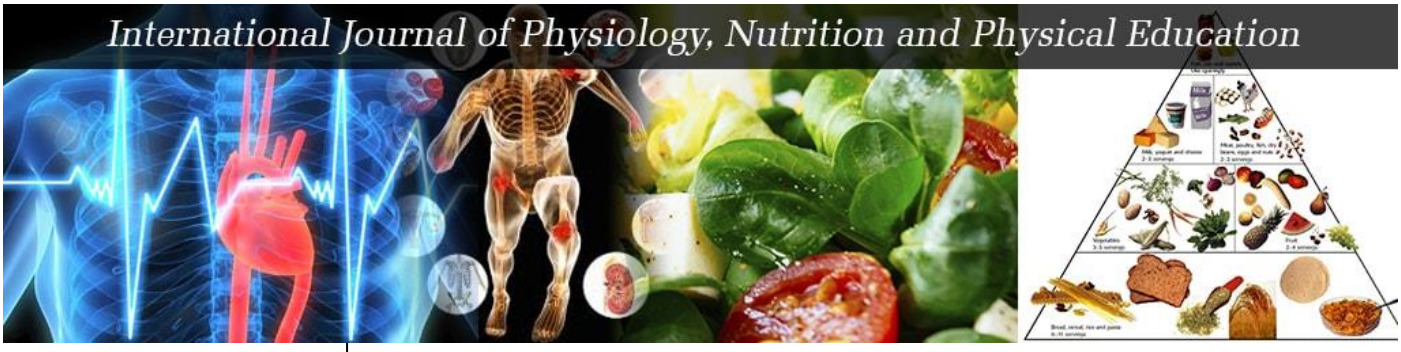

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Relationship of selected physiological variables with swimming performance

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Abstract
Man learned to swim long before it was possible for him to leave us any written record of his aquatic accomplishments (Robert Bartels, 1969) [9]. Heart rate testing is one of the most common forms of physiological monitoring, given the availability of several different heart rate monitors that can be used in the pool. Heart rates are often taken during sub maximal and maximal effort swimming to evaluate the response to different training sets. The purpose of the study was to investigate the relationship of physiological variables (Resting Heart rate, Breath hold time, Peak expiratory flow rate) with Short Distance swimming performance. For this study, 25 District level Short Distance male swimmers specialized in 50 meters free hand swimming from different clubs of West Bengal were considered as subjects. Subjects were selected purposively and the age of the subjects ranged 16 to 17 years. Correlation of co-efficient was employed to calculate the collected data at 0.05 level of confidence. The result showed that there was no significant Relationship of Swimming Performance with Resting Heart rate, Breath hold time and Peak expiratory flow rate. There was a positive relationship of resting heart rate and peak expiratory flow rate with swimming performance. As it is established fact that performance has an inverse relation with time. So it can be concluded that both variables ware negatively associated with each other in true sense. In case of breath hold time there was a negative relationship with swimming performance. As it is established fact that performance has an inverse relation with time. So it can be concluded that both variables were positively associated with each other in true sense.

Keywords: Swimmer, resting heart rate, breath hold time, peak expiratory flow rate

Introduction
Life was first sustained in water and that it took millions of years before it was established on land. Millions more passed before man came into being. As a land animal and man learned to walk upright, taking the weight of his body on his feet, and he discovered that the water, where he could no longer walk upright and employ his muscles as or land, was a source of danger (N.W. Sarsfield, 1965) [10]. Man learned to swim long before it was possible for him to leave us any written record of his aquatic accomplishments (Robert Bartels, 1969) [9]. Most animal swim by instinct, even those who do not really like water, and can swim at their first attempt by performing their accustomed movements of running (Edna Simms, 1963) [11]. Man, on the other hand, has to be taught this art and he finds the process of learning to swim somewhat artificial inspite of the fact that water is the first natural element for man Childhood is considered one of the most important stages in man's life. During this stage, a child's abilities develop and his talents mature and she/he gets manageable and docile. This makes the early years crucial for his/her future as they have a profound effect on his/her lifelong formation. This also makes the attention paid to childhood one of the most important criteria against which the progress of any society is measured. Heart rate testing is one of the most common forms of physiological monitoring, given the availability of several different heart rate monitors that can be used in the pool. Heart rates are often taken during sub maximal and maximal effort swimming to evaluate the response to different training sets. During swimming, peak heart rates are typically lower than those obtained on land (Astrand *et al.*, 1961, Holmer, 1974, Magel *et al.*, 1975) [12, 13, 14], Approximately 12 to 15 beats.min-1 when comparing maximal swimming to maximal running (Holmer, 1974) [13].
Several reasons for the blunted heart rate response in the pool have been proposed, including the utilization of a smaller muscle mass (Holmer, 1979, Magel *et al.*, 1975) [13, 14], or altered

hemo dynamics associated with a horizontal body position or reduced effects of gravity (Magel *et al.*, 1969) [16]. Studies of heart rates obtained from highly trained college swimmers using tethered and free swimming ranged from 181-186 beats.min-1 (Magel *et al.*, 1967) [17].

Magel and co-workers (Magel *et al.*, 1969) [16] reported that swim events of longer duration tend to elicit higher peak heart rates (~173 beats.min-1 for 50- 100 m versus ~181 beats.min-1 for 200-m events). With the exception of Breaststroke which tended to have a lower heart rate, there were no differences observed in heart rate between the other three swimming strokes (Magel *et al.*, 1969) [16].

It appears that establishing heart rate profiles for each individual swimmer in the various strokes employed in training is useful. Heart rate is a measure that coaches and scientists can routinely use in training as means of determining training intensity and evaluate changes in physical condition (Maglischo, 2003) [18].

Swimming is one of the most exciting of Olympic sports as it offers many challenges and attractions for sport and recreation purposes. Swimming is also an attractive pastime, its cardiovascular benefits being promoted for health and general fitness. Nowadays a considerable body of knowledge about swimming is available to sports scientists (Par minder pal Singh, 2016) [19]. In order for successful performance, the athlete needs well-developed physical characteristics specific to the requirements of swimming and the particular events in which they compete.

Swimming includes events involving four different strokes (freestyle, breaststroke, butterfly and backstroke) and a medley, where the one swimmer undertakes all in a predetermined order. Competitive pool swimming events are contested over distances ranging from 50- to 1500-m. These events are typically divided into sprint (50- and 100-m), middle distance (200- and 400-m) and distance (800- and 1500-m) categories. In the shortest sprint events in swimming (50-m freestyle and form stroke), which last only 22 to 30 seconds. The sprint athletes have a program that is more speed orientated, while the middle distance/distance swimmers focus more on developing speed endurance qualities to a greater extent. The volume of training varies from one individual to another, particularly at the elite level. It also varies according to the swimmer's current phase of training. While there are marked differences in training between different types of swimmers, there are several common elements. In a usual week, elite swimmers typically train for 8-10 sessions in the pool, and undertake several dry land and weight training sessions, and occasionally add cross-training activities such as running or cycling.

Swimming requires high muscle strength and technical ability in order to achieve a good performance. This sport involves four different swimming style including freestyle stroke, butterfly stroke, breaststroke and backstroke. In the swimming, performance depends on a number of factors including development of relevant muscle groups and anthropometry. Several researchers have indicated that development of relevant muscle strength is important to achieve a success (Gola *et al*., 2014) [6].

Methodology

The purpose of the study was to identify the relationship of Physiological variables with short distance swimming performance. For this study 25 Districts level Short Distance male swimmers, specialized in 50 meters free hand swimming from different clubs of West Bengal was considered as subjects. Subjects were selected purposively and the Age of the subjects ware ranged from 16 to 17 years. Correlation of co-efficient was employed to calculate the collected data at 0.05 level of confidence.

Criterion Measures

The following variables were selected to fulfill the objective of the present study and the tests were conducted to measure the parameters were

Variables	Measuring Tools	Unit of Measurement
Resting Heart rate	Stethoscope	Minute
Breath hold time	Stopwatch	Seconds
Peak expiratory flow rate	Peak flow meter	Best of 3 attempts

Findings of the study

The strength of Correlation of Co-efficient

The structure of strength of relationship is shown in the following table

Range	Strength of association
0 (zero value)	Zero relation or absolutely no relationship
From 0.01 to ± 0.20	Slight or almost negligible relationship
From ± 0.21 to ± 0.40	Low correlation or small relationship
From ± 0.41 to ± 0.70	Moderate correlation
From ± 0.71 to ± 0.90	High correlation or marked relationship
From ± 0.91 to ± 0.99	Very high correlation or quite dependable relationship
± 1	Perfect correlation

Table 1: Relationship of Resting Heart Rate and Performance Level of Short Distance Swimmers

Name of the Variables	Mean	Standard Deviation	Standard Error	Highest Score	Lowest Score	'r' Ratio
RHR	78.72	11.49	2.298	108	60	0.23
Performance (Seconds)	26.72	0.87	0.174	28.13	25.5	

*Significant at $r_{0.05}$ (2, 23) = 0.396

From the above table- 1, it is clearly seen that in respect of resting heart rate of short distance swimmers, mean and standard deviation were 78.72 and 11.49 with standard error 2.298 and in performance of swimmers, mean & standard deviation were 26.72 and 0.87 with standard error 0.174. The table also reflected that the correlation of coefficient was 0.23 which was lower than the tabulated value [$r_{0.05}$ (23) = 0.396]. So there was positive non-significant relationship existed between resting heart rate and performance. As we know it is established fact that performance has an inverse relation with

time. So it can be concluded that both variables ware inversely associated with each other in true sense. The strength of relationship was low between them. Swimming lowers resting heart rate. Resting heart rate refers the rate at which the heart beats when a person isn't doing anything physically strenuous, according to the National Emergency Medicine Association. A resting heart rate of between 60 to 90 is considered normal, but regular exercise and a high level of fitness can lower this to the 40 to 60 range. Swimming exercises the heart, and teaches the body to use oxygen more efficiently compared to other forms of exercise, notes the Harvard Health Newsletters. Using heart rate training you would significantly improve efficiency of our workout and boost our swimming performance. As the relationship is negative we can say that in this study resting heart rate is not influencing swimming performanceofshort distanc swimmers.

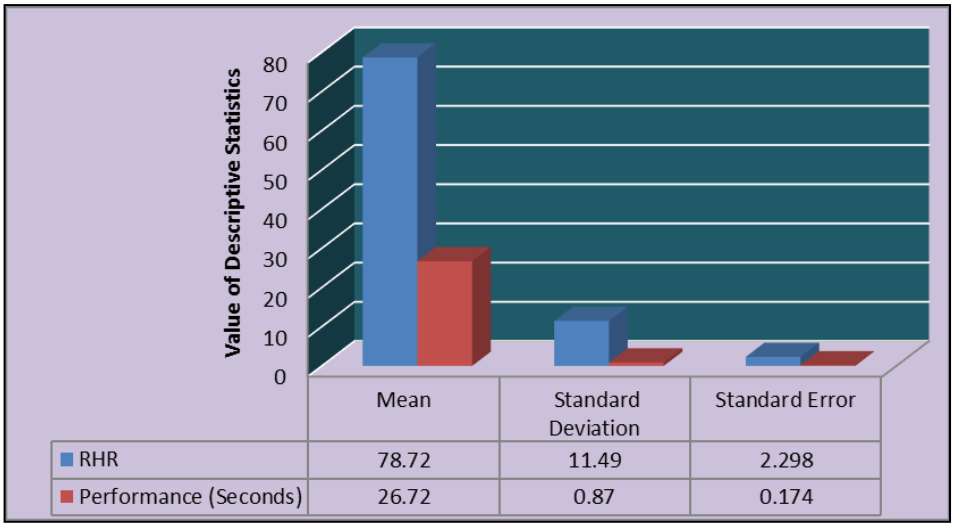

Fig 1: Graphical presentation regarding relationship of resting heart rate and performance level of short distance swimmers

Table 2: Relationship of breath hold time and performance level of short distance swimmers

Name of the Variables	Mean	Standard Deviation	Standard Error	Highest Score	Lowest Score	'r' Ratio
BHT	37.35	13.23	2.646	66	12.88	-0.08
Performance (Seconds)	26.72	0.87	0.174	28.13	25.5	

*Significant at $r_{0.05}$ (2, 23) = 0.396

From the above table- 2, it is clearly seen that in respect of breath hold time of short distance swimmers, mean and standard deviation were 37.35 and 13.23 with standard error 2.646 and in performance of swimmers, mean & standard deviation were 26.72 and 0.87 with standard error 0.174. The table also reflected that the correlation of coefficient was -0.08 which was lower than the tabulated value [$r_{0.05}$ (23) = 0.396]. So there was negative non-significant relationship existed between breaths hold time and performance. As we know it is established fact that performance has an inverse relation with time. So it can be concluded that both variables ware positively associated with each other in true sense. The strength of relationship was slight between them. Holding our breath can improve our energy, endurance and conditioning – all of which are extremely important for athletic performance. Holding our breath, especially under water, forces blood flow into our organs, improving their health, and possibly our cognition as well. As the relationship is positive we can say that in this study breath hold time is influencing swimming performance of short distance swimmers.

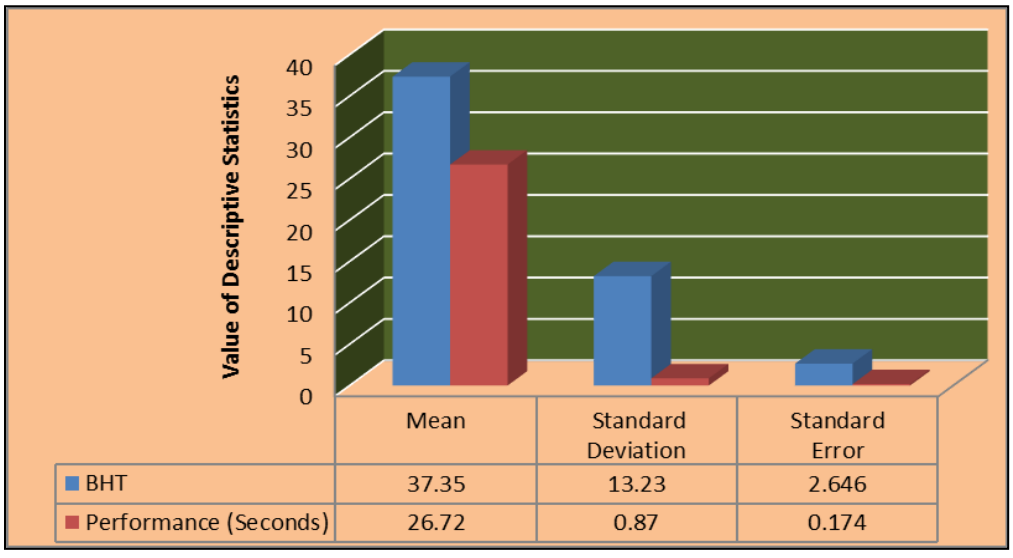

Fig 2: Graphical Presentation Regarding Relationship of Breath Hold Time and Performance Level of Short Distance Swimmers

Table 3: Relationship of Peak Expiratory Flow Rate and Performance Level of Short Distance Swimmers

Name of the Variables	Mean	Standard Deviation	Standard Error	Highest Score	Lowest Score	'r' Ratio
PEFR	373.6	13.23	2.646	490	190	0.03
Performance (Seconds)	26.72	0.87	0.174	28.13	25.5	

*Significant at $r_{0.05}$ (2, 23) = 0.396

From the above table- 3, it is clearly seen that in respect of peak expiratory flow rate of short distance swimmers, mean and standard deviation were 373.6 and 13.23 with standard error 2.646 and in performance of swimmers, mean & standard deviation were 26.72 and 0.87 with standard error 0.174. The table also reflected that the correlation of coefficient was 0.03 which was lower than the tabulated value [$r_{0.05}$ (23) = 0.396]. So there was positive non-significant relationship existed between peak expiratory flow rate and performance. As we know it is established fact that performance has an inverse relation with time. So it can be concluded that both variables ware inversely associated with each other in true sense. The strength of relationship was slight between them. Swimming involves high pressure on the thorax from outside. So the respiratory muscles and the diaphragm are required to develop greater pressure as a consequence of immersion in water during the respiratory cycle, thus leading to functionally better respiratory muscles. Also the heat conductance of water is more than that of air. Regular swimming practice may tend to alter the elasticity of the lungs and the chest wall which leads to improvement in lung functions in swimmers. As the relationship is negative we can say that in this study peak expiratory flow rate is not influencing swimming performance of short distance swimmers.

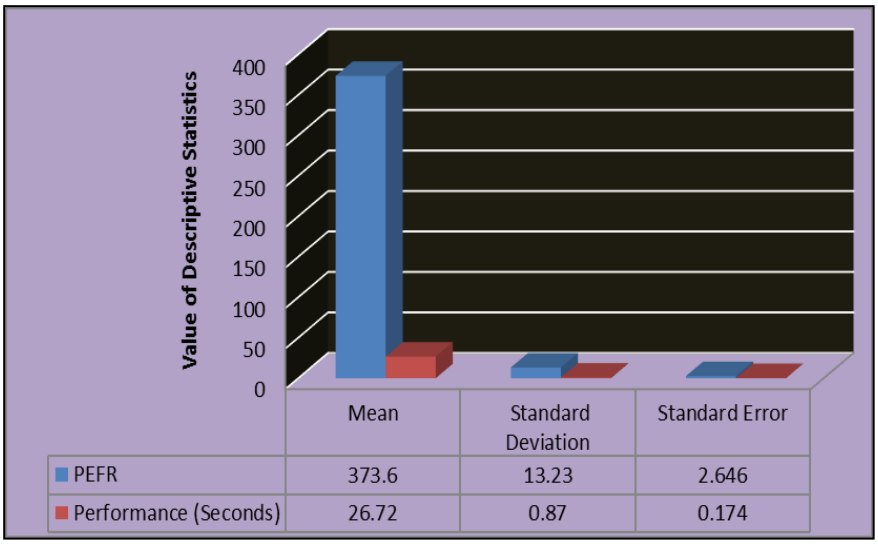

Fig 3: Graphical Presentation Regarding Relationship of Peak Expiratory Flow Rate and Performance Level of Short Distance Swimmers

Discussion of Findings

The findings on the basis of the results revealed that no significant association were found in relation to resting heart rate, breath hold time and peak expiratory flow rate with performance of short distance swimmers. As the relationship is positive we can say that in this study breath hold time is influencing swimming performance of short distance swimmers. The swimmers in our study were young (16-17 years) and it was seen that swimmers of age group 16-17 years had higher power values on the power testing. Young age and training load led to higher muscular power production in swimmers. Results were seen in the studies which found that swimmers had been achieving peak performances in a very younger age with the help of their muscle power. As we have taken a short distance swimming the other factors such as resting heart rate and peak expiratory flow rate does not affect swimming performance. Swimmers of the present study performed high intensity short distance swimming sprints; therefore an increase in the value of girths and diameters resulted in increased power values. Cross sectional area of the muscle was presented with increased muscle strength generating characteristics. Since swimmers of our study demonstrated muscularity and increased cross-sectional area, it led to greater muscular power and thus decreased swimming time as it would improve the propulsive efficiency. On the other hand, a number of other studies had emphasized the important role of 'muscular power' as a determinant of athletic performance.

Conclusion

The Physiological variables of short distance swimmers namely resting heart rate, breath hold time and peak expiratory flow rate are not significantly related to the performance level of short distance swimmers. The Physiological variables of short distance swimmers namely resting heart rate and peak expiratory flow rate have positive relation with the performance level of short distance swimmers but as we know it is established fact that performance has an inverse relation with time. So it can be concluded that both variables ware inversely associated with each other in true sense. The Physiological variables of short distance swimmers namely breathe hold time have negative relation with the performance level of short distance swimmers but as we know it is established fact that performance has an inverse relation with time. So it can be concluded that both variables ware positively associated with each other in true sense.

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