

Letter To Editor

Effect of physical training on breath holding time in Indian subjects

(Received on March 1, 2013)

Sir,

Breath holding time is the time taken by the subject to hold his breath as long as he can. During voluntary breath holding, tissues continue to utilize oxygen and liberate carbon dioxide. Therefore during breath holding arterial pO₂ falls and pCO₂ rises. Since both these factors are powerful respiratory stimulants, a point is reached where the respiratory drive becomes so strong that the person cannot hold the breath any longer (1). The point at which breathing can no longer be voluntarily inhibited is called the breaking point. The breaking point is generally reached when alveolar pO₂ is 56 mm of Hg and alveolar pCO₂ is 49 mm of Hg. Either an increase in pCO₂ or a decrease in pO₂ stimulates central and peripheral chemoreceptors which in turn stimulate respiration through respiratory centers, thus influencing breath holding time.

Normal Breath holding time (BHT) is 45-55 seconds (2). Breathing can be voluntarily stopped for a variable period which depends on mechanical factors like lung volume, chemical factors like pCO₂, pO₂ and H⁺ ion concentration, non-chemical factors like involuntary muscular contractions, psychological factors like motivation, stress, competition, extrinsic factors like training (3,4) and muscular exercise. BHT is prolonged for about 5 minutes after hyperventilation. Hyperventilation is a state of rapid and deep breathing that leads to increased volume of air moving into and out of the lungs per unit time. Hyperventilation washes off carbon dioxide very effectively and improves oxygen supply to the lungs marginally. As a result, arterial pCO₂ falls markedly and pO₂ rises slightly. The fall in pCO₂ depresses the respiratory center. Hence the urge to breathe is diminished after hyperventilation (1). Hyperventilation should not be carried out for

prolonged periods, as the resulting alkalosis may precipitate an attack of tetany (5). When done for over a minute, hyperventilation causes the arterial pCO₂ to fall from the normal level of 40 mm Hg to 15-20 mm Hg. This leads to vasoconstriction of cerebral blood vessels and dizziness following reduced oxygen supply to the brain.

An athlete is a person who is trained to compete in a sport involving physical strength, speed or endurance. Physical training influences BHT. There are only few studies done on BHT of athletes particularly in India. Hence this study was undertaken to determine and compare the breath holding time in athletes and non-athletes. This cross-sectional study was conducted among 30 healthy non-athletes and 30 healthy athletes which includes runners and swimmers from Chennai. Females were not included in this study. Based on the current level of daily physical activity, non-athletes who were relatively inactive and athletes are doing very vigorous physical activity both aerobic and anaerobic for 60 minutes, 4-5 days per week were selected (6). Their age group ranged between 17 to 25. After a period of rest for 2 to 3 minutes, the subject was asked to pinch the nostrils with thumb and index finger before starting to hold the breath in all procedures. The subject was instructed to hold his breath as long as possible at the end of quiet inspiration, at the end of maximum inspiration and at the end of hyperventilation (deep and fast breathing for 20 times) and the breaking point time was noted in seconds using a stopwatch. The procedure was repeated thrice at 5 minutes interval and best of the three efforts was noted down.

Statistical package for social science (SPSS 12.0) is used for statistical analysis. The results were expressed as Mean±Standard Deviation (S.D). Independent t test was applied to analyze the

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TABLE I : Breath holding time between athletes and non-athletes.

Parameters	Athletes (n=30)	Non-athletes (n=30)	P value
Normal inspiration (sec)	58.70±10.16	33.13±15.59	<0.001
Deep inspiration (sec)	74.77±13.59	48.27±16.02	<0.001
Hyperventilation (sec)	94.57±13.20	62.20±21.68	<0.001

Data presented are mean±SD. Analysis of data was done by independent t-test.* P-value < 0.05 was considered significant.

statistical significance of voluntary breath holding in athletes and non-athletes. P value of <0.05 was taken as significant. From the results we have found that breath holding after inspiration and after deep inspiration is higher in athletes which were statistically significant (P<0.05). This may be due to larger initial lung volumes. This greater lung volume could be due to increase in the strength of the respiratory muscles (7) which in turn decreases the involuntary contractions of the respiratory muscles and thereby lessens the discomfort of breath holding. Our study also showed that BHT after hyperventilation

is significantly greater than other variables in athletes compared to non-athletes. This shows that breath holding time is determined by the initial pCO₂, and decreased sensitivity of the respiratory centre to pCO₂.

To conclude, regular physical training increases the amount of oxygen delivered to the tissues and removal of carbon dioxide from the body. Physical training enhances the respiratory efficiency by increasing the strength of diaphragm and intercostal muscles, and by increasing the number of alveoli. It increases the vital capacity and prolongs the breath holding time. Breath holding training is useful in athletes to improve their respiratory endurance and their performance. Breath holding test is used as a rough index of cardiopulmonary reserve. BHT of less than 20 seconds indicates diminished cardiac or pulmonary reserve. Measures should be taken to increase physical activity among non-athletes to improve the ventilatory function and vital functions of the body to lead a good quality life.

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