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Physiological parameters response to the effect of PNF stretching and yin yoga among research scholars

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Abstract
Physiological fitness plays an important role in maintaining health, reducing stress, and improving overall well-being among women pursuing higher education. Women Ph.D. scholars often experience demanding academic schedules, prolonged sedentary work, and mental stress, which may negatively influence physiological parameters such as heart rate, flexibility, muscular relaxation, and overall physical health. Therefore, incorporating suitable physical practices is essential to promote physiological balance and enhance quality of life. The purpose of this study was to find out the effect of PNF Stretching and Yin Yoga on selected physiological parameters among Women Research Scholars. The selected subjects (N=60) were divided into three equal groups each consisting of 20 (n=20) Women Research Scholars. Experimental group I (N=20) underwent PNF Stretching (PNFSTG), Experimental group –II (N=20) underwent Yin Yoga (YYGT), and the Group-III (N=20) acted as control group (CG). All the selected subjects were given proper orientation about the purpose of the study, testing and training procedures. The selected subjects were initially tested on criterion variables used in this study and this was considered as the pre-test data and recorded for analysis. The Experimental groups were given respective training for a period of 12 weeks. After twelve weeks of their training program again the subjects were tested on the same criterion variables as such in the pre-test and considered this as the post-test data for the analysis. Vo_2 Max was assessed by 20m multi stage fitness test and the unit of measure was in ml/kg/lit and breath holding time was assessed by breath holding fitness test and unit of measure was in seconds. The data distribution "t" test was done for finding whether there is any statistically significant pre-test to post-test mean differences in their respective variables of each groups. ANCOVA tests the significance of "adjusted post test mean" differences between the experimental and control groups for each variable. Whenever the "F" ratio for adjusted post test was found to be significant, Scheffee's post hoc test was applied to test the significant difference between the paired adjusted means.0.05 level of confidence was fixed for physiological parameters to test the level of significance.

Keywords: PNF stretching, yin yoga, women research scholars, physiological, breath holding time, vo_2 max

Introduction

Women Ph.D. scholars often experience prolonged sedentary work, academic pressure, irregular physical activity, and psychological stress, which may negatively affect physiological parameters such as resting heart rate, circulation, flexibility, and muscular efficiency. Regular physical activity and mind–body interventions are therefore recommended to maintain physiological balance and improve health outcomes (World Health Organization, 2020) [10].

Among the various training methods, Proprioceptive Neuromuscular Facilitation (PNF) stretching has been widely recognized as an effective technique for improving flexibility and neuromuscular coordination. PNF stretching involves a sequence of muscle contraction and relaxation that enhances range of motion and muscular function (Herman Kabat *et al.,* 1952). Research indicates that PNF stretching can significantly improve flexibility, muscular strength, and circulation (David *et al.,* 2011).

Similarly, Yin Yoga is a slow-paced form of yoga that emphasizes long-held postures targeting deep connective tissues, ligaments, and joints. It promotes relaxation, improves blood flow, and stimulates the parasympathetic nervous system, thereby enhancing physiological recovery and reducing stress (Paul Grilley, 2002). Studies have shown that yoga practices contribute to improved cardiovascular function and reduced physiological stress responses (Shirley *et al.,* 2012).

Therefore, examining the physiological responses to PNF stretching and Yin Yoga training among women Ph.D. scholars may provide valuable insights into their effectiveness in improving physiological health and overall well-being.

Methodology

The purpose of this study was to find out the effect of different stretching on selected physiological parameters among Women Research Scholars. The selected subjects (N=60) were divided into three equal groups each consisting of 20 (n=20) Women Research Scholars. Experimental group I (N=20) underwent PNF Stretching (PNFSTG), Experimental group –II (N=20) underwent Yin Yoga (YYGT), and the Group-III (N=20) acted as control group (CG). All the selected subjects were given proper orientation about the purpose of the study, testing and training procedures. The selected subjects were initially tested on criterion variables used in this study and this was considered as the pre-test data and recorded for analysis. The Experimental groups were given respective training for a period of 12 weeks. After twelve weeks of their training program again the subjects were tested on the same criterion variables as such in the pre-test and considered this as the post-test data for the analysis. Vo_2 Max was assessed by

20m multi stage fitness test and the unit of measure was in ml/kg/lit and breath holding time was assessed by breath holding fitness test and unit of measure was in seconds.

Descriptive statistics such as mean and standard deviation are found in order to get the basic idea ofthe data distribution "t" test was done for finding whether there is any statistically significant pre-test to post-test mean differences in their respective variables of each groups. ANCOVA tests the significance of "adjusted post test mean" differences between the experimental and control groups for each variable. Whenever the "F" ratio for adjusted post test was found to be significant, Scheffee's post hoc test was applied to test the significant difference between the paired adjusted means.0.05 level of confidence was fixed for vo21 max and breath holding time parameters to test the level of significance.

Table 1: Computation Of 'T' Ratio on Breath Holding Time of Experimental and Control Groups (Scores in Seconds)

Groups	Pre – test mean	Pre – test S. D (±)	Post - test mean	Post – test S. D (±)	't' ratio
PNF Stretching Group (PNFSG)	29.38	2.92	33.15	1.09	7.34*
Yin Yoga Group (YYG)	29.70	1.50	35.99	0.92	14.90*
Control Group (CG)	29.52	0.78	29.46	1.90	1.62*

* Significant at 0.05 level for the degrees of freedom 1 and 19, (2.09)

Table I shows that the 't' ratios on breath holding time of PNFSG and YYG were 7.34 and 14.90 respectively. Since, these values were higher than the required table value of 2.09, it was found to be statistically significant at 0.05 level of confidence for degrees of freedom 1 and 19. Further, the obtained 't' ratio between pre and post test of the control group 0.62 was lesser than the required table value of 2.09, and it was found to be not statistically significant

From the results it was inferred that, PNFSG and YYG produced a significant improvement in breath holding time of Research Scholars.

Table 2: Analysis of Covariance on Pre, Post and Adjusted Post Test Means on Breath Holding Time of Experimental and Control Groups (Scores in Seconds)

Test	PNF Stretching Group (PNFSG)	Yin Yoga Group (YYG)	Control Group (CG)	Source of variance	df	Sum of square	Mean square	F-ratio
Pre-test mean	29.38	29.70	29.52	B/S	2	1.03	0.51	0.84
				W/S	57	352.79	6.18	
Post-test mean	33.15	35.99	29.46	B/S	2	81.28	40.64	21.44*
				W/S	57	108.00	1.89	
Adjusted post-test mean	33.14	35.98	29.45	B/S	2	75.09	37.54	30.80*
				W/S	56	68.24	1.21	

* Significant at 0.05 level for the degrees of freedom (2, 57) and (2, 56), 3.16

Table II reveals the computation of 'F' ratios on pre test, post test and adjusted post test means of PNFSG, YYG and CG on breath holding time.

The obtained 'F' ratio for the pre test means of PNFSG, YYG and CG on breath holding time as 0.84. Since, the 'F' value was less than the required table value of 3.16 for the degrees of freedom 2 and 57, it was found to be not significant at 0.05 level of confidence.

Further, the 'F' ratio for post test means of PNFSG, YYG and CG on breath holding time was 21.44. Since, the 'F' value was higher than the required table value of 3.16 for the degrees of freedom 2 and 57, hence it was found to be statistically significant at 0.05 level of confidence.

The obtained 'F' ratio for the adjusted post test means of PNFSG, YYG and CG on breath holding time was 30.80. Since, the 'F' value was higher than the required table value of 3.16 for the degrees of freedom 2 and 56, it was found to be statistically significant at 0.05 level of confidence. The results revealed that there was a significant difference in post-test means among PNFSG, YYG and CG in resting pulse rate of Research Scholars.

Table 3: Scheffe's Post Hoc Test for The Differences Between the Paired Adjusted Post-Test Means of Breath Holding Time

PNF Stretching Group (PNFSG)	Yin Yoga Group (YYG)	Control Group (CG)	Mean difference	Confidence Interval
33.14	35.98		2.84*	1.99
33.14		29.45	3.69*	
	35.98	29.45	6.53*	

* Significant at 0.05 level

Table III reveals the mean differences between the paired adjusted post test means of all groups.

The mean difference between PNFSG and YYG, PNFSG and CG, YYG and CG was 2.84, 3.69 and 6.53 respectively. The value of mean difference of adjusted post means were higher than the required confidence interval value of 0.001 and it was found to be significant at 0.05 level of confidence.

From these results, it was inferred that twelve weeks of YYG produced significant improvement in breath holding time of Research Scholars than PNFSG and CG group.

Mean values of pre, post and adjusted posttest of PNFSG, YYG and CG on breath holding time are presented in Figure I.

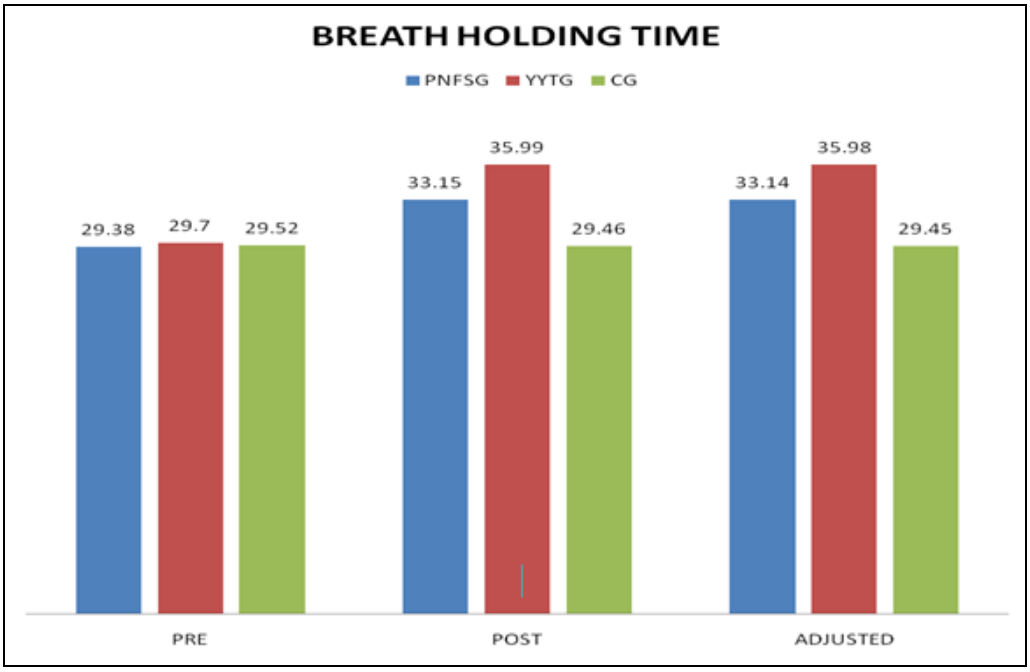

Fig 1: Bar diagram showing pre, post and control group test means on pnf stretching group yin yoga group and control group of breath holding time (Scores in Seconds)

Table iv: Computation of 't' ratio on vo_2 max of experimental and control groups, (scores in ml/kg/lit)

Groups	Pre – test mean	Pre – test S. D (±)	Post - test mean	Post – test S. D (±)	't' ratio
PNF Stretching Group (PNFSG)	26.30	1.08	28.90	0.98	6.77*
Yin Yoga Group (YYG)	26.40	1.25	30.60	1.45	15.43*
Control Group (CG)	26.90	1.30	26.77	1.72	1.06*

* Significant at 0.05 level for the degrees of freedom 1 and 19, (2.09)

Table IV shows that the 't' ratios on Vo_2 MAX of PNFSG and YYG were 6.77 and 15.43 respectively. Since, these values were higher than the required table value of 2.09, it was found to be statistically significant at 0.05 level of confidence for degrees of freedom 1 and 19.

Further, the obtained 't' ratio between pre and post test of the control group 1.06 was lesser than the required table value of 2.09, and it was found to be not statistically significant

From the results it was inferred that, PNFSG and YYG produced a significant improvement in Vo_2 MAX of Research Scholars.

Table –V: Analysis of Covariance on Pre, Post and Adjusted Post Test Means on Vo_2 Max of Experimental and Control Groups, (Scores in Ml/Kg/Lit)

Test	PNF Stretching Group (PNFSG)	Yin Yoga Group (YYG)	Control Group (CG)	Source of variance	df	Sum of square	Mean square	F-ratio
Pre-test mean	26.30	26.40	26.90	B/S	2	0.20	0.10	0.07
				W/S	57	84.33	1.48	
Post-test mean	28.60	30.60	26.77	B/S	2	54.25	27.12	13.40*
				W/S	57	115.37	2.02	
Adjusted post-test mean	28.62	30.61	26.77	B/S	2	48.38	24.19	27.92*
				W/S	56	48.51	0.86	

* Significant at 0.05 level for the degrees of freedom (2, 57) and (2, 56), 3.16

Table V reveals the computation of 'F' ratios on pre-test, post test and adjusted post test means of PNFSG, YYG and CG on Vo_2 MAX.

The obtained 'F' ratio for the pre-test means of PNFSG, YYG and CG on Vo_2 MAX was 0.07. Since, the 'F' value was less than the required table value of 3.16 for the degrees of freedom 2 and 57, it was found to be not significant at 0.05 level of confidence.

Further, the 'F' ratio for post test means of PNFSG, YYG and CG on Vo_2 MAX was 13.40. Since, the 'F' value was higher than the required table value of 3.16 for the degrees of freedom 2 and 57, hence it was found to be statistically significant at 0.05 level of confidence.

The obtained 'F' ratio for the adjusted post test means of PNFSG, YYG and CG on Vo_2 MAX was 27.92. Since, the 'F' value was higher than the required table value of 3.16 for the degrees of freedom 2 and 56, it was found to be statistically significant at 0.05 level of confidence. The results revealed that there was a significant difference in post-test means among PNFSG, YYG and CG in Vo_2 MAX of Research Scholars.

Table 6: Scheffe's post hoc test for the differences between the paired adjusted post-test means of vo_2 max

PNF Stretching Group (PNFSG)	Yin Yoga Group (YYG)	Control Group (CG)	Mean difference	Confidence Interval
28.62	30.61		1.99*	0.83
28.62		26.77	1.85*	
	30.61	26.77	3.84*	

* Significant at 0.05 level

Table VI reveals the mean differences between the paired adjusted post test means of all groups.
The mean difference between PNFSG and YYG, PNFSG and CG, YYG and CG was 1.99, 1.85 and 3.84 respectively. The value of mean difference of adjusted post means were higher than the required confidence interval value of 0.001 and it was found to be significant at 0.05 level of confidence. From these results, it was inferred that twelve weeks of YYG produced significant improvement in Vo_2 MAX of Research Scholars than PNFSG and CG group.
Mean values of pre, post and adjusted posttest of PNFSG, YYG and CG on Vo_2 MAX are presented in Figure II.

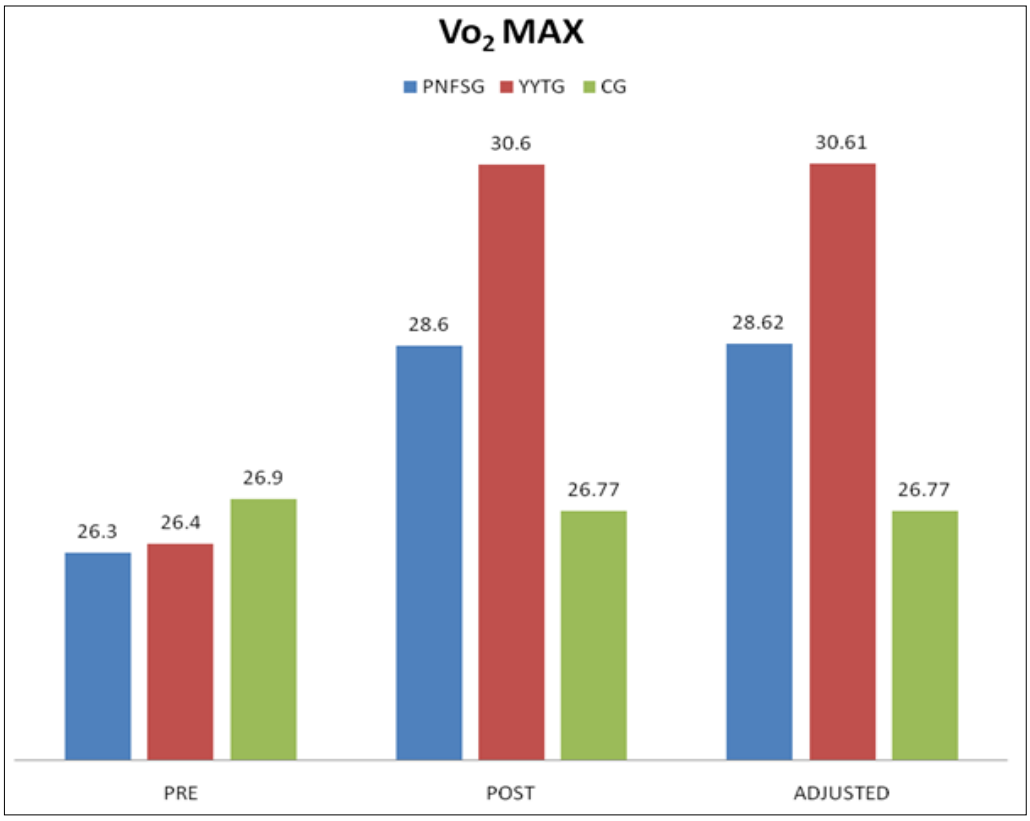

Fig 2: Bar Diagram Showing Pre, Post and Control Group Test Means on Pnf Stretching Group Yin Yoga Group and Control Group of Vo_2 Max (Scores in Ml/Kg/Lits)

Discussion On Findings

The findings of the study indicate that both PNF stretching and Yin Yoga training produced positive changes in the physiological parameters of women Ph.D. scholars. Regular practice of PNF stretching improved flexibility and neuromuscular coordination, which may contribute to better muscular efficiency and circulation. Similarly, Yin Yoga training promoted relaxation and enhanced parasympathetic nervous system activity, leading to improvements in resting heart rate and overall physiological balance. The results suggest that mind–body practices help reduce academic stress and sedentary lifestyle effects among research scholars. Therefore, incorporating PNF stretching and Yin Yoga into regular physical activity routines may effectively improve physiological health and well-being among women Ph.D. scholars.

Physiological Variables

In the present study, systolic blood pressure, diastolic blood pressure, VO_2 max and breath holding time were selected as physiological variables to examine the effectiveness of the PNF Stretching Group (PNFSG) and the Yin Yoga Group (YYG).

The results of the study revealed that the PNF Stretching Group (PNFSG) showed significant improvement in all selected physiological variables when compared between baseline and post-test scores. The percentage of improvement recorded was VO_2 max and 7.64% in breath holding time. These improvements may be attributed to enhanced neuromuscular efficiency, improved circulation, and moderate autonomic regulation resulting from systematic stretching practices.

Similarly, the Yin Yoga Group (YYG) demonstrated greater significant improvement in the selected physiological variables. The percentage of improvement observed was VO_2 max and 11.56% in breath holding time between baseline and post-test scores. The superior improvements may be attributed to prolonged passive stretching combined

with controlled breathing and meditative relaxation, which enhance parasympathetic dominance, improve cardiovascular efficiency, and optimize respiratory function.

It is noted that the Yin Yoga Group showed greater improvement in VO_2 max (13.72% vs. 10.38%), breath holding time (11.56% vs. 7.64%) compared to the PNF Stretching Group.

The greatest improvement (13.72%) was observed in VO_2 max in the Yin Yoga Group, while the smallest improvement (6.18%) was found in resting pulse rate in the PNF Stretching Group.

Inspection of the data indicates that there are meaningful physiological differences between the PNF Stretching and Yin Yoga Groups. The findings suggest that although both interventions are effective in improving cardiovascular and respiratory efficiency, Yin Yoga produced comparatively greater improvements in systolic blood pressure, diastolic blood pressure, VO_2 max, breath holding time, and resting pulse rate than PNF Stretching. Therefore, Yin Yoga may be considered a more effective intervention for enhancing overall physiological health and autonomic regulation.

Regarding physiological variables, significant improvements were observed in resting pulse rate, systolic and diastolic blood pressure, VO_2 max, and breath holding time among both experimental groups. The Yin Yoga Group demonstrated greater reductions in blood pressure and resting pulse rate, possibly due to enhanced vagal tone and parasympathetic dominance induced by slow breathing and meditative focus. Ross and Thomas (2010) [8] reported that yoga interventions improve cardiovascular efficiency and autonomic regulation. The PNF Stretching group showed notable improvement in VO_2 max and breath holding time, which may be attributed to improved muscular efficiency and respiratory coordination developed during stretching exercises. Both interventions proved superior to the Control group, which showed no statistically significant physiological improvement.

Conclusion

1. Within the limitations and on the basis of the findings, it was very clear that 12 weeks of PNF stretching (PNFST) produces significant changes in the physiological variables among Women Research Scholars.
2. It was very clear that 12 weeks of Yin Yoga Training (YYTG) produces significant changes in the physiological variables among Women Research Scholars.
3. The findings of this research clearly demonstrate that 12 weeks of Yin Yoga Training (YYTG) produces the most comprehensive and significant improvements in the physiological of Women Research Scholars. Therefore, this training approach can be confidently recommended for coaches, physical educators, and trainers seeking to optimize performance in Women Research Scholars.
4. It is concluded that the PNF and Yin Yoga Training need to be incorporated in the training protocol to enhance the overall performance of team sports.

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