Calculation of Human respiratory system after Physical activity of sportsperson

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Abstract

A lung consisting of a series of body parts including the lungs, diaphragm and nasal cavity, the respiratory system is responsible for transporting oxygen and carbon dioxide to and from muscles and tissues. During exercise, the respiratory system increases to meet the demands of the working muscles. The respiratory system also uses the cardiovascular system -- heart, blood and blood vessels -- to transport oxygen and carbon dioxide. Due to the effect of exercise on respiratory system the lungs volume increase as a result of increase in vital capacity. The breathing frequency is decreased in trained individuals. After the training the maximum minute ventilation is increased. Tidal volume is also increased. Through the physical exercise ventilatory efficiency is also enhances. Gas exchange capacity is also increased.

Key words : Respiratory system, lungs, diaphragm and nasal cavity, breathing

Introduction

Before describing the impact of physical exercise or training on respiratory system, one must have knowledge about this system. Nutrients release energy for doing any work or activity; the process of release of energy from nutrients is called respiration. The respiration system consists of organs responsible for taking in oxygen for respiration and releasing carbon dioxide and water vapour, which are the waste products formed during respiration. The passages in the nose, windpipe (trachea), bronchi, lungs, and air sacs are the main organs of the respiratory system. Many parameters of respiratory system get affected due to physical exercises/training particularly aerobic or endurance training. A lung consisting of a series of body parts including the lungs, diaphragm and nasal cavity, the respiratory system is responsible for transporting oxygen and carbon dioxide to and from muscles and tissues. During exercise, the respiratory system increases to meet the demands of the working muscles. The respiratory system also uses the cardiovascular system -- heart, blood and blood vessels -- to transport oxygen and carbon dioxide.

Lungs volume

With endurance training lung volume and capacities increase. Vital capacity, which maximal volume of air forcefully, expelled after a maximal inspiration is increased after endurance training.

Respiratory rate or breathing frequency (BF)

Breathing frequency is the number of breath per minute. After training, breathing frequency or respiratory rate is decreased. In normal untrained individual the resting breathing frequency is about 12-20 breath/minute.

Maximum minute ventilation

Minute ventilation is the amount of air, which inspires or expires in one minute. After training maximum minute ventilation is increased.

Tidal volume

The tidal volume, which is the amount of air inspired or expired per breath, is also increased as a result of endurance training.

Ventilatory efficiency

With physical exercises/training particularly endurance training our ventilator efficiency increases.

Pulmonary diffusion

Pulmonary diffusion is the exchange of gases taking place in the alveoli. During maximal level of exercises more alveoli become active for diffusion.

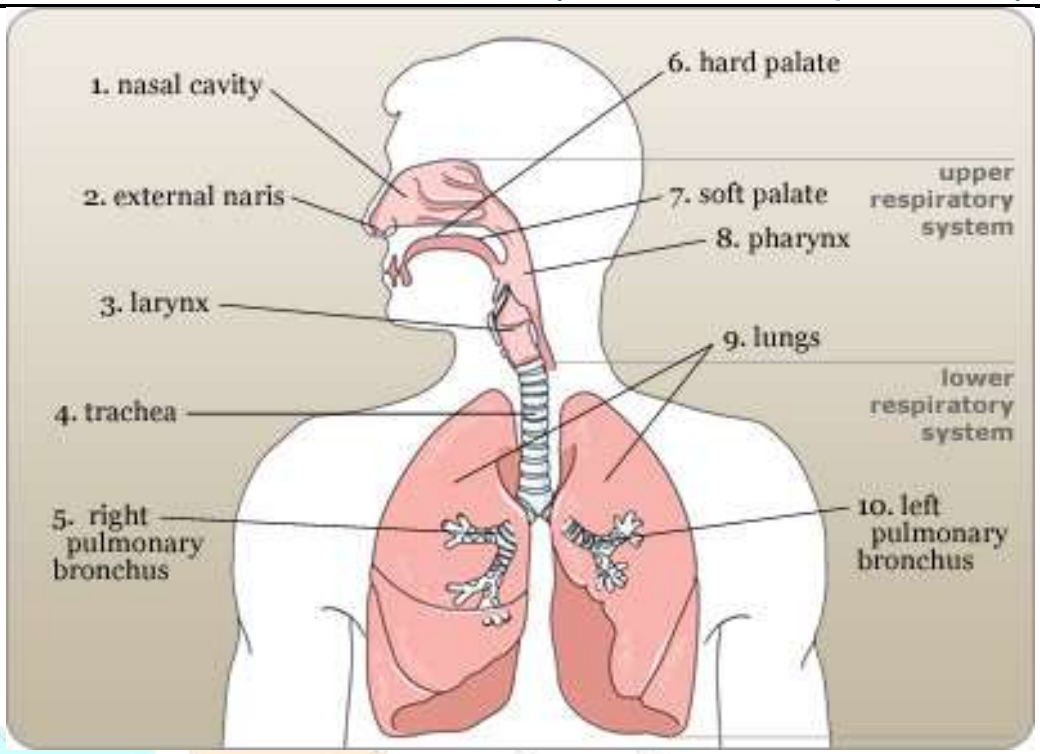


Diagram 1.1 Respiratory system

Your heart speeds up to pump extra food and oxygen to the muscles. Breathing speeds up to get more oxygen and to get rid of more carbon dioxide. When a fit person, such as an athlete, exercises the pulse rate, breathing rate and lactic acid levels rise much less than they do in an unfit person.

Effects of physical activity and sports on the respiratory system mainly depend on changes in alveolar CO2 levels. Here, after analyzing basics of oxygen transport (changes in CO2 and O2 concentrations in the blood and cells). Respiratory system is responsible for breathing. Respiratory system is divided into two parts like, Upper Respiratory Tract (URT) and Lower Respiratory Tract (LRT). In URT it consists of Nasal Cavity, sinuses, pharynx and larynx and in LRT, it contains trachea, lungs, diaphragm and bronchi. The human respiratory system is a series of organs responsible for taking in oxygen and expelling carbon dioxide. The primary organs of the respiratory system are lungs, which carry out this exchange of gases. The lungs act as the functional units of the respiratory system by passing oxygen into the body and carbon dioxide out of the body.It corresponds with several of the major scientists in this area over the past 50 years, who have shared their personal motivation to study respiration and exercise, their own perception of their contributions, and the important questions that remain unanswered in the field. The Englishman, John Mayow (1645-1679) modeled the lung and thorax mechanical interactions and recognized the principle of elastic lung recoil. The Scottish physician, Johannas Carson made the first measurements of lung elasticity in the early nineteenth century and described the battle between muscle and elastic forces as: “Breathing is in a great measure the effect of this interminable contest between the elasticity of lungs and the irritability of the diaphragm.” The golden age of the quantitation of breathing mechanics spanned around the 1940s-1960s. The scientific giants of this era in breathing mechanics research—most of them physicians—included Wallace Fenn (1893-1971), Herman Rahn (1912-1990), Jere Mead, and Arthur Otis, and a little later, Richard Riley, Moran Campbell, Joseph Milic-Emili, SolbertPermutt, Peter Macklem, and Robert Hyatt. In the past decade, some progress has been made in estimating the oxygen and blood flow required by the respiratory muscles for exercise hyperpnea. Hyatt's fundamental concepts of flow limitation revealed the complexity of the nature of the mechanical loads, which occur once expiratory flow limitation begins during exercise. In the late eighteenth century, it was shown that O_2 uptake and CO_2 output in humans actually increased with muscular exercise. The resulting studies on the non-steady state of exercise made it clear that the challenges to the exchange of pulmonary gases are different for O_2 uptake and CO_2 output during the phase in which the mixed-venous gas tensions change as a result of increased muscle gas exchange. Exercise and the respiratory system in healthy people Consider the short-term effects of exercise in healthy people. Textbooks on exercise physiology suggest that, in fit and healthy people, arterial CO2 levels rise slightly with light, moderate, medium and sub maximum exercise intensity levels regardless of the route of breathing during exercise (mouth or nasal or combined). Since CO2 is the powerful

vasodilation agent, expanded arteries and arterioles improve blood and O2 delivery to all vital organs of the human body, including the heart and brain. Vasodilation ensures aerobic respiration in body cells making it possible for healthy people to enjoy all the benefits of aerobic exercise without any major problems related to tissue hypoxia causing excessive blood lactate, muscle spasms, injuries, low recovery rates, overexcitement, stress, poor sleep later, etc. Consisting of a series of body parts including the lungs, diaphragm and nasal cavity, the respiratory system is responsible for transporting oxygen and carbon dioxide to and from muscles and tissues. During exercise, the respiratory system increases to meet the demands of the working muscles. The respiratory system also uses the cardiovascular system -- heart, blood and blood vessels -- to transport oxygen and carbon dioxide.

Oxygen Transport

To meet the increasing oxygen demands from the working muscles, additional oxygen must be transported through the blood vessels. During exercise, the sympathetic nerve stimulates the veins to constrict to return more blood to the heart. This blood is carrying carbon dioxide from the muscles and can increase the total stroke volume of the heart by 30 to 40 percent.

Respiratory Rate

With an increased amount of oxygen and carbon dioxide transport, your respiratory rate -- rate of breathing -- also increases. This increase is also influenced by the sympathetic nerves stimulating the respiratory muscles to increase the rate of breathing. At rest, your respiratory rate is about 14 per minute but can increase to 32 per minute during exercise. The increased respiration rate allows more oxygen to reach the lungs and blood to be delivered to the muscles.

Long Term Response

A long-term respiratory system response to exercise involves several physiological adaptations. These adaptations ultimately result in an increase in overall efficiency of the respiratory system to gather, transport and deliver oxygen to the working muscles. The long-term respiratory function is commonly measured with a VO2 max test that calculates your body's ability for oxygen consumption during maximal exercise. Through exercise and training, the effectiveness of the respiratory system and VO2 max improve.

The respiratory system controls your breathing, providing oxygen to your body and eliminating carbon dioxide. Exercise causes muscle movement, increasing carbon dioxide in your body and resulting in an increased respiratory rate -- the frequency of breaths per minute -- to eliminate it from your bloodstream.

Average Resting Respiratory Rate

Normal respiration rate, which we all experience throughout the day, is a passive process controlled by the respiratory system, located in the medulla oblongata of the brain. This normal respiration rate remains constant most the day, but with the initiation of exercise, there is a dramatic change. The resting breathing rate is dependent on age, sex, size, health and lung capacity.

Average Respiratory Rate During Exercise

Respiration rate during exercise depends on several factors, including level of activity, altitude, lung capacity and health. Higher levels of activity and altitudes increase respiration rate. Good health and larger lung capacity typically decrease it. The mechanism at play is the release of epinephrine during exercise, increasing the body's temperature, causing an increased need to breathe more.

Breathing Rate Post Exercise

After exercise has stopped, extra oxygen is required to metabolize the built-up lactic acid and to replace any oxygen that has been borrowed from the muscle fibers, air in the lungs and body fluids. To cure this oxygen debt, labored breathing continues after exercise to regain oxygen and to restore homeostasis in the body.

Calculate Your Average Breathing Rate

Your breathing rate and amount of time it takes to restore the body after exercise depends on the individual and the quantity of carbon dioxide in the blood. Once homeostasis is achieved, breathing rate will return to normal rate. To find your average breathing rate, count the number of breaths you take per minute while resting, exercising and post-exercise five times, then add the numbers together per activity and divide by five to get your average.

Long-Term Effects of Exercise on the Respiratory System

Your respiratory system controls your breathing and begins when you draw in air through your nose or mouth. The air travels through your windpipe into both of your lungs, where small air sacs capture oxygen and distribute it in your bloodstream through small blood vessels called capillaries. Your diaphragm is the muscle

the controls respiration and contracts when you inhale. Your diaphragm then relaxes, collapses your chest and forces out carbon dioxide when you exhale.

Alveoli

Capillaries surround small air sacs, called alveoli, inside your lungs that capture the oxygen you breathe in. Your lungs adapt to regular exercise by activating more alveoli. More alveoli can supply more oxygen to working muscles and tissues throughout your body. Pneumonia occurs when fluids in your lung prevent alveoli from exchanging gases. Having more alveoli can suppress the effects of pneumonia by reducing the proportion of alveoli that are affected by this disease. Emphysema occurs when alveolar walls break down and gradually reduce the exchange of oxygen and carbon dioxide in your lungs. Regular exercises may help slow the progression of emphysema by increasing the number of gas-exchanging alveoli.

Mucus

Exercise exposes your lungs to stronger rushes of airflow. Aerobic exercise in particular exposes your lungs to strong and constant rushes of air. This activity helps clear mucus in your lungs. Mucus build-up can diminish your lung capacity and lead to bacterial infections. According to a 1997 "European Respiratory Journal" article by the University of Ulsan's Wong Don Kim, excessive mucus in your lungs is associated with higher mortality, may obstruct airflow and increases your risk of infections. Regular exercise can help offset these conditions by preventing mucus from building up in your lungs.

Capillaries

Capillaries are the smallest blood vessels in your body. Oxygen seeps out of thin capillary walls as carbon dioxide seeps in during respiration. Exercise stimulates vasodilation, which increases the diameter of blood vessels in your body, including the capillaries. Your body adapts to long-term exercise by increasing the size and number of capillaries, including alveolar capillaries. This adaptation makes the exchange of carbon dioxide and oxygen more efficient.

Muscles

The skeletal muscles that control respiration include your diaphragm and intercostals. Your diaphragm is a broad band of muscle that sits under your lungs and forms the base of a region known as the thoracic cavity by attaching to the lower parts of your ribs, sternum and spine. The intercostals form the muscle tissue in between individual ribs. The long-term effect of exercise is to build the endurance of these respiratory muscles, allowing deeper, fuller and more efficient breaths.

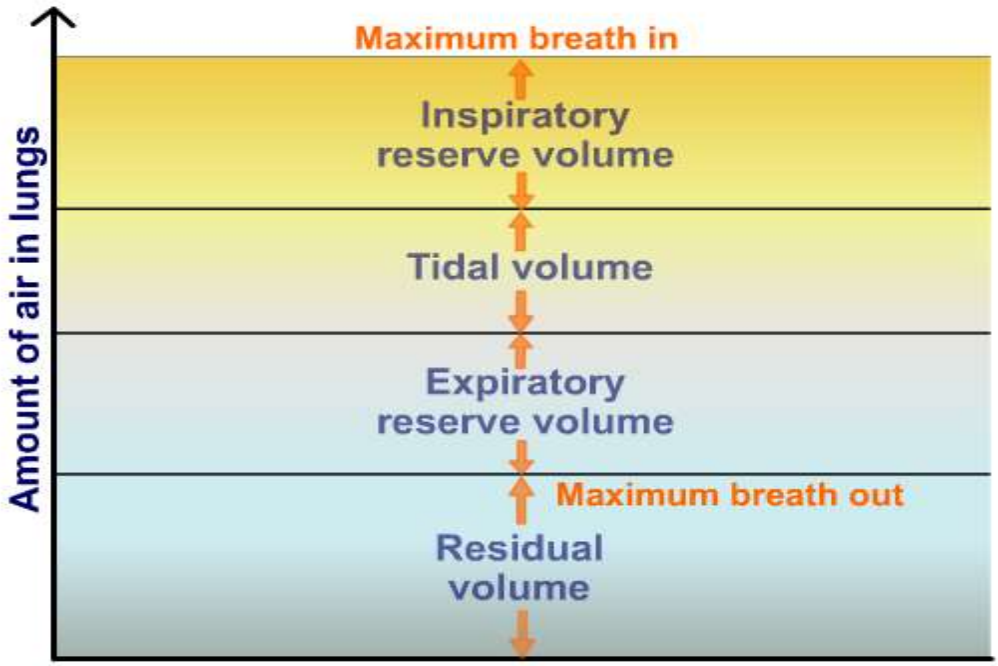


Figure 1.3 Measurement of breathe

It is normal to get breathless during exercise. However, regular exercise can increase the strength and function of your muscles, making them more efficient. Your muscles will require less oxygen to move and they will

produce less carbon dioxide. This will immediately reduce the amount of air you will need to breathe in and out for a given exercise. Training also improves your circulation and strengthens your heart.

Exercise will improve your overall physical and psychological well-being. It can decrease the risk of developing other conditions such as stroke, heart disease and depression. Regular exercise is also one of the most important interventions to prevent the onset of type-II diabetes.

The primary functions of the cardiovascular and respiratory systems are to provide the body with oxygen (O2) and nutrients, to rid the body of carbon dioxide (CO2) and metabolic waste products, to maintain body temperature and acid-base balance, and to transport hormones from the endocrine glands to their target organs (Wilmore and Costill 1994). To be effective and efficient, the cardiovascular system should be able to respond to increased skeletal muscle activity. Low rates of work, such as walking at 4 kilometers per hour (2.5 miles per hour), place relatively small demands on the cardiovascular and respiratory systems. However, as the rate of muscular work increases, these two systems will eventually reach their maximum capacities and will no longer be able to meet the body's demands.

Table 1. Composition of inhaled and exhaled air

Gas	Amount in inhaled air	Amount in exhaled air
Oxygen	21%	17%
Carbon dioxide	Very small amount	3%
Nitrogen	79%	79%
Water vapour	Small amount	Large amount

Material and Methods

To find out the percentage of among football, cricket, and athletics player; to check out the nature of effect of exercise on respiratory system for physical strength.

Research Methodology

The methodology that was used to carry out this study is defined as an operational framework within which the facts are placed so that their meaning may be seen more clearly. The task that follows the definition of the research problem is the preparation of the design. The methodology of this research includes the research design, population to be studied and sampling strategy, the data collection process, the instruments used for gathering data, and how data was analyzed and presented. A quantitative cross-sectional study design was chosen to accomplish the objectives of the study. Fifteen subjects were selected through convenience sampling procedure from Barkatullah university ground Bhopal by sing a structural introduction to collect the information. **R**esearch is based on researcher's personal observation & critical thinking after the observation of several international books & concern Wikipedia related with cardio vascular fitness & exercises.

Study Design

The purpose of the study was to find out to explore various changes in respiratory system of the body with respect to the physiological mechanism involved as well as to the relevant training factor. The teachers of physical education, coaches, sports, persons and students of physical education must be aware about the effect of physical exercises training on various systems to realize the qualitative changes in the body for better performance.

Our body has many systems. Respiratory System is one of them which plays an important role in our body.

Respiratory system is a systematic series of vessels that transport oxygen to the tissues from the lungs & back to the lungs.

A cross sectional prospective survey design is chosen because data were collect from samples at one point of time and the questions are asked retrospectively on events, sites and feelings (Bowling, 1998). Survey

researches describe parameters of population and predict relationship among these characteristics (Depoy&Gitlin, 1998). The goals of the quantitative research are to answer a specific research question by showing statistical evidence that the data may be addressed in a particular way (Bailey, 1997). A survey is a research which involves collecting information from a large number of people using interviews, in order that an overall picture of that group can be described in terms of any characteristics which are interest to the research (Hicks, 1999). The advantages of survey design are that one can reach a large number of respondents with relatively minimal expenditure, numerous variables can be measured by a single instrument, and statistical manipulation during the data analytical phase can permit multiple use of the data set (Depoy&Gitlin, 1998). The most common survey approach is the prospective design which focuses particularly on present events (Hicks, 1999). So, for conducting of this study a cross sectional prospective survey approach was used.

Study site

Bhopal is the capital of Madhya Pradesh situated in central part of India. Barkatullah University situated in Bhopal.

Sample selection

Samples were selected by convenience sampling technique, easily to find out the data for my study purpose.

Data collection

Data collection is one of the most crucial parts of research. For this study data collection includes- method of data collection-, materials used for data collection, duration and procedure of data collection.

Duration of data collection

The duration of data collection was 5th January to10 June. To collect data necessary time was taken, for each participant. It was taken 20-30 minute to complete each interview.

Data analysis

Data was analyzed using descriptive and inferential statistics. This enabled the researcher to make possible predictions about the study. The descriptive statistical tools helped the researcher to describe the data and determine the extent to be used. The findings were presented using tables and charts. Data analysis used and Microsoft excels, percentages, tabulations, means. Tables were used to summarize responses for further analysis and facilitate comparison. This generated quantitative reports through tabulations, percentages, and measure of central tendency. Notes that the use of percentages is important for two reasons; first they simplify data by reducing all the numbers to range between 0 and 100. Second, they translate the data into standard form with a base of 100 for relative comparisons.

Inform consent

The aims and objectives of this study should be informed to the subjects verbally. Before conducting research with the respondents, it is necessary to gain consent from the subjects (Bailey, 1997). The consent form was given to the subject and explained them. The subjects had the rights to withdraw themselves from the research at any times. It should be assured the participant that her name or address would not be used. The information of the subjects might be published in any normal presentation or seminar or writing but they would not be identified. The participant will also be informed or given notice that the research result would not be harmful for them. It would be kept confidential. Every participant has the right to discuss about her problem with senior authority.

Result and Discussion

Exercise effect in various way the respiratory system and their frequency, during the rest the frequency is different and after exercise the frequency is different.

Table. 4.1 MV (Minute Ventilation) and Rf (Respiratory Frequency) at rest

Condition	MV, L/min	Rf, breaths/min	Oxygen extraction, %	Breath pattern	References (click below for details)
Diseases*	12-18	>18	<12 %	Overbreathing	Over 40 studies
Healthy	6-7	10-12	25 %	Normal	Results of 14 studies
Norm	6	12	25 %	Normal	Medical textbooks
Super-health	2	3	>60 %	Ideal	Observations/yoga

As it is easy to observe, heavy breathing at rest results in relatively heavy breathing during exercise and that makes moderate or intensive exercise in the sick very difficult or impossible.

Table. 4.2Minute ventilation during moderate exercise (15-fold metabolism)

Condition	Minute ventilation	Short-term respiratory effects	Blood lactate	Duration of performance
Chronic diseases	About 150 L/min	Maximum mouth ventilation	Very high	A few minutes
Normal breathing	90 L/min	Heavy nose breathing	Elevated	1-2 hours
Super health states	30 L/min	Easy nose breathing	Nearly normal	Many hours

If you attend a typical mass running event or open marathon, you will notice numerous ambulances with paramedics, who are ready to provide rescue help and **oxygen**, regardless of the details of the chronic disease (heart disease, stroke, seizures, exercise-induced asthma, and so forth). Whatever the condition, *low brain and heart oxygen levels* are most likely physiological causes of possible deaths. Hence, the main questions then are: What are the factors that define effects of exercise on the respiratory system? What is going on with blood gases or O2 and CO2 in the blood and body cells? The answers depend on the pre-existing respiratory parameters and levels of blood gases before and after exercise.

The benefits of regular exercise include more then just having a well-toned body. Besideserving as a mood intensifier, physical activity has both long term and short term effect on the respiratory system. Good oxygen throughout your body may provide long term standing positive effect to our health. Body gives temperature when work out is for 30 min. at least 5 day in a week may help mitigate a chance of developing many lungs related diseases.

Effect of exercise on respiratory system is recognized by evaluating the pulse rate of person in normal condition and after the exercise: 1000mt running, shuttle run, and yoga. After taken the pulse rate of 20 people of cricket, athletics, and football player of Barkatullah University the following changes were observed shown in table 4.3.

Table 4.3To observed the pulse rate after 1000mt race

S.No.	Value observed		Reference range	
	Pulse rate	% SPO_2	Pulse rate	% SPO_2
1	142	97	60 to 100 beats/min	94% to 99%
2	98	115	60 to 100 beats/min	94% to 99%
3	99	113	60 to 100 beats/min	94% to 99%
4	99	152	60 to 100 beats/min	94% to 99%
5	98	139	60 to 100 beats/min	94% to 99%
6	99	104	60 to 100 beats/min	94% to 99%
7	98	118	60 to 100 beats/min	94% to 99%
8	98	126	60 to 100 beats/min	94% to 99%
9	99	145	60 to 100 beats/min	94% to 99%
10	98	128	60 to 100 beats/min	94% to 99%
11	97	124	60 to 100 beats/min	94% to 99%
12	97	132	60 to 100 beats/min	94% to 99%
13	99	154	60 to 100 beats/min	94% to 99%
14	150	97	60 to 100 beats/min	94% to 99%
15	120	99	60 to 100 beats/min	94% to 99%

Before the person starts exercise, the body go through an anticipative response during this response the body will release adrenaline consistently before the person sweat. The adrenaline facilitates cardio respiratory activity, carbohydrate and fat metabolism. In table 4.3 found the pulse rate against the normal range lies 70% has been under the reference range, 30% pulse rate has been above the normal range. The % SPO_2 against the normal range lies 10% has been under the reference range, 90% - %SPO_2has been above the normal range. As per the physical strength of a sports person is normal in given study.

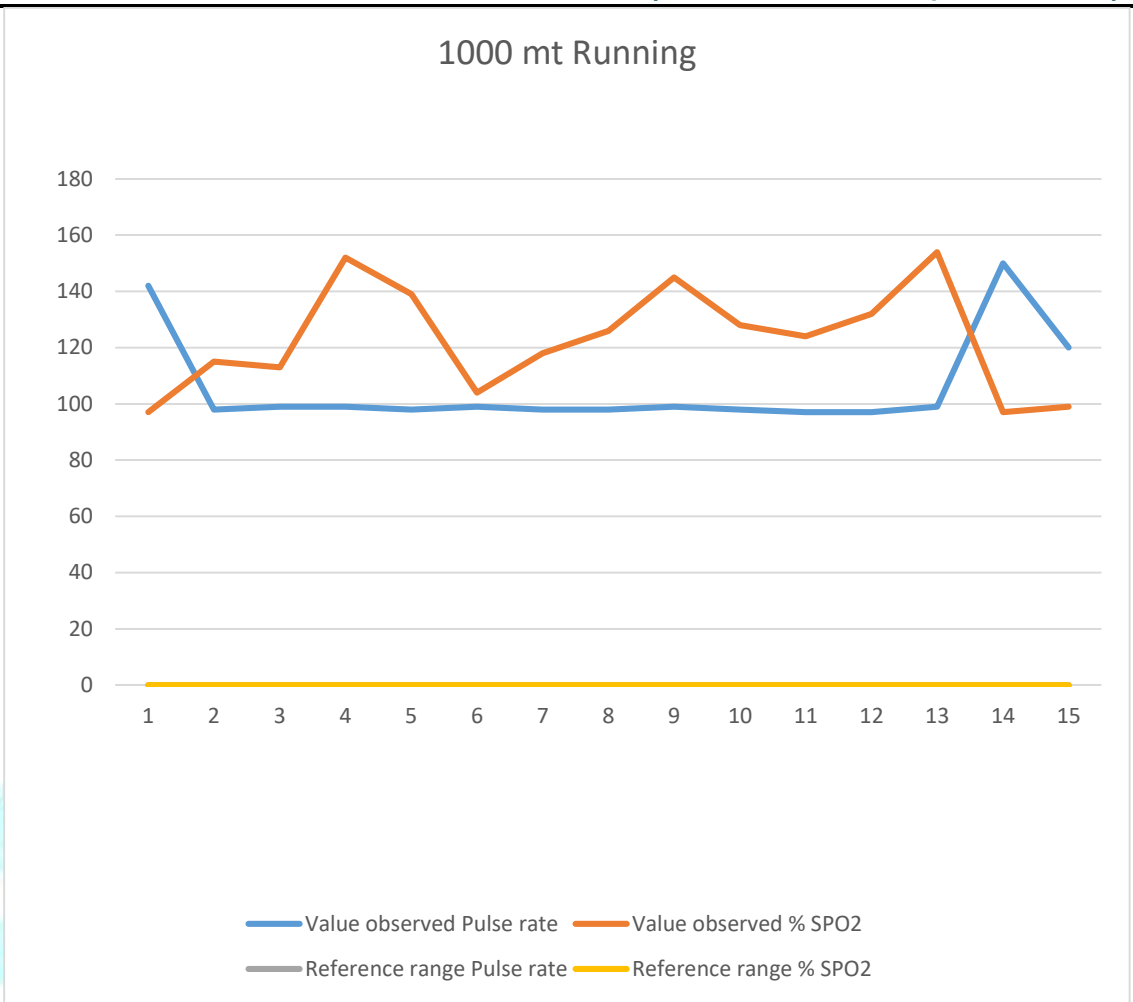


Figure 4.3 value observed pulse rate after 1000mt run

Table 4.4 To observed the pulse rate after shuttle run

S.NO.	VALUE OBSERVED		REFERENCE RANGE	
	% SPO_2	Pulse rate	% SPO_2	Pulse rate
1	176	97	94% to 99%	60 to 100 beats/minute
2	131	93	94% to 99%	60 to 100 beats/minute
3	180	94	94% to 99%	60 to 100 beats/minute
4	186	97	94% to 99%	60 to 100 beats/minute
5	172	97	94% to 99%	60 to 100 beats/minute
6	168	97	94% to 99%	60 to 100 beats/minute
7	153	97	94% to 99%	60 to 100 beats/minute
8	153	98	94% to 99%	60 to 100 beats/minute
9	158	94	94% to 99%	60 to 100 beats/minute
10	180	99	94% to 99%	60 to 100 beats/minute
11	177	97	94% to 99%	60 to 100 beats/minute
12	160	97	94% to 99%	60 to 100 beats/minute
13	147	97	94% to 99%	60 to 100 beats/minute
14	167	92	94% to 99%	60 to 100 beats/minute
15	179	79	94% to 99%	60 to 100 beats/minute

In table 4.3 found the pulse rate against the normal range lies 98% has been under the reference range, 02% pulse rate has been above the normal range. The % SPO_2 against the normal range lies 0% has been under the reference range, 100% - %SPO_2 has been above the normal range. As per the physical strength of a sports person is normal in given study.

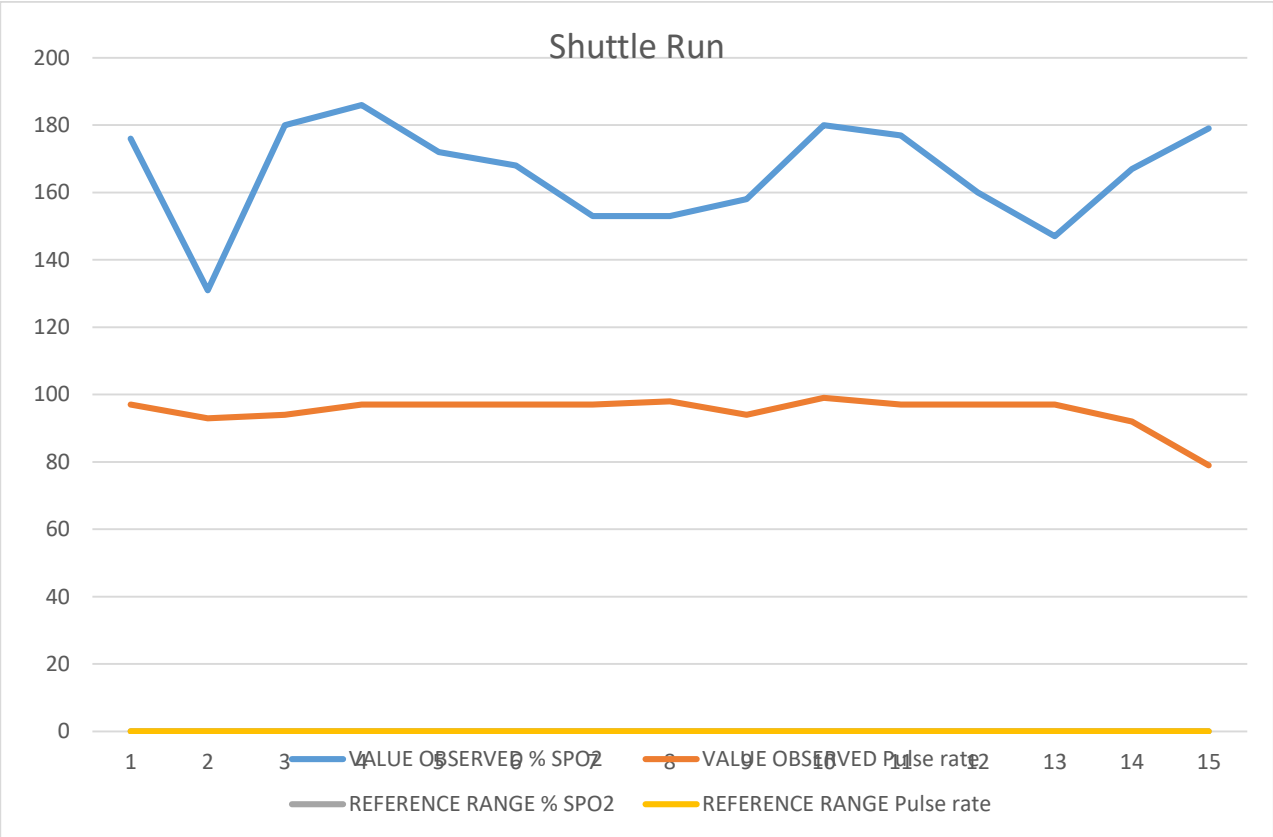


Figure 4.3 value observed after after shuttle run

Table 4.4To observed the pulse rate after yoga exercise

S.NO.	VALUE OBSERVED		REFERENCE RANGE	
	% SPO_2	Pulse rate	% SPO_2	Pulse rate
1	153	80	94% to 99%	60 to 100 beats/minute
2	136	97	94% to 99%	60 to 100 beats/minute
3	123	97	94% to 99%	60 to 100 beats/minute
4	95	90	94% to 99%	60 to 100 beats/minute
5	137	97	94% to 99%	60 to 100 beats/minute
6	134	99	94% to 99%	60 to 100 beats/minute
7	121	99	94% to 99%	60 to 100 beats/minute
8	138	99	94% to 99%	60 to 100 beats/minute
9	108	99	94% to 99%	60 to 100 beats/minute
10	153	98	94% to 99%	60 to 100 beats/minute
11	116	97	94% to 99%	60 to 100 beats/minute
12	87	93	94% to 99%	60 to 100 beats/minute
13	147	94	94% to 99%	60 to 100 beats/minute
14	120	92	94% to 99%	60 to 100 beats/minute
15	98	97	94% to 99%	60 to 100 beats/minute

In table 4.4 found the pulse rate against the normal range lies 100% has been under the reference range, 00% pulse rate has been above the normal range. The % SPO_2 against the normal range lies 2% has been under the reference range, 98% - %SPO_2 has been above the normal range. As per the physical strength of a sports person is normal in given study.

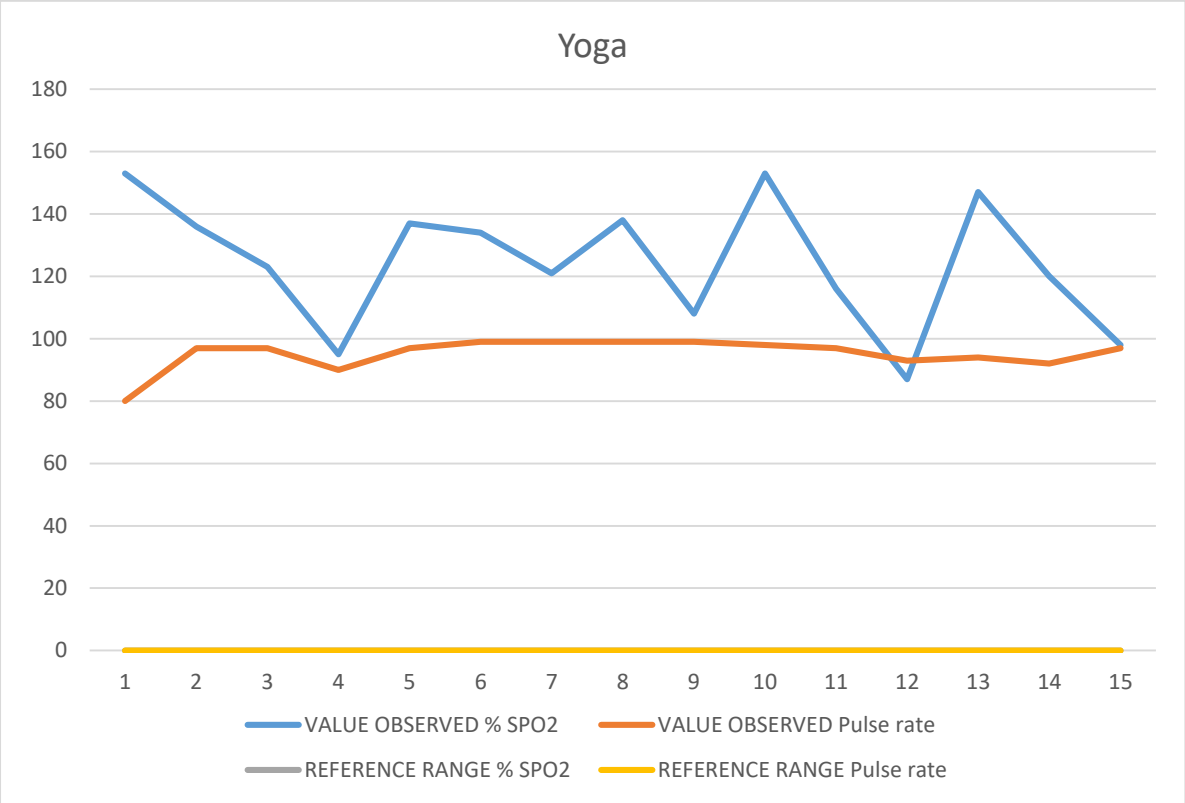
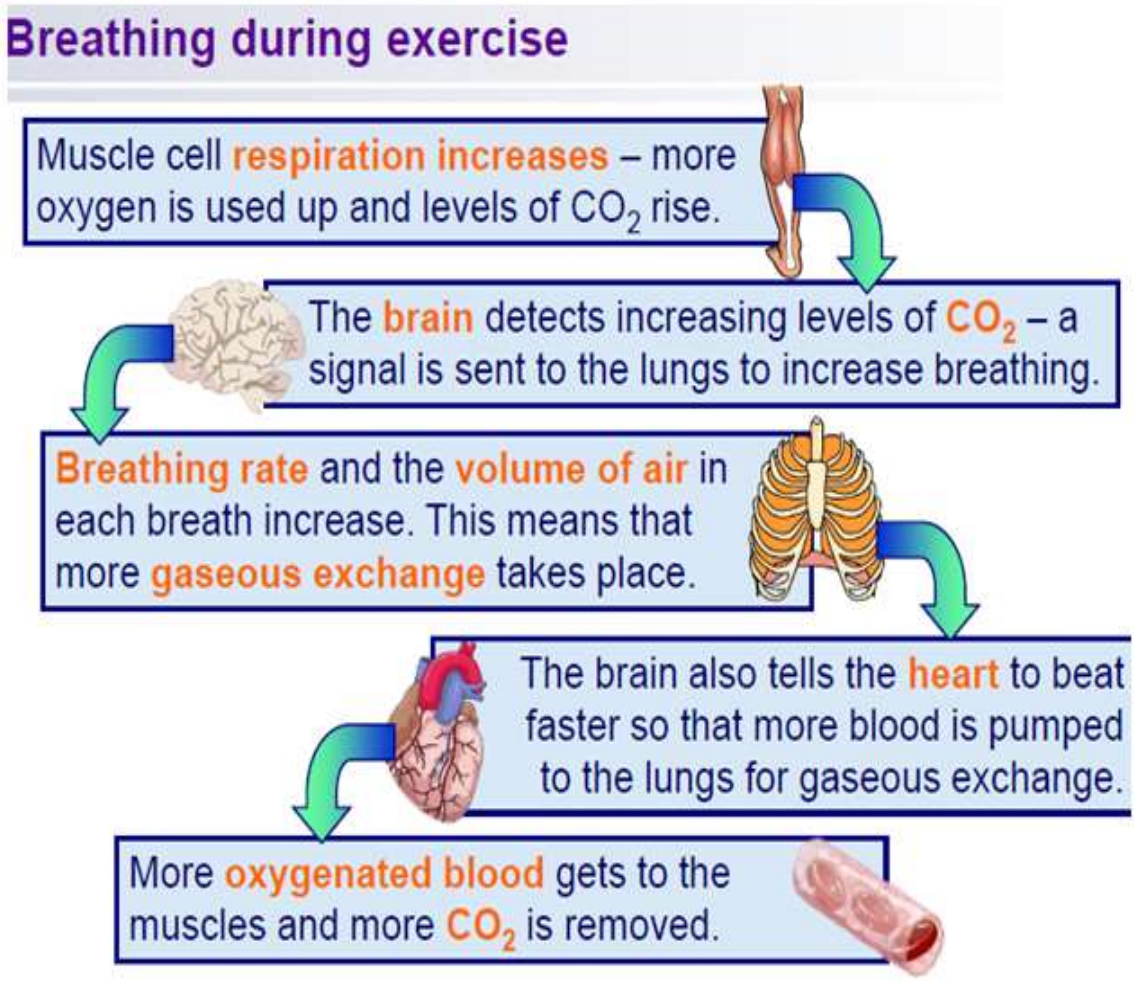


Figure 4.5 Values observed after yoga exercise

The circulatory system response to an increased need for blood by adjusting the width of the blood vessel. As sports person needs to maintain the body temperature while work out to circulate the blood into circulatory system. As per the study to find out the strength of a sports person with the help of pulse rate and % SPO_2, by 1000mt race, shuttle run, yoga.

Diastolic murmurs are characterized based on the part of the diastolic portion of the cardiac cycle during which they occur. It is caused by regurgitation flow of blood across a semi-lunar wall. Atrial contraction show in figure 1.5.



Due to the effect of exercise on respiratory system the lungs volume increase as a result of increase in vital capacity. The breathing frequency is decreased in trained individuals. After the training the maximum minute ventilation is increased. Tidal volume is also increased. Through the physical exercise ventilatory efficiency is also enhances. Gas exchange capacity is also increased.

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