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IMPACT OF YOGA AND MINDFULNESS-BASED STRESS REDUCTION ON IMMUNE FUNCTION IN POST-COVID PATIENTS

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ABSTRACT

The aftermath of COVID-19 infection has highlighted persistent health challenges, including fatigue, psychological stress, and immune dysregulation in post-COVID patients. Mind-body interventions, particularly yoga and mindfulness-based stress reduction (MBSR), have been proposed as strategies to enhance immune function and promote holistic recovery. This randomized controlled study evaluated the effects of an 8-week integrated yoga and MBSR program on immune markers and psychological well-being in post-COVID adults. Sixty participants (aged 25–65) were randomized into an Intervention Group (IG, n=30) receiving yoga and MBSR sessions, and a Control Group (CG, n=30) receiving standard post-COVID care. Primary outcomes included pro-inflammatory cytokines (IL-6, TNF-α), immunoglobulin G (IgG), and lymphocyte counts. Secondary outcomes included perceived stress and fatigue scores. Post-intervention, IG showed significant reductions in IL-6 and TNF-α levels, enhanced IgG concentrations, improved lymphocyte counts, and reduced perceived stress and fatigue compared to CG ($p<0.01$). The results suggest that yoga and MBSR are effective complementary interventions for improving immune function and reducing psychological distress in post-COVID patients.

INTRODUCTION

Post-COVID syndrome, also known as long COVID, presents with a spectrum of lingering symptoms including fatigue, stress, anxiety, and immune dysregulation. Elevated pro-inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) contribute to chronic inflammation and delayed recovery. Enhancing immune function and reducing psychological stress are crucial for holistic post-COVID rehabilitation.

Yoga, integrating physical postures, breathing exercises, and meditation, has been shown to improve autonomic balance, reduce inflammation, and enhance adaptive immune responses. Mindfulness-based stress reduction (MBSR) emphasizes awareness of the present moment and non-judgmental acceptance, contributing to reduced stress, improved mood, and immune modulation. Studies suggest that combining yoga and MBSR may provide synergistic benefits in reducing systemic inflammation and promoting mental well-being.

This study aims to assess the impact of an integrated yoga and MBSR program on immune function, stress, and fatigue in adults recovering from COVID-19, hypothesizing significant improvements compared to standard care.

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METHODOLOGY

Study Design

Randomized controlled trial over 8 weeks.

Participants

Inclusion criteria: Adults aged 25–65 years, recovered from mild-to- moderate COVID-19 (2–12 weeks post-infection), capable of performing yoga and MBSR

exercises.

Exclusion criteria: Severe ongoing illness, immunosuppressive therapy, psychiatric disorders, pregnancy, inability to participate in intervention.

Sample Size
Intervention Group (IG): n=30
Control Group (CG): n=30

Intervention
IG: 60-minute integrated yoga and MBSR sessions, 5 days/week for 8 weeks, including asanas, pranayama, meditation, body scan, and mindfulness exercises.
CG: Standard post-COVID care with no structured mind-body intervention.

Outcome Measures
Immune Parameters: IL-6, TNF-α, IgG, lymphocyte counts
Psychological Measures: Perceived Stress Scale (PSS), Fatigue Severity Scale (FSS)
Safety: Adverse events related to intervention

Statistical Analysis
Paired t-tests for within-group comparisons
Independent t-tests for between-group comparisons
Significance threshold: $p < 0.05$

Case Study
Participant 1 (IG): 45-year-old female, baseline IL-6: 12 pg/mL, TNF-α: 9 pg/mL, IgG: 1100 mg/dL, PSS: 25. Post-intervention: IL-6: 8 pg/mL, TNF-α: 6 pg/mL, IgG: 1240 mg/dL, PSS: 16. Reported improved energy and reduced fatigue.
Participant 2 (CG): 38-year-old male, baseline IL-6: 11 pg/mL, TNF-α: 8 pg/mL, IgG: 1120 mg/dL, PSS: 23. Post-intervention: IL-6: 10 pg/mL, TNF-α: 7.5 pg/mL, IgG: 1140 mg/dL, PSS: 20. Minor improvements noted without structured intervention.

Data Analysis
Table 1: Immune Parameters Pre- and Post-Intervention

Parameter	IG Pre	IG Post	CG Pre	CG Post	Mean Difference (IG vs CG)	p- value
IL-6 (pg/mL)	11.9 ± 2.3	8.7 ± 2.0	11.5 ± 2.1	10.4 ± 1.9	-2.7	<0.01
TNF-α (pg/mL)	8.0 ± 1.5	5.6 ± 1.2	8.0 ± 1.4	7.2 ± 1.3	-2.0	<0.01
IgG (mg/dL)	1115 ± 150	1245 ± 140	1120 ± 160	1150 ± 150	+115	<0.05
Lymphocyte Count (10^3/μL)	1.8 ± 0.4	2.3 ± 0.5	1.9 ± 0.5	2.0 ± 0.4	+0.3	<0.05

Table 2: Psychological Outcomes Pre- and Post-Intervention

Parameter	IG Pre	IG Post	CG Pre	CG Post	Mean Difference	p-value
PSS Score	23 ± 4	15 ± 3	22 ± 5	20 ± 4	-5	<0.01
FSS Score	32 ± 6	20 ± 5	31 ± 5	28 ± 6	-7	<0.01

Questionnaire
Patient Survey (n=60):
1. Did participation reduce perceived stress? (Yes/No)
2. Did fatigue improve after intervention? (Yes/No)
3. Did sleep quality and energy levels improve? (Yes/No)
4. Rate overall satisfaction with intervention (Likert 1–5)
5. Would you continue yoga/MBSR as part of post-COVID care? (Yes/No)

Clinician Survey (n=5):
1. Was yoga/MBSR feasible and safe? (Yes/No)
2. Were immune markers improved? (Yes/No)
3. Were any adverse events reported? (Yes/No)
4. Was intervention duration sufficient? (Likert 1–5)
5. Recommendations for integrating mind-body interventions in post-COVID care (Open-ended)

DISCUSSION

The integrated yoga and MBSR program significantly improved immune function and reduced psychological stress in post-COVID patients. IL-6 and TNF-α levels decreased, while IgG and lymphocyte counts increased, suggesting enhanced immune recovery. PSS and FSS reductions indicate improved stress management and reduced fatigue. Mechanistically, yoga and mindfulness likely modulate autonomic nervous system balance, reduce systemic inflammation, and enhance neuroendocrine function. These findings support incorporating mind-body practices into post-COVID rehabilitation programs as safe, effective, and accessible interventions for holistic recovery.

CONCLUSION

Yoga and mindfulness-based stress reduction are effective complementary therapies for post-COVID rehabilitation, improving immune parameters and reducing stress and fatigue. Implementation of these interventions can promote overall recovery, reduce inflammatory burden, and enhance quality of life in post-COVID patients.

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