

## Relationship between Competitive Performance and Selected Physiological Parameters of Elite Male and Female Gymnasts

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### Abstract

The purpose of this study was to investigate and compare the physiological variables in relation to performance of elite male and female gymnasts of inter-university level. The subjects of the study were sixty three elite male and female gymnasts (males = 32, females= 31) of inter-university level belong to different cultural background of India and who represented their respective university teams in All India Inter-university Gymnastics Championships at Amritsar. Blood pressure (systolic and diastolic) and the heart rate, winning performance scores of elite male and female gymnasts were chosen as the criterion measures for the study. The results of the study indicated that both blood pressure and heart rate of elite male and female gymnasts were raised after the performance on competitive apparatus. There was no correlation between competitive performance of both gender and selected physiological parameters. Significant differences existed between pre-test and post-test heart rate, both blood pressure of elite female gymnasts of inter-university level, but similarity was found in the pre-test and post-test of systolic blood pressure in elite male gymnasts. Elite male and female gymnasts of inter-university level had similarity in their post-test heart rate, systolic and diastolic blood pressure, but similarity was found in the pre-test of heart rate in elite female gymnasts.

**Keywords: Elite, Performance, Gender, parameters, Tests.**

### Introduction

In competitive situations, the sports are anxious to a certain degree which eventually affect their performance no human being is free from tension and stress. In the stressful setting provided by competitive sports it is usual to observe a player.

In many exercise and fitness magazines, the idea is established that heart rate alone is a good predictor of the aerobic benefits of exercise. This idea greatly oversimplifies the complexity and grand design of the cardiovascular system. Chamber size increase is a result of an increased filling rate during

prolonged endurance training exercise. An increase in ventricular wall thickness occurs from high intensity strength training. The total peripheral resistance to blood flow increases due to muscle contraction. More pressure must be generated by the heart to move blood. (Menzel, 1997).

Exercise elevated both blood pressure and pulse rate, increasing more after jumping rope than after walking. Immediately after jumping rope, the pulse rate was about twice as high as the immediate pulse rate after walking. Blood pressure after jumping rope increased about 46% and 61% for systolic and diastolic, respectively, over walking. Additionally, it took longer for pulse rate

and blood pressure to return to their resting measurements after jumping rope than after walking. The pulse and blood pressure after walking had returned to normal after a thirty-minute rest, but after jumping rope neither had returned to normal after a thirty-minute rest. (Roth & Roth, 2005).

Many individuals are seeking alternative forms of exercise to running and swimming as a means of developing or maintaining a degree of physical fitness. Sports and games are frequently selected in the expectation that they will provide sufficient intensity and duration to elicit training effects, especially on the cardiovascular system. Several authors have stated that optimal training effects are obtained when stress levels produce 75-85% of the individual's maximum heart rate (Astrand, 1974; Lavoie, 1977; and ACSM, 1978).

The heart rate is increased and the heart pumps more forcefully with each beat. The Blood flow to some parts of the body is increased, while it is decreased in others. Blood pressure is increased muscular tension is increased throughout the body preparing the individual for rapid activation of muscle strength and power.

Exercise increases blood pressure and pulse rate with more rigorous exercise having a larger effect both immediately and 30 minutes after the exercise. (Roth & Roth, 2005).

Bartunkova et al (1979) obtained heart rates of 142 to 162 bpm for junior representative players during a 10 min game of badminton, which represented 70-80% of the predicted maximum heart rate. Misner et al (1980) indicated that average subject achieved a mean heart

rate of 60% of the age adjusted maximal exercise heart for extended periods of tennis play. The actual extent and pattern of changes in the cardiovascular system has, therefore, been shown to vary with the type, duration, and intensity of the sport. Actual game characteristics, however, and subsequent physiological demands on the participants, have also been shown to be affected by the skill level of the players. Docherty (1978) found heart rates could be elevated to 80-85% of the player's PMHR during a thirty minute game of badminton and the more skilful players had significantly greater stress placed on their cardiovascular system as reflected by heart rate.

None of the peak values on the swim bench correlated with heart rate responses to game-playing. However, the mean exercise intensity correlated with the fourth quarter values of heart rate (Konstantaki et al, 1998). Seasonal training improved exercise capacity and decreased resting cardiovascular parameter. (Perini et al, 2006). Radial Resting pulse interval was highly correlated with systolic blood pressure during static periods, and moderately correlated with diastolic blood pressure during static periods, correlations of radial Resting pulse interval with systolic blood pressure and diastolic blood pressure during exercise and rest separately. (Marie et al 2006). Playing tennis raised the players' heart rates to 68-70% of their predicted maximum heart rate (PMHR). (Docherty, 1982).

The purpose of this study was to investigate and compare the physiological variables in relation to performance of elite male and female gymnasts of inter-university level.

It was hypothesized that both blood pressure and heart rate of elite male and female gymnasts would rise after the performance on competitive apparatus. It was further hypothesized that there would no correlation between competitive performance of both gender and selected physiological parameters.

## Material and Methods

### Sample

The subjects of the study were sixty three elite male and female gymnasts (males = 32, females= 31) of inter-university level belong to different cultural background of India and who represented their respective university teams in All India Inter-university Gymnastics Championships held at Guru Nanak Dev University, Amritsar (Punjab) age ranging from 17 to 25 yrs.

Keeping in view, the importance of the selected physiological variables for Gymnasts, feasibility of collection of data, legitimate time and cost involved in this study, the following variables have been selected:

1. Physiological Variables: Heart Rate, Blood pressure (Independent Variables)
2. The winning performances scores of elite male and female gymnasts serve as a dependent variable.

### Criterion measures

Blood pressure (systolic and diastolic) and the heart rate, winning performance scores of elite male and female gymnasts were chosen as the criterion measures for the study.

The subjects were contacted at the site of All India Interuniversity

Championships personally and their sincere cooperation was solicited. Respondents were called to a common place, when they were not busy and had enough time to spare for testing. Necessary instructions were provided to the subject before the administration of each test. Confidentiality of the responses was guaranteed so that the subjects would not camouflage their real feelings. Once the instructions are clearly understood by them, the physiological parameters were tested with the help of Physician.

Heart Rate was measured by using stethoscope in resting condition prior to the competitions and within the 5 minutes after completion of the event.

Blood Pressure was recorded (systolic and diastolic B. P.) in resting and within 5 minutes after completion of event through a sphygmomanometer.

Performances scores of elite male and female gymnasts were obtained from the record of the inter-university competition were chosen as the criterion measures for the study.

## Results and Discussion

To assess the selected physiological parameters of elite male and female Gymnasts in relation to their competitive performance, mean, standard deviation, t-ratio, F-ratio and Persons product moment correlation coefficient ( $r$ ) were computed. Wherever, F-ratio was found significant, Scheffe's Test of Post-hoc Analysis was carried out to identify the significance of differences between the ordered paired means of male and female Gymnasts. The level of significance was set at .05 level.

**Table 1: Descriptive statistics of selected physiological variables of elite male and female gymnasts of inter-university level**

VARIABLE	TEST	MALE GYMNASTS		FEMALE GYMNASTS	
		MEAN	SD	MEAN	SD
Heart Rate	Pre-Test	67.09	2.40	67.84	2.45
	Post-Test	132.00	19.56	124.94	16.27
Systolic BP	Pre-Test	117.56	9.02	84.26	14.35
	Post-Test	111.31	17.88	104.42	16.54
Diastolic BP	Pre-Test	88.66	6.89	66.00	7.75
	Post-Test	73.81	10.78	70.58	8.52

**Table 2: significance of difference between mean scores of pre-test and post-test of physiological variables of male gymnasts of inter-university level**

VARIABLE	TEST	MEAN	MD	DM	T-RATIO
Heart Rate	Pre-Test	67.91			
	Post-Test	132.00	64.09	3.48	18.40*
Systolic BP	Pre-Test	117.56			
	Post-Test	111.31	6.25	3.54	1.77
Diastolic BP	Pre-Test	88.66			
	Post-Test	73.81	14.84	2.26	6.56*

\*Significant at .05 level,  $t_{.05(62)} = 2.00$

It is evident from Table 2, that the statistically significant differences were found between pre-test and post-test heart rate and diastolic blood pressure of inter-university level male gymnasts, as the obtained t-value of 18.40, and 6.56 respectively were much higher

than the required t-value of  $t_{.05(62)} = 2.00$ . But insignificant differences existed between pre-test and post-test systolic blood pressure of inter-university level male gymnasts, as the obtained F-value of 1.77 was less than the required  $F_{.05(62)} = 2.00$ .

**Table 3: significance of difference between mean scores of pre-test and post-test of physiological variables of male gymnasts of inter-university level**

VARIABLE	TEST	MEAN	MD	DM	T-RATIO
Heart Rate	Pre-Test	67.84			
	Post-Test	124.94	57.09	2.95	19.31*
Systolic BP	Pre-Test	84.26			
	Post-Test	104.42	20.16	3.93	5.13*
Diastolic BP	Pre-Test	60.00			
	Post-Test	70.58	4.58	2.06	2.22*

\*Significant at .05 level,  $t_{.05(60)} = 2.00$

**Table 4: Analysis of Variance on Pre-Test of Physiological Variables of Inter-University Level Male and Female Gymnasts**

Dimensions	Source of Variation	df	Sum of Squares	Mean Square	F-Ratio
Heart Rate	Between Groups	1	0.07	0.07	0.012
	Within Groups	61	358.91	5.88	
Systolic BP	Between Groups	1	17465.27	17465.27	122.49*
	Within Groups	61	8697.81	142.59	
Diastolic BP	Between Groups	1	8082.53	8082.53	150.52*
	Within Groups	61	3275.22	53.69	

\*Significant at .05 level  
 $F_{.05(1, 61)} = 4.00$

It is evident from Table 3, that the statistically significant differences were found between pre-test and post-test heart rate and systolic and diastolic blood pressure of inter-university level female gymnasts, as the obtained t-value of 19.31, 5.13, and 2.22 respectively were higher than the required t-value of  $t_{.05}(60) = 2.00$ .

From Table 4, It is evident that the statistically significant differences

**Table 5: Analysis Of Variance on Post-Test of Physiological Variables of Inter-University Level Male and Female Gymnasts**

Dimensions	Source of Variation	df	Sum of Squares	Mean Square	F-Ratio
Heart Rate	Between Groups	1	785.84	785.84	2.42
	Within Groups	61	19799.87	324.59	
Systolic BP	Between Groups	1	748.18	748.18	2.52
	Within Groups	61	18864.6	269.99	
Diastolic BP	Between Groups	1	164.47	164.47	1.74
	Within Groups	61	5778.42	94.73	

From Table 5, It is evident that the statistically insignificant differences existed among inter-university level male and female gymnasts in post-test

**Table 5: Analysis Of Variance on Post-Test of Physiological Variables of Inter-University Level Male and Female Gymnasts**

Variables Correlated	Male Gymnasts	Female Gymnasts
Heart Rate vs Performance Score	-0.127	-0.365
Systolic BP vs Performance Score	-0.256	-0.238
Diastolic BP vs Performance Score	-0.068	0.008

Non-significant at .05 level,  $r_{.05}(30) = .349$  (Males)

Table 6 indicates that insignificant correlation existed between pre-test heart rate - performance score followed by systolic blood pressure and diastolic blood pressure of inter-university level male gymnasts, as the obtained Pearson's Product Moment Correlation Coefficients  $r$  of -.127, -.256, and -.068 respectively were lesser than the required  $r_{.05}(30) = .349$ . In case of female

existed among inter-university level male and female gymnasts in pre-test systolic and diastolic blood pressure, as the obtained F-value of 122.49 and 150.52 were much higher than the required  $F_{.05}(1, 61) = 4.00$ . But insignificant differences existed among inter-university level male and female gymnasts in pre-test heart rate, as the obtained F-value of 0.012 was much less than the required  $F_{.05}(1, 61) = 4.00$

heart rate, systolic and diastolic blood pressure, as the obtained F-value of 2.42, 2.52, and 1.74 were lesser than the required  $F_{.05}(1, 61) = 4.00$ .

gymnasts of inter-university level, insignificant correlation also existed between pre-test heart rate - performance score followed by systolic blood pressure and diastolic blood pressure, as the obtained Pearson's Product Moment Correlation Coefficients  $r$  of -.365, -.238, and .008 respectively were lesser than the required  $r_{.05}(29) = .355$ .

**Table 7: Relationship between Post-Test of Physiological Variables and Competitive Performance Score of Male and Female Gymnasts of Inter-University Level**

Variables Correlated	Male Gymnasts	Female Gymnasts
Heart Rate vs Performance Score	-0.047	-0.533
Systolic BP vs Performance Score	-0.438	-0.051
Diastolic BP vs Performance Score	-0.245	0.053

Non-significant at .05 level,  $t_{.05} (30) = 0.349$  (Males), Non-significant at .05 level,  $t_{.05} (29) = 0.355$  (Females)

Table 7 indicates that insignificant correlation existed between post-test heart rate - performance score followed by systolic blood pressure and diastolic blood pressure of inter-university level male gymnasts, as the obtained Pearson's Product Moment Correlation Coefficients  $r$  of .047, -.438, and -.245 respectively were lesser than the required  $r_{.05} (30) = .349$ . In case of female gymnasts of inter-university level, insignificant correlation also existed between post-test heart rate - performance score followed by systolic blood pressure and diastolic blood pressure, as the obtained Pearson's Product Moment Correlation Coefficients  $r$  of -.533, -.051, and .053 respectively were lesser than the required  $r_{.05} (29) = .355$ .

**Discussion**

When male gymnasts inter-university level were compared separately between pre-test and post-test of physiological variables, produced significant differences on heart rate and diastolic blood pressure. But they had no significant difference between pre-test and post-test of systolic blood pressure. In case of female gymnasts, they had significant differences between pre-test and post-test of heart rate, systolic and diastolic blood pressure.

The analysis of variance with both sexes' gymnasts of inter-university level and pre-test of physiological variables indicated that significant differences existed among inter-university

level male and female gymnasts in their pre-test of systolic blood pressure and diastolic blood pressure. But they did not differ in their post-test of heart rate, systolic and diastolic blood pressure.

To see whether male and female gymnasts of inter-university level taken independently have differences in their correlation between performance score and selected physiological variable, it was found that male and female gymnasts produced insignificant correlation between performance score and pre-test and post of heart rate followed by systolic and diastolic blood pressure.

It was hypothesized that "both blood pressure and heart rate of elite male and female gymnasts would rise after the performance on competitive apparatus" is totally accepted, as the results of per-test and post-test motioned in Table 1.

It was further hypothesized that "there would no correlation between competitive performance of both gender and selected physiological parameters" is totally accepted, as the results of per-test and post-test motioned in Table 6 & 7.

**Conclusions**

1. Elite male gymnasts of inter-university level had different heart rate and diastolic blood pressure in their pre-test and post-test results. But similarity was found between pre-test and post-test systolic blood pressure of elite male gymnasts.

2. Significant differences existed between pre-test and post-test heart rate, systolic and diastolic blood pressure of elite female gymnasts of inter-university level.
3. Significant differences exhibited among elite male and female gymnasts of inter-university level in the pre-test systolic and diastolic blood pressure except heart rate.

4. Elite male and female gymnasts of inter-university level had similarity in their post-test heart rate, systolic and diastolic blood pressure.

Similar correlation existed between pre-test and post-test heart rate – winning performance score followed by systolic blood pressure and diastolic blood pressure of elite male and female gymnasts of inter-university level.

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