

Evaluating the Physiological Effects of Yoga on Border Security Force (BSF) Personnel: A Study on Grip Strength, Pulse, and Blood Pressure

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Abstract: *This study investigates the physiological impact of a structured yogic intervention on Border Security Force (BSF) personnel, focusing on three key parameters: hand grip strength, pulse rate, and blood pressure. Employing a pre-test and post-test experimental design, the research involved 60 male BSF personnel, purposively selected and randomly divided into an experimental group (n = 30) and a control group (n = 30). The experimental group underwent an 8-week yoga program comprising asanas, pranayama, and relaxation techniques, while the control group maintained their regular routine without yoga intervention. Standardized tools were used to measure grip strength (electronic dynamometer), pulse rate, and blood pressure (digital BP monitor). Results revealed a statistically significant improvement in grip strength and a marked reduction in both pulse rate and blood pressure in the experimental group, while no notable changes were observed in the control group. These findings suggest that yoga can be an effective non-pharmacological strategy to enhance muscular strength and cardiovascular health among BSF personnel, contributing to their physical resilience and operational readiness.*

Keywords: Pulse rate, Strength, Physiological, Yoga, Physical, Cardiovascular

1. Introduction

In the end, the goal of yoga—a psycho-somatic spiritual discipline—is to bring about the connection of one's unique consciousness with the global consciousness, as well as the unity and harmony of one's mind, body, and soul. "Pranayama" means "life energy" or "vital force" in Sanskrit, while "ayama" means "to prolong" in the same language (Sharma, Divya & Sharma, B. 2024).

Protecting India's borders is an important responsibility of the Border Security Force (BSF), the country's principal border guarding institution. Frequently operating in hostile environments and inaccessible landscapes, BSF troops endure psychologically and physically taxing situations. Their job demands them to be physically healthy, mentally sharp, and emotionally stable, since they are required to do long hours of patrolling and respond rapidly to emergencies (Bussing Arndt et al., 2012). Stress, exhaustion, and physical strain may build up from these constant pressures and eventually harm physiological functioning, performance efficiency, and health as a whole.

Considering these obstacles, it is crucial to include health behaviors that promote both prevention and restoration into the daily life of BSF staff. Traditional forms of physical education tend to emphasize endurance, strength, and self-control at the expense of areas like stress management, cardiovascular wellness, and muscle repair. Here is where the ancient Indian holistic practice of yoga, which dates back hundreds of years, shows promise. Through its integration of physical postures (asanas), breath control (pranayama), and meditation (dhyana), yoga enhances not just flexibility and strength but also stability of the cardiovascular system, mental resilience, and autonomic regulation (Satyajit r. Jayasinghe 2004).

Nature has created the human body, which is very intricate. There are a lot of intricate parts that all fit together well. In the event that one system fails, the complete equipment begins to malfunction so that all systems can continue to work

properly. To keep one's body in good condition throughout one's lifetime, it is essential to practice regular self-care. Doing yoga poses regularly is the surest method to keep your body healthy and strong for a long time. The goal of yoga, as a holistic treatment, is to promote health on all levels: mental, emotional, and spiritual (Kobylynska et al., 2018). The asanas of yoga are a complex technique for controlling one's energy. By practicing a stance over and over again, you may acquire the energy associated with it. Without consciously targeting any one region or set of internal organs, the balancing impact of yoga asanas extends to every portion of the body at the same time.

Benefits of Yogic Practices

Numerous elite athletes have found that practicing yoga enhances their performance in sports. Yoga offers mental, emotional, energetic, and physical advantages, imparting the lesson that "winning is not paramount" and that "life encompasses more" than only "higher" and "lower" sports (Trakroo, Madanmohan & Bhavanani, Ananda. 2016).

- 1) Asanas, kriyas, mudras, and pranayama, at the physical level, stabilize and equilibrate the imbalanced physical training necessary for athletic performance.
- 2) Yoga facilitates the enhancement of all human body systems, including the circulatory, respiratory, digestive, excretory, endocrine, neurological, and musculoskeletal systems, therefore fortifying, detoxifying, and purifying the body while enabling conscious control.
- 3) Yoga is introspective and isometric. It is the interval between our inherent inertia and willpower. The body's components are arranged in relation to one another, creating a distinctive harmony of body, mind, and breath. When this internal conflict is resolved, it enhances both the body's awareness and the mind's emotional depth.
- 4) Yoga mitigates anxiety, anger, cognitive fatigue, ego fragility, guilt, and melancholy. It induces comprehensive transformations in the body and mind, resulting in the practitioner experiencing rejuvenation, profound relaxation, and heightened energy (Saraswati, 1984).

- 5) Yoga facilitates the expansion of awareness. It enhances cognitive clarity, understanding, and creativity. Consequently, focus, attention, memory, and several other abilities improve.
- 6) Lung function improves due to yoga practice. Yoga may also improve breath-holding duration.
- 7) Yoga practices may assist in rectifying postural deficiencies and physical anomalies. Yoga training may serve as an efficacious therapeutic approach for managing chronic ailments.
- 8) Yoga mitigates and reduces the severity of substance misuse by diminishing autoimmune stimulation.

Recent scientific research has validated the efficacy of yoga in improving physiological markers, including pulse rate, blood pressure, and muscular strength across diverse groups (**Patel NS et al., 2024**). Consistent yoga practice is linked to a decreased resting heart rate, enhanced blood circulation, regulated blood pressure, and increased neuromuscular coordination (**Park et al., 2017**). Notwithstanding the increasing data, there is a deficiency of research examining yoga's function especially in high-demand professional environments such as the BSF. Most paramilitary and military training programs mostly depend on traditional methods, without systematic incorporation of mind-body techniques such as yoga.

This study aims to address this gap by assessing the physiological effects of a structured yoga program on BSF personnel, concentrating on three quantifiable indicators of physical health: grip strength (as a proxy for upper body muscular endurance), pulse rate (an indicator of cardiac efficiency and autonomic balance), and blood pressure (a critical parameter in cardiovascular health). These variables were selected because to their reliability, non-invasiveness, and sensitivity to both physical effort and relaxation therapies.

Objectives

Following are the main objectives of the study: -

- 1) To evaluate the effect of yoga on grip strength, pulse rate, and blood pressure among BSF personnel.
- 2) To compare the physiological outcomes between yoga-trained and non-trained groups after the intervention.

2. Review of Related Studies

Saini, Namita et al., (2016) examined the findings of a number of studies that have been published specifically on the subject of the physiological effects of yoga and diet counselling. B.K.S. Iyengar asserts that yoga is an ancient Indian science that encompasses all parts of a person's being, ranging from physical wellness to the realization of one's own potential. Changes in food, mental attitude, and the practice of particular techniques such as yoga asanas (postures), breathing practices (pranayamas), and meditation are all part of yoga, which is a form of self-management of life. The goal of yoga is to achieve the highest level of consciousness possible. Despite the fact that there is a growing body of scientific research on yoga, we have found very few studies that discuss the role of yogic practices and food advice in the treatment of health and disease. Taking this into consideration, a review of literature that were pertinent to the

topic was carried out in order to assess the physiological consequences of yoga practices and food guidance. According to the findings of the review, there were significant health benefits, such as an improvement in the pattern of sleep, cognition, body mass index, reproductive health, respiration, blood pressure, joint diseases, diabetes, and recovery from and treatment of addiction. It decreased the risk of cardiovascular disease and cancer, as well as stress, anxiety, depression, and chronic pain. Yoga also had an effect on the quality of life, autonomic function, immune system, and overall well-being of the practitioner. As a result, Yoga and Diet counseling is a fresh emerging clinical field of mind-body therapy that is progressively being utilized all over the world under the umbrella of alternative medicine.

Kurwale, Manisha & Gadkari, Jayeshree. (2014). There has been a significant increase in the number of women experiencing depression and anxiety. Women who are employed experience a higher amount of stress than women who are not employed. The growing amount of stress brought on by work at home and at the workplace, as well as its influence on the family and the atmosphere at home, can be observed, which has an effect on their emotional, psychological, and physical health. A significant amount of interest in the field of medical research has been generated by the idea that yoga can be beneficial in terms of lowering anxiety levels and improving cardiorespiratory parameters. The purpose of this study was to investigate the impact that yogic exercises and meditation had on women who are employed. A yogic session was performed for a period of sixteen weeks. Prior to and following the yoga training, the following cardiorespiratory parameters were measured: pulse rate, respiratory rate, blood pressure, and the amount of time spent holding one's breath. Before and after yoga training, the participants' anxiety scores, which serve as an indicator of stress, as well as their visual reaction times, which serve as indicators of cognitive function, and their finger dexterity scores, which serve as indicators of motor abilities, were measured. By using a paired 't' test, the statistical analysis was carried out. The results of the study indicated that there was a statistically significant improvement in cardiorespiratory parameters, anxiety score, visual reaction time, and finger dexterity score ($P < 0.05$) following participating in yogic training. Since this is the case, the most effective method that can be utilized to fulfill the needs of the is a sequenced practice that incorporates asana, breathing exercises, meditation, and relaxation techniques. needs of society in the present day.

Pal, Rameswar et al., (2013). By observing the physiological and physical parameters of physically active service people over the course of three months (90 minutes per day, five days per week), the purpose of this study was to determine the impact that yogic practice had on these parameters. Materials and methods: In this study, a random selection was made from the paramilitary force of the country to pick sixty healthy male volunteers, with an average age of 27 years and three months. A pre-designed yoga training course that lasted for three months and included Prayer, Suddhi Kriyas, Yogasanas, Pranayamas, Meditation, Mudra, and Bandh was administered every day in the morning for a period of ninety minutes by a professional yoga instructor or instructor. The results of the study showed that after three months of yoga

training, there was no significant change in body weight or body mass index. However, there was a substantial decrease in both systolic blood pressure and mean blood pressure ($p < 0.05$). Neither the diastolic blood pressure nor the respiratory rate showed any significant signs of change during the course of our investigation. There was a substantial increase ($p < 0.001$) in the length of time that the breath was held, as well as the strength of the peripheral muscles, including the back and leg muscles. However, there was no significant change in the peak expiratory flow rate. The achievement of a substantial improvement in anaerobic power ($p < 0.05$) was achieved by increasing both the peak power and the average power. The current study came to the conclusion that the practice of selected yogic training for a period of three months led to an improvement in both the health and performance of the physically active paramilitary unit of the Indian army.

Pratima M. et al. (2008). an investigation titled "Effect of Suryanamaskara Practice on Cardio-respiratory Fitness Parameters: A Pilot Study" has been carried out. All of the following is included in the study. Over the past few years, the medical community has shown an increased interest in yoga. One of the activities that is included in yoga is called Suryanamaskara, and it is considered to be an all-around exercise. The current study investigated whether or not regular practice of the yoga posture known as "surya namaskara" is effective in enhancing cardiorespiratory fitness. In the current study, there were a total of 78 participants, with 48 males and 30 females participating. It has been noticed that practicing surya namaskara for a period of six months results in a reduction in both the resting pulse rate and blood pressure. At the same time, it improves the efficiency of the cardiorespiratory system and the capacity of the respiratory system, as measured by a bicycle ergometer and a variety of lung function tests, in both male and female patients. Based on the findings of this study, we have come to the conclusion that the practice of suryanamaskara can be recommended to increase the efficiency of cardiorespiratory function in both healthy individuals and patients.

Upadhyay Dhungel K. et al. (2008). In this study, an investigation was conducted on the effects of Alternate Nostril Breathing (ANB) and Nadishudhi Pranayama on several cardiorespiratory functions in young adults who were in good health. For a period of four weeks, the participants involved in the study engaged in ANB exercise for fifteen minutes each morning. After a period of four weeks of training, the characteristics of the cardiovascular and respiratory system were measured. An increase in both the Peak expiratory flow rate (PEFR L/min) and the Pulse pressure (PP) was seen to be of considerable magnitude. Although the drop in systolic blood pressure (SBP) was not statistically significant, the decreases in pulse rate (PR), respiratory rate (RR), and diastolic blood pressure (DBP) were statistically significant.

Madanmohan et al., (2008) conducted a study to determine whether or not yoga training over a period of six weeks can enhance respiratory pressures, handgrip strength, and handgrip endurance, as well as regulate the sweating response to dynamic exercise. Twenty-three of the forty-six healthy individuals, thirty males and sixteen females, between the ages of seventeen and twenty, were engaged in yoga

instruction, fifteen of whom were male and eight of whom were female. The remaining twenty-three subjects served as controls. Before and during the six-week trial period, measurements were taken to evaluate the following: weight loss following the Harvard step test (an index of sweat loss), maximum inspiratory pressure, maximum expiratory pressure, 40 mm endurance, handgrip strength, and handgrip endurance. A significant difference was found between the weight loss that occurred after yoga training and the weight loss that occurred before the training in the yoga group ($n = 15$ male subjects). This weight loss was a response to the Harvard step test. To the contrary, the control group did not exhibit a statistically significant difference in terms of weight loss following the step test at the conclusion of the study period. The results of the 40 mm Hg test showed that both male and female volunteers who participated in yoga training saw a significant rise in their respiratory pressures and endurance. Yoga training was found to reduce the amount of sweating that occurred in response to the step test, as demonstrated by the findings of the current study. In addition, practicing yoga for a short length of time with a duration of six weeks might result in considerable increases in the strength and endurance of the respiratory muscles.

3. Research Methodology

The present study follows a pre-test and post-test experimental design to evaluate the physiological effects of yogic practices on Border Security Force (BSF) personnel. The primary objective is to assess the influence of yoga on three selected physiological variables—hand grip strength, pulse rate, and blood pressure.

The study was conducted on a sample of 60 BSF personnel, selected through purposive sampling from a BSF training center. All participants were screened for physical fitness and were free from chronic cardiovascular or neuromuscular conditions. The participants were randomly assigned into two equal groups. The experimental group ($n = 30$) underwent a structured yogic intervention, while the control group ($n = 30$) did not participate in any yoga training during the study period.

The yogic intervention was designed by certified yoga instructors and administered over a duration of 8 weeks, with sessions held five days per week. Each session lasted 60 minutes and consisted of various components including yogic asanas (e.g., Tadasana, Trikonasana, Bhujangasana), pranayama techniques (e.g., Anulom Vilom, Bhramari), and meditation or relaxation practices such as Yoga Nidra and Shavasana. This holistic program aimed to improve cardiovascular function, musculoskeletal strength, and mental calmness.

To measure the physiological parameters, standard and reliable tools were used. Blood pressure and pulse rate were assessed using a digital blood pressure monitor, with results recorded in mm Hg and beats per minute, respectively. Hand grip strength was measured using an electronic hand dynamometer, with readings noted in kilograms. Each subject's dominant hand was tested, and the best score from three trials was recorded for analysis.

All baseline (pre-test) measurements were taken before the start of the yoga program, and the final (post-test) measurements were collected at the end of the 8-week intervention. For grip strength, standardized positioning and instructions were followed to ensure reliability across participants.

The collected data were analysed using statistical methods. Paired t-tests were employed to compare the pre- and post-intervention scores within the experimental group, while independent t-tests were used to compare the experimental group with the control group. A p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software.

This methodological approach ensured rigorous control and accurate measurement to evaluate the impact of yoga on the physical well-being of BSF personnel through objective physiological indicators.

4. Results and Discussion

Table 1: Participants' Information Sheet of Experimental and Control Group

Variables	Options	Experimental Group		Control Group	
		f	%	f	%
Age Group	24–28 years	1	3.33	2	6.67
	29–33 years	17	56.67	16	53.33
	34–36 years	10	33.33	11	36.67
	37–39 years	2	6.67	1	3.33
Marital Status	Married	27	90.00	28	93.33
	Not Married	3	10.00	2	6.67
Height Range (cm)	160–164.9	1	3.33	2	6.67
	165–169.9	3	10.00	2	6.67
	170–174.9	15	50.00	16	53.33
	175–179.9	9	30.00	8	26.67
	180–184.9	2	6.67	2	6.67
Weight Range (kg)	55–64.9	3	10.00	3	10.00
	65–74.9	15	50.00	15	50.00
	75–84.9	10	33.33	10	33.33
	85–94.9	2	6.67	2	6.67

In terms of age, the majority of participants in both groups fell within the 29–33 years category, accounting for 56.67% in the experimental group and 53.33% in the control group. This was followed by the 34–36 years age group, representing 33.33% and 36.67%, respectively. The youngest group (24–28 years) and oldest group (37–39 years) had comparatively fewer participants in both groups, indicating that the study sample was largely concentrated in the late twenties to mid-thirties age range.

With regard to marital status, a significant proportion of participants in both groups were married—90% in the experimental group and 93.33% in the control group—suggesting that most of the BSF personnel were in stable domestic environments. Unmarried participants made up a small fraction in both groups. In terms of height, the dominant range for both groups was 170–174.9 cm, comprising 50% of the experimental group and 53.33% of the control group. This was followed by the 175–179.9 cm range, with 30% and 26.67%, respectively. Very few participants fell in the shortest (160–164.9 cm) or tallest (180–184.9 cm) categories.

The weight distribution shows a similar pattern, with the 65–74.9 kg range being most common in both groups (50% each), followed by the 75–84.9 kg category (33.33% in both groups). Very few participants were in the lightest (55–64.9 kg) or heaviest (85–94.9 kg) categories.

Table 2: Pre-Test vs Post-Test Comparison (Experimental Group Only)

Parameter	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	Change
Grip Strength (kg)	34.2 ± 3.8	38.9 ± 3.6	↑ 4.7 kg
Pulse Rate (bpm)	78.1 ± 5.2	72.1 ± 4.9	↓ 6 bpm
Systolic BP (mm Hg)	124.3 ± 6.1	118.7 ± 5.8	↓ 5.6 mmHg
Diastolic BP (mm Hg)	83.9 ± 4.7	79.1 ± 4.3	↓ 4.8 mmHg

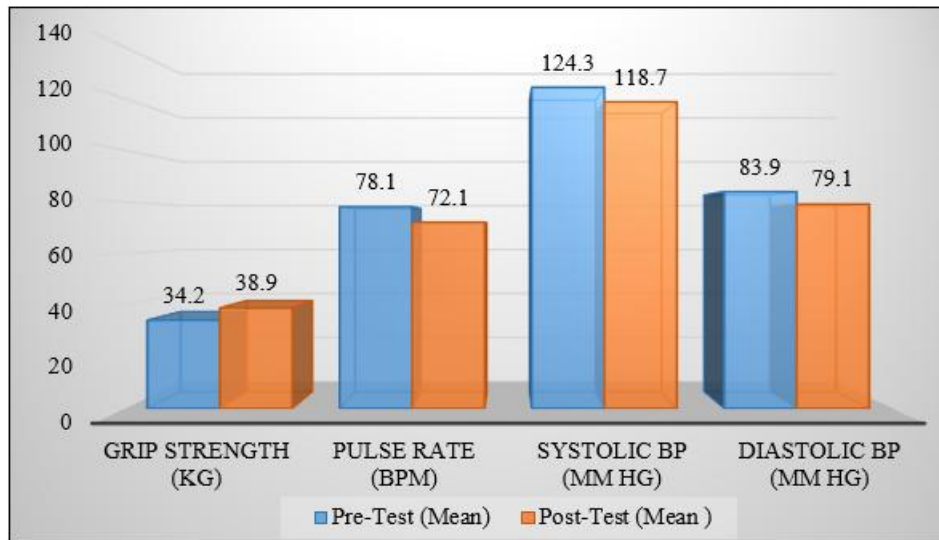


Figure 1: Graph showing mean scores of Pre & Post-tests of experimental group

The pre- and post-test comparison for the experimental group shows notable improvements following the yoga intervention. Grip strength increased significantly by 4.7 kg, indicating enhanced muscular performance. Additionally, there was a reduction in pulse rate by 6 bpm, suggesting improved cardiovascular efficiency and relaxation. Both systolic and

diastolic blood pressure also showed a significant decrease (5.6 mmHg and 4.8 mmHg, respectively), reflecting better cardiovascular regulation. Overall, these changes suggest that the yoga program had a positive physiological impact on BSF personnel.

Table 3: Pre-Test vs Post-Test Comparison (Control Group Only)

Parameter	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	Change
Grip Strength (kg)	34.3 ± 3.6	34.5 ± 3.5	+0.2 kg
Pulse Rate (bpm)	77.5 ± 5.1	77.8 ± 5.4	+0.3 bpm
Systolic BP (mm Hg)	124.0 ± 6.0	124.1 ± 6.2	+0.1 mmHg
Diastolic BP (mm Hg)	83.8 ± 4.6	84.0 ± 4.8	+0.2 mmHg

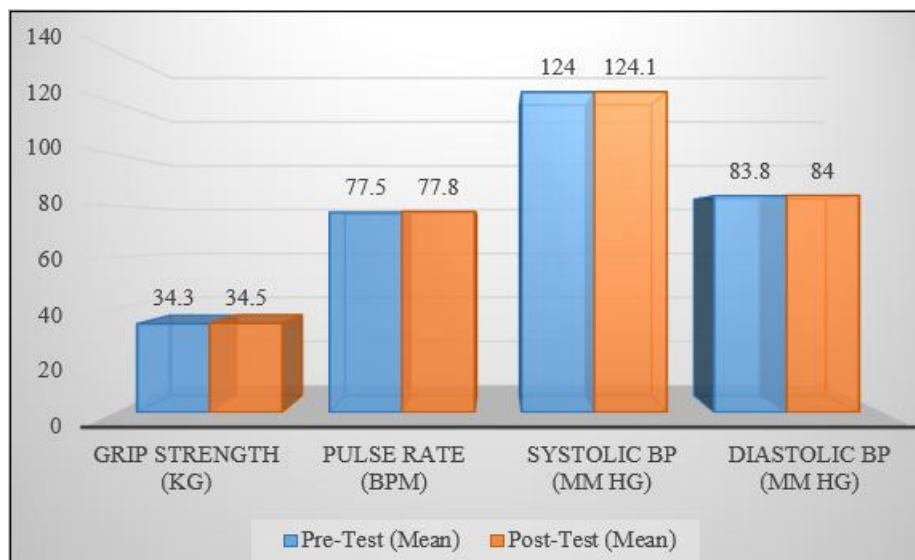


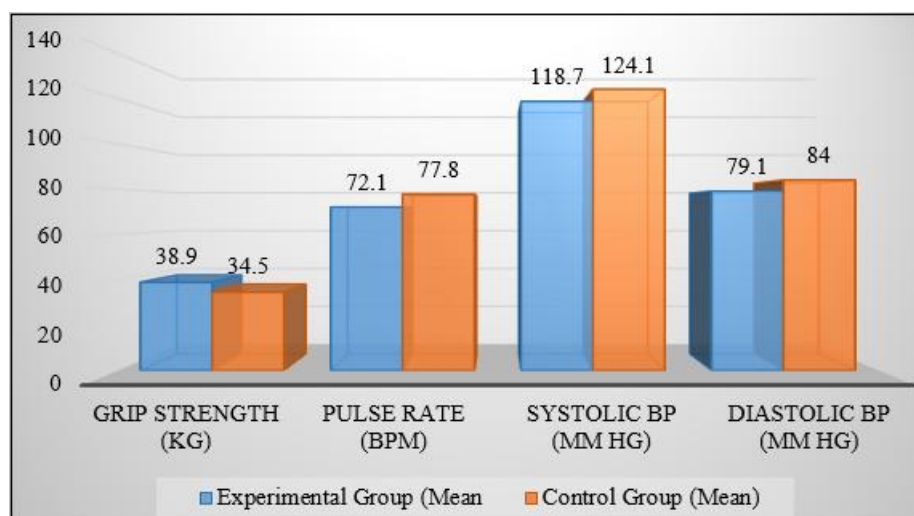
Figure 2: Graph showing mean scores of Pre & Post-tests of control group

The pre- and post-test comparison for the control group shows negligible changes across all measured parameters. Grip strength increased by just 0.2 kg, while pulse rate rose slightly by 0.3 bpm. Similarly, systolic and diastolic blood pressure showed minimal increases of 0.1 mmHg and 0.2 mmHg,

respectively. These marginal variations indicate that, in the absence of any intervention, the physiological parameters of the control group remained essentially unchanged, underscoring the impact observed in the experimental group.

Table 4: Comparative Analysis of selected Physiological Parameters Between Experimental and Control Groups

Parameter	Experimental Group (Mean \pm SD)	Control Group (Mean \pm SD)	Difference
Grip Strength (kg)	38.9 \pm 3.6	34.5 \pm 3.4	+4.4 kg
Pulse Rate (bpm)	72.1 \pm 4.9	77.8 \pm 5.4	-5.7 bpm
Systolic BP (mm Hg)	118.7 \pm 5.8	124.1 \pm 6.2	-5.4 mmHg
Diastolic BP (mm Hg)	79.1 \pm 4.3	84.0 \pm 4.8	-4.9 mmHg

**Figure 2:** Graph showing mean scores of Physiological Parameters for Experimental and Control Groups

The post-test comparison between the experimental and control groups reveals significant physiological differences favouring the experimental group. Participants who underwent yoga training showed a notably higher grip strength by 4.4 kg, indicating improved muscular function. Their pulse rate was 5.7 bpm lower, reflecting enhanced

cardiovascular efficiency and relaxation. Additionally, both systolic and diastolic blood pressure were reduced by 5.4 mmHg and 4.9 mmHg, respectively, in the experimental group compared to controls. These results clearly suggest that the yoga intervention led to measurable improvements in physical health.

Table 5: Statistical Comparison of Pre- and Post-Test Values Between Experimental and Control Groups

Physiological Variable	Group	Pre-Test	Post-Test	SD	t	p
Grip Strength (kg)	Experimental Group	34.2	38.9	3.7	6.15	0.000*
	Control Group	34.3	34.5	3.55	0.41	0.683
Pulse Rate (bpm)	Experimental Group	78.1	72.1	5.05	5.88	0.000*
	Control Group	77.5	77.8	5.25	0.33	0.745
Systolic BP (mm Hg)	Experimental Group	124.3	118.7	5.95	5.47	0.000*
	Control Group	124.0	124.1	6.1	0.12	0.903
Diastolic BP (mm Hg)	Experimental Group	83.9	79.1	4.5	5.26	0.000*
	Control Group	83.8	84.0	4.7	0.31	0.758

*Significant at $p < 0.05$ level

Table 5 presents a comparative statistical analysis of pre- and post-test values for both experimental and control groups across four physiological parameters. The experimental group showed significant improvements after the 8-week yoga intervention. Grip strength increased from 34.2 to 38.9 kg ($t = 6.15$, $p = 0.000$), indicating a notable gain in muscular strength. Similarly, pulse rate decreased significantly from 78.1 to 72.1 bpm ($t = 5.88$, $p = 0.000$), suggesting enhanced cardiovascular efficiency and relaxation.

In terms of blood pressure, the experimental group showed a clear reduction in both systolic BP (from 124.3 to 118.7 mmHg, $t = 5.47$, $p = 0.000$) and diastolic BP (from 83.9 to 79.1 mmHg, $t = 5.26$, $p = 0.000$), further supporting the calming and circulatory benefits of yoga practice.

In contrast, the control group showed no statistically significant changes in any of the parameters measured. The minimal differences in grip strength, pulse rate, and blood

pressure (with p -values all > 0.05) confirm the absence of measurable physiological improvement without intervention. These findings collectively highlight the positive impact of yoga on the physical health of BSF personnel.

5. Conclusion

The findings of this study clearly demonstrate the positive physiological impact of yoga on Border Security Force (BSF) personnel. The experimental group, which underwent an 8-week structured yogic intervention, exhibited significant improvements across all measured parameters—grip strength, pulse rate, and both systolic and diastolic blood pressure—while the control group, which did not participate in yoga, showed no meaningful changes.

Statistical analysis revealed a significant increase in grip strength (from 34.2 kg to 38.9 kg) in the experimental group, indicating improved muscular function, while the control

group's grip strength remained nearly unchanged. Moreover, the pulse rate in the experimental group decreased from 78.1 bpm to 72.1 bpm ($p = 0.000$), suggesting enhanced cardiovascular efficiency and reduced sympathetic activity, unlike the control group, where the change was negligible.

In terms of blood pressure, the experimental group saw notable reductions in both systolic (124.3 mmHg to 118.7 mmHg) and diastolic pressure (83.9 mmHg to 79.1 mmHg), both statistically significant ($p < 0.05$). Conversely, the control group exhibited only minor, non-significant fluctuations.

These results strongly suggest that regular yogic practices can lead to measurable improvements in strength and cardiovascular health. Yoga emerges not only as a holistic wellness tool but also as a practical, non-pharmacological intervention for enhancing physical performance and reducing stress-induced physiological strain among security personnel. The study validates the integration of yoga into regular fitness regimes of BSF and similar forces to promote long-term health and operational readiness.

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