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ORIGINAL RESEARCH ARTICLE

Effect of Yoga Intervention on Blood Pressure, Heart Rate, and Body Mass Index in Indo-Tibetan Border Police Personnel for High-Altitude Missions in India

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ABSTRACT

Background: The Indo-Tibetan Border Police (ITBP) personnel face unique health challenges due to high-altitude deployments above 3,000 meters. Prolonged exposure to such extreme conditions often leads to hypertension, altered heart rates, and fluctuations in body mass index (BMI). These health issues can adversely affect operational readiness. Yoga, a time-tested practice known to promote physical and mental well-being, has potential therapeutic effects for managing these challenges. This study investigates the impact of a structured yogic regimen on blood pressure, heart rate, and BMI among ITBP personnel.

Materials & Methods: This longitudinal intervention study included 100 ITBP personnel, aged 25–45 years, with no history of cardiovascular or metabolic diseases. Participants were selected purposively, ensuring they were stationed at altitudes above 3,000 meters. Pre- and post-intervention measurements of systolic and diastolic blood pressure, heart rate, and BMI were recorded. Statistical analyses were conducted to assess the significance of changes in these parameters.

Results: Statistical analysis revealed significant improvements in all measured parameters. Systolic and diastolic blood pressure reduced from mean pre-test values of 121.17 mmHg and 82.67 mmHg to post-test values of 117.53 mmHg and 77.12 mmHg, respectively. Heart rate showed a mean reduction from 78.47 to 73.12 beats per minute. BMI decreased from a mean of 22.41 to 21.93 kg/m^2, demonstrating weight stabilization and improved physical well-being.

Conclusion: The study demonstrates that structured Yogic practices significantly enhance cardiovascular health and physical well-being among ITBP personnel in high-altitude regions. The observed reductions in blood pressure, heart rate, and BMI underscore Yoga's potential as an effective preventive health measure for individuals in high-stress environments. Integrating Yoga into regular health management strategies can enhance operational readiness and overall well-being. Further studies are recommended to explore the long-term benefits and broader occupational applications of Yoga.

1. INTRODUCTION

The Indo-Tibetan Border Police (ITBP) is responsible for guarding the high-altitude borders of India, a task that subjects its personnel to extreme environmental conditions. High-altitude regions, characterized by low oxygen levels and harsh weather, impose significant stress on the human body, often leading to various health issues such as hypertension, altered heart rate, and weight fluctuations. These challenges necessitate effective strategies to

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maintain the physical and mental well-being of ITBP personnel Yogic practices, encompassing shatkriyās (six cleansing techniques), Āsanas (physical postures), Prānāyāma (breathing exercises), and meditation, have been extensively documented for their benefits on cardiovascular health, stress reduction, and overall physical fitness. Yoga is known to enhance autonomic balance, reduce oxidative stress, and improve metabolic efficiency, making it a promising intervention for individuals exposed to high-stress environments.

Several studies have documented the effects of Yoga on BP, HR, and BMI in various populations. Yoga has consistently been shown to reduce systolic and diastolic BP, making it a valuable intervention for preventing and managing hypertension. For instance, a study by Tyagi and Cohen (2014)[1] demonstrated that regular Yoga practice resulted in significant reductions in BP among hypertensive patients. The integration of prānāyāma and meditation with āsanas was associated with improved cardiovascular health, which can be particularly beneficial in high-altitude settings where cardiovascular strain is intensified due to hypoxia.

Heart rate, another critical physiological marker, is also positively influenced by yoga practice. A randomized controlled trial by Sengupta et al. (2018)[2] investigated the impact of yoga on cardiovascular function and reported a significant decrease in resting HR among participants who engaged in yoga compared to a control group. The authors emphasized the role of prānāyāma and meditation in enhancing vagal tone, which contributes to reduced sympathetic nervous system activity, leading to a lower resting heart rate. Such reductions in HR are crucial for ITBP personnel, as high-altitude exposure increases the resting HR due to the increased work of breathing and oxygen transport demands.

In addition to cardiovascular health, yoga has been found to have a positive effect on BMI, promoting healthy weight management and body composition. A study by Rioux and Ritenbaugh (2013) [3] examined the impact of yoga on BMI among overweight and obese adults and found that consistent yoga practice was associated with reductions in BMI. The authors attributed this to the holistic nature of yoga, which not only includes physical activity but also emphasizes mindfulness, stress reduction, and behavioral changes related to eating habits. For ITBP personnel, maintaining an optimal BMI is critical for performance in challenging environments, as both excessive weight and underweight conditions can impair physical capacity and endurance at high altitudes.

This study aims to evaluate the effects of a structured Yoga regimen on key health parameters—blood pressure, heart rate, and BMI—among ITBP personnel stationed at high altitudes. By examining these physiological markers, we seek to understand the potential of Yoga as a supportive practice to enhance the health and operational readiness of ITBP personnel. The findings of this research could inform policy and training programs, contributing to the optimization of health strategies for those serving in high-altitude and high-stress conditions.

1.1 Objectives of this Study

To study the effects of specific Yogic practices on blood pressure among ITBP personnel.

To study the effects of specific Yogic practices on heart rate among ITBP personnel.

To study the effects of specific Yogic practices on body mass index (BMI) among ITBP personnel.

2. METHOD

2.1 Participants

A total of 100 ITBP personnel were chosen to participate in the research study from the Basic Training Centre (BTC) located in Bhanu, within the Indo-Tibetan Border Police force stationed on NH 73 in Panchkula, Haryana.

2.2 Study Design

This study was designed as a longitudinal intervention study to evaluate the effects of yogic practices on blood pressure, heart rate, and body mass index (BMI) in Indo-Tibetan Border Police (ITBP) personnel deployed for high-altitude missions. It is based on pre-test and post-test assessments.

2.3 Intervention

The intervention group participated in a structured yogic practice regimen for 8 weeks. The regimen included:

Āsanas (Physical Postures): A set of 10 postures focusing on flexibility, strength, and balance.

Prānāyāma (Breathing Techniques): Three types of prānāyāma exercises focusing on breath control and lung capacity.

Meditation: Guided meditation sessions for mental relaxation and stress reduction.

Each session lasted for 60 minutes and was conducted six days a week under the supervision of a certified yoga instructor.

2.4 Data Collection

The data collection for this study was conducted in collaboration with Green Hospital, a renowned super-specialty healthcare institution situated in SAS Nagar, Mohali. This strategic partnership ensured the precision and reliability of the physiological measurements recorded before and after the Yogic intervention. The study aims to evaluate the impact of a structured Yoga regimen on key physiological parameters, including blood pressure, heart rate, and body mass

index (BMI), among Indo-Tibetan Border Police (ITBP) personnel preparing for high-altitude missions in India.

2.5 Measurements

Baseline (pre-intervention) and after 8 weeks (post-intervention).

Blood Pressure: Measured using a digital sphygmomanometer. Both systolic and diastolic pressures were recorded.

Heart Rate: Measured using a heart rate monitor.

BMI: Calculated using the formula weight (kg) / height (m)^2.

2.6 Data Analysis

Statistical analysis was performed usingSPSS software. Paired t-tests were used to compare the pre- and post-intervention values within groups. Independent t-tests were used to compare changes between the intervention and control groups. A p-value of <0.05 was considered statistically significant.

2.7 Ethical Considerations

The study was approved by the ITBP and Haryana Yog Aayog (HYA) Ethical Committee. Informed consent was obtained from all participants prior to the commencement of the study. Participants were assured of the confidentiality of their data and their right to withdraw from the study at any time without repercussions.

3 ANALYSIS AND INTERPRETATION OF THE STUDY

The participants underwent a structured program of yogic practices, and data were collected on their blood pressure, heart rate, and BMI before and after the intervention.

3.1 Yogic practices on blood pressure among ITBP personnel.

In order to study, the statistical analysis of specific Yogic practices on blood pressure among ITBP personnel has been conducted using the collected data. The computed statistical measures have been presented in tables and figures for reference and analysis.

The study aimed to assess the impact of specific yogic practices on the blood pressure of ITBP personnel by comparing pre-test and post-test results. Two key parameters were analyzed: systolic and diastolic blood pressure.

For systolic blood pressure, the mean pre-test score was 121.172 with a standard deviation (S.D.) of 4.92, while the mean post-test score was 117.531 with an S.D. of 3.98. The standard error of difference (SED) between the two means was 0.633, with 189 degrees of freedom (df). A t-value of 5.7536 was calculated, showing an extremely statistically significant reduction in systolic blood pressure following the yoga intervention.

Similarly, diastolic blood pressure showed a marked decrease. The mean pre-test score was 82.673 with an S.D. of 4.62, while the post-test mean was 77.119 with an S.D. of 3.55. The SED was 0.583, and the df was 185. The t-value of 9.5325 again indicated an extremely statistically significant reduction in diastolic blood pressure after the yoga practices. The data clearly demonstrate that specific Yogic practices led to a significant reduction in both systolic and diastolic blood pressure among ITBP personnel, highlighting the efficacy of Yoga as an intervention for blood pressure management.

3.2 Yogic practices on heart rate among ITBP personnel.

In order to study, the statistical analysis of specific Yogic practices on heart rate among ITBP personnel has been conducted using the collected data. The computed statistical measures have been presented in tables and figures for reference and analysis.

The study aimed to evaluate the impact of specific Yogic practices on the heart rate of Indo-Tibetan Border Police (ITBP) personnel, focusing on pre-test and post-test scores. The data analysis revealed that the pre-test group, consisting of 100 participants, had a mean heart rate of 78.466 beats per minute with a standard deviation (S.D.) of 6.80. In contrast, the post-test group, also comprising 100 participants, demonstrated a reduced mean heart rate of 73.119 beats per minute, with a lower S.D. of 5.49.

The standardized error difference (SED) was calculated at 0.874, with a degree of freedom (df) of 189. The computed t-value of 6.1181 indicates a highly significant difference between the pre-test and post-test scores, categorized as "extremely statistically significant." This suggests that the specific Yogic practices employed in the intervention effectively contributed to a reduction in heart rate among ITBP personnel.

The findings highlight the potential of Yogic practices in managing physiological responses, particularly heart rate, suggesting their efficacy in enhancing the overall cardiovascular health of individuals subjected to stressful environments, such as those faced by ITBP personnel. This study supports the incorporation of Yoga as a valuable tool for wellness and stress management in high-pressure occupations.

3.3 Yogic practices on body mass index (BMI) among ITBP personnel.

In order to study, the statistical analysis of specific Yogic practices on BMI among ITBP personnel has been conducted using the collected data. The computed statistical measures have been presented in tables and figures for reference and analysis. The study investigates the impact of specific Yogic practices on the Body Mass Index (BMI) of Indo-Tibetan Border Police (ITBP) personnel, testing the hypothesis that no significant difference exists between pre-test and post-test BMI scores. The data collected from 100 participants reveal a pre-test mean BMI of 22.412, with a standard deviation (S.D.) of 1.093, while the post-test mean BMI is 21.932, with an S.D. of 1.202.

The standard error of the difference (SED) is calculated at 0.162, allowing for further statistical analysis. With 196 degrees of freedom, the computed t-value is 2.9545, indicating a very statistically significant difference between the pre-test and post-test scores. This suggests that the specific Yogic practices implemented during the intervention have had a meaningful impact on reducing BMI among the personnel.

The results are visually represented in a figure comparing pre-test and post-test scores, further highlighting the effectiveness of the Yogic intervention. These findings support the hypothesis that targeted Yogic practices can significantly influence BMI, underscoring the potential benefits of integrating Yoga into health and wellness programs for personnel in physically demanding roles like the ITBP.

4. DISCUSSION

The findings of this study suggest that Yogic practices can have a positive impact on the cardiovascular health and overall physical well-being of ITBP personnel deployed in high-altitude regions. The significant reductions in blood pressure and heart rate observed in this study align with existing literature on the benefits of Yoga for cardiovascular health. Moreover, the present study aimed to explore the impact of specific Yogic practices on the physiological parameters of blood pressure, heart rate, and body mass index (BMI) among Indo-Tibetan Border Police (ITBP) personnel. The results indicate that participation in the structured Yogic intervention led to significant improvements across all measured outcomes, thereby affirming the efficacy of Yoga as a viable method for enhancing cardiovascular health and overall wellness.

In terms of blood pressure, both systolic and diastolic readings showed marked reductions following the Yoga intervention. This finding is consistent with previous research that highlights the role of Yoga in managing hypertension. For instance, a meta-analysis by Cramer et al. (2014) [4] concluded that Yoga can effectively lower blood pressure, particularly among individuals with pre-existing hypertension. The current study aligns with this body of literature, reinforcing the notion that regular practice of Yogic techniques can serve as an effective intervention for blood pressure management in high-stress professions.

The heart rate results also demonstrated a significant decrease post-intervention. This outcome suggests that the specific Yogic practices employed in this study may enhance relaxation and reduce physiological stress responses. A study conducted by Brown et al. (2013)[5] supports this notion, reporting that mindful breathing and meditation—common elements of Yogic practice—are associated with lowered heart rates and improved cardiovascular health. The present findings contribute to this growing body of evidence, suggesting that incorporating Yoga into the daily routines of ITBP personnel could bolster their cardiovascular resilience, particularly in stressful environments.

The analysis of BMI further substantiates the effectiveness of Yoga as a holistic health intervention. The observed reduction in BMI following the Yoga practices aligns with findings from a study by Ross et al. (2016)[6], which indicated that regular Yoga practice contributes to significant weight management and reductions in body fat among diverse populations. The current study's results imply that the integration of Yogic practices can be particularly beneficial for individuals in physically demanding roles, supporting not only physical fitness but also overall health and well-being.

Overall, the findings of this study advocate for the incorporation of Yoga into health and wellness programs for ITBP personnel and similar high-stress professions. Given the physiological benefits demonstrated, it is recommended that organizations consider establishing structured Yoga programs to enhance the health and resilience of their personnel. Future research should explore long-term effects and the potential for Yoga to serve as a preventive health measure in other occupational settings.

5. CONCLUSION

The analysis and interpretation of the study on the effects of specific Yogic practices on the physiological parameters of Indo-Tibetan Border Police personnel reveal significant findings. The results indicate that the structured Yogic intervention led to marked reductions in both systolic and diastolic blood pressure, as well as heart rate, suggesting a positive impact on cardiovascular health. These outcomes highlight the effectiveness of Yoga in managing stress-related physiological responses, which are particularly relevant for individuals in high-pressure occupations like the ITBP.

Moreover, the study demonstrated a meaningful reduction in body mass index, further supporting the notion that targeted Yogic practices can contribute to improved physical health. The statistical significance of these findings underscores the potential of incorporating Yoga into health and wellness initiatives aimed at enhancing the well-being of personnel

facing demanding physical and psychological challenges.

Overall, this study advocates for the integration of Yogic practices into routine health management strategies for individuals in physically demanding roles, emphasizing Yoga's role as a valuable tool for promoting cardiovascular health and overall wellness in stressful environments. The evidence supports the idea that such interventions can play a crucial role in fostering healthier lifestyles and mitigating the impacts of stress.

6. ACKNOWLEDGMENT

Nil.

7. AUTHOR'S CONTRIBUTIONS

All the authors contributed equally to the design and execution of the article.

8. FUNDING

Nil.

9. ETHICAL APPROVALS

This study was approved by the Haryana Yog Aayog Institutional Ethical Committee under no. HYA/HRY/2024/374 dated 09/02/2024.

10. CONFLICTS OF INTEREST

Nil.

11. DATA AVAILABILITY

This is an original manuscript and all data are available for only review purposes from principal investigators.

12. PUBLISHERS NOTE

This journal remains neutral with regard to jurisdictional claims in published institutional affiliations..

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Table 1: Comparison between pre-test and post-test of yoga intervention on blood pressure among ITBP personnel in respect of mean scores and S.D.

Groups		N	Mean	S.D.	SED	df	t-value	Level of Significance
Systolic Blood Pressure	Pre-test Score	100	121.172	4.92	0.633	189	5.7536	extremely statistically significant
	Post-test Score	100	117.531	3.98				
Diastolic Blood pressure	Pre-test Score	100	82.673	4.62	0.583	185	9.5325	extremely statistically significant
	Post-test Score	100	77.119	3.55				

Table 2 : Comparison between pre-test and post-test of yoga intervention on heart rate among ITBP personnel with respect to mean scores and S.D..

Groups	N	Mean	S.D.	SED	df	t-value	Level of Significance
Pre-test Score	100	78.466	6.80	0.874	189	6.1181	extremely statistically significant
Post-test Score	100	73.119	5.49				

Table 3: Comparison between Pre-test and Post-test of Yoga Intervention on BMI among ITBP personnel in respect of Mean Scores & S.D.

Groups	N	Mean	S.D.	SE_D	df	t-value	Level of Significance
Pre-test Score	100	22.412	1.093	0.162	196	2.9545	very statistically significant
Post-test Score	100	21.932	1.202				

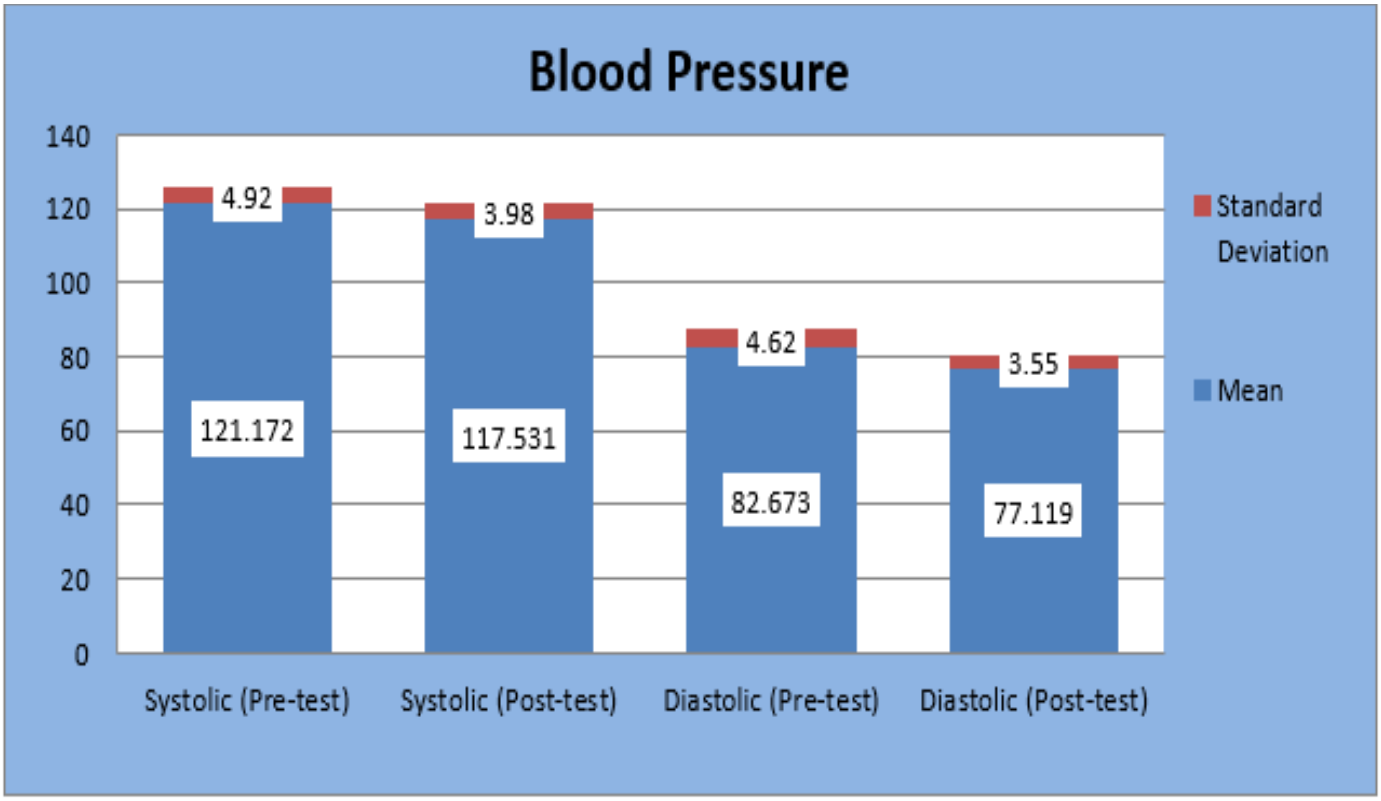
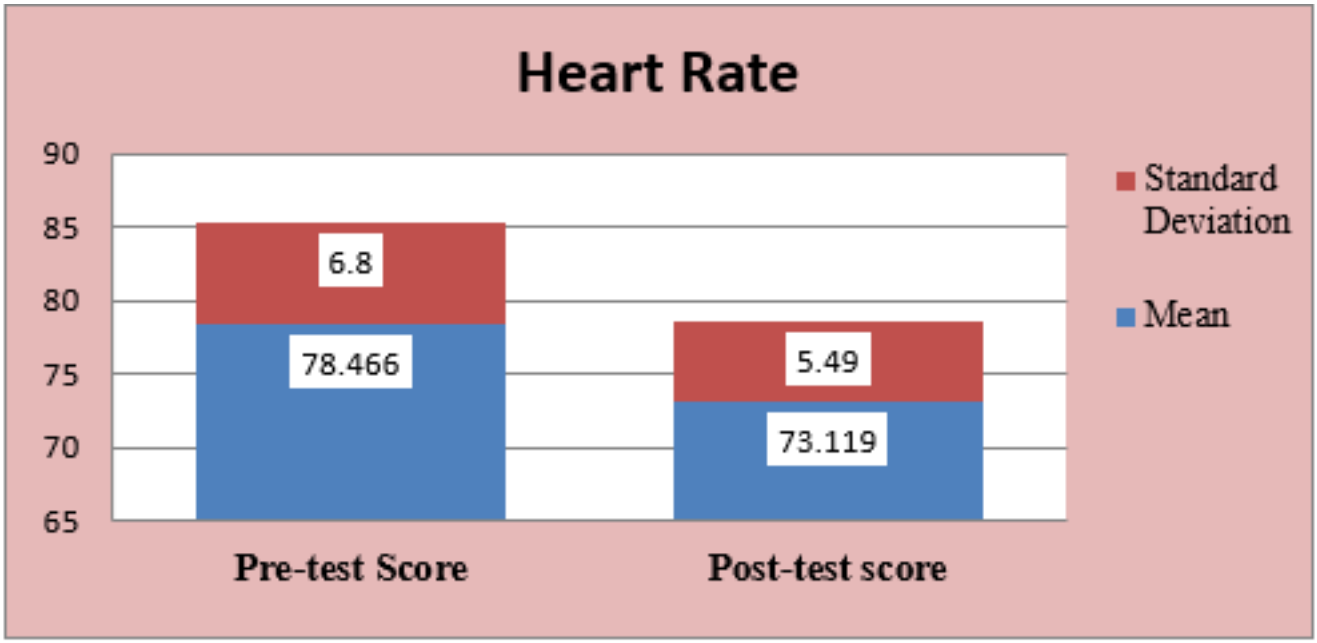


Figure: Comparison between Pre-test and Post-test Scores of Yoga Intervention on Blood Pressure among ITBP Personnel in Respect of Mean Scores & S.D.



Comparison between Pre-test and Post-test scores of Yoga Intervention on Heart Rate among ITBP personnel in respect of Mean scores & S.D.

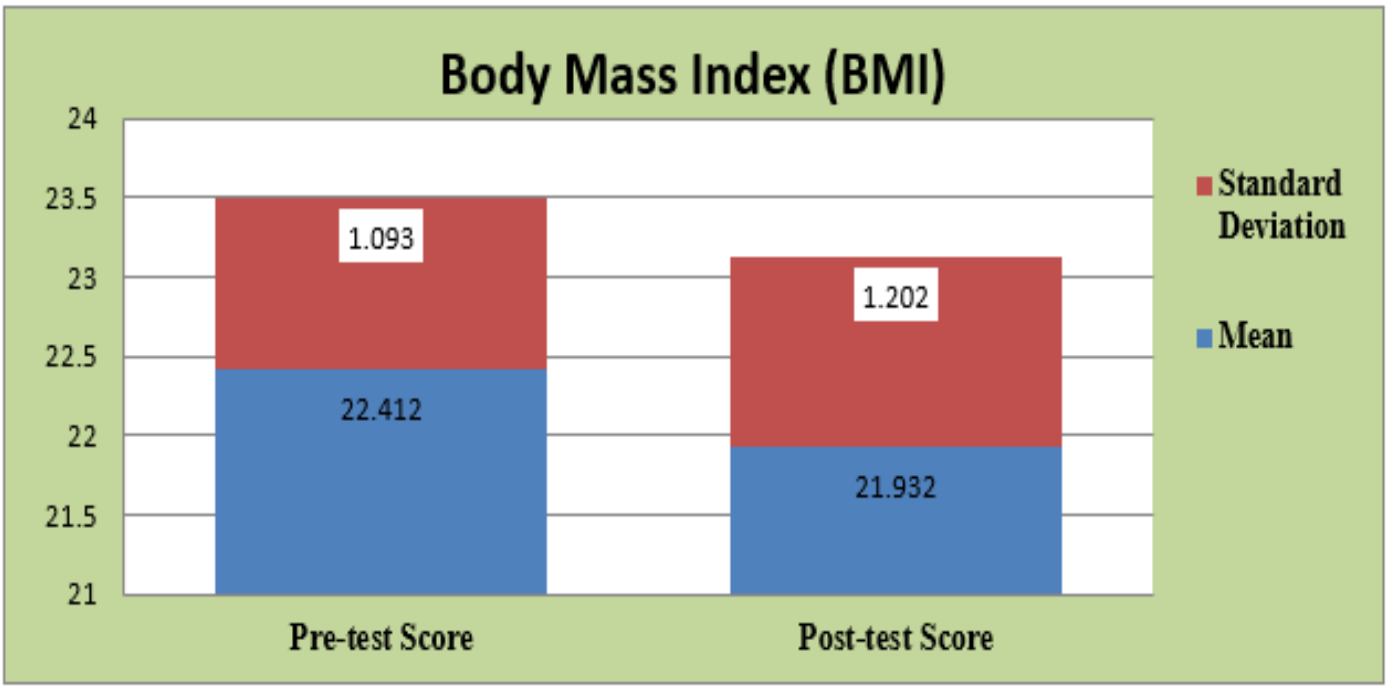


Figure: Comparison between Pre-test and Post-test scores of Yoga Intervention on BMI among ITBP personnel in respect of Mean scores & S.D.