©

International Journal on
Eternal Wisdom and Contemporary Science

Volume 1 • Issue 1 • June 2024 • pp 58-74

Yoga for Industrial Workers with Prolonged Standing Hours: A Single-Blind Randomized Controlled Trial

Pramod Shahane
BE (Mech.), MSc. in Yoga Therapy, S-VYASA, Bangalore, India
under the guidance of
Dr. Apar Saoji, *BNYS, PhD (Yoga)* & Dr. Ragavendraswamy, *BNYS, PhD (Yoga)*
Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Bangalore, India

Abstract:

Several work scenarios necessitate long hours of standing. Prolonged standing is known to be associated with lower limb discomfort, vascular disorders, trunk discomfort and musculoskeletal disorders. Health problems due to prolonged standing affects individual's well-being resulting in absenteeism and productivity loss at the workplace. It can also burden health insurance. Therefore, prevention and management of adverse effects of long-term standing is an important concern in industries.

The present study was designed to understand the effect of yoga intervention on the adverse effects associated with prolonged standing work environment. A total of 66 participants from a factory setting in Pune were randomly assigned into experimental and control groups of 33 each. Rater's blinding was used while analysing the data. A standardised and validated yoga intervention was provided at the factory to the experimental group, after completing their shift, for a period of 60 min, 6 days a week for four weeks. The control group was offered the same intervention after completion of the study period.

Yoga intervention for four weeks has shown significant improvements in parameters like Ankle Blood Pressure, Ankle Brachial Pressure Index, Ankle and Mid-Calf Circumference, Body Mass Index (BMI), Respiratory rate, Bhramari Pranayama duration, as well as subjective feeling of fatigue, perceived level of stress and quality of life. The control group on the other hand, showed increase in fatigue, worsened quality of life in the follow-up period of four weeks. We can, therefore, say that yoga intervention for four weeks improves health parameters at both physical and psychological levels which may, in turn, potentially improve work efficiency. Yoga, thus, could be a useful practice to enhance workplace wellness in industry settings.

Key Words: Yoga, Lower limb discomfort, Vascular disorders, Lower limb venous flow, workplace wellness, Musculoskeletal disorders

INTRODUCTION

Sitting vs. standing has been ongoing debate in human well-being because the human body is not designed for prolonged sitting. While standing offers benefits, remaining in one position for extended periods also carries health risks. Finding an optimal balance seems ideal, but achieving it in real-world scenarios can be challenging.

Many workplaces require employees to stand for extended periods, including assembly lines, machining operations, supermarket cashiers, quality control workers, healthcare staff, etc. In some scenario, the person has to stand in the same position for hours to carry out their work, whereas in some situations, some movement is a part of the process design. The standing working environment, which is a widely adopted industrial practise, can be broadly categorised into two types: dynamic standing, where some movement is involved, and static/passive standing, where the worker remains in a fixed position.

Previous research links prolonged standing to lower limb discomfort, vascular disorders, trunk discomfort, and musculoskeletal disorders. Factors contributing to discomfort include muscular fatigue and increased blood pooling in the lower limbs. It's hypothesized that standing reduces venous return, leading to higher pressure and potentially explaining increased discomfort, impaired venous valves, and peripheral vascular disorders (Antle et al., 2018; Antle & Côté, 2013). Additionally, research suggests stationary standing decreases blood flow to muscles, accelerating fatigue and causing pain in legs, back, and neck (Halim et al., 2012). Prolonged standing may also lead to temporary joint immobility and potential rheumatological issues due to wear and tear on tendons and ligaments (Putz-Anderson et al., 1997). Diurnal work with prolonged stationary standing can worsen muscle fatigue, lower back pain, neck/shoulder stiffness, and other health problems.

These health issues impact individual well-being, increase absenteeism, decrease workplace productivity, and strain health insurance systems. Therefore, the prevention of musculoskeletal disorders that were associated with prolonged standing in the workplace has become an increasingly important concern in vast majority of industries.

Yoga, practiced in India for centuries to promote physical and mental well-being, has shown effectiveness in managing musculoskeletal issues like lower back pain (Cramer, 2013; Tekur et al., 2008), lower limb pain (Deepeshwar et al., 2018), and fatigue (Kiecolt-Glaser et al., 2014). Research demonstrates its benefits for medical professionals (Saoji, 2016), computer professionals (Telles et al., 2009), defense personnel (Highland et al., 2018), and athletes (Hakked et al., 2017; Polsgrove et al., 2016)

While limited research exists on the effects of yoga for industrial workers with prolonged standing shifts (Pravalika et al., 2023; Yamuna et al., 2024), the potential to address the health concerns associated with prolonged standing justifies further investigation. This study aimed to explore this possibility.

OBJECTIVES AND HYPOTHESIS

The present study aims to investigate the effects of a yoga intervention on the adverse health conditions associated with prolonged standing work environments.

Objectives:

- To examine the effect of yoga intervention on lower limb blood pressure.
- To evaluate the effectiveness of yoga in managing musculoskeletal symptoms and fatigue.
- To explore the effects of yoga on perceived stress and quality of life.

Research Hypothesis:

Yoga intervention may reduce lower limb discomfort, fatigue, and perceived stress, and improve quality of life.

Null Hypothesis:

Yoga intervention has no significant effect on lower limb discomfort, fatigue, perceived stress, and quality of life

METHODOLOGY USED

A total of 66 participants/subjects were recruited (33 in experimental group and 33 in control group). Subjects were selected from a factory located in Chakan, Pune, India, operated by M/s Keihin FIE Private Limited, a subsidiary of Keihin Corporation, Japan.

Inclusion criteria:

- Adult volunteers aged 20-50 years, working in shifts at M/s Keihin FIE Private Limited, Chakan, for at least 6 months prior to study recruitment.
- Subjects with self-reported lower limb discomfort and/or pain, or low back pain attributed to work.
- Cleared for participation by a trained physician through a routine clinical examination.

Exclusion criteria:

- Subjects with major health conditions, including cardiovascular, respiratory, or psychiatric illnesses, were excluded.
- Subjects with osteoarthritis of the hips or knees, other rheumatological problems, or back pain due to spinal pathology were excluded.

Ethical Consideration:

Written informed consent was obtained from all participants after a detailed explanation of the study protocol. Participants had the opportunity to ask questions and were free to withdraw at any point without penalty. The study was approved by the Institutional Ethics Committee of Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Bangalore.

Study Design:

We employed a single-blind, randomized wait-list controlled design. This is a type of randomized controlled trial (RCT) where participants are divided into two groups (intervention and control). The initial 66 participants were randomly assigned to either the yoga group (n=33) or the wait-list control group (n=33). The control group received no yoga intervention during the four-week study period but was offered the same intervention after the completion of the study and assessment of the yoga group. Blinding of the data analysts was ensured.

Intervention:

Yoga program was specifically designed and validated by S-VYASA to address the needs of workers in prolonged standing postures was implemented. The details of the yoga practices are presented in Table 1 (Yamuna et al., 2023).

Table 1: Validated Yoga module

Sr	Yoga Module – Subject content	Rounds (Nos)	Time (Min)
	Starting Prayer: ॐ सहनाववतु.....	1	2
	Loosening Exercises: Sitting position		
1	Knee tightening and rotation (Clock wise / Anti clock wise)	10	2
2	Ankle rotation (Clock wise / Anti clock wise)	10	2
3	Feet movements – (Push/Pull & Right / Left)	10	2
	Loosening Exercises: Standing Position		
4	Toe walking – (Forward and Backward)	10	1
5	Heel walking – (Forward and Backward)	10	1
	Instant Relaxation Technique	1	1
	Loosening Exercises: Supine Position		
6	Side lying leg lifts	10	2
7	Supine position- Single and both Leg raise to 10, 30, 45, 60 and 90 degrees with a hold for 5 seconds.	5	3
8	Supine position- Single straight leg raising slowly to 90 degree and then rotation clockwise and anticlockwise. Do for both legs.	5	3
	Breathing Exercises		
9	Ankle Stretch Breathing	10	2
10	Tiger Breathing	10	2
11	Alternate Leg Raising (from Supine position)	10	2
	Quick Relaxation Technique	1	4
	Asanas - Standing Postures		
12	Parivritta trikonasana (RH side and LH side)	1	2
13	Veerabadrasana (RH side and LH side)	1	2
	Asanas - Sitting Postures		
14	Vakrasana (RH side and LH side)	1	2
	Asanas - Prone Postures		
15	Bhujangasana	1	2
16	Shalabasana	1	2
	Asanas - Supine Postures		
17	Pawanamukthasana (Left leg, Right leg, Both legs)	1	3
18	Vipareetakarani	1	2
	Deep Relaxation Technique	1	8
	Pranayama		
19	Nadisuddhi Pranayama	5	3
20	Bhramari Pranayama	3	2
	Closing Prayer: ॐ सर्वे भवन्तु सुखिनः	1	2

ASSESSMENT TOOLS

Blood Pressure (Systolic and Diastolic) at Arm and Ankle:

Blood pressure was measured using an automated oscillometric blood pressure monitor (OMERON HEM 7130 Model) on participants in a lying down position at both the arm and ankle. Ankle-brachial pressure index (ABPI) was calculated to assess peripheral vascular health based on the readings (Verberk et al., 2012).

Pulse Rate:

Pulse rate, measured in beats per minute (bpm), was assessed using the same automated oscillometric blood pressure monitor that was used to measure blood pressure.

Leg Circumference at Ankle and Mid-calf:

Ankle and mid-calf circumference were measured manually using a flexible tape to assess potential lower limb swelling. Participants were seated on an examination table with legs dangling at a 90-degree knee flexion, ensuring no weight bearing on the feet.

Respiratory Rate:

Respiratory rate (cycles per minute) was observed by monitoring chest or abdominal rise and fall while participants were asked to relax on a chair, close their eyes, and focus on pleasant memories to minimise manipulation.

Breath holding time - Bhramari Pranayama duration:

Breath-holding time (BHT) was measured as the maximum duration a participant could hold their breath comfortably before resuming breathing. Participants were instructed to take four long breaths to calm down, followed by one long inhalation and exhalation with an "Om" sound (Bhramari Pranayama). The longer duration of two attempts was recorded.

BMI – Body Mass Index:

BMI was calculated using weight (kg) divided by height squared (m^2). The standard BMI categories were mentioned (normal: 18.5-24.9, overweight: 25-29.9, obese: 30-39.9, morbidly obese: >40).

Biologically it is possible that person may have obese BMI and be metabolically healthy and person with normal BMI can be metabolically unhealthy. But it is also true that Obesity does have links with many health consequences like high blood pressure, type 2 diabetes, coronary heart disease, Sleep apnea, etc.

Musculoskeletal Health Questionnaire:

It is a validated tool for assessment of joint, back, neck, bone and muscle symptoms (Hill et al., 2016). This 15-item scale was used to determine the overall health of musculoskeletal system in healthy as well as clinical population.

SF 12 Health Survey:

The 12-Item Short Form Health Survey (SF-12) is a validated tool to assess the physical and mental Quality of Life (Gandek et al., 1998) of an individual and was deployed to assess the impact of yoga intervention on Quality of Life.

Chalder Fatigue Scale:

This self-administered 14-item questionnaire was used for measuring the extent and severity of physical and mental fatigue (Chalder et al., 1993).

Fatigue Severity Scale:

It is a self-report measure (Krupp, 1989) which was used to assess the respondent on a 9-item scale like how fatigue affects motivation, exercise, physical functioning, carrying out duties, interfering with work, family, or social life.

Perceived Stress Scale:

The Perceived Stress Scale (Cohen et al., 1983) is a classic stress assessment instrument which was used to understand the impact of yoga on the perceived stress using questions related to the subject's feelings and thoughts during the period of the study.

DATA EXTRACTION & DATA ANALYSIS

Data Extraction:

Data was collected from participants before and after the intervention using standardised measurements, questionnaires, and manual scoring keys for all participants in both the experimental and control groups. The data was organized in a spreadsheet with one row for each participant.

Data Analysis:

The normality of the data was tested using Shapiro-Wilk's Test and based on the normality, appropriate tests were employed for analysis of the data.

Within Group Analysis:

- For normally distributed data, paired-samples t-tests were performed to analyse changes within each group over time.
- For non-parametric data, Wilcoxon signed-rank tests were used to assess changes within each group.

Between Group Analysis:

- For normally distributed data, independent-samples t-tests were conducted to compare changes between the experimental and control groups.
- For non-parametric data Mann-Whitney U tests were used for between-group comparisons.

RESULTS

The results of the objective variables are presented in Table 2. The results of the questionnaires are presented in Table 3. Statistical significance levels are indicated in the tables.

Table 2: Results of the objective variables

Variable	UoM	Experimental Group		Control Group		p-value	df	Effect size
		Pre	Post	Pre	Post			
Weight	Kgs	71.02 ± 7.88	70.08 ± 7.70 ***	71.05 ± 8.06	70.80 ± 8.01	=0.708	64	0.091
BMI – Body mass index	Kg/m^2	24.85 ± 2.53	24.52 ± 2.40 ***	25.44 ± 2.23	25.35 ± 2.15	=0.147	64	0.364
Respiratory rate (RR)	Cycles/Min	19.52 ± 2.82	17.33 ± 2.38 ***	18.48 ± 2.74	19.39 ± 3.37	<0.05	64	0.706
Bhramari time (BhrT)	Sec	16.61 ± 4.37	21.36 ± 4.08 ***	15.18 ± 4.79	15.21 ± 4.40	< 0.001	64	1.449
Pulse rate – Arm (HR)	beats/Min	78.36 ± 8.52	73.79 ± 6.17 **	78.88 ± 9.04	79.55 ± 8.61	< 0.01	64	0.769
BP (Systolic) – Arm (SBP Arm)	mmHg	118.15 ± 9.97	116.58 ± 9.09	118.00 ± 10.05	118.91 ± 8.95	=0.297	64	0.258
BP (Diastolic) – Arm (DBP Arm)	mmHg	74.24 ± 6.84	74.06 ± 6.34	74.52 ± 7.13	75.88 ± 6.94	=0.271	64	0.274
BP (Systolic) – Ankle SBP Ankle)	mmHg	126.67 ± 12.51	122.15 ±10.02 **	127.70 ± 11.09	128.12 ± 8.85	<0.05	64	0.631
BP (Diastolic) – (DBP Ankle)	mmHg	73.15 ± 7.37	71.03 ± 5.98**	74.76 ± 7.05	75.79 ±6.19	<0.01	64	0.782
Ankle Brachial Pressure Index	No.	1.07 ± 0.08	1.05 ± 0.07 *	1.08 ± 0.06	1.08 ± 0.06	=0.067	64	0.460
Ankle – Circumference (Ank Cir)	Cms	26.94 ± 1.41	25.39 ± 1.52 ***	27.02 ± 1.34	27.17 ± 1.65	<0.001	64	1.122
Mid-Calf – Circumference (Calf Cir)	Cms	36.39 ± 2.14	34.64 ± 2.86 ***	36.44 ± 2.02	36.36 ± 2.14	<0.01	64	0.681

Table 3: Results of the Subjective variables

Variable	Experimental Group		Control Group		p-value	df	Effect size
	Pre	Post	Pre	Post			
CFS: Chalder Fatigue Scale Scores	13.97 ± 4.38	8.601 ± 5.18 **	13.79 ± 1.11	14.48 ± 1.25 ***	<0.001	64	1.558
FSS: Fatigue Severity Scale Score	3.75 ± 0.90	2.91 ± 1.20 ***	3.96 ± 0.70	4.11 ± 0.67 **	<0.001	64	1.235
PSS: Perceived Stress Scale Score	18.79 ± 3.43	14.33 ± 4.35 ***	19.30 ± 1.90	20.18 ± 1.70 *	<0.001	64	1.771
MHQ: Musculoskeletal Health Questionnaire Score	24.09 ± 7.67	13.73 ± 8.75 ***	22.36 ± 2.86	23.82 ± 3.20 ***	<0.001	64	1.531
SF12_P: SF12 Health Survey Physical Score	13.64 ± 2.01	15.55 ± 1.72 ***	13.58 ± 1.84	14.15 ± 1.09 **	<0.001	64	0.972
SF12_M: SF12 Health Survey Mental Score	16.88 ± 2.30	21.67 ± 2.12 ***	16.36 ± 1.73	16.18 ± 1.74	<0.001	64	2.831
SF12_G: SF12 Health Survey Global Score	30.52 ± 3.90	37.21 ± 3.37 ***	29.94 ± 3.23	30.27 ± 2.41	<0.001	64	2.369

df: Degree of freedom
** p < 0.05; ** p < 0.01; *** p < 0.001*

DISCUSSION

Our four-week yoga intervention resulted in significant improvements in weight, BMI, respiratory rate, Bhramari pranayama time, blood pressure at the ankle (systolic and diastolic), ankle-brachial pressure index and ankle and mid-calf circumference. The control group, on the other hand, did not show significant changes in most variables and even exhibited increased perceived stress, fatigue scores, and worsened musculoskeletal health at the follow-up. These trends are presented in Tables 4 and 5.

Industry workers engaged in prolonged standing are susceptible to lower limb blood vessel problems (Krijnen et al., 1997). Studies suggest that such populations have higher lower limb blood pressure and ABPI, which are risk factors for peripheral vascular diseases (Aboyans et al., 2012). The observed reductions in ankle blood pressure, ABPI, and ankle/mid-calf circumference following yoga intervention are particularly significant in preventing these vascular complications in the target population.

Musculoskeletal issues and fatigue are other major health concerns for these workers. Our findings demonstrated a reduction in both after the intervention period. Similar improvements in musculoskeletal health with yoga practice have been observed in other populations, such as patients with low back pain (Tekur et al., 2008) and osteoarthritis (Deepeshwar et al., 2018). The reduction in fatigue aligns with findings from studies on patients with chronic disorders (Banasik et al., 2011).

Table 4: Trends of changes in the objective variables

Variable	Experimental Group	Control Group
Weight	↓↓↓	—
BMI – Body mass index	↓↓↓	—
Respiratory rate (RR)	↓↓↓	—
Bhramari time (BhrT)	↑↑↑	—
Pulse rate – Arm (HR)	↓↓	—
BP (Systolic) – Arm (SBP Arm)	—	—
BP (Diastolic) – Arm (DBP Arm)	—	—
BP (Systolic) – Ankle (SBP Ankle)	↓↓	—
BP (Diastolic) – Ankle (DBP Ankle)	↓↓	—
Ankle Brachial Pressure Index	↓	—
Ankle – Circumference (Ank Cir)	↓↓↓	—
Mid Calf – Circumference (Calf Cir)	↓↓↓	—

Table 5: Trends of changes in the subjective variables

Variable	Experimental Group	Control Group
CFS: Chalder Fatigue Scale Scores	↓↓	↑↑↑
FSS: Fatigue Severity Scale Score	↓↓↓	↑↑
PSS: Perceived Stress Scale Score	↓↓↓	↑
MHQ: Musculoskeletal Health Questionnaire Score	↓↓↓	↑↑↑
SF12_P: SF 12 Health Survey Physical Score	↑↑↑	↑↑
SF12_M: SF12 Health Survey Mental Score	↑↑↑	—
SF12_G: SF12 Health Survey Global Score	↑↑↑	—

We also assessed quality of life using the SF-12 and perceived stress, finding significant improvements in the yoga group. These observations regarding enhanced quality of life and reduced perceived stress are consistent with the effects of yoga practices reported in other studies (Bower et al., 2012; Twal et al., 2016; Yang et al., 2016). In recent years, yoga has been utilized in various contexts to promote well-being, including reducing distress among tsunami survivors (Telles et al., 2007) and flood victims (Telles et al., 2010). Additionally, yoga has been extensively used in occupational settings to reduce discomfort and enhance worker efficiency, with applications for medical students (Saoji, 2016), healthcare professionals (Woodyard, 2011), athletes (Hakked et al., 2017), defence personnel (Amaranath et al., 2016), computer professionals, and musicians (Khalsa et al., 2009). To our knowledge, this is the first study to investigate the role of yoga in improving the health of industrial workers required to stand for extended periods. Similar studies could be replicated with other professions with prolonged standing requirements, such as supermarket cashiers and traffic police officers.

An important aspect of this study was the implementation of the yoga intervention directly at the workplace, promoting workplace wellness. Workplace wellness programs are crucial due to their impact on worker efficiency and overall industry output. The World Health Organization designated 2015 as the year for "Healthy Workplaces," aiming to address work-related physical and psychosocial risks and promote healthy behaviours among the workforce ("WHO | Healthy Workplaces: A WHO Global Model for Action," 2015).

Because the intervention occurred at the workplace, compliance was 100%. All participants completed the study without dropping out. While not formally measured, the company reported negligible worker absenteeism due to illness during the study period. Participants also expressed satisfaction with their improved health and found yoga beneficial for maintaining optimal physical function.

The observed positive effects in the experimental group may be attributed to the nature of the yoga intervention itself. The program included physical postures designed to stretch and relax muscles, yogic breathing techniques to regulate energy flow, and meditation for mental calmness. This integrated mind-body-breath approach is known to be beneficial in various health conditions. Specific focus on inverted postures, leg strengthening exercises, and core work might have improved lower limb circulation, contributing to the reduction in ABPI and ankle/mid-calf circumference. Additionally, yoga's stress-reducing and mood-enhancing effects (Kirkwood et al., 2005; Rao et al., 2017) likely contributed to the improved psychological well-being observed in the yoga group. Enhanced mood and better musculoskeletal health may have further contributed to reduced fatigue and improved quality of life.

The lack of improvement or even decline in fatigue, musculoskeletal health, perceived stress, and quality of life scores in the control group highlights the potential need for an active intervention like yoga for this target population.

CONCLUSION

The four-week yoga intervention significantly improved the physical and psychological health of industrial workers who stand for prolonged periods. These improvements included reduced blood pressure at the ankle, improved ankle-brachial pressure index, decreased ankle and mid-calf circumference, reduced fatigue and musculoskeletal complaints, improved perceived stress, and enhanced quality of life. This study suggests that yoga can be a valuable tool for workplace wellness programs in industries requiring prolonged standing, potentially benefiting workers in similar occupations such as supermarket cashiers and traffic police officers.

SUGGESTED FUTURE WORK

The study employed a randomized controlled trial design with rater blinding, which minimizes bias as double-blinding is not feasible with yoga interventions. Additionally, the wait-list control group received the intervention after the follow-up period. A strength of the study was the high compliance rate with no dropouts in either group due to the workplace intervention setting. The assessment battery comprehensively evaluated both physical and psychological health aspects relevant to workers with prolonged standing. The yoga module itself was specifically designed and validated for this target population by experts at S-VYASA.

One limitation of the study was the use of a passive control group that continued with their usual activities. Including an active control group with a different physical exercise program could have provided insights into the specific effects of yoga compared to other forms of exercise. Additionally, the impact of the yoga intervention on work efficiency was not objectively measured but could be explored in future studies.

The study findings suggest that yoga is a safe and effective intervention to improve the health of workers with prolonged standing. This approach can be beneficial in various work environments with similar demands, potentially impacting a large population. Future studies could incorporate objective measures, such as Doppler studies, to assess vascular health and evaluate work performance changes in response to the yoga intervention. Additionally, including objective stress measures and biomarkers could provide further insights into the mechanisms underlying the observed positive effects.

****

Brief Profile of the Author:

Pramod Shahane has done graduation in Engineering - BE (Mech.) from Government College of Engineering Amaravati, Nagpur University; Master of Management Sciences from Pune University; Master of Science in Manufacturing System Engineering from University of Warwick, UK; Master of Science in Yoga Therapy from S-VYASA, Bangalore.

He has 34 years of working experience in Automobile Industry in various functions like Production, Quality, Research and Development, Project Management, Component Development, Supply Chain Management and Export Operations. He completed Yoga Teachers course from Shivananda Ashram, Thiruvananthapuram and Basic Vedanta from Shivananda Ashram, Rishikesh. He likes Trekking, Scuba Diving and reading Spiritual Text.

Statements and Declaration: This paper is an expansion of the work done by Pramod Shahane towards the partial fulfilment of Master of Science in Yoga Therapy (2018), under the guidance of Dr. Apar Saoji & Dr. Ragavendraswamy, from Swami Vivekananda Yoga Anusandhana Samsthana, No.19, Eknath Bhavan, Gavipuram Circle, Kempegowda Nagar, Bangalore-560019, India. No financial support was received for the work within this manuscript. The authors declare they have no conflict of interest.

The consent forms and questionnaires used for monitoring the changes in the subjective variables to assess quality of life were not included while submitting this paper. These forms are available upon request from the author.

References:

Aboyans, V., Criqui, M. H., Abraham, P., Allison, M. A., Creager, M. A., Diehm, C., Fowkes, F. G. R., Hiatt, W. R., Jönsson, B., Lacroix, P., Marin, B., McDermott, M. M., Norgren, L., Pande, R. L., Preux, P.-M., Stoffers, H. E. J., Treat-Jacobson, D., American Heart Association Council on Peripheral Vascular Disease, Council on Epidemiology and Prevention, … Council on Cardiovascular Radiology and Intervention, and C. on C. S. and A. (2012). Measurement and interpretation of the ankle-brachial index: a scientific statement from the American Heart Association. *Circulation*, *126*(24), 2890–2909. https://doi.org/10.1161/CIR.0b013e318276fbcb

Amaranath, B., Nagendra, H., & Deshpande, S. (2016). Effect of integrated Yoga module on positive and negative emotions in Home Guards in Bengaluru: A wait list randomized control trial. *International Journal of Yoga*, *9*(1), 35–43. https://doi.org/10.4103/0973-6131.171719

Antle, D. M., Cormier, L., Findlay, M., Miller, L. L., & Côté, J. N. (2018). Lower limb blood flow and mean arterial pressure during standing and seated work: Implications for workplace posture recommendations. *Preventive Medicine Reports*, *10*, 117–122. https://doi.org/10.1016/j.pmedr.2018.02.016

Antle, D. M., & Côté, J. N. (2013). Relationships between lower limb and trunk discomfort and vascular, muscular and kinetic outcomes during stationary standing work. *Gait & Posture*, *37*(4), 615–619. https://doi.org/10.1016/j.gaitpost.2012.10.004

Banasik, J., Williams, H., Haberman, M., Blank, S. E., & Bendel, R. (2011). Effect of Iyengar yoga practice on fatigue and diurnal salivary cortisol concentration in breast cancer survivors. *Journal of the American Academy of Nurse Practitioners*, *23*(3), 135–142. https://doi.org/10.1111/j.1745-7599.2010.00573.x

Bower, J. E., Garet, D., Sternlieb, B., Ganz, P. A., Irwin, M. R., Olmstead, R., & Greendale, G. (2012). Yoga for persistent fatigue in breast cancer survivors: A randomized controlled trial. *Cancer*, *118*(15), 3766–3775. https://doi.org/10.1002/cncr.26702

Chalder, T., Berelowitz, G., Pawlikowska, T., Watts, L., Wessely, S., Wright, D., & Wallace, E. P. (1993). Development of a fatigue scale. *Journal of Psychosomatic Research*, *37*(2), 147–153. https://doi.org/10.1016/0022-3999(93)90081-P

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A Global Measure of Perceived Stress. *Journal of Health and Social Behavior*, *24*(4), 385. https://doi.org/10.2307/2136404

Cramer, H. (2013). Review: Yoga reduces low back pain and back-specific disability. In *Annals of Internal Medicine* (Vol. 159, Issue 8). https://doi.org/10.7326/0003-4819-159-8-201310150-02013

Deepeshwar, S., Tanwar, M., Kavuri, V., & Budhi, R. B. (2018). Effect of yoga based lifestyle intervention on patients with knee osteoarthritis: A randomized controlled trial. *Frontiers in Psychiatry*, *9*(MAY), 180. https://doi.org/10.3389/fpsyt.2018.00180

Gandek, B., Ware, J. E., Aaronson, N. K., Apolone, G., Bjorner, J. B., Brazier, J. E., Bullinger, M., Kaasa, S., Leplege, A., Prieto, L., & Sullivan, M. (1998). Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: Results from the IQOLA Project. *Journal of Clinical Epidemiology*, *51*(11), 1171–1178. https://doi.org/10.1016/S0895-4356(98)00109-7

Hakked, C. S., Balakrishnan, R., & Krishnamurthy, M. N. (2017). Yogic breathing practices improve lung functions of competitive young swimmers. *Journal of Ayurveda and Integrative Medicine*. https://doi.org/10.1016/j.jaim.2016.12.005

Halim, I., Omar, A. R., Saman, A. M., & Othman, I. (2012). Assessment of Muscle Fatigue Associated with Prolonged Standing in the Workplace. *Safety and Health at Work*, *3*(1), 31–42. https://doi.org/10.5491/SHAW.2012.3.1.31

Highland, K. B., Schoomaker, A., Rojas, W., Suen, J., Ahmed, A., Zhang, Z., Carlin, S. F., Calilung, C. E., Kent, M., McDonough, C., & Buckenmaier, C. C. (2018). Benefits of the Restorative Exercise and Strength Training for Operational Resilience and Excellence Yoga Program for Chronic Low Back Pain in Service Members: A Pilot Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*, *99*(1), 91–98. https://doi.org/10.1016/j.apmr.2017.08.473

Hill, J. C., Kang, S., Benedetto, E., Myers, H., Blackburn, S., Smith, S., Dunn, K. M., Hay, E., Rees, J., Beard, D., Glyn-Jones, S., Barker, K., Ellis, B., Fitzpatrick, R., & Price, A. (2016). Development and initial cohort validation of the Arthritis Research UK Musculoskeletal Health Questionnaire (MSK-HQ) for use across musculoskeletal care pathways. *BMJ Open*, *6*(8), e012331. https://doi.org/10.1136/bmjopen-2016-012331

Khalsa, S. B. S., Shorter, S. M., Cope, S., Wyshak, G., & Sklar, E. (2009). Yoga Ameliorates Performance Anxiety and Mood Disturbance in Young Professional Musicians. *Applied Psychophysiology and Biofeedback*, *34*(4), 279–289. https://doi.org/10.1007/s10484-009-9103-4

Kiecolt-Glaser, J. K., Bennett, J. M., Andridge, R., Peng, J., Shapiro, C. L., Malarkey, W. B., Emery, C. F., Layman, R., Mrozek, E. E., & Glaser, R. (2014). Yoga's impact on inflammation, mood, and fatigue in breast cancer survivors: A randomized controlled trial. *Journal of Clinical Oncology*, *32*(10), 1040–1049. https://doi.org/10.1200/JCO.2013.51.8860

Kirkwood, G., Rampes, H., Tuffrey, V., Richardson, J., & Pilkington, K. (2005). Yoga for anxiety: a systematic review of the research evidence. *British Journal of Sports Medicine*, *39*(12), 884–891; discussion 891. https://doi.org/10.1136/bjsm.2005.018069

Krijnen, R. M., de Boer, E. M., Adèr, H. J., & Bruynzeel, D. P. (1997). Venous insufficiency in male workers with a standing profession. Part 1: epidemiology. *Dermatology (Basel, Switzerland)*, *194*(2), 111–120. https://doi.org/10.1159/000246077

Krupp, L. B. (1989). The Fatigue Severity Scale. *Archives of Neurology*, *46*(10), 1121. https://doi.org/10.1001/archneur.1989.00520460115022

Polsgrove, Mj., Eggleston, B., & Lockyer, R. (2016). Impact of 10-weeks of yoga practice on flexibility and balance of college athletes. *International Journal of Yoga*, *9*(1), 27. https://doi.org/10.4103/0973-6131.171710

Pravalika, B., Yamuna, U., & Saoji, A. A. (2023). Yoga for musculoskeletal pain, discomfort, perceived stress, and quality of sleep in industry workers: a randomized controlled trial. *International Archives of Occupational and Environmental Health*, *96*(10), 1349–1360. https://doi.org/10.1007/s00420-023-02013-3

Putz-Anderson, V., Bernard, B., Burt, S. S. E. S., Cole, L., Fairfield-Estill, C., Fine, L. L. J. L., Grant, K., Gjessing, C., Jenkins, L., Hurrel Jr., J., Nelson, N., Pfirman, D., Roberts, R., Stetson, D., Haring-Sweeney, M., & Tanaka, S. (1997). Musculoskeletal Disorders and Workplace Factors - A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back. In *Public Health: Vol. Publicatio* (Issue July 1997).

Rao, R., Raghuram, N., Nagendra, H., Kodaganur, G., Bilimagga, R., Shashidhara, H., Diwakar, R., Patil, S., & Rao, N. (2017). Effects of a yoga program on mood states, quality of life, and toxicity in breast cancer patients receivi ng conventional treatment: A randomized controlled trial. *Indian Journal of Palliative Care*, *23*(3), 237. https://doi.org/10.4103/IJPC.IJPC_92_17

Saoji, A. A. (2016). Yoga: A Strategy to Cope up Stress and Enhance Wellbeing Among Medical Students. *North American Journal of Medical Sciences*, *8*(4), 200–202. https://doi.org/10.4103/1947-2714.179962

Tekur, P., Singphow, C., Nagendra, H. R., & Raghuram, N. (2008). Effect of Short-Term Intensive Yoga Program on Pain, Functional Disability and Spinal Flexibility in Chronic Low Back Pain: A Randomized Control Study. *The Journal of Alternative and Complementary Medicine*, *14*(6), 637–644. https://doi.org/10.1089/acm.2007.0815

Telles, S., Dash, M., & Naveen, K. V. (2009). Effect of yoga on musculoskeletal discomfort and motor functions in professional computer users. *Work*, *33*(3), 297–306. https://doi.org/10.3233/WOR-2009-0877

Telles, S., Naveen, K. V., & Dash, M. (2007). Yoga Reduces Symptoms of Distress in Tsunami Survivors in the Andaman Islands. *Evidence-Based Complementary and Alternative Medicine*, *4*(4), 503–509. https://doi.org/10.1093/ecam/nem069

Telles, S., Singh, N., Joshi, M., & Balkrishna, A. (2010). Post traumatic stress symptoms and heart rate variability in Bihar flood survivors following yoga: a randomized controlled study. *BMC Psychiatry*, *10*(1), 18. https://doi.org/10.1186/1471-244X-10-18

Twal, W. O., Wahlquist, A. E., & Balasubramanian, S. (2016). Yogic breathing when compared to attention control reduces the levels of pro-inflammatory biomarkers in saliva: a pilot randomized controlled trial. *BMC Complementary and Alternative Medicine*, *16*, 294. https://doi.org/10.1186/s12906-016-1286-7

Verberk, W. J., Kollias, A., & Stergiou, G. S. (2012). Automated oscillometric determination of the ankle-brachial index: A systematic review and meta-analysis. In *Hypertension Research* (Vol. 35, Issue 9, pp. 883–891). https://doi.org/10.1038/hr.2012.83

WHO | Healthy workplaces: a WHO global model for action. (2015). *WHO*.

Woodyard, C. (2011). Exploring the therapeutic effects of yoga and its ability to increase quality of life. *International Journal of Yoga*, *4*(2), 49–54. https://doi.org/10.4103/0973-6131.85485

Yamuna, U., Madle, K., Majumdar, V., & Saoji, A. A. (2023). Designing and validation of Yoga module for workers with prolonged standing. *Journal of Ayurveda and Integrative Medicine*, *14*(5), 100788. https://doi.org/10.1016/j.jaim.2023.100788

Yamuna, U., Pravalika, B., Madle, K., Majumdar, V., & Saoji, A. A. (2024). Effect of Yoga in Industrial Workers with Chronic Venous Insufficiency: A Randomized Controlled Trial. *Journal of Integrative and Complementary Medicine*. https://doi.org/10.1089/jicm.2023.0691

Yang, Z.-Y., Zhong, H.-B., Mao, C., Yuan, J.-Q., Huang, Y.-F., Wu, X.-Y., Gao, Y.-M., & Tang, J.-L. (2016). Yoga for asthma. *The Cochrane Database of Systematic Reviews*, *4*, CD010346. https://doi.org/10.1002/14651858.CD010346.pub2