Research Article

Influence of bahirang yoga on respiratory and circulatory variables

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■**ABSTRACT**

The purpose of the study was to find out the influence of bahirang yoga on respiratory and circulatory variables. The study was conducted on one hundred male subjects randomly selected from school of Nagpur. Based on their initial performance they were divided into four groups. Group-IUjjayi, group-II Bhastrika, group-III combined (Ujjayi and Bhastrika) practice and group-IV control, who didn't undergo any treatment. From intra-group comparison, it can be concluded that variables was improved by the training of selected bahirang yoga (Pranayama). From the inter group comparison, it can be said that group-I,II,III were the best in improving of subjects, so training of bahirang yoga to determine between pre and post-test of different groups for different variable, 't' test was used and to find out differences among the groups F- test was used.

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Physiological health and physical fitness can be achieved and maintained only through participation in selected yogic, physical activity and sports (Chaterjee, 1966). Pranayama plays an important role in the development of respiratory system, and out of many automatic functions in the body (Kuvalayanand, 1966). It is only the respiratory activity which goes on continuously and which is partially under our control, involving a good number of skeletal muscles. It also influences very many automatic functions like the activity of the heart, circulation and digestion, directly as wellas indirectly. Naturally then, any control of respiration is likely to have a far-reaching effect on the whole psycho-physiological system. From the oldest times, it has been claimed that Pranayama leads to the eradication of the flows of psycho-physiological reactivity.

Bahirang yoga:

Yama, Niyama, Asana, Pranayama and pratyahara are five steps of bahirang yoga.

■ **METHODOLOGY**

One hundred male subjects studying in school of Nagpur was selected as subject for the purpose of this study. The age group of subjects was ranged between 14 to 17 years.The subjects were assigned randomly into four groups each containing twenty five subjects *viz.* (experimental groups practiced the selected bahirang yoga that means Pranayama) experimental group- I (Ujjayi), experimental- group- II (Bhastrika), experimental group- III (Combined group, means both Pranayama (Ujjayi and Bhastrika) and control group- IV.

Selection of the variables:

The following variables were selected:

– Respiratory rate – It was measured by stop watch per minute.

– Vital capacity – It was measured with the help of wet Spiro meter.

– Positive and negative breath holding time – It was measured by stop watch.

– Systolic and diastolic blood pressure – It was

measured with help of Sphygmomanometer.

– Pulse rate – It was measured by feeling palpation on the radial artery.

– Cardio-vascular efficiency – It was measured with the help of modified harvard step test.

– Fasting blood glucose – It was measured with the help of Dextro meter.

– Haemoglobin percentage – It was measured with the help of Haemometer

Procedures:

Whole experiment was conducted by three phases.

I phase (Pre-test) :

In this phase of pre-test, the subjects of the three experimental groups and control group were instructed to participate in four tests of respiratory and circulatory variables i.e.respiration per minute test, Wet Spirometer test number of second, and Sphygmomanometer test in two difference days. The scores of each subject were recorded accurately and preserved carefully

II phase (Treatment/Training phase):

After completion of the pre-test, as stated above, the subjects of experimental group participated in the session *Pranayama,* one time morning session for sixty minutes per day except Sundays and holidays for a total period of twelve weeks. The subjects of the control group did not participate in any of the *Pranayama* session. However, the subjects of the control group were kept busy with different varieties of interesting study materials during the total experimental period.

III phase (Post-test):

After completion of twelve weeks experimental period, all the subjects of the four groups were instructed to participate in all tests of respiratory and circulatory variables conducted like pre-test. The post-test scores of the experimental and control groups were recorded carefully.

■ **OBSERVATIONS AND DISCUSSION**

The pre and post-test scores of all the four groups are given in Table 1. On all the respiratory and circulatory variables, significant differences were found between pre and post-test scores of Ujjayi group, Bhastrika group and combined (U&B) group while no significant differences were found on any of these variables between pre and post scores of controlled group. The inter group comparisons are given in Tables 2, 3, and 4. It is evident from Table 2 Ujjayi and Bhastrika group.

After interpreting the Table 1, it was found that there was no significant difference in all the variables of control group as the calculated 't' values 0.830, 0.043, 0.003, 0.166, 0.23, 0.11,0.596, 0.906 and 0.55 for Respiratory rate, Vital capacity, Positive breath holding time, Negative breath holding time, Systolic blood pressure, Diastolic blood pressure, Pulse rate, Fasting blood glucose and Haemoglobin percentage were below Tabulate 't' value of 2.06 required for 't' ratio to be significant at 0.05 level of confidence with the degree of freedom 24.
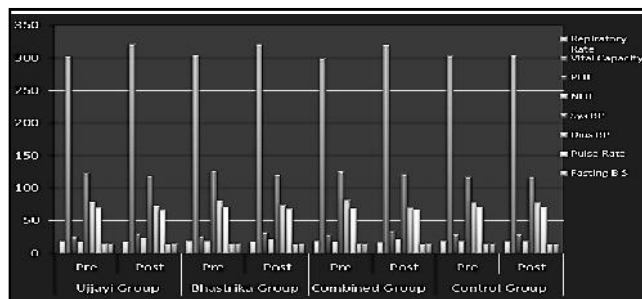

Fig. 1 : Pre and post test in mean scores of all the groups

Table 1 : Significance difference between pre and post-test in mean scores of all the four groups on all the variables											
Test item	Ujjayi group			Bhastrika group			Combined group			Control group		
	Pre	Post	't' value	Pre	Post	't' value	Pre	Post	't' value	Pre	Post	't' value
Respiratory Rate	18.2	17.16	2.89*	18.56	16.56	5.27*	18.24	16.36	5.49*	18.64	18.20	0.30@
Vital Capacity	302.6	321.0	2.64*	304.0	321.2	2.6*	299.4	319.8	4.7*	302.8	303.08	0.043@
P. Breath H. Time	25.26	30.97	3.24*	26.124	32.16	3.74*	27.95	34.21	5.098*	28.63	28.64	0.003@
N. Breath H. Time	18.05	23.196	2.62*	18.608	21.46	3.23*	17.62	22.13	3.46*	18.74	18.608	0.166@
S. Blood Pressure	123.8	119	2.68*	126.8	120.2	2.73*	126.2	121	2.59*	117.2	116.8	0.23@
D. Blood Pressure	78.8	72.68	3.15*	80.8	74.16	3.54*	82.2	69.88	6.24*	77.8	77.6	0.11@
Pulse Rate	69.72	66.16	3.80*	70.64	68.48	2.77*	69.36	67.04	2.706*	70.76	70.32	0.596@
Fasting B. Glucose	14.44	14.12	1.26@	14.16	13.8	1.63@	14.64	14.08	1.747@	14.36	14.04	0.906@
Haemoglobin percentage	14.2	14.84	168@	14.32	14.84	1.66@	14.4	14.76	1.15@	14.28	14.08	0.55@

Significant at 't'0.05 (24) = 2.06 @ in significant
P. Breath H. Time – Positive Breath Holding Time, N. Breath H. Time- Negative breath holding Time
S – Systolic, D- Diastolic

Table 2 : 't' ratio for composite score pre and post-test						
Group	Mean 1	Mean 2	MD	Df	SE	't' ratio
Group-I	49.46	49.47	0.01	48	0.9447	0.0106@
Group-II	50.71	49.97	0.8	48	0.8599	0.95@
Group-III	50.28	48.64	1.64	48	0.8599	1.9108@
Group-IV	49.68	48.48	1.2	48	0.9672	1.243@

@ In significant at 't' 0.05(48) = 1.96

Table 2, shown insignificant difference between pre and post-test in all groups because obtained 't' ratio were observed less than table value i.e. 't' 0.05 (48) =1.96

Table 3 : One way analysis of variance of respiratory rate of four different groups					
Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	79.72	26.573	12.08795*	
$(SS)_w$	96	211.04	2.198333	1.484578	

Table 4 : One way analysis of variance of vital capacity of the four different groups					
Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	5827.87	1942.623	4.233079*	
$(SS)_w$	96	44055.84	458.915	21.4223	

But in case of experimental group-I, II, III significant differences were found in respect of Respiratory rate, Vital capacity, Positive breath holding time, Negative breath holding time, Systolic blood pressure, Diastolic blood pressure, and Pulse rate as the group-I, Calculated 't' values 2.89, 2.64, 3.24, 2.62, 2.68, 3.15 , 3.80,group-II 5.27, 2.6, 3.74, 3.23, 2.73, 3.54 , 2.765 and group-III 5.49, 4.7, 5.098, 3.46, 2.59, 6.24,2.706, respectively were higher than the Tabulate 't' ratio to be significant 0.05 level of confidence with the degree of freedom 24. No significant differences were found in case of cardio-vascular efficiency, Fasting blood glucose, Haemoglobin percentage as the group-I, Calculated 't' values *viz.,* 0.627, 1.258, 1.68 and group-II 0.420, 1.627, 1.66 and group-III 0.663, 1.747, 1.15, respectively were lower than the Tabulated 't' value of 2.06required for 't' ratio to be significant at 0.05 level of confidence with the degree of freedom 24.

According to Table 3, 4, 5, 6, 7, 8, 9 and 10, it was observed that there was significant differences in Respiratory rate, Vital capacity, Positive breath holding time, Negative breath holding time, Systolic blood pressure, Diastolic blood pressure, Pulse rate and Cardio-vascular efficiency among four groups because the obtained F- values (12.08795, 4.233079, 4.829263, 7.505391, 12.82275, 6.066737, 12.05972 and 4.067719) were comparatively greater than the tabulatedvalue of2.71required for F- ratio to be significant at 0.05level of confidence and Fasting blood glucose and Haemoglobin percentage among four groups because the obtained F- values (2.327419, 2157755) was comparatively less than the tabulated value of 2.71required for F- ratio to be insignificant at 0.05level of confidence after that least significant post hoc test was applied to significant

Table 5 : One way analysis of variance of positive breath holding time of the four groups					
Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	415.3095	139.84366	4.829263*	
$(SS)_w$	96	2751.955	28.6662	5.354082	

Table 6 : One way analysis of variance of negative breath holding time of the four difference groups					
Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	270.3941	90.00906	7.505391*	
$(SS)_w$	96	64941.23	676.4711	26.00906	

Table 7 : One way analysis of variance of systolic blood pressure of the four difference groups					
Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	1578	526	12.82275*	
$(SS)_w$	96	3938	41.02083	6.404751	

Table 8 : One way analysis of variance of diastolic blood pressure of the four different groups					
Source of variance	df	SS	MSS	SD	F- ratio
(SS)$_b$	3	815.87	271.9567	6.066737*	
(SS)$_w$	96	4303.44	44.8275		

Table 9 : One way analysis of variance of pulse rate of the four different groups					
Source of variance	df	SS	MSS	SD	F- ratio
(SS)$_b$	3	302.67	100.89	2.05972*	
(SS)$_w$	96	803.12	8.365833	2.892375	

Table 10 : One way analysis of variance of cardio-vascular efficiency of the four different groups					
Source of variance	df	SS	MSS	SD	F- ratio
(SS)$_b$	3	102.8288	34.27627	4.067719*	
(SS)$_w$	96	808.9354	8.42641	2.902828	

*Significant at F $_{0.05}$(3, 96) =2.71

difference the paired means. The mean difference have been presented in Table 13.

In Table 4 the mean difference value of group-I and IV (1.48), group-II and IV (2.08), group-III and IV (2.28) revealed that there was a significant difference in respiratory rate, as the mean difference value was greater than the critical difference value 0.8219, are the mean difference value of group-I and II(0.6), group-I and III(0.8), group-II and III(0.2) did not differ significantly, as the obtained mean difference value was less as compared to difference value 0.8219.

In Table 6, the mean difference value of group-I and IV (17.92), group-II and IV (18.12) group-III and IV(16.72), revealed that there was a significant difference in vital capacity as the mean difference value was greater than the critical difference value 11.875, and the mean difference value of group-I and II(0.2), group-I and III(1.2), group-II and III(1.14), did not differ significantly, as the obtained mean difference value was less as compared to difference value 11.875.

In Table 15 the mean difference value of group-I and III (3.3344), group-II and IV (3.6844), group-III and IV (5.5748) revealed that there was asignificant difference in positive breath holding time, as the mean difference value was greater than the critical difference value2.9681, and the mean difference value of group-I and II(91.444), group-I and III(2.404), group-II and III (1.8904), did not differ significantly, as the obtained mean difference value is as compared to difference value 2.9681.

In Table 16 the mean difference value of group-I and II (2.0), group-I and III (1.0656), group-I and IV (4.452), group-II and III (0.6708), group-II and IV (2.7156),group-III and IV (3.864) revealed that there was not significant difference in negative breath holding time, as the mean difference value was than the critical difference value 14.4186.

In Table 17 the mean difference value of group-III and IV (4.2), revealed that there was a significant difference in systolic blood pressure, as the mean difference value was greater than the critical difference value 3.5506 and the mean difference value of group-I and II (1.2), group-I and III(2.0), group-I and IV (2.2), group-II and IV (3.4), group-II and III (0.8) did not differ significantly, as the obtained mean difference value was less as compared to difference value 3.5506.

In Table 18 the mean difference value of group-I and IV (5.12), group-II and III (4.28),Group-III and IV (7.92), revealed that there was a significant difference in diastolic blood pressure, as the difference value was greater than the critical difference value 3.711, and the mean difference value of group-I and II (1.48),group-I and III (2.8), group-II and IV (3.64),did not differ significantly, as the obtained mean difference value was less as compared to difference value 3.711.

In Table 19 the mean difference value of group-I and II (2.32), group-I and IV (4.6), group-II and IV, (2.28), group-III and IV (3.72) revealed that there was a significant difference in pulse rate, as the mean difference value was greater than rhe critical difference value 1.6034, and the mean difference value of group-I and III (0.88), group-II and III(1.44) did not differ significantly, as the obtained mean difference value was less as the compared to difference value 1.6034.

In Table 20 the mean difference value of group-I and III (2.5012), group-II and III (2.466), group-III and IV (1.634) revealed that there was a significant difference in cardio-vascular efficiency, as the mean difference value was greater than the critical difference value 1.6092 and the mean difference value of group-I and II (0.0352), group-I and IV (0.8672), group-II and IV (0.832) did not differ significantly, as the obtained mean difference value was less as compared value 1.6092.

In Table 21 the mean difference value of group-I and III (0.04), group-II and IV (0.24), group-I and II (0.32), group-I and IV (0.08), group-II and III (0.28), group-III and IV (0.04) did not differ significantly, as the obtained mean difference

Table 11 : One way analysis of variance of fasting blood glucose of the four difference groups

Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	1.55	0.516667	2.327419@	
$(SS)_w$	96	115.44	1.2025	1.096586	

Table 12 : One way analysis of variance of haemoglobin percentage of the four different groups

Source of variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	10.19	3.396667	2.157755@	
$(SS)_w$	96	151.12	1.574167	1.254658	

Table 13 : Paired mean difference for respiratory rate

Group-I	Group-II	Group-III	Group-IV	MD	CD
17.16	16.65			0.6@	
17.16		16.36		0.8@	
17.16			18.64	1.48*	0.8219
	16.65	16.36		0.2@	
	16.65		18.64	2.08*	
		16.36	18.64	2.28*	

@Insignificant   * indicates significance of value at P=0.05 level of confidence

Table 14 : Paired mean difference for vital capacity

Group-I	Group-II	Group-III	Group-IV	MD	CD
321	321.2			0.2@	
321		319.8		1.2@	
321			303.08	17.92*	11.875
	321.2	319.8		1.14@	
	321.2		303.08	18.12*	
		319.8	303.08	16.72*	

@Insignificant   * indicates significance of value at P=0.05 level of confidence

Table 15 : Paired mean difference for positive breath holding time

Group-I	Group-II	Group-III	Group-IV	MD	CD
30.824	32.3164			1.444@	
30.824		34.2068		3.3344*	
30.824			28.632	2.2404@	2.9681
	32.3164	34.2068		1.8904@	
	32.3164		28.632	3.6844*	
		34.2068	28.632	5.5748*	

@Insignificant   * indicates significance of value at P=0.05 level of confidence

Table 16 : Paired mean difference for negative breath holding time

Group-I	Group-II	Group-III	Group-IV	MD	CD
23.196	21.4596			2.0@	
23.196		22.1301		1.0656@	
23.196			18.744	4.452@	14.4186
	21.4596	22.1301		0.6708@	
	21.4596		18.744	2.7156@	
		22.1301	18.744	3.3864@	

@Insignificant   * indicates significance of value at P=0.05 level of confidence

Table 17 : Paired mean difference for systolic blood pressure					
Group-I	Group-II	Group-III	Group-IV	MD	CD
119	102.2			1.2@	
119		121		2.0@	
119			116.8	2.2@	3.5506
	102.2		116.8	3.4@	
	102.2	121		0.8@	
		121	116.8	4.2*	

@Insignificant   * indicates significance of value at P=0.05 level of confidence

Table 18 : Paired mean difference for diastolic blood pressure					
Group-I	Group-II	Group-III	Group-IV	MD	CD
72.68	74.16			1.48@	
72.68		69.88		2.8@	
72.68			77.8	5.12@	3.711
	74.16	69.88		4.28@	
	74.16		77.8	3.64@	
		69.88	77.8	7.92@	

@ in significant   * indicates significance of value at P=0.05 level of confidence

Table 19 : Paired mean difference for pulse rate					
Group-I	Group-II	Group-III	Group-IV	MD	CD
66.16	68.48			2.32@	
66.16		67.04		0.88@	
66.16			70.76	4.6*	1.6034
	68.48	67.04		1.44@	
	68.48		70.76	2.28*	
		67.04	70.76	3.72*	

@ in significant   * indicates significance of value at P=0.05 level of confidence

Table 20 : Paired mean difference for cardio-vascular efficiency					
Group-I	Group-II	Group-III	Group-IV	MD	CD
66.7848	66.7492			0.0352@	
66.7848		64.2832		2.5012*	
66.7848			65.9175	0.8672@	1.6092
	66.7492	64.2832		2.466*	
	66.7492		65.9175	0.832@	
		64.2832	65.9175	1.634*	

@ in significant   * indicates significance of value at P=0.05 level of confidence

Table 21 : Paired mean difference for fasting blood glucose					
Group-I	Group-II	Group-III	Group-IV	MD	CD
14.12			14.08	0.04@	
	13.8	14.04		0.24@	
14.12	13.8			0.32@	0.6079
14.12		14.04		0.08@	
	13.8		14.08	0.28@	
		14.04	14.08	0.04@	

@ indicates significance of value at P=0.05 level of confidence

Table 22 : Paired mean difference for haemoglobin percentage

Group-I	Group-II	Group-III	Group-IV	MD	CD
14.84	14.84			0.00@	
14.84		14.76		00.08@	
14.84			14.08	0.76*	0.6955
	14.84	14.76		0.08@	
	14.84		14.08	0.76*	
		14.76	14.08	0.68@	

@in significant   *indicates significance of value at P=0.05 level of confidence

Table 23 : Anova table for composit post

Source of Variance	df	SS	MSS	SD	F- ratio
$(SS)_b$	3	370.5055	123.5018	6.516736*	
$(SS)_w$	96	18875.68	18.95149	4.35333	

*Significant at F 0.05(3, 96) =2.71

Table 24 : Paired mean difference for composite post

Group-I	Group-II	Group-III	Group-IV	MD	CD
49.47	49.97			0.5@	
49.47		48.64		0.83@	
49.47			48.48	0.99@	2.4133
	49.97	48.64		1.33@	
	49.97		48.48	1.49@	
		48.64	48.48	0.16@	

@ indicates significance of value at P=0.05 level of confidence

value was less as compared to value 0.difference 6079.

In Table 22 the mean difference value of group-I and IV (0.76), group-II and IV(0.76) revealed that there was a significant difference in haemoglobin percentage, as the mean difference value was greater than the critical difference value 0.6955 and the mean difference value of group-I and II(0.00), group-I and III(00.08), group-II and III(0.08), group-III and IV (0.68) did not differ significantly, as the obtained mean difference value was less as compared to difference value 0.6955.

In Table 23, it was observed that there was significant difference in Composite Score Post among four groups because the obtained F- value (6.6.516736) was comparatively higher than the tabulated value of 2,71 required for F-ratio to be significant at 0.05 level of confidence after that least significant difference Post Hoc Test was applied to test significant difference the paired means.

In Table 24 the mean difference value of group-I and II(0.5), group-I and III(0.83), group-I and IV(0.99), group-II and III(1.33), group-II and IV(1.49),group-III and IV(0.16) did

not differ significantly, as the obtained mean was less as compared to difference value 2.4133.

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