

## EFFECT OF AEROBIC EXERCISES AND SWIMMING ON CARDIO- VASCULAR FITNESS OF VOLLEYBALLERS: A STUDY IN THE STATE OF SIKKIM

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### **Abstract:**

**Purpose:** Purpose of the Study was to examine the effect of aerobic exercises and swimming on the cardiovascular fitness of volleyball players.

**Methods:** For the purpose of the study, 30 volleyball players of different age groups were selected from Sikkim Government College. The subjects were chosen through a random sampling method to ensure fairness and minimize bias in selection. *Tools for the Test* is Harvard Step Test, The Modified Harvard Step Test was used to assess cardiovascular endurance.

**Result and Conclusion:** Based on a thorough analysis of the collected data, the following conclusions were drawn: Swimming exercises had a significant positive effect on the cardio-vascular efficiency of volleyball players. Aerobic exercises also produced a significant improvement in the cardio-vascular efficiency of volleyball players, complementing the effects of swimming.

**Key Words:** Aerobic Exercises, Swimming, Cardio – vascular, Fitness Volleyballers

### **Introduction:**

Since time immemorial, physical fitness has been essential for human survival. Throughout history, great thinkers have emphasized its importance in leading a productive and meaningful life. Aristotle, the renowned Greek philosopher, asserted that the body is the temple of the soul, and that true harmony among body, mind, and spirit can be achieved only through physical well-being. By their very nature, sports are enjoyable and challenging activities that demand skill, discipline, and sound physical condition.

Cardiovascular efficiency remains one of the most complex concerns in the field of physical education. Although extensive research has been conducted to develop the most appropriate instrument for

measuring physical fitness, efforts to establish a single, comprehensive test have met with only limited success. The physiological demands of different types of exercise vary considerably, making universal assessment difficult.

Despite these differences, professionals increasingly recognize one key indicator of overall fitness: the efficiency of the cardiorespiratory system. Among the various field methods available for assessing cardiorespiratory endurance, the modified Harvard Step Test is widely regarded as one of the most practical and reliable tools for evaluating cardiovascular fitness. “High sports performance,” wherein the game’s essence involves the interplay of skill, technical and tactical prowess, motor component development, and physiological parameters researcher by Singh et al. (2016; 2018)

Cardiovascular function refers to the ability of the heart and circulatory system to deliver oxygen and nutrients to working muscles and to remove metabolic waste products. This demand increases in direct proportion to the intensity of muscular activity. During vigorous exercise, the requirement for oxygen and energy rises significantly above resting levels, causing the heart rate and blood circulation to accelerate in order to meet the body’s needs. The efficiency and intensity of muscular performance largely depend on the adequacy of cardiovascular function. Cardiovascular efficiency may be defined as the capacity to sustain strenuous activity involving large muscle groups over an extended period of time without undue fatigue.

### **Statement of the Problem**

A player’s physical fitness is reflected in his or her performance, which in turn depends upon various motor abilities such as motor fitness, agility, speed, flexibility, reaction time, power, strength, balance, and endurance. These components collectively determine the efficiency and effectiveness of performance in competitive sports. Certain motor abilities assume greater importance in specific games. Therefore, it is essential to identify the key physical components most closely related to the demands of a particular sport. Although nearly all motor qualities contribute to overall performance, volleyball particularly demands higher levels of agility, power, and endurance. It has been observed during volleyball matches that many players struggle to sustain performance for extended periods. This limitation is often attributed to inadequate endurance. As a result, players may fail to adapt to the rapidly changing situations of the game and are unable to maintain consistent performance. Such shortcomings are frequently linked to insufficient agility, power, and cardiovascular endurance. The present statement of problem entitle *“Effects of aerobic exercise and swimming on the cardiovascular fitness of volleyball players in Sikkim”*.

### **Purpose of the Study**

The primary purpose of this study is to examine the effects of aerobic exercises and swimming on the cardiovascular fitness of volleyball players, particularly in the hilly state of Sikkim, where geographical conditions may influence physical performance and endurance.

**Hypothesis of the Study:** The study is based on the following hypothesis:

There will be a significant positive effect of aerobic exercises and swimming on the cardiovascular fitness of volleyball players in the hilly state of Sikkim.

**Delimitations of the Study:** The study is delimited to the following aspects:

1. The study is confined to 30 male volleyball student players of Sikkim Government College.
2. The participants have competed at the inter-collegiate level.

**Limitations of the Study:** The study has the following limitations:

1. The dietary patterns of the participants were not uniform.
2. The inherent potential and genetic predispositions of the participants were not known.
3. The timing of the tests varied.
4. The socio-economic backgrounds of the participants differed.

**Significance of the Study:** The significance of the study is justified on the following grounds:

1. The study will help determine the relative effectiveness of selected aerobic exercises and swimming in improving the cardiovascular fitness of volleyball players in the state of Sikkim.
2. The findings of the study will assist coaches in incorporating appropriate aerobic and swimming exercises into their training and coaching programmes to enhance players' performance

## **Methodology of the Study**

### ***Sources of Data and Sampling***

For the purpose of the study, 30 volleyball players of different age groups were selected from Sikkim Government College. The subjects were chosen through a random sampling method to ensure fairness and minimize bias in selection.

### ***Tools for the Test***

The following equipment was used for data collection:

- Stopwatch
- Whistle
- 20-inch bench
- Swimming pool
- Score sheets

**Harvard Step Test:** The Modified Harvard Step Test was used to assess cardiovascular endurance.

### ***Equipment Required:***

- 20-inch bench
- Stopwatch
- Score sheet

**Administration of the Test:** The test was administered according to the following procedure:

1. The subject stepped up and down on a 20-inch bench at a rate of 30 steps per minute. Each complete step consisted of four counts:
  - One foot placed on the bench
  - The other foot placed on the bench (standing erect)
  - One foot placed back on the floor
  - The other foot placed back on the floor

The cadence was maintained either with the help of a metronome or by counting rhythmically “up, up, down, down.”

2. The exercise continued for five minutes (300 seconds) unless the subject stopped earlier due to exhaustion. In such cases, the total duration of exercise performed (in seconds) was recorded.
3. Immediately after completing the exercise, the subject sat down. The pulse rate was counted during recovery at the following intervals:
  - Between 1 and 1.5 minutes
  - Between 2 and 2.5 minutes
  - Between 3 and 3.5 minutes after exercise

#### Calculation of Physical Efficiency Index (PEI)

The Physical Efficiency Index (PEI) was calculated using the following formula:

$$PEI = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{Sum of recovery pulse counts}}$$

**Scoring:** The score was obtained by applying the above formula. A higher PEI score indicated better cardiovascular efficiency and endurance.

**Classification of Physical Condition Based on PEI:** The Physical Efficiency Index (PEI) scores were interpreted according to the following classification:

Physical Condition	PEI Score
Excellent	90 and above
Good	80–89
High Average	65–79
Low Average	55–64
Poor	54 and below

**Tabulation of the Data:** To examine the effect of aerobic exercises and swimming on the cardiovascular fitness of volleyball players, the collected data were systematically tabulated. The *t*-test was employed as the statistical technique to determine the significance of differences between pre-test and post-test scores.

**Analysis of Data and Interpretation:** The level of significance was set at 0.05. The detailed statistical analysis and interpretation of the results are presented in the following tables.

**Table1: SUMMARY OF 'T' TEST OF EFFECT OF AEROBIC SWIMMING**

Pre-Training	Post-Training	Difference	Diff.Square
84.26	81.52	2.74	7.51
84.74	82.41	2.33	5.43
85.22	81.96	3.26	10.63
84.74	81.52	3.22	10.37
85.22	82.87	2.35	5.52
84.77	82.41	2.36	5.57
85.71	82.87	2.84	8.07
85.22	81.96	3.26	10.63
86.20	83.33	2.87	8.24
84.26	81.52	2.74	7.51
85.71	82.87	2.84	8.07
84.74	81.96	2.78	7.73
85.22	82.41	2.81	7.90
85.71	82.87	2.84	8.07
84.74	81.96	2.78	7.73
<b>Total:1276.44</b>	<b>1234.44</b>	<b>42.02</b>	<b>118.95</b>

Source:Primary Data

*T-Test* for Small Correlated Samples: Cardio-Vascular Efficiency of Swimmers. To determine the effect of training on the cardio-vascular efficiency of swimmers, a *t*-test for small correlated samples (paired *t*-test) was applied. The statistical details are presented below:

Variable	Pre-Training	Post-Training
Number of Students	15	15
Mean	82.296	85.097
Mean Difference		2.801
Standard Deviation of Difference		0.287
Standard Error		7.669
Degree of Freedom		14
Obtained <i>t</i> -Value		36.527
Table <i>t</i> -Value (0.05 level)		2.145

**Interpretation:** The obtained  $t$ -value (36.527) is considerably higher than the table value (2.145) at the 0.05 level of significance with 14 degrees of freedom. Therefore, the difference between pre-training and post-training mean scores is statistically significant. This indicates that the training programme had a significant positive effect on the cardio-vascular efficiency of the swimmers.

A significant difference was observed between the two sets of measurements taken for cardio-vascular efficiency. From the above table, it is evident that the mean score before training was 82.296, whereas after the training programme it increased to 85.097. The mean difference between the two tests was 2.801, and the standard deviation of the difference was 0.287. The obtained  $t$ -value (36.527) was far greater than the table value of  $t$  (2.145) at 14 degrees of freedom and at the 0.05 level of significance. Since the calculated value exceeds the critical value, the difference between pre-training and post-training scores is statistically significant. Therefore, it is concluded that aerobic training had a significant positive effect on the cardio-vascular efficiency of the swimmers.

**Table2:** SUMMARY OF 'T' TEST OF EFFECT OF AEROBIC SON VOLLEYBALLERS

Pre-Training	Post-Training	Difference	Diff.Square
85.22	82.41	2.81	7.90
84.74	81.96	2.78	7.73
85.71	81.96	3.75	14.06
85.22	81.52	3.70	13.69
84.26	81.52	2.74	7.51
84.74	82.41	2.33	5.43
85.71	81.96	3.75	14.06
85.22	81.96	3.26	10.63
84.74	81.52	3.22	10.73
85.22	82.41	2.81	7.90
84.74	81.52	3.22	10.73
85.22	82.41	2.81	7.90
84.74	81.96	2.78	7.73
85.22	81.52	3.70	13.69
85.22	81.96	3.26	10.63
<b>Total:1275.92</b>	<b>1229.00</b>	<b>46.92</b>	<b>149.58</b>

Source:Primary Data

*T-Test* for Small Correlated Samples: Cardio-Vascular Efficiency of Volleyballers. To assess the effect of training on the cardio-vascular efficiency of volleyball players, a paired  $t$ -test (small correlated sample) was applied. The statistical results are presented below:

Variable	Pre-Training	Post-Training
Number of Students	15	15
Mean	81.933	85.061
Mean Difference		3.128
Standard Deviation of Difference		0.433
Standard Error		0.116

Variable	Pre-Training	Post-Training
Degree of Freedom		14
Obtained <i>t</i> -Value		27.019
Table <i>t</i> -Value (0.05 level)		2.145

**Interpretation:** The obtained *t*-value (27.019) is much higher than the table value (2.145) at the 0.05 level of significance with 14 degrees of freedom. This indicates that the difference between the pre-training and post-training mean scores is statistically significant. Therefore, it may be concluded that the training programme produced a significant improvement in the cardio-vascular efficiency of the volleyball players.

A significant difference was found between the two measurements of cardio-vascular efficiency.

From Table 2, it is observed that the mean score of volleyball players before training was **81.933**, which increased to **85.061** after the training programme. The standard deviation of the difference was **0.433**. The obtained *t*-value (**27.019**) was considerably higher than the table value of *t* (**2.145**) at 14 degrees of freedom and at the 0.05 level of significance. Since the calculated *t*-value exceeds the critical value, the difference between pre-training and post-training means is statistically significant. Therefore, it is concluded that aerobic training had a significant positive effect on the cardio-vascular efficiency of volleyball players.

To compare the effect of aerobics on the cardio-vascular efficiency of players from both games, the *t*-test was again applied to the post-training scores of swimmers and volleyball players. The details of this comparative analysis are presented in Table 3.

**Table 3:** Summary of *t*-Test for Cardio-Vascular Efficiency: Comparison Between Volleyballers and Swimmers

Variable	Volleyballers	Swimmers
Number of Students	15	15
Post-Training Mean	81.933	82.296
Standard Deviation	0.123	0.123
Mean Difference	0.363	–
Obtained <i>t</i> -Value	2.072	–
Level of Significance	0.05	–
Degrees of Freedom	28	–
Tabulated <i>t</i> (0.05 level)	2.048	–

**Interpretation:** The obtained  $t$ -value (**2.072**) is slightly higher than the table value (**2.048**) at the 0.05 level of significance with 28 degrees of freedom. This indicates that there is a statistically significant difference between the post-training cardio-vascular efficiency of volleyball players and swimmers. Thus, it may be concluded that while both groups showed improvement, the effect of aerobic training on cardio-vascular efficiency was marginally greater in swimmers compared to volleyball players.

A significant difference was observed between the post-training means of volleyball players and swimmers. From Table 3, it is evident that the post-training mean of volleyball players was **82.296**, while that of swimmers was **81.933**. The standard deviation of the scores was **0.123**. The obtained  $t$ -value (**2.072**) is greater than the tabulated  $t$  (**2.048**) at 28 degrees of freedom and the 0.05 level of significance.

Therefore, it is concluded that aerobic training produced a significant improvement in the cardio-vascular efficiency of both volleyball players and swimmers, with a slightly greater effect observed in volleyball players.

### Summary:

Sports play a vital role in enhancing health and developing physical fitness among participants. They provide young people with a healthy and socially acceptable outlet for their physical and emotional energy, while also satisfying competitive and aggressive instincts in a constructive manner. Today, the term “sports” encompasses a wide range of activities, including games, athletics, and swimming, often pursued for recreation, competition, or skill development. Unlike athletics, where movements are largely repetitive and predictable, team games such as football, hockey, and basketball involve constantly changing patterns of movement, requiring quick adaptation and coordination. Physical education programs are designed to include a variety of activities, such as rhythmical exercises, aquatics, team and individual sports, minor games, self-defense, self-testing exercises, dance, bodybuilding, yogic practices, and corrective exercises, all aimed at holistic development of the individual.

### Discussion:

A review of the relevant literature provides important context for understanding the findings of the present study and highlights gaps that it aimed to address. S.T. Edward’s study on soccer and wrestling examined the differences in physical fitness and cardio-vascular endurance between athletes of these two sports. His findings emphasized that sport-specific demands influence cardio-vascular performance, suggesting that different activities may yield different adaptations in endurance and fitness. This supports the rationale for investigating sport-specific training effects in volleyball players. Swapan Mukherjee’s research on swimmers demonstrated that structured swimming training significantly improves physiological parameters and cardio-pulmonary efficiency. This reinforces the role of swimming as an effective aerobic exercise for enhancing cardiovascular fitness, indicating that similar benefits might be observed in athletes from other sports, including volleyball.

S.K. Mishra explored the effects of aerobic and anaerobic exercises on the attitudes of students toward physical education. His findings showed that both types of training positively influenced student attitudes, suggesting that aerobic activities not only improve physical fitness but can also enhance engagement and motivation in sports programmes. While Mishra’s study focused on psychological outcomes, it indirectly supports the inclusion of aerobic training in broader physical conditioning. Saraswathy’s study highlighted that aerobic and interval training significantly improved body

composition and haematological variables among college women. The findings indicate that aerobic exercise positively affects physiological parameters such as hemoglobin content, red blood corpuscle count, and body fat percentage—factors closely linked to cardio-vascular efficiency.

Padmanabhan’s research demonstrated that pranayama and interval training can enhance physiological variables, particularly breath-holding capacity. This underscores the importance of combining aerobic conditioning with breathing exercises to optimize cardio-respiratory function. Brose and Hanson investigated overload training in baseball players and found that it significantly improved velocity and accuracy of throwing. Their work confirms that structured and progressively challenging training protocols can elicit measurable improvements in sport-specific performance, suggesting that similar systematic aerobic and swimming interventions could enhance volleyball players’ endurance and overall cardio-vascular fitness.

Singh, L. S., Singh et al., (2024). The study concludes that a six-week plyometric training program positively influences the aerobic capacity, blood pressure, and pulse rate of football players. The findings highlight the importance of integrating plyometric training into football training regimens to enhance overall fitness. Coaches and trainers can gain valuable insights from this study for designing effective training programs. Future research should investigate the long-term effects and optimal duration of plyometric training for sustained benefits, as well as the underlying physiological mechanisms to better understand its effectiveness in sports conditioning.

From the reviewed literature, it is evident that while aerobic exercise, swimming, and interval training have been shown to improve physiological parameters and sport performance, there is a lack of research specifically addressing the effect of aerobic and swimming exercises on the cardio-vascular fitness of volleyball players, particularly in the hilly region of Sikkim. The present study was therefore undertaken to fill this gap. By evaluating the impact of aerobic and swimming exercises on volleyball players, it contributes to a better understanding of sport-specific cardio-vascular conditioning and provides practical insights for training programmes tailored to the unique demands of volleyball in the Sikkim region.

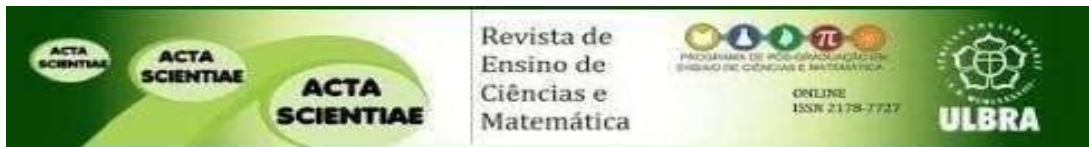
### Conclusions:

Based on a thorough analysis of the collected data, the following conclusions were drawn: Swimming exercises had a significant positive effect on the cardio-vascular efficiency of volleyball players. Aerobic exercises also produced a significant improvement in the cardio-vascular efficiency of volleyball players, complementing the effects of swimming.

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