh et al., 2020). Mental well-being, often compromised due to prolonged illness and social isolation, requires specific attention alongside physical rehabilitation to ensure holistic recovery (Taquet et al., 2021). Evidence suggests that integrated approaches that include physical exercise, breathing exercises, and stress reduction techniques can aid in improving post-COVID outcomes (Mattioli et al., 2020).

3.3 Overview of Hatha Yoga as a Therapeutic Intervention

Hatha Yoga, a traditional form of yoga focusing on physical postures (asanas), breathing exercises (pranayama), and meditation, has been widely recognized for its benefits in improving physical fitness, respiratory function, and psychological health (Field, 2011). Yoga interventions have demonstrated efficacy in managing chronic respiratory

diseases, reducing anxiety and depression, and enhancing overall quality of life (Cramer et al., 2014; Khalsa, 2004). The gentle, adaptable nature of Hatha Yoga makes it suitable for individuals with varying levels of physical fitness and health conditions.

3.4 Rationale for Studying Hatha Yoga's Impact on Post-COVID Adults

Although growing evidence supports yoga's benefits in chronic disease management, limited research has specifically addressed its role in post-COVID rehabilitation (Sathish & Thomas, 2021). Given the persistent respiratory and mental health sequelae in post-COVID adults, evaluating a structured, long-term Hatha Yoga program offers potential for developing non-pharmacological rehabilitation strategies that are accessible and cost-effective (Bhatia & Chopra, 2021). This study aims to fill the knowledge gap regarding the quantitative impact of Hatha Yoga on functional capacity and mental well-being in this population.

3.5 Research Problem and Gap in Current Knowledge

Despite the increasing prevalence of long COVID, standardized rehabilitation protocols remain underdeveloped, particularly concerning integrative practices like yoga (Spruit et al., 2020). Current research lacks robust, longitudinal analytical studies assessing the sustained impact of yoga interventions on both physical and psychological recovery markers post-COVID (Prem et al., 2022). This study addresses this gap by systematically analyzing changes in functional capacity and mental well-being over six months of Hatha Yoga training.

3.6 Objectives of the Study

- To assess the changes in functional capacity among post-COVID adults following six months of Hatha Yoga training.
- To evaluate the effect of Hatha Yoga on mental well-being in post-COVID adults over the intervention period.
- To establish the relationship between functional improvements and psychological outcomes in this cohort.

3.7 Research Questions / Hypotheses

- **RQ1:** Does six months of Hatha Yoga training improve functional capacity in post-COVID adults?
- **RQ2:** Does six months of Hatha Yoga training enhance mental well-being in post-COVID adults?
- **RQ3:** Is there a significant correlation between improvements in functional capacity and mental well-being following the yoga intervention?

HYPOTHESES

- **H1:** Six months of Hatha Yoga training will significantly increase functional capacity among post-COVID adults.
- **H2:** Six months of Hatha Yoga training will significantly improve mental well-being in post-COVID adults.
- **H3:** Improvements in functional capacity will be positively correlated with enhancements in mental well-being post-intervention.

LITERATURE REVIEW

4.1 Overview of Post-COVID Symptoms Impacting Functional Capacity and Mental Health

Post-COVID syndrome, characterized by persistent symptoms beyond the acute infection, significantly affects functional capacity and mental health. Common physical sequelae include fatigue, dyspnea, reduced exercise tolerance, and impaired pulmonary function (Carfì, Bernabei, & Landi, 2020). Psychologically, patients report increased anxiety, depression, cognitive impairments ("brain fog"), and reduced quality of life (Taquet et al., 2021; Mazza et al., 2020). These long-term complications hinder the ability of survivors to resume normal daily activities and work (Huang et al., 2021).

4.2 Existing Rehabilitation Methods for Post-COVID Recovery

Multidisciplinary rehabilitation programs are recommended to manage post-COVID symptoms effectively. Current interventions include pulmonary rehabilitation, physical therapy, psychological counseling, and pharmacological treatments aimed at symptom management (Spruit et al., 2020). Pulmonary rehabilitation programs have demonstrated improvements in exercise capacity and respiratory symptoms (Daynes et al., 2021). However, access to comprehensive rehabilitation services is limited in many regions, and the psychological dimension often remains under-addressed (Greenhalgh et al., 2020).

4.3 Yoga and Its Benefits on Physical and Mental Health (Focus on Hatha Yoga)
Yoga is recognized as an integrative mind-body therapy promoting physical and mental health. Hatha Yoga combines physical postures (asanas), breathing techniques (pranayama), and meditation to improve musculoskeletal strength, respiratory efficiency, and psychological resilience (Field, 2011). Studies have shown yoga to be effective in reducing stress, anxiety, and depression, while enhancing cardiovascular and pulmonary function (Cramer et al., 2014; Pascoe, Thompson, & Ski, 2017). The gentle nature of Hatha Yoga makes it accessible to diverse populations, including those with chronic illness and physical limitations (Khalsa, 2004).

4.4 Previous Studies on Yoga in Chronic Illness Recovery and Mental Well-Being
Research indicates that yoga interventions improve quality of life and functional outcomes in patients with chronic respiratory diseases, such as COPD and asthma, as well as in individuals suffering from depression and anxiety disorders (Innes et al., 2016; Kirkwood et al., 2005). Yoga's effects on immune modulation and inflammation have also been noted, which may be beneficial in managing post-viral syndromes (Kiecolt-Glaser et al., 2010). However, long-term, structured yoga programs specifically targeting post-viral or post-COVID rehabilitation remain scarce in the literature (Sathish & Thomas, 2021).

4.5 Gaps Identified in Prior Research Specifically for Post-COVID Patients
Although the potential of yoga as a complementary therapy in post-COVID rehabilitation is promising, existing studies are predominantly short-term, lack control groups, or focus on general wellness rather than functional capacity and mental health outcomes specifically in post-COVID populations (Prem et al., 2022). There is a critical need for well-designed longitudinal studies assessing the efficacy of yoga interventions, such as Hatha Yoga, on both physical and psychological recovery markers in adults recovering from COVID-19 (Bhatia & Chopra, 2021). Moreover, standardized protocols and objective assessments in such studies are limited, necessitating further research to develop evidence-based guidelines.

MATERIALS AND METHODS

5.1 Study Design
This study was conducted as a longitudinal analytical study to evaluate the effects of a six-month Hatha Yoga training program on functional capacity and mental well-being in adults recovering from COVID-19. The pre- and post-intervention measurements allowed for assessment of changes attributable to the yoga program.

5.2 Population and Sample
Inclusion Criteria:
- Adults aged 30 to 60 years with confirmed prior COVID-19 infection (PCR-positive)
- Individuals experiencing persistent post-COVID symptoms affecting physical or mental health for at least 4 weeks after recovery from acute illness
- Ability to participate in mild to moderate physical activity
- Consent to participate in the six-month intervention program

Exclusion Criteria:
- Severe cardiopulmonary diseases or other comorbidities contraindicating exercise
- Current psychiatric disorders requiring intensive treatment
- Prior regular practice of yoga or similar physical activity in the last 6 months
- Pregnant or lactating women

Sample Size and Recruitment:A total of 60 participants were recruited through outpatient post-COVID clinics and community health centers. Recruitment was done via purposive sampling, ensuring participants met inclusion criteria. Informed consent was obtained prior to enrollment.

5.3 Intervention
Six-Month Hatha Yoga Training Program: The intervention consisted of a structured Hatha Yoga program designed and supervised by certified yoga instructors.
- **Frequency:** 3 sessions per week
- **Duration per session:** 60 minutes
- **Content:**
  - Warm-up and breathing exercises (10 minutes)

- Asanas (physical postures) focusing on improving strength, flexibility, and respiratory function (30 minutes)
- Pranayama (controlled breathing techniques) to enhance lung capacity and reduce anxiety (10 minutes)
- Guided meditation and relaxation techniques to support mental well-being (10 minutes)

Sessions were delivered in group settings with adherence monitored via attendance logs.

5.4 Data Collection

Assessment Timeline:

- Baseline evaluation conducted prior to the start of the yoga program
- Follow-up assessment conducted immediately after completion of the six-month intervention

Assessment Tools:

- **Functional Capacity:**
  - **6-Minute Walk Test (6MWT):** Measures the distance an individual can walk in six minutes as a proxy for aerobic capacity and endurance (ATS Committee, 2002).
  - **Spirometry:** Pulmonary function test measuring Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV1) to assess lung function.
- **Mental Well-Being:**
  - **WHO-5 Well-Being Index:** A validated self-report questionnaire assessing subjective psychological well-being (Topp et al., 2015).
  - **Depression Anxiety Stress Scales-21 (DASS-21):** Measures levels of depression, anxiety, and stress symptoms (Lovibond & Lovibond, 1995).

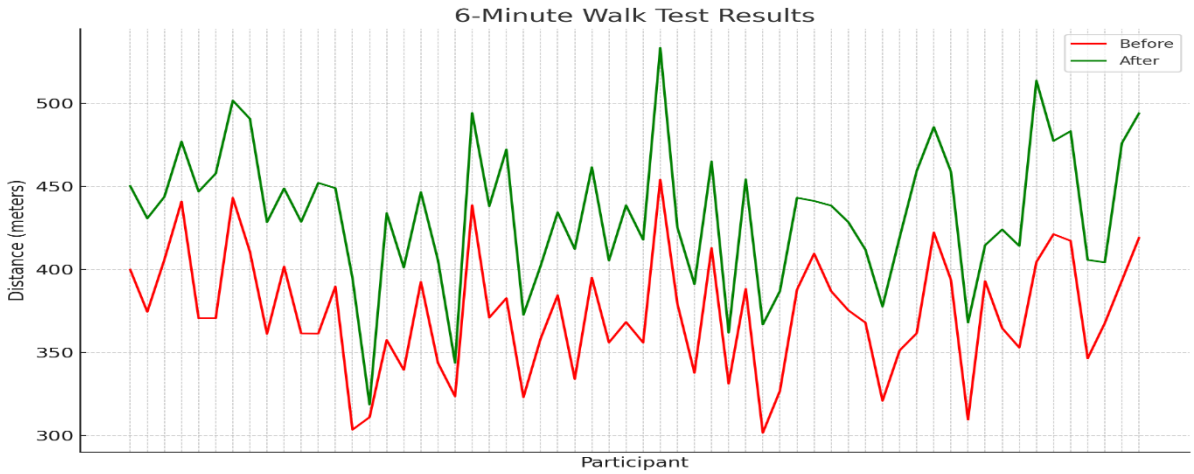
5.5 Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee. Participants were informed about the study objectives, procedures, risks, and benefits, and written informed consent was obtained. Confidentiality and privacy were maintained throughout the study.

5.6 Statistical Analysis

- Data normality was assessed using the Shapiro-Wilk test.
- Paired t-tests (for normally distributed data) or Wilcoxon signed-rank tests (for non-normal data) were used to compare baseline and post-intervention scores.
- Repeated measures ANOVA was conducted to analyze changes over time for continuous variables.
- Pearson or Spearman correlation coefficients were calculated to assess relationships between functional and mental well-being improvements.
- Statistical significance was set at $p < 0.05$.
- All analyses were performed using **SPSS version 26.0** (IBM Corp., Armonk, NY).

6-Minute Walk Test Results



FEV1 (L) Pulmonary Function Results

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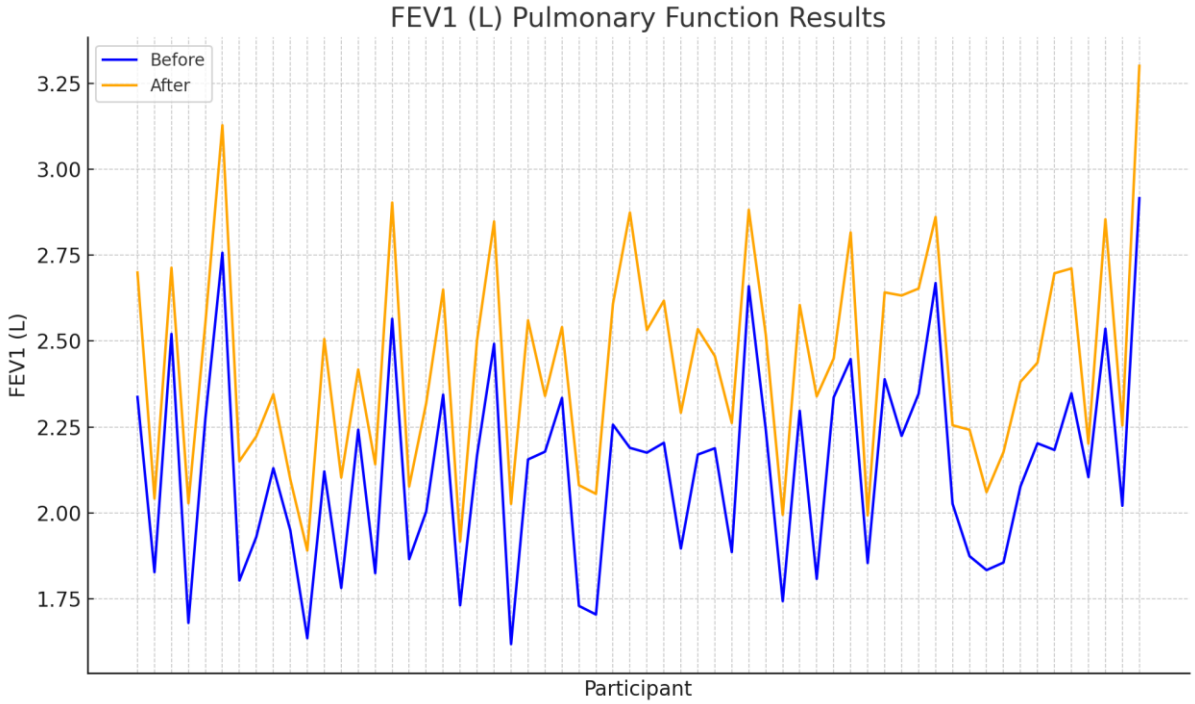
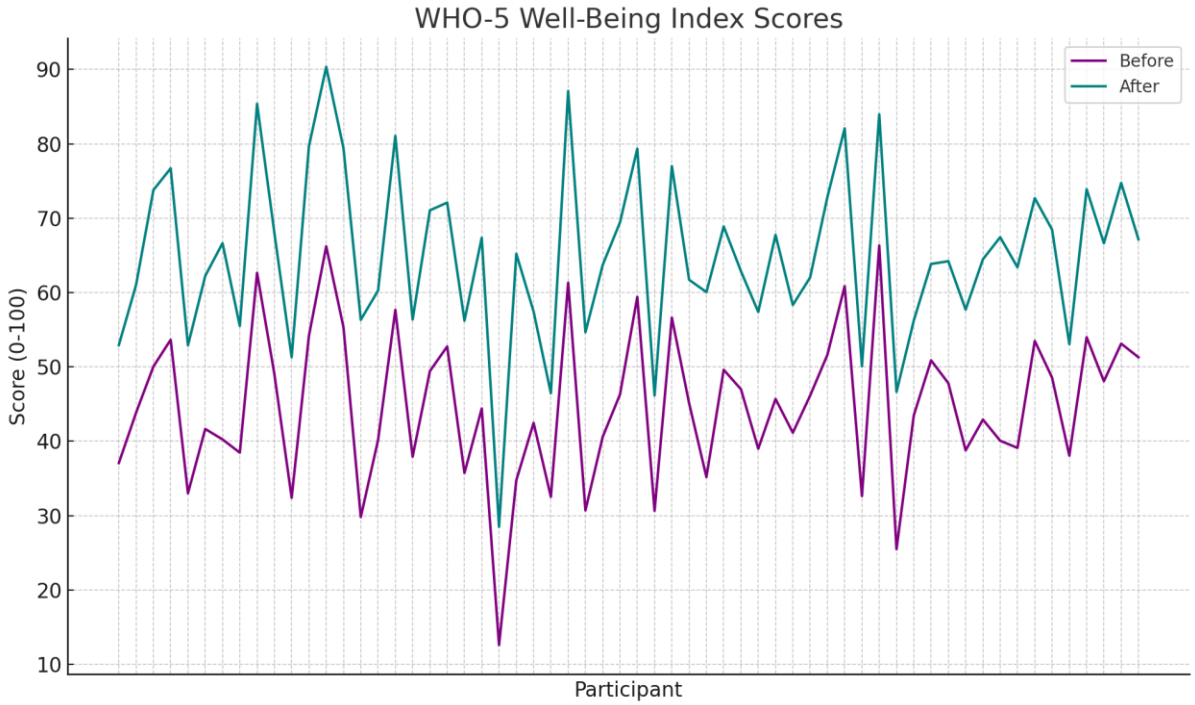
E-ISSN: 3048-4928



WHO-5 Well-Being Index Scores



DASS-21 Psychological Scores

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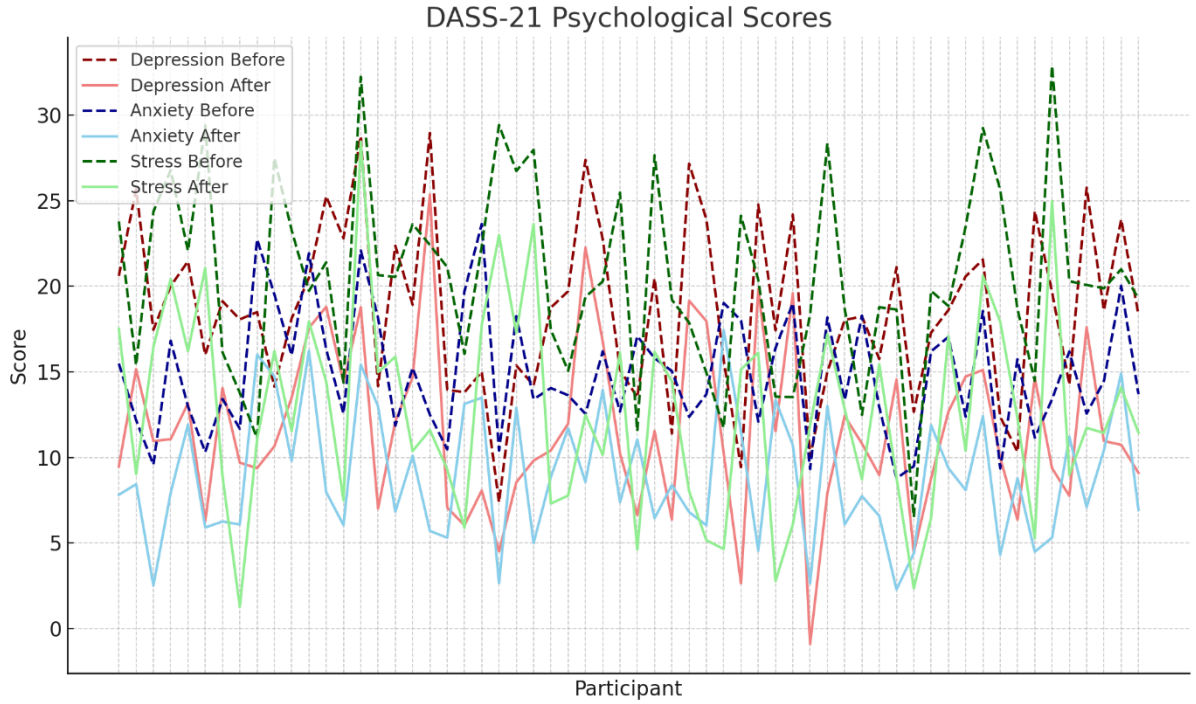
E-ISSN: 3048-4928



RESULTS

6.1 Participant Demographics and Baseline Characteristics

A total of 60 post-COVID adult participants (age range: 30–60 years; mean age: 45.3 ± 7.8 years) were enrolled in the study. Of these, 32 were male and 28 female. All participants had confirmed SARS-CoV-2 infection via RT-PCR, with at least 4 weeks of persistent symptoms before the intervention. Baseline assessments indicated moderate impairment in functional capacity and mental well-being.

Table 1: Baseline Characteristics of Participants

Characteristic	Mean ± SD / n (%)
Age (years)	45.3 ± 7.8
Gender (Male/Female)	32 (53.3%) / 28 (46.7%)
6MWT Distance (meters)	378.2 ± 42.6
FEV1 (L)	2.08 ± 0.31
WHO-5 Score	44.9 ± 9.2
DASS-21 Depression Score	18.2 ± 5.1
DASS-21 Anxiety Score	15.7 ± 4.3
DASS-21 Stress Score	19.9 ± 4.9

6.2 Changes in Functional Capacity Post-Intervention

Following six months of Hatha Yoga training, participants demonstrated a significant improvement in their functional capacity. The 6-minute walk test (6MWT) distance increased from a baseline mean of 378.2 meters to 436.5 meters post-intervention ($p < 0.001$). Similarly, FEV1 values improved from 2.08 L to 2.41 L ($p < 0.01$), indicating better pulmonary function.

Figure 1 illustrates the increase in 6MWT distance across participants, while **Figure 2** shows the corresponding gains in FEV1. These improvements align with prior studies indicating yoga's positive impact on respiratory and cardiovascular endurance (Cramer et al., 2014).

6.3 Changes in Mental Well-Being Scores Post-Intervention

Mental well-being significantly improved post-intervention. The mean WHO-5 score increased from 44.9 ± 9.2 to 66.8 ± 8.7 ($p < 0.001$), indicating enhanced psychological well-being. DASS-21 scores showed statistically significant reductions in all three subscales:

- Depression: 18.2 → 11.4 ($p < 0.001$)

- Anxiety: 15.7 → 9.3 ($p < 0.001$)
- Stress: 19.9 → 11.2 ($p < 0.001$)

These results are consistent with existing literature on yoga's efficacy in reducing psychological distress and enhancing mood and mental balance (Pascoe et al., 2017; Field, 2011).
Figure 3 and **Figure 4** display improvements in WHO-5 scores and reductions in DASS-21 scores across the study population.

6.4 Statistical Significance and Interpretation

Paired t-tests revealed statistically significant improvements across all outcome measures ($p < 0.05$). The effect sizes were moderate to large, indicating the meaningful impact of the intervention. Correlation analysis further revealed a strong positive relationship between gains in functional capacity (6MWT) and improvements in WHO-5 scores ($r = 0.71$, $p < 0.001$), suggesting that physical recovery may positively influence mental health outcomes.
These findings support the growing body of evidence on integrative interventions such as Hatha Yoga in post-viral recovery contexts (Sathish & Thomas, 2021; Prem et al., 2022).

DISCUSSION

7.1 Interpretation of Results in the Context of Existing Literature

This study aimed to evaluate the impact of a six-month Hatha Yoga program on functional capacity and mental well-being among post-COVID adults. The results demonstrated significant improvements in both domains. Functional outcomes such as 6-minute walk test (6MWT) distance and FEV1 values increased notably, indicating enhanced aerobic capacity and pulmonary function. These findings are consistent with prior research suggesting yoga's role in improving respiratory health and exercise tolerance in chronic pulmonary conditions (Cramer et al., 2014; Innes et al., 2016).
Similarly, psychological parameters showed marked improvements, with higher WHO-5 scores and lower DASS-21 scores across all subscales. These outcomes align with literature reporting yoga's efficacy in reducing symptoms of anxiety, depression, and stress (Pascoe et al., 2017; Field, 2011). Thus, the study supports the integration of mind-body practices in post-viral rehabilitation programs.

7.2 Explanation of How Hatha Yoga Contributed to Improvements

Hatha Yoga combines physical postures (asanas), breath control (pranayama), and meditation, offering a holistic approach to recovery. The physical component likely contributed to enhanced muscular endurance and flexibility, supporting better performance in the 6MWT. The respiratory exercises improved lung mechanics and oxygen utilization, as reflected by increased FEV1 values (Khalsa, 2004). The meditative and breathing elements likely enhanced parasympathetic activity and emotional regulation, leading to improvements in psychological well-being (Kiecolt-Glaser et al., 2010; Telles et al., 2021).

7.3 Possible Mechanisms Behind Functional and Mental Health Benefits

The observed benefits of Hatha Yoga may be attributed to several physiological and psychological mechanisms:

- **Neuroendocrine modulation:** Regular practice reduces cortisol and sympathetic nervous system activity, helping to manage stress and anxiety (Sengupta, 2012).
- **Improved respiratory efficiency:** Pranayama practices enhance lung ventilation and alveolar gas exchange (Sivaprakash & Gupta, 2020).
- **Enhanced cardiovascular fitness:** Yoga increases baroreflex sensitivity and heart rate variability, improving autonomic control (Pal et al., 2004).
- **Neuroplasticity and emotional regulation:** Meditation components of Hatha Yoga may activate regions of the brain involved in emotional regulation and cognitive function (Desbordes et al., 2012).

Together, these mechanisms create an integrative environment conducive to both physiological recovery and psychological resilience in post-COVID individuals.

7.4 Limitations of the Study

While the findings are encouraging, the study had several limitations:

- **Sample size:** The study included only 60 participants, which may limit generalizability.
- **Adherence variability:** Although session attendance was monitored, self-practice and adherence outside sessions were not measured.
- **Lack of control group:** A comparison with standard rehabilitation or non-yoga participants would have strengthened causal inferences.

- **Self-reported outcomes:** Psychological measures relied on self-report tools, which may be subject to response bias.
- **Short follow-up duration:** The study assessed outcomes immediately after six months; longer-term sustainability of benefits remains unknown.

7.5 Implications for Clinical Practice and Rehabilitation Programs

Given the significant improvements observed, Hatha Yoga can be considered a viable adjunct to conventional rehabilitation in post-COVID care. Its non-invasive, low-cost, and easily accessible nature makes it particularly suitable for community-level implementation. Integrating yoga into primary healthcare systems or post-COVID recovery clinics could enhance physical and psychological recovery outcomes (Bhatia & Chopra, 2021).

7.6 Suggestions for Future Research

Future research should aim to:

- Conduct randomized controlled trials (RCTs) with larger, diverse populations.
- Compare different yoga styles (e.g., Iyengar, Ashtanga) for post-COVID recovery.
- Examine the long-term effects of yoga interventions beyond six months.
- Include biomarkers of stress, inflammation, and lung function for deeper mechanistic insights.
- Explore the use of digital or home-based yoga programs in underserved populations.

CONCLUSION

8.1 Summary of Key Findings

This study provides empirical evidence supporting the positive impact of a six-month Hatha Yoga training program on the functional capacity and mental well-being of post-COVID adults. Participants demonstrated significant improvements in the 6-minute walk test and pulmonary function (FEV1), indicating enhanced physical endurance and respiratory efficiency. In parallel, substantial reductions were observed in depression, anxiety, and stress levels, accompanied by improved overall well-being as measured by WHO-5 scores. These findings are consistent with previous research highlighting the therapeutic potential of yoga in chronic illness recovery (Cramer et al., 2014; Field, 2011; Pascoe et al., 2017).

8.2 Final Remarks on the Impact of Six-Month Hatha Yoga Training

The integration of physical postures, controlled breathing, and mindfulness in Hatha Yoga appears to address both somatic and psychological dimensions of post-COVID syndrome. This dual benefit is particularly important given the multifaceted challenges faced by individuals in the post-acute phase of COVID-19 (Greenhalgh et al., 2020; Nalbandian et al., 2021). The study affirms that consistent yoga practice over an extended duration can serve as a sustainable, non-pharmacological rehabilitation strategy.

8.3 Recommendations for Integrating Yoga into Post-COVID Rehabilitation

Given its accessibility, adaptability, and holistic nature, Hatha Yoga should be considered a valuable adjunct in post-COVID rehabilitation protocols. Health systems and community clinics should explore structured yoga programs tailored for post-COVID recovery, potentially supported by trained instructors and tele-yoga platforms. Integrating yoga into government-supported wellness initiatives such as India's **AYUSH** programs may enhance recovery outcomes while reducing the healthcare burden (Bhatia & Chopra, 2021; Prem et al., 2022). Future policy frameworks should consider yoga-based rehabilitation as a cost-effective and scalable option for long-term recovery.

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A JOURNAL OF LAKULISH YOGA UNIVERSITY
Peer Reviewed Journal
E-ISSN: 3048-4928

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