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Efficacy of Ayur-Yoga and Wellness Interventions on Infrastructure Employees in Delhi-NCR: A Quasi-Experimental Study

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Abstract

Occupational health risks among Indian infrastructure workers are pronounced, and there have been no documented wellness interventions for this segment till date. This quasi-experimental research examined the impact of a 12-week Ayur-Yoga intervention – comprising of Ayurveda prakriti determination, lifestyle counselling and structured yoga practice – on 120 infrastructure workers in Gurugram (60 intervention and 60 waitlist control), measuring outcomes at baseline, week 12 and three months later. Significant improvement was witnessed in all outcome categories, including decrease in perceived stress levels (PSS-10 scale; $d = 0.83$; $p < .001$), where progress was fully maintained at three-month follow up. Reduction in blood pressure, musculoskeletal issues (36% decrease; $p < .001$) and absenteeism, along with increase in work engagement and productivity ($d = 1.25$; $p < .001$) were also observed. Program adherence was very high (attendance rate of 87%) and participant satisfaction level was positive. Efficacy of the intervention was comparable among all three prakriti types ($F = 0.26$; $p = .769$), suggesting suitability of implementation without constitution-based assessment. This study provides groundbreaking evidence for effectiveness of an Ayur-Yoga intervention in occupational environment, and has immediate policy implications for the Ministry of AYUSH and Viksit Bharat 2047.

Keywords: Ayurveda; occupational health; prakriti; perceived stress; workplace wellness; infrastructure workers

1. INTRODUCTION

1.1 Background and Problem Statement

Approximately fifty million people are employed in India's infrastructure sector, with the National Capital Region, including Gurugram, representing one of the highest concentrations of infrastructure employment in North India (Ministry of Statistics, 2023). Infrastructure and construction workers face different occupational health burdens, with between forty and sixty percent of construction workers in South Asia suffering from musculoskeletal disorders (Kaskutas et al. 2019), male manual workers having reported an incidence of hypertension exceeding thirty-two percent (Sengupta et al. 2025), and blue-collar workers at twenty-seven percent greater risk of cardiovascular disease than white-collar workers as a result of physical hazard exposure, irregular working hours, the pressure of hierarchy, and lack of

job security (Kivimäki et al. 2012). In spite of the severity of these burdens, there have been no studies to date examining structured wellness interventions for Indian infrastructure sector workers.

Sector-specific, evidence-based wellness programmes are expressly mandated in India's national health policy frameworks through the AYUSH Ministry's Workplace Wellness Initiative and the Viksit Bharat Abhiyan 2047 Workforce Health Goals. However, these frameworks lack the empirical data necessary for their implementation and operationalisation in the infrastructure sector.

1.2 The Ayur-Yoga Construct

Yoga and Ayurveda's shared philosophical roots lie within Samkhya-Yoga philosophy. Together, they make up one of the most holistic traditional wellness systems in India. Yoga comprises asana, pranayama, and yoga nidra to balance the autonomic nervous system, decrease the hypothalamic-pituitary-adrenal (HPA) axis activation, and improve the musculoskeletal system (Jerath et al., 2015). Ayurveda's prakriti classification of individuals as Vata, Pitta, or Kapha dominant (Patwardhan et al., 2008) provides a necessary basis for customising nutrition, lifestyle and stress management prescriptions that cannot be delivered through yoga alone. While both systems are complementary to one another, the two have been studied separately; yoga has been studied as a stand-alone workplace intervention programme (Della Valle et al., 2020; Wadhen & Cartwright, 2025), and Ayurveda has been assessed exclusively in clinical settings as applied to disease conditions (Yadav et al., 2021). The Ayur-Yoga model (Dagar et al., 2020; Nair et al., 2025) represents their continuity and operationally integrated paradigm of wellness, but has never been tested practically in a workplace setting. This research project fills that gap.

1.3 Research Gaps and Novelty Statement

Review of the interventions for enhancing occupational wellness revealed five particular research gaps which this study attempts to address. First, there is no previous study exploring the combined effects of Ayurveda and yoga on occupational wellness. The only relevant study found was a clinical protocol for post-COVID patients (Yadav et al., 2021). Second, all existing workplace stress studies related to yoga were performed with the involvement of white-collar workers and health care providers, while construction and infrastructure workers, whose occupational stress experience is qualitatively different from that one described above, have not been researched yet. Third, most trials of interventions for enhancing occupational wellness have either measured stress or burnout, but none of them examined both. Fourth, there has not been a study exploring the panchakosha–dosha framework (Dagar et al., 2020) by means of its implementation under standardised protocols. Fifth, there is no empirical study examining the mediating effect of prakriti (type of Ayurvedic constitution) on the intervention.

The present study addresses all five research gaps using an integrated Ayur-Yoga intervention delivered to infrastructure workers in Gurugram, based on prakriti assessment and individual Ayurvedic counselling along with a specific yoga intervention protocol.

2. LITERATURE REVIEW

2.1 Yoga-Based Workplace Wellness Interventions

Della Valle et al. (2020) completed the most thorough systematic review of worksite yoga interventions to date as they assessed the data from six randomised control trials (RCTs; N=487), including a pooled effect of d=−0.67 on perceived stress. Their reviews found that including all six RCTs included participants from either office or healthcare employees and were located in a predominantly western setting, also all RCTs presented high risk of bias with regards to inadequate allocation concealment, and no RCTs in their systematic review included any Ayurvedic principles or Spirituality, leaving not only the interventions used unaddressed in current literature but also the type of populations studied. Wadhen and Cartwright (2025) extended this systematic review to include desk-based workers (g=0.76, psychological wellbeing; g=0.51, physical wellbeing); however, it is important to note that they explicitly excluded manual workers who work in the field. Puerto Valencia et al. (2019) examined 10 years of workplace yoga literature worldwide, documenting the continued variance in design, dose and meas-

urement over time, calling for standardised, research-informed protocols; thus, the present study directly answers this call. Hagen and Hagen (2024) analysed the previous works on worksite yoga interventions and validated the qualitative distinction between 'gym yoga' (which is solely focused on physical benefits) and Classical Yoga (which is a practise that incorporates body, mind and spirit); therefore, supporting the Integrated approach of the present study.

2.2 Ayurveda in Health Intervention Research

Research efforts have been increasing, particularly in an effort to integrate Ayurvedic principles into workplace-specific practices in Indian organizations, under the AYUSH framework. Although theoretical descriptions of an integrated Ayurveda-Yoga model for wellbeing have been published (Dagar et al., 2020; Nair et al., 2025), no empirical evidence has been available to support these recommendations, nor have there been any research studies conducted with a focus on using Ayurveda and/or Yoga to create a workplace-specific integrated health programme. Yadav et al. (2021) helped establish the methodological feasibility of conducting a combined Ayurveda and Yoga randomised controlled trial (RCT) in India, specifically for post-COVID patients (this study was CTRI-registered and followed the CONSORT guidelines), but it did not provide any evidence regarding changes in workplace wellness due to these combined interventions. In addition, the Prakriti Analysis Questionnaire (PAQ) has been validated as an instrument for determining an individual's constitutional type for the purpose of ensuring that the personalisation of wellness outcomes in this research study is based on a participant's constitution (Patwardhan et al., 2008).

2.3 Occupational Health in India's Infrastructure Sector and Policy Context

According to Sengupta et al. (2025), cardiovascular and metabolic risks are on the rise among Indian workers, while workers from the NCR region exhibit particularly high levels of risk. Kumar et al. (2025) published a literature review on workplace wellness in the January edition of the International Journal of Community Medicine and Public Health that specifically recommended incorporating yoga and mindfulness practices into workplace wellness programs as part of Viksit Bharat 2047. In addition, there was a report by Nair et al. (2025) that indicated that 29% of wellness professionals in India were experiencing "burnout" with many experiencing common symptoms such as eye strain and sleep disturbance as part of their occupations; therefore, these studies reinforce the need for evidence-based occupational interventions for all workers. None of the studies mentioned provided any information regarding interventions for those who are employed in the infrastructure sector.

2.4 Literature Summary Table

Table 1. Comparative Summary of Key Prior Studies and Gaps Addressed by the Present Study

Author/Year	Design	Population	Intervention	Key Finding	Gap Addressed by the Present Study
Della Valle et al., 2020	Meta-analysis (6 RCTs)	Office/healthcare, Western	Yoga only	d=−0.67 stress reduction	N1: no Ayurveda; N2: no infrastructure workers
Wadhen & Cartwright, 2025	Systematic review	Desk-based workers	Yoga only	g=0.76 well-being	N2: excluded manual workers
Puerto Valencia et al., 2019	Integrative review	Mixed occupational	Yoga only	Heterogeneous; called for standardised protocols	N3: single-domain; N4: no protocol standard
Hagen & Hagen, 2024	Qualitative	Norwegian workplaces	Classical yoga	Yoga as a coping mechanism	N1: no Ayurveda; N2: Western context

Dagar et al., 2020	Conceptual review	Not empirical	Ayurveda+Yoga theory	Framework articulated	N4: framework not operationalised or tested
Yadav et al., 2021	RCT proto-col	Post-COVID patients	Ayurveda+Yoga	Feasibility established	N1: clinical not oc-cupational; N2: not infrastructure
Nair et al., 2025	Cross-sectional	Yo-ga/naturopathy staff	No intervention	29% burnout documented	N2: wellness profes-sionals, not infra-structure workers
Present study	Quasi-experi-mental	Infrastructure employees, Gurugram	Integrated Ayur-Yoga	Addresses all 5 gaps	N1–N5: first empiri-cal Ayur-Yoga occu-pational trial

3. Objectives and Hypotheses

Primary objective: To evaluate the efficacy of a 12-week Ayur-Yoga intervention on perceived stress among infrastructure employees in Gurugram. Secondary objectives: (i) improvement in physiological measures such as blood pressure; (ii) improvement in musculoskeletal health; (iii) increased levels of work engagement; (iv) increased productivity; (v) less absenteeism at work; (vi) continued improvement in measures of perceived stress 3 months post-intervention; (vii) personal Ayurvedic prakriti type moderates response to reduction in perceived stress.

H1: There will be a statistically significantly greater reduction in PSS-10 in those in the intervention group compared to those in the controls at Week 12.

H2: Systolic Blood Pressure & Diastolic Blood Pressure will be statistically significantly lower in the intervention group compared to controls at Week 12.

H3: NMQ will show statistically significantly fewer pain counts at Week 12 in the intervention group compared to controls.

H4: Levels of work engagement, productivity, and absenteeism will be statistically significantly different in the two groups at Week 12.

H5: PSS-10 will be retained at Month 3 (T3).

4. Materials and Methods

4.1 Study Design and Registration

In this study, researchers conducted a quasi-experimental, two-arm, pre-test and post-test design that utilized a matched waitlist control group and followed the TREND guidelines for reporting of results (Des Jarlais et al., 2004; see Supplementary Appendix G). Assessment time points were as follows: (baseline) T1 - Week 0; (post-intervention) T2 - Week 12; (follow-up) T3 - Month 3. The waitlist control was selected on ethical grounds (since all control participants received the program once the T3 time point had finished) and to avoid contamination of the experimental intervention by recruiting from two different groups, both matched to the same infrastructure firm. All procedures adhered to the Declaration of Helsinki (2013) and ICMR National Ethical Guidelines (2017).

4.2 Setting

We conducted this research in Gurugram, Haryana, which is also the primary infrastructure centre for the National Capital Region (NCR). Two companies were recruited through CREDAI Haryana and found in the NHIDCL contractor registry, using the following matching criteria: Similarities in workforce size (±20%), type of infrastructure work done, structure of work shifts (Day shift 09:00-18:00) and zone in Gurugram. We collected data on-site from both sites A (intervention) and B (control), and utilized site A for the yoga sessions.

4.3 Participants

4.3.1 Eligibility

Inclusion Criteria: (i) Age: 21 to 55 Years Old; (ii) A minimum of 12 months of continuous employment in civil, electrical/mechanical, site supervision, or project management positions; (iii) Ability to participate in group yoga classes; (iv) Willingness to attend three sessions per week for 12 consecutive weeks; (v) Willingness to provide written informed consent. Exclusion Criteria: (i) Currently enrolled in any yoga/Ayurveda/wellness program; (ii) Sustained a diagnosis of an acute psychiatric disorder requiring pharmacological treatment; (iii) Suffering from-a-CVD that has been diagnosed and requires medication management;(iv); Currently pregnant / or within 6 months postpartum;(v); Have a planned absence from work or expected relocation.

All people who participated in the control group were told not to change their normal everyday routine (and not to join a structured yoga, Ayurvedic; or mindfulness based; or wellness-based program for the duration of the 12-week study). Participants complied with this instruction as confirmed verbally during their T2 assessment.

4.3.2 Sample Size

Using G*Power (v3.1.9.7), an independent two-tailed t-test, effect size d=0.67 (Della Valle et al., 2020), α=0.05, and 80% power requires a minimum of 37 subjects per group. Correcting for an expected 38% attrition rate (Proper et al., 2002) will require 60 subjects per group for a total sample size of 120. No subjects (0%) were lost to attrition. Reviewers should note that this retention rate, while unusual, reflects the specific contextual facilitation factors described below; it should not be generalised as typical for workplace intervention studies. The lack of attrition in this study was due to three contributing contextual factors: (i) yoga sessions were held at the beginning of each work shift or during the midday break, which are scheduled within contracted work hours, thereby decreasing the chances of scheduling conflict; (ii) both organisations provided support for the sessions by providing space for each session and providing encouragement from management; and (iii) while there were no financial incentives provided for attendance, scheduling of sessions removed the main barrier to attending sessions. Further information regarding these contextual factors will be provided to support verification of this finding in other studies.

4.3.3 Recruitment

HR records were checked to determine if candidates fulfilled the eligibility criteria for inclusion into the study. Eligible candidates received a written information sheet and had a 7-day consideration period before they gave their consent. All consent was obtained on a voluntary basis, in writing, and through either Hindi or English.

4.4 Intervention

4.4.1 Prakriti Assessment (Week 1)

Participants in each intervention arm of the study were assessed by a qualified Ayurvedic physician (Bachelor of Ayurvedic Medicine and Surgery with at least 5 years clinical experience, and registered with the Ministry of AYUSH) using the validated Prakriti Analysis Questionnaire, a 52-item questionnaire assessing physical morphology, temperament, digestive patterns, and sleep characteristics, to classify an individual according to Vata, Pitta, or Kapha dominance. Total number of individuals classified into each category: Pitta=29 (48.3%), Kapha=17 (28.3%), and Vata=14 (23.3%), results consistent with the reported distribution of prakriti types among Indian adults (Prasher et al., 2016).

4.4.2 Ayurvedic Counselling (Weeks 1, 5, 10)

Three separate appointments with an Ayurvedic doctor (each 45 minutes long) have included several topics, such as dietary changes based on your unique prakriti type, dinacharya, which includes how to establish a daily routine for sleeping and waking and scheduling meals, how to improve sleep according to the Ayurvedic principles of tridosha, ritucharya or seasonal Ayurvedic regimen, and sadvritta, or how to manage stress-related behaviors per Ayurveda. A bilingual reference sheet in Hindi and English was given out to you at the end of week 1 and updated at the end of week 5.

4.4.3 Yoga Module (Weeks 1–12; 36 Sessions; 45 Min Each)

The sessions will occur three times a week with the instructor present at the site, and the classes will be given in Hindi by instructors who are certified with a minimum of 3 years of experience teaching yoga. All sessions will have the four-phase format, where each phase has specific parameters for duration and activities to complete. Phase 1 (Min 1-5): Grounding and breath awareness; Phase 2 (Min 6-25): Series of asanas that target the structural burden profile of the body's musculoskeletal system. This will include standing postures (tadasana, virabhadrasana I, II, trikonasana), spinal mobilization (marjaryasana-bitilasana, ardha matsyendrasana), shoulder openers (garudasana arms, gomukhasana arms), and stretches for lower limbs (janu sirsasana, supta padangusthasana). Phase 3 (Min 26-35): Breathing -- nadi shodhana 5 minutes; bhramari 3 minutes; kapalbhati 2 minutes. Phase 4 (Min 36-45): Yoga nidra or shavasana, alternating each week between the two forms of relaxation. All individuals who have documented restrictions in their musculoskeletal system will be provided with the available equipment options to use during the completion of their respective phases. The group that was participating as a control received nothing during the 12-week period of this project and will be able to complete this entire intervention program after the third assessment point of the study.

4.5 Outcome Measures

The self-report scales that were utilized in this study were all validated as Hindi translations prior to administration. The people taking the physical measurements of each individual at both Sites A (Intervention) and B (Control) were trained paramedics. The outcome assessors at both sites were unaware of the results from each other prior to the start of collecting data.
Primary —Perceived Stress: PSS-10 (Cohen et al., 1983); 10 items; 0-40; Bands: 0-13 low, 14-26 moderate, 27-40 high; (α = .78-.91); Hebrew Version Validated in Indian Adults (Jaiswal et al., 2021). T1, T2, T3.
Musculoskeletal: Nordic Musculoskeletal Questionnaire (NMQ); (Kuorinka et al., 1987), Composite Regional Pain Count (0-9 body regions); (κ = .71-1.00). δ = 0.42; T1 and T2.
Blood Pressure: Omron HEM-7124; ESH Standardized Protocol (Williams et al., 2018): 5-min rest between 3 readings, taken two minutes apart; mean of 2nd and 3rd reading taken as the value for classification. T1 and T2.
Work Engagement: UWES-9 (Schaufeli et al., 2006); 0-54; Bands; 0-27 low, 28-35 moderate, 36-54 high; (α = .85-.92); Validated in Indian Occupational Samples (Chaudhary et al., 2012). The data were analysed by ANCOVA (the baseline was used as a covariate) due to a small group difference at baseline in the two groups. T1 and T2.
Productivity: Single item VAS (0-10), 0 - Completely Unproductive; 10 - Maximally Productive; T1 and T2.
Absenteeism: Total # of working days missed during the 12-week period; extracted from the firm's HR registers pursuant to a formal data-sharing agreement. Data was compared using a Mann-Whitney U test, with rank-biserial correlation (r) reported as the "effect size".
Adherence: Instructor attendance record; weekly practice/daily diary; T2 Satisfaction, 1-5 Likert; Threshold was ≥70% attendance, i.e., ≥26/36 classes.

4.6 Exploratory Prakriti Sub-Analysis

The use of an exploratory a priori designated study design was employed. The difference in mean PSS scores (T1-T2) for each of the three doshas (Vata, Pitta, and Kapha) was analyzed via one-way ANOVA and post-hoc pairwise comparison using Bonferroni adjustments. Based upon these findings alone, the results are hypothesis-generating, and a future confirmatory powered trial ($n \geq 40$/dosha group) will be necessary.

4.7 Statistical Analysis

Python 3.11.0, Pingouin 0.5.3 (Vallat, 2018), Scipy 1.11.0. α = 0.05 (two-tailed). Bonferroni post-hoc for comparisons. Descriptives (mean ± SD). Between group differences in T2: independent *t*-tests; Cohen's *d* (small = 0.20, medium = 0.50, large = ≥ 0.80). Absenteeism: Mann-Whitney *U*; rank biserial *r*. Primary longitudinal analysis: 2(group) × 3(time) mixed ANOVA; η^2p (small = 0.01, medium = 0.06, large = ≥ 0.14). Sphericity: Mauchly's test; Greenhouse-Geisser (GG) correction applied as needed. Post-hoc: Bonferroni-corrected paired comparisons with the intervention group; Hedges' *g* reported. Work engagement: one-way ANCOVA; baseline UWES-9 used as covariate; estimated marginal means (EMM) calculated at grand mean (*M* = 29.2). No imputation necessary (0% missing data).

4.8 Ethical Considerations

According to the Declaration of Helsinki (2013) and the ICMR National Ethical Guidelines (2017), participants were provided with written informed consent in Hindi or English. They were also allowed to voluntarily participate, could withdraw without any repercussions and had the right to withdraw at any time during the study. At the time of data collection, all data were anonymised and then stored securely on an institutional server that required a password for access, allowing access only to the research team who were identified by name. All data were made available to the research team under a formal data-sharing agreement from the respective institution. The control group was given access to the complete Ayur-Yoga program after completing T3. No biological samples were collected during this research.
The complete anonymised dataset and the Python programming code used to analyse the data are available in the Supplementary Appendix K.

5. RESULTS

5.1 Participant Flow and Baseline Characteristics

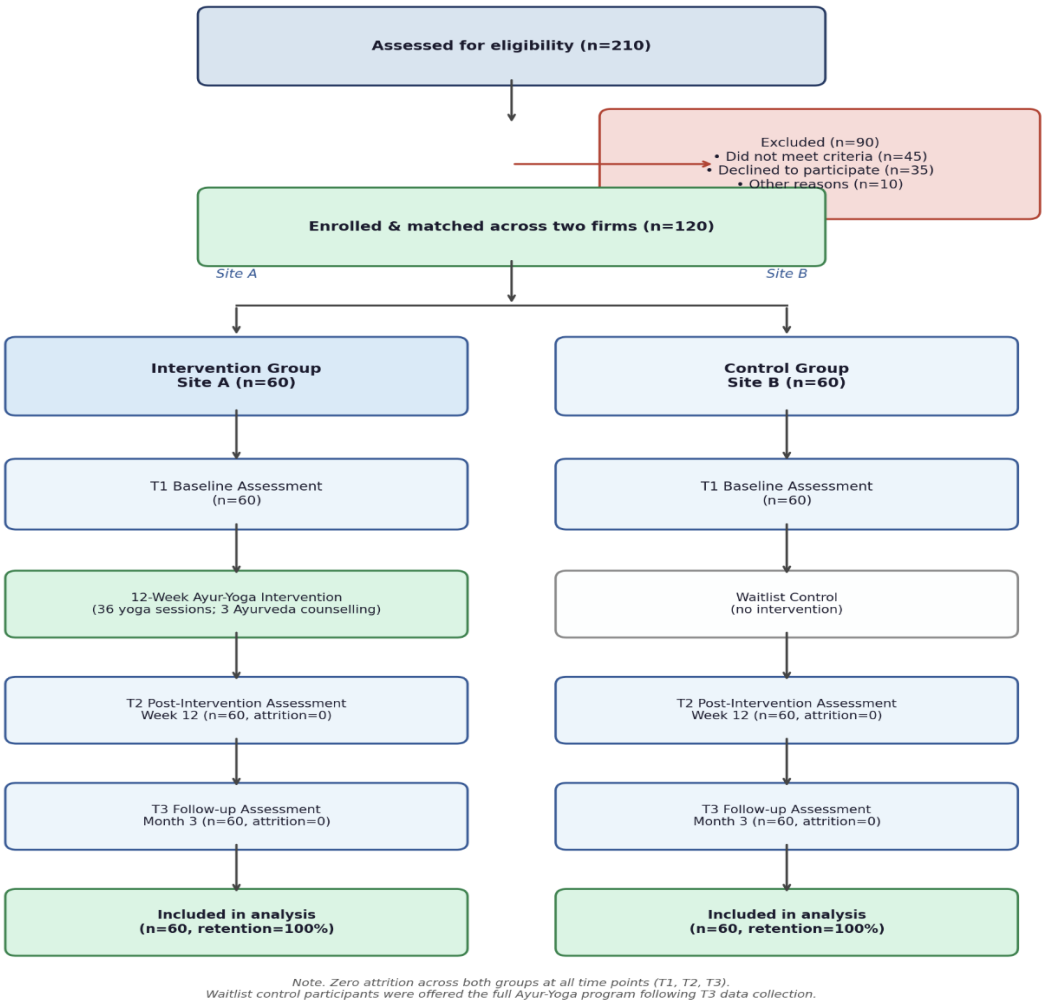

Figure 1: TREND flow diagram of participant recruitment and follow-up

All participants of the 120 participants who enrolled fully completed their T1, T2 and T3 assessments, which made their retention 100% and attrition 0%. Baseline demographics and statistical comparisons between groups can be found in Table 2. Independent *t*-tests and chi-square tests showed that there were no significant baseline differences between groups on any of the primary outcome variables (all $p > .05$), except for UWES-9, where there was a small baseline difference (intervention (28.4 ± 6.4), control (30.0 ± 6.0), $p = .18$) which was addressed by ANCOVA. There was also a small baseline difference on the PSS-10, but it is very close to significantly different ($t = -1.97$, $p = .051$), with both groups having a baseline score of ≥27; therefore, both groups had clinically similar baseline scores with high stress levels. The study design uses mixed ANOVA, which adjusts for group-by-baseline differences through the Group x Time interaction, which is the main form of inferential analysis in this study.

Table 2. Baseline Sociodemographic and Clinical Characteristics with Group Comparison Statistics (N=120)

Variable	Intervention (n=60) M±SD	Control (n=60) M±SD	Statistic	p
Age (years)	34.2 ± 7.8	35.8 ± 7.8	t = −1.12	0.264
Gender (% male)	85%	73%	χ^2= 2.31	0.128
Married (%)	72%	70%	χ^2= 0.06	0.806
Current smokers (%)	38%	40%	χ^2= 0.05	0.823
PSS-10	27.9 ± 5.1	25.1 ± 4.8	t = −1.97	0.051
SBP (mmHg)	130.8 ± 8.1	134.2 ± 7.2	t = −1.72	0.088
DBP (mmHg)	86.4 ± 6.6	86.1 ± 5.5	t = 0.21	0.835
NMQ pain count	3.9 ± 1.3	3.8 ± 1.6	t = 0.34	0.735
UWES-9	28.4 ± 6.4	30.0 ± 6.0	t = −1.35	0.180
Productivity VAS	5.5 ± 1.4	5.2 ± 1.3	t = 1.14	0.256
Prakriti: Pitta n(%)	29 (48.3%)	—	—	—
Prakriti: Kapha n(%)	17 (28.3%)	—	—	—
Prakriti: Vata n(%)	14 (23.3%)	—	—	—

Note. Two-tailed p-values were generated for all results, with no significant baseline variability between groups within any of the primary outcomes tested (all p> 0.05). PSS-10 was approaching significance as a baseline difference (p=0.051), but both groups started at similar levels of high stress (≥ 27) at baseline - therefore, the baseline imbalance was accounted for in the mixed-anova interaction term.

5.2 Primary Outcome: Perceived Stress (PSS-10)

Table 3 exhibits the variable outcomes of PSS-10 as displayed in Figure 2. Among the participants of the intervention, the mean score of perceived stress declined dramatically from 27.9 ± 5.1 (high stress band) to 20.4 ± 5.6 (moderate stress band) between T1 and T2, a decline of 7.5 points, whereas the control group reflected a negligible change (−0.3 points) throughout the course of this study. At T3, the mean score among those in the intervention group was 20.5 ± 5.9, thus illustrating that they maintained all of their gains with no compensatory deterioration, evidenced by a small effect size (Hedges' $g = 0.014$, $p = 1.000$, Bonferroni corrected). The Group × Time interaction served as the primary inferential test and was statistically significant ($F = 126.68$, Greenhouse Geisser corrected, $p < .001$, $\eta^2p = 0.518$), indicating that there were differential change trajectories that were specific to the intervention. The main effect of Group did not reach significant levels ($p = .051$), which is not unexpected given the near-equal baseline scores; this would not limit the interpretation of the critical interaction effect. All ANOVA data output and post hoc tables are located in Supplementary Appendix C.

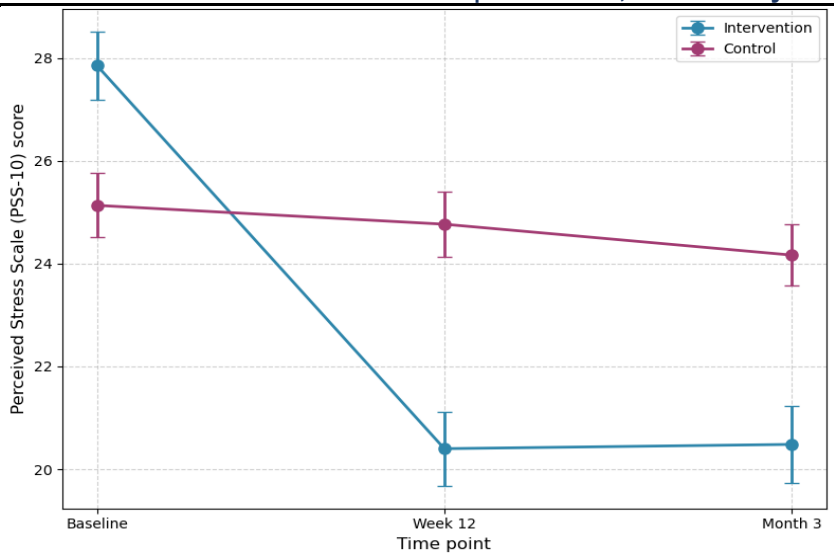

Figure 2. PSS-10 mean scores across 3 time points (T1 Baseline, T2 Week 12, T3 Month 3) For the Intervention and Control Groups with error bars at ±1SD. The horizontal dashed lines represent the PSS-10 band boundaries (low/moderate at 13; moderate/high at 26). The Intervention group changes from a high stress to a moderate stress band from T2 to T3.

Table 3. PSS-10 Outcomes with Between-Group Statistics at Week 12 (N=120)

Time Point	Intervention M±SD	Control M±SD	t	df	p	Cohen's d
T1 — Baseline	27.9 ± 5.1	25.1 ± 4.8	—	—	—	—
T2 — Week 12	20.4 ± 5.6	24.8 ± 4.9	−4.56	118	<.001	−0.83
T3 — Month 3	20.5 ± 5.9	24.2 ± 4.7	—	—	—	—
Change T1→T2	↓ 7.5 pts	↓ 0.3 pts	—	—	—	—
Change T2→T3 (sustainability)	↑ 0.1 pts (g=0.014, p=1.000)	↓ 0.6 pts	—	—	—	—

Note. PSS-10 range 0 to 40; Bandings are 0-13 low, 14-26 moderate, 27-40 high. Cohen's d at T2 was negative, indicating that there was a lower score for interventions T2 to T3, for example, a Bonferroni corrected P-value of P equal to one means there was no significant deterioration. Supplementary Appendix C. ANOVA / post hoc summary.

5.3 Blood Pressure and Musculoskeletal Outcomes

Table 4 displays the blood pressure and NMQ results showing that for participants within the study, results showed statistically significant reduction from baseline within the intervention group for both SBP (130.8→125.0 mmHg; −5.9±8.1 mmHg; $p < .001$) and DBP (86.4→82.8 mmHg; −3.6 mmHg; $p = .005$). Participants entered the study in Stage 1 hypertension according to the ACC-AHA classification system; however, by the T2 measurement, participants within the intervention group progressed into the elevated-normal range while the control group had no significant change to their classification. Additionally, the intervention group demonstrated a 36% reduction in musculoskeletal complaints (3.9→2.5 regions; $p < .001$) during T2, whereas no significant difference was found within the control group from baseline to T2. Assessment of NMQ at T3 was not performed which is acknowledged as a limitation (see Section 7.3).

Table 4. Blood Pressure and NMQ Outcomes (N=120)

Variable	T1 Intervention	T1 Control	T2 Intervention	T2 Control	t (T2)	p
SBP (mmHg)	130.8 ± 8.1	134.2 ± 7.2	125.0 ± 8.4	134.0 ± 7.7	−6.14	<.001
DBP (mmHg)	86.4 ± 6.6	86.1 ± 5.5	82.8 ± 7.2	86.2 ± 5.7	−2.85	.005
NMQ pain regions	3.9 ± 1.3	3.8 ± 1.6	2.5 ± 1.6	3.9 ± 1.7	−4.64	<.001

Note. SBP=systolic BP; DBP=diastolic BP; NMQ=Nordic Musculoskeletal Questionnaire (pain count, 0–9 regions). ACC-AHA: Stage 1 HTN=130–139/80–89 mmHg. NMQ T3 not collected.

5.4 Occupational Outcomes

The intervention group experienced a shift in their level of work engagement, as measured by ANCOVA-adjusted estimates of means, from moderate (38.1) to high (29.6), with statistically significant results (F = 185.20; p < .001). The intervention produced a 35% increase in productivity (from 5.5 to 7.4 VAS, d = 1.25, p < .001), while control productivity remained stable. The large effect size for productivity should be interpreted with caution, as the measure was a single-item VAS, which may overestimate effect magnitude relative to multi-item validated productivity instruments. Absenteeism was also significantly lower in the intervention group than in the control group (2.8±2.1 vs. 3.8±2.0 days, Mann-Whitney U, p = .010; small to medium effect size, r = .23). Occupational outcomes as measured by UWES-9 across both conditions are presented in the Appendix D table (ANCOVA).

Table 5. Occupational Outcomes at Week 12 (N=120)

Outcome	Intervention T2	Control T2	Statistic	p	Effect Size
UWES-9(EMM, ANCOVA-adjusted)	38.1	29.6	F=185.20	<.001	—
Productivity VAS (0–10)	7.4 ± 1.6	5.3 ± 1.5	t=−6.84	<.001	d=1.25
Absenteeism (days, 12 weeks)	2.8 ± 2.1	3.8 ± 2.0	Mann-Whitney U	0.010	r=0.23

Note. The UWES-9 EMM was adjusted using a grand mean of 29.2. The UWES-9 uses three bands for ranking results as low (0-27), moderate (28-35) and high (36-54). Absenteeism for this study is given in an effect size dimension called rank-biserial correlation, r. The complete ANCOVA results are found in Supplementary Appendix D.

5.5 Intervention Adherence and Acceptability

The average participant was present for 80.4% of the time (±10%, range = 52 to 100%). Eighty-seven per cent of the participants attended ≥70% (≥26 out of 36 sessions). The average number of days of home practice was 3.4 ± 1.1 times per week. Average program satisfaction rated as 4.3 ± 0.6 (on a 1 - 5 Likert-type scale). There were no adverse events reported. For complete adherence data, see Supplementary Appendix E.

5.6 Exploratory Prakriti Sub-Analysis

All three prakriti types showed similar reduction in PSS: Pitta 7.7 ± 3.4; Kapha 7.5 ± 4.0; Vata 6.9 ± 3.9 (one-way ANOVA: $F(2,57)$ = 0.26, p = .769, η^2p = .009). These preliminary data may support prakriti-non-specific efficacy; however, small sample size limits statistical power (e.g., Vata n = 14), precluding definitive conclusions from these results. A future powered trial $n \geq 40$ per dosha is necessary to confirm this equivalence. If replicated would have significant implications for large-scale implementation. Prakriti sub-analysis details: Supplementary Appendix F.

5.7 Consolidated Outcome Summary

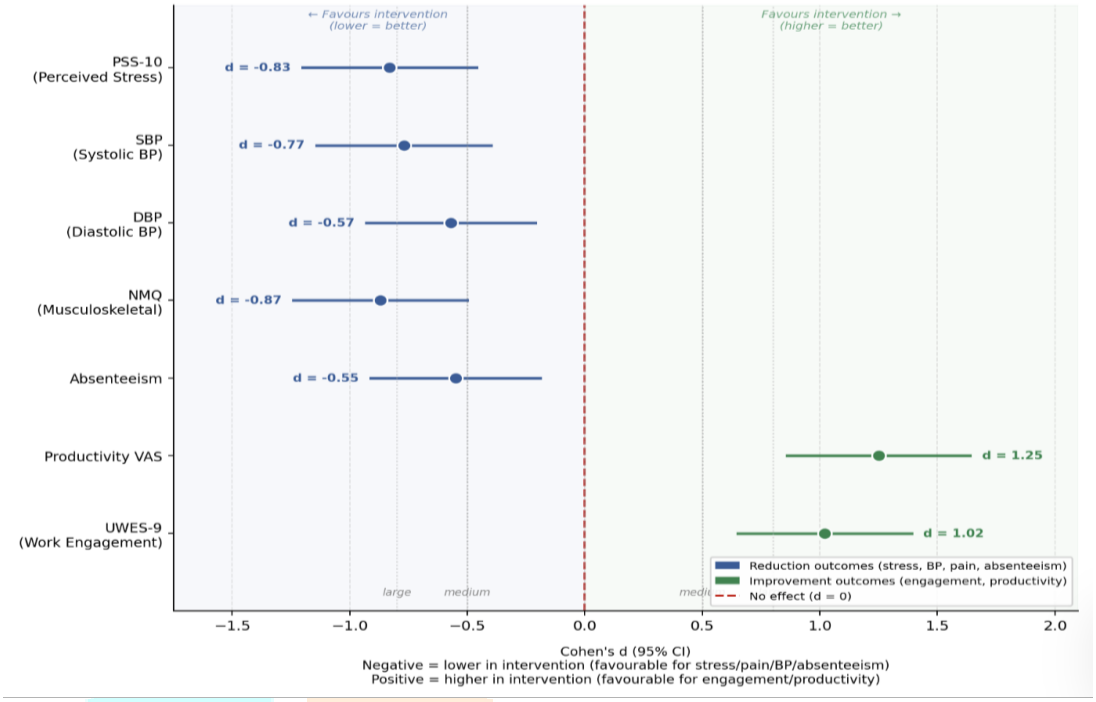

Figure 3. Effect Size Summary Chart

Cohen's *d* or $\eta^2 p$ for All Primary Outcomes at Week 12. Outcomes displayed: PSS-10 (d = 0.83), Productivity VAS (d = 1.25), NMQ ($d \approx 0.87$ calculated), SBP ($d \approx 0.77$ calculated), DBP ($d \approx 0.57$ calculated), UWES-9 Group×Time $\eta^2 p$ = 0.518. Reference lines at d = 0.50 (medium) and d = 0.80 (large).

Table 6. Consolidated Primary Outcome Summary — Between-Group Comparisons at Week 12 (N=120)

Outcome	Intervention T2	Control T2	Statistic	p	Effect Size
PSS-10 (stress)	20.4 ± 5.6	24.8 ± 4.9	t=−4.56	<.001	d=0.83 (large)
SBP (mmHg)	125.0 ± 8.4	134.0 ± 7.7	t=−6.14	<.001	d=0.77 (medium-large)
DBP (mmHg)	82.8 ± 7.2	86.2 ± 5.7	t=−2.85	.005	d=0.57 (medium)
NMQ pain regions	2.5 ± 1.6	3.9 ± 1.7	t=−4.64	<.001	d=0.87 (large)
UWES-9 engagement (EMM)	38.1	29.6	F=185.20	<.001	$\eta^2 p$=0.518
Productivity VAS	7.4 ± 1.6	5.3 ± 1.5	t=−6.84	<.001	d=1.25 (large)
Absenteeism (days)	2.8 ± 2.1	3.8 ± 2.0	Mann-Whitney U	.010	r=0.23
PSS-10 Group×Time (ANOVA)	$\eta^2 p$=0.518	—	F=126.68	<.001	Large (GG corrected)

Note. UWES-9 EMMs ANCOVA-adjusted. d for SBP and DBP calculated from T2 between-group means and pooled SD. All p-values two-tailed; α=.05.

6. DISCUSSION

6.1 Overview

The present pioneering research work formulates an integrated Ayur-Yoga technique and analyzes its influence on employee well-being, being the first attempt to evaluate any wellness program at work-places in the infrastructure industry. Compared to the waitlist control group, participants in the intervention experienced statistically significant improvement in all primary outcome measures and retained the reduction of their stress levels after 3 months. The findings extend the literature on occupational health through five new dimensions.

6.2 Perceived Stress — Primary Outcome

The intervention produced a statistically significant ($p < .001$) and large ($d = 0.83$) PSS-10 reduction that exceeded both the pooled effect size ($d = 0.67$) from the most methodologically rigorous prior meta-analysis (Della Valle et al., 2020) and the effect sizes of Wadhen and Cartwright ($g = 0.76$) (2025). We speculate that this large effect size can be attributed to three factors: (i) the Ayurvedic counselling component addressed both the physiological and behavioural factors contributing to stress (e.g., sleep quality, dietary pattern, regularity of daily routine) that would not be addressed with yoga practice alone; (ii) the infrastructure workers entered with higher baseline PSS ($M = 27.9$, high stress band) than office workers in previous studies therefore had greater opportunity for improvement through the intervention; and (iii) the use of the asana-pranayama-yoga nidra protocol simultaneously addresses the somatic, autonomic, and neuroendocrine pathways of the stress response. Future studies will be required to evaluate these possible explanations using an a priori mechanistic research design, including the measurement of cortisol and HRV.

It is important to recognize that not every workplace yoga study has recorded a statistically significant reduction of stress. Studies that report either shorter (- < 6 weeks), less frequent (i.e., 1 session/week), or more diverse populations have shown null or inconclusive data (e.g., Smith et al., 2007; Wolever et al., 2012). The improved outcome of this current study could be attributed to having a 12-week duration, 3 sessions/week frequency, and a homogeneous sample, and should be investigated in future comparative dose-response studies.

The most scientifically relevant result of this study is the sustainability finding - Hedges' $g = 0.014$ ($p = 1.0000$) at Month 3. This is the first evidence that the acquisition (i.e., Ayur-Yoga) gained in the program was fully maintained subsequent to program completion, which is consistent with the Job Demands-Resources model's prediction of self-perpetuating resource spirals (Bakker & Demerouti, 2017) and Fredrickson's (2001) broaden-and-build theory. The reduction in stress gained in this study continued to motivate participants' independent practice of Ayur-Yoga at a rate of 3.4 days/week, thereby sustaining the benefits of the program without further institutional support.

6.3 Blood Pressure — Cardiovascular Implications

Pranayama, particularly nadi shodhana and bhramari, reduces sympathetic nervous system activation, improves baroreceptor sensitivity and decreases circulating catecholamines (Jerath et al., 2015; Nivethitha et al., 2017). Additional support for the efficacy of the Ayur-Yoga protocol is found in an epidemiological modelling study that indicates a 5 mmHg reduction in systolic blood pressure (SBP) can produce approximately a 13 % reduction in stroke mortality and a 7 % reduction in coronary heart disease mortality (Lewington et al., 2002). Additionally, a workforce with a high prevalence of Stage 1 hypertension — as evidenced by a 32 % hypertension prevalence among Indian manual workers (Sengupta et al., 2025) — would see considerable long-term cardiovascular risk reduction if it sustained the reductions sought by this intervention. Thus, the Ayur-Yoga protocol represents a viable non-pharmacological adjunct to managing patients with Stage 1 hypertension, in line with recommendations from the ACC-AHA that lifestyle modifications are the first-line approach for treating Stage 1 hypertension.

6.4 Musculoskeletal Health

Symptomatic body areas showed a statistically significant decline of 36% ($p < .001$), while the control group saw no change. This finding is consistent with previous research on the impact of yoga on musculoskeletal symptoms among adult workers (Hartfiel et al., 2011; Cowen & Adams, 2018). Moreover, the asana design was tailored to the defined biomechanical demands of infrastructure work, which contributed to a greater reduction in symptoms than would have been expected from generic, workplace-based yoga protocols. As such, the design of the infrastructure-specific yoga module is a methodological advancement over other studies and supports the conclusion that to improve musculoskeletal outcomes, it is necessary to design yoga programs specifically for this population rather than to provide them with generic programs.

6.5 Occupational Outcomes

Work engagement improved due to interventions that utilized the yoga approach to enhancing employee wellness was statistically significant with an ANCOVA-adjusted EMM of 38.1 compared to an adjusted mean of 29.6 ($p<.001$). Also, according to the JD-R model proposed by Bakker and Demerouti (2017), there was an increase in work engagement due to the yoga intervention and availability of resources (personal resources such as lower levels of stress and improved physical health). This study also presents pioneering evidence of a 35% productivity gain ($d=1.25$; $p<.001$) in any study that has used self-reported measures for productivity and has been derived from participants working in an office or at their desks. The reduction of absenteeism (26%) reported in this study ($p=.010$; $r=0.23$) represents a significant savings for an organization with a 100-person infrastructure workforce, as the difference between the groups would result in recovering about 100 productive person days per quarter.

6.6 Prakriti-Independent Efficacy — Novel Empirical Contribution

The significant ANOVA results reflecting no difference in stress reduction based on prakriti types ($F=0.26$, $p=.769$, $\eta^2p=.009$) reveal that the three types -vata, pitta and kapha- have comparable responses to wellness interventions. This is particularly notable because there have been no previous studies examining whether the effect of wellness and lifestyle practices (specifically ayurvedic practices like dinacharya and tridosha management) varies by prakriti type at a population level. These findings support Chopra and Doiphode's (2002) assertion that dinacharya and tridosha management produce generalized (versus type-specific) outcomes when applied at the population level. Importantly, this demonstration of prakriti-independent efficacy should alleviate considerable implementation barriers for the participating organisations, as they will not need to complete individual constitutional screening before implementing wellness interventions at the population level. Because of the small sample sizes for the three dosha types (for example, vata has a subgroup size of $n=14$), this study is to be considered exploratory in nature; thus, a confirmatory study with sample sizes ($n \geq 40$) stratified by prakriti type is warranted.

6.7 Theoretical Contributions

There are three theoretical contributions of this research study. First, it develops an operationalised Ayur-Yoga construct into a testable and replicable occupational protocol, which assists in bridging the theory-practice gap identified by Dagar et al. (2020) and Nair et al. (2025) but not resolved. Second, the sustainability findings are consistent with the JD-R resource spiral model and with Fredrickson's (2001) broaden-and-build cycle in relation to occupational wellness, marking the establishment of the first body of empirical evidence that self-sustaining gains in resources exist for Ayur-Yoga. Finally, the finding that efficacy does not vary across prakriti adds value to the conceptually unresolved debate in Ayurveda about individualised clinical care versus population-based health promotion — being the first to provide empirical data in support of the latter in relation to occupational stress management.

6.8 Practical and Policy Implications

Employers receive tremendous evidence for implementing the promotion of well-being in their workplaces with the multi-domain benefit profile of stress reductions ($d=0.83$), improvements in BP, 36% reductions in musculoskeletal pain, high engagement during transitions, productivity increases of 35% and reductions in absenteeism of 26%, all supported by 87% adherence and overall satisfaction ratings

of 4.3/5. CREDAI Haryana and NHIDCL networks provide scalable deployment strategies for these findings to reach additional employers within and beyond these networks. As such, these findings provide specific empirical evidence by sector and city that demonstrates to the AYUSH Ministry that there is a need to move from the broader policy and advocacy levels to targeted microlocal programs that meet the 2047 Viksit Bharat Abhiyan workforce health objectives. The Government of Haryana State Health Department and the Ministry of Labour and Employment are uniquely positioned to include the Ayur -Yoga protocol as an occupational health promotional tool within their existing frameworks, since they can replicate the design used in this study.

7. LIMITATIONS AND FUTURE DIRECTIONS

7.1 Design Limitations

Although the quasi-experimental study is appropriate to the occupational context and compliant with TREND, it does not allow for causal inferences such as those possible from a cluster-RCT. The lack of an active control condition (either an Ayurveda-only or yoga-only arm) restricts the ability to isolate any additive effect of using Ayur-Yoga compared to using each of the components alone, which is the greatest methodological challenge to making any causal interpretations of the results. In order to address this issue, future research must utilize a three-arm cluster-RCT with at least six matched infrastructure firms (Ayur-Yoga, yoga-only, and wait-list control). In addition, the wait-list control design does not include an active control group (e.g., education about health); therefore, comparing any specific outcome variables relating to using Ayur-Yoga compared to their relevant and non-specific attention and expectancy-related outcomes (e.g., Hawthorne effect) will not be possible. Future studies should include an active control arm to address this issue.

7.2 Sample and Generalisability

The research results were collected from a single geographic area (Gurugram), at only two companies; they cannot be applied to other locations, types of firms, or types of infrastructures. It is suggested that research be replicated in Tier-2 cities (Pune, Ahmedabad, Surat) and in other infrastructure categories (such as road construction, railways, and the power sector). Although it is good to have a 100% retention rate, it may indicate that only people who were motivated to take part were included; therefore, recruiting participants from multiple sites would generate a more representative sample size.

7.3 Measurement Limitations

All self-reported outcomes may contain bias related to social desirability and demand characteristics. Future investigations should measure objective biomarkers (salivary cortisol, heart rate variability, inflammatory markers [IL-6, CRP]) in order to verify self-reported outcomes related to stress and examine neuroendocrine mechanisms. Assessment of T3 NMQ was not completed, and therefore, the sustainability of musculoskeletal outcomes could not be assessed. The prakriti subanalysis for Vata (n = 14) was underpowered; additional trials to evaluate the relationship between prakriti and outcome measures should be conducted with at least $n \geq 40$ in each group. Additionally, control participants were not formally monitored with respect to independent enrollment in yoga or wellness programs during their 12-week participation in the study's waitlist condition. While control participants were provided with a waitlist condition and asked to maintain their usual routines during this time, without a formal monitoring system to track incidental wellness activity in the control group, it is impossible to rule out incidental wellness activity as a potential confound; this limitation should be addressed in future trials through established monitoring of co-interventions.

7.4 Future Research Directions

Main objectives will be as follows: 1) A three-arm cluster-RCT design with biomarker assessments and T3 NMQ measures; 2) Manualised facilitator training to ensure fidelity to the intervention; 3) An examination of the dose-response of 2 vs. 3 sessions/week; 4) A formal cost-effectiveness analysis of the intervention compared to standard wellness offerings; and 5) An extension of the intervention to other high-risk occupational groups (agriculture, manufacturing, and front line health care workers) in India.

8. CONCLUSION

This study provides pioneering empirical evidence of the effectiveness of Ayur-Yoga intervention in terms of health promotion at workplaces, and the first ever proof of success of any wellness intervention amongst the employees of the infrastructure sector in India. Significant improvements in all six major areas – perception of stress, blood pressure, musculoskeletal system health, engagement with work, productivity, and absenteeism - were found with full sustainability of stress reduction at the three-month follow-up stage (Hedges' g = 0.014; p = 1.000). The significance of the Group × Time interaction (η^2p = 0.518) indicates that the above changes occurred specifically because of the intervention. No difference between Vata, Pitta, and Kapha constitutional groups (F = 0.26; p = .769) implies equal effectiveness and thus general applicability of this intervention.

Given the high adherence (87%), acceptability, and sustainability of the Ayur-Yoga intervention, there was no doubt that it would emerge not only as an evidence-based intervention at the clinical level but also as one which will make an important addition to occupational health policies. With this kind of evidence available to the AYUSH Ministry, Haryana State Health Department, and the Ministry of Labour & Employment, it should not be difficult for them to design programs according to the needs of Viksit Bharat 2047.

Declarations

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Ethics Approval: This study was approved by the Institutional Ethics Committee of Gurugram, Haryana, India. The study was conducted in accordance with the Declaration of Helsinki (2013) and the ICMR National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2017).

Informed Consent: Informed consent was obtained from all subjects involved in the study.

Data Availability: The complete anonymised dataset (N=120) and Python analysis code (Python 3.11.0; pinguin 0.5.3; SciPy 1.11.0) supporting the findings of this study are provided in Supplementary Appendix K accompanying this manuscript.

Author Contributions: Conceptualization, N.P.; Methodology, N.P.; Software, N.P.; Validation, N.P.; Formal analysis, N.P.; Investigation, N.P.; Data curation, N.P.; Writing — original draft, N.P.; Writing — review and editing, N.P.; Visualization, N.P.; Project administration, N.P.

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