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Research Article

CLINICAL EFFECTS OF PRANAYAMA ON PERFORMANCE OF RIFLE SHOOTERS

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ABSTRACT

Background: Yoga has an enormous scientifically proven effect on man's physical and psychological functioning. Pranayama constitute the most vital aspects of yoga. Various methods of pranayama have a sound scientific basis and are traditionally believed to produce equilibrium between psychic and somatic aspects of bodily functions. The link between body and mind is obligatory for the better performance of sports persons. **Aim:** The aim of the study is to find out the effect of pranayama on the performance of Rifle shooters by measuring the parameters like-breath holding time, lung functional capacity and shooting performance. **Method:** 52 state level shooters subjects were chosen from 2 centres between the age group of 15-30years. Out of them, 26 shooters were given training in the techniques of pranayama for 3weeks.The other 26 subjects served as control i.e. with out Pranayama training. Variables like shooting performance, breath holding time (BHT), peak expiratory flow rate (PEFR), respiratory rate (RR) and pulse rate (PR) were measured in both the groups. **Results:** The study showed highly significant improvement in all the five variables shooting performance (in mm), BHT, PEFR, RR and PR with p value of 3.62E-05, 2.78E-07, 1.31E-09, 0.013, 3.40E-04respectively. **Conclusion:** So it can be concluded that pranayama is efficacious for better performance of Rifle shooters and should be included in their training practice.

Keywords: Yoga, Pranayama, Rifle shooting, Breathing exercise, Peak expiratory flow rate.

INTRODUCTION

Shooting is a sport which requires supreme precision, striking control and close co- ordination between eye, nervous system and the musculoskeletal system. This sport is based mainly on positioning the body and stability of themind.[1] Shooter has to aim at the target while breathing; with the natural inspiration and expiration movements of the chest wall, the rifle too move upanddown.[2] Due to the movement created by breathing it is impossible to release an accurate shot without holding the breath.

However, as soon as breathing is suspended the body's functions begin to depreciate as oxygen starvation sets in. The eyes ability to function is the first to go followed by the muscles, which begin to contract. The breath hold should not be prolonged, so that the unnatural feeling sets in. If it is too long, the body suffers from oxygen deprivation which will cause a fatiguing sensation with muscle tremors and blurred vision and So there is a physiological urge that I must breathe, I must breath' as the body attempts to protect itself it begins to send out indications to resume breathing. These indications produce involuntary movements of the diaphragm, which interfere with the shooter's attentiveness and chest wall starts to move. All of which are not favorable to firing a meticulous shot. Shooters have to implement breathing control during the shooting

process. They have to achieve eye sight alignment while breathing and finish aiming and shooting while holding breath. Shooters do this by inhaling and exhaling naturally and stop at the very point of physiological exhale, starting this respiratory hold, firing the shot and begin to inhale again. Breath hold should not be prolonged. If firing is not done within7 second so faiming then the shooter will relax, and will not take that shot. He will lower the rifle, and start again because if the position is held too long then the shooter may lose the equilibrium and concentration which is needed to take the shot.

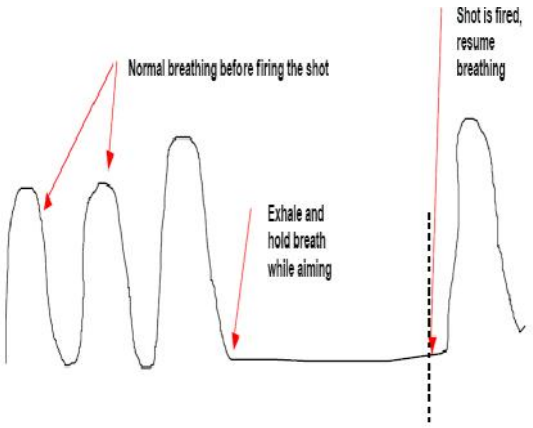

Fig1[4]: Breathing and their relationship to correct sighting

Proper breathing is an often overlooked aspect of Rifle shooting's first principles, even though controlled breathing helps store uceun wanted rifle movements and also induce a calming effect. Breathing links physical, mental, and emotional status. The three primary blocks to positive emotional energy flow–anger, sorrow, and fear are each characterized by an imbalance in breathing. Anger often produces weak inhalation with strong and forceful exhalation. Sorrow manifests very weak exhalation coupled with fitful, spasmodic inhalation. Fear causes tension in the body and often causes breathing to be reduced to almost nothing or to stop completely for a few moments. All these emotions are faced by the sports person during competition. Recognizing these breathing patterns allows the sports person to stop and take corrective action using comfortably slow and deep belly breathing. This will actually take some control over the emotions, conscious mind and will relax the body. Because we have much more control over our body than the mind, breathing in this way, has profound an effect on our ability to indirectly control and calm emotional and mental activity. Even when positive emotional energy is flowing, the same breathing technique still has mental and physical benefits with calmness of mind and relaxation of the body. So, by using breathing control rifle shooters can learn to recognize and break this Cycleoftension.[5] This breathing control can be taught in the powerful form of Pranayama.

When the Breath wanders, the mind is unsteady, but when the Breath is still, so is the mind still." – Hatha Yoga Pradipika. Now, one will think, what is Pranayama? What are its effects? How it is helpful to a sports person? According to the Oxford dictionary Pranayama is defined as 'the regulation of the breath through certain techniques and exercises. The word, 'Prana' is both the breath and the life force. Second part of the word 'yama' means to control, which is the key feature of Pranayama, deep and prolonged breath which can be hold voluntarily called as Kumbhaka in Pranayama. This deep and prolonged breathing not only increases the uptake of oxygen at the cellular level throughout the body, but also gives both physiological and psychological benefits. There is substantiating information that is practicing Pranayama significantly improves cardiovascular efficiency along with the respiratory functions. Pranayama produces decrease in systolic, diastolic and mean blood pressure and this can be used as the prophylactic measure to combat the rise in blood pressure associated with everyday stress and strains of life, and also the competitive anxiety. Conscious, deep and regular breathing can harmonize and strengthen intrinsic cardiovascular rhythms and modify baroreflex sensitivity.[7] Pranayama also helps in controlling autonomic function and results in alteration of autonomic equilibrium. It also works at the cerebral level, causing deep, psychosomatic relaxation. [6] For example; breathing via left and right nostril has an effect of decreased or increased sympathetic activity, respectively.[25] Calmness, which is a result of practicing Pranayama is helpful for the individuals with hypertension and others with cardiovascular conditions. Because of the main emphasis on breathing Pranayama aids in clearing the lung field and passage simultaneously increases the strength of the main respiratory muscle 'diaphragm'. Pranayama is a very well-ordered, so the phases of breathing, inhalation, breath hold and exhalation is always done in a fixed ratio. Only sometimes the set of ratio can vary between 1:2:2 or 1:4:2

depending on the comfort and level of practice. Yogic Asana and Pranayama have been shown to reduce the resting respiratory rate and increase vital capacity, timed vital capacity, maximum voluntary ventilation, breath holding time and maximal inspiratory and expiratory pressures, which produces favourable conditions for improving any sports performance.

Studies show that Pranayama decrease the reaction time. It indicates that Pranayama impacts the central nervous system, and decrease in reaction time can be brought into effect by enhancing processing ability and sensory, motor functions. These effects of Pranayama training on the central nervous system could be due to better concentration power and the ability to ignore and/or inhibit extraneous stimuli resulting in less distractibility. Which collectively leads to decreased mental fatigability and an increase in performance quotient.[8] Hence, there is a need to study the effects of Pranayama on the performance of the shooters, so that if there is any improvement, then an organized breathing exercise protocol can be assimilated into their existing training program and can be used as another powerful tool in the shooter's toolkit.

Aim: The aim of the study is to find out the effect of Pranayama on the performance of Rifle shooters.

Objectives: To find that the practice of Pranayama enhances Breath-Holding Time [BHT], Peak Expiratory Flow Rate [PEFR], basal pulse rate these factors lead to improved shooting performance.

MATERIALS AND METHODOLOGY

Research Design: Experimental, Case–control study

Population: 52 state level shooters

Sample: Group A–26shootersbothmaleand female doing Pranayama (experimental group) Group B– 26 shooters both male and female not was doing Pranayama (control group).

Type of sampling: Random sampling

Source of sample: subjects were recruited from the Air rifle shooting club and research centre approved by guide and college.

Duration of Study: 12months.

Inclusion Criteria: Male and female shooters of age between 15–30years, State level performers

Exclusion Criteria: Respiratory or cardiac disorder, Neurological disorder, Eye problems, Psychological problem, sleeping disorders

Materials: To carry out the study following materials were used:

I) **For Evaluating shooting Performance**: Air rifle, Target Paper, 15 cm measuring ruler

II) **For recording Breath-Holding Time:** Digital stop watch[10]

III) For recording lung-function: Mini-Wright Peak flow meter used to measure Peak Expiratory Flow Rate [PEFR].

Fig2: Mini – Wright Peak Flow Meter

Mini-Wright Peak Flow Meter Procedure for Data Collection: All the subjects coming to the Air rifle shooting club were divided into 2 groups by convenience sampling – Experimental (n=26) and control (n=26. All subjects consent was taken to participate in the study. Each participant shooter was given a Performa which asked information relevant to the study, such as name, age, sex, smoking and drinking habits and sleeping quality and duration. Subject information sheet was given, which gave an idea about the study to the subjects. **Main tests**: Subjects were in standing position when breath holding time (BHT) was measured with the help of stop watch. Subjects were asked to pinch their nose closed at the end of inhalation and BHT (breath holding time) was counted in seconds; nose was closed until they experience the first desire to breathe. Peak Expiratory Flow Rate (PEFR) was recorded with peak expiratory flow meter.

To take a peak flow reading:

1. Check that the pointer is at zero.
2. Subjects were taken in standing position.
3. Subjects were asked to hold the peak flow

meter level (horizontally) and keep your fingers away from the pointer.

4. Asked to take a deep breath and close your lips firmly around the mouthpiece.
5. Then blow as hard as you can.
6. Pointer reading was checked.
7. The pointer was reset back to zero.
8. This was done three times and the highest reading was recorded

For Shooting-performance based data, each participant was asked to best of their ability shoot five rounds (each round consisting of five shots) in the shooting rangeof10minstanding position. Target paper was collected and the distance between the two far most hits was measured. Scoring was done as per the Firing Standard

Specified by A.M.U. (Armed marksmanship unit) which is as follows: **Excellent**- 12.5mm (½in), **Good**-2.5cm (1in), **Fair**-3cm(1½ in)

Fig 3: Performing Rifle shooting

Kapalabhati Pranayama: To perform the kapalabhati pranayama technique, sit in a comfortable position crossing your legs. Perform two to three deep inhales and exhales. Now inhale deeply and exhale forcefully drawing all the air out. Your belly should be drawn in, as you exhale. When you inhale, let it happen passively without you making any effort to inhale as the belly goes back to normal position. Exhale forcefully again and continue doing this for about 20 to 30 times.

Anulomvilom: Hold your right nasal with thumb, breathe in from the left. Now open right nasal and close left nasal with middle and ring finger and breathe out from right nasal. Now breathe in from right nasal. Now close right nasal and open left and breathe out and in from left nasal and so on.

Duration: 10 minutes

Bhramari: One should close their eyes with both hands by four fingers and thumb on the ear. Now inhale and exhale forcibly with a humming or buzzing sound. Inhalation and exhalation should be from both nostrils and mouth should be closed. One should start slowly and then accelerate.

While performing bhramari pranayama one should take care that inhalation and exhalation should be from the lungs and abdominal movements should be minimal.

Shitali Pranayama: Sheetal also means cool, and this pranayama technique will help you achieve the same. To perform shitali pranayama be seated in a comfortable position. Cross your legs and take five to six deep breaths to get yourself prepared. Now open your mouth in an "o" shape and start to inhale through the mouth. When you exhale, do so with your nose. This can be repeated five to ten times. A session of 30 Min. was carried out each day in the evening for 3 weeks, instructions for which were delivered verbally. On the other hand, the subjects in the Group B (control Group) were not given any training during the same time span. On the 22nd day of training, again the parameters were measured for both Group A and Group B.

RESULTS

The data was collected and analyzed with unrelated and related‘t’ test.

Table1: Comparison of Shooting performance(mm)'before and after among study group:

Shooting performance (mm)	N	Mean	Std. Deviation	Median	IQR	Unpaired T test	p value
Experiment	26	-2.65	2.727	-2.50	4	4.535	*3.62E-05
Control	26	1.00	3.072	0.50	4	Difference is significant	

*****p valuesignificant at 1.31E-09

Table 2: Comparison of PEFR (L/min)'before' and 'after' among study group:

PEFR (L/min) difference	N	Mean± SD	Median	IQR	Unpaired T test	
Experiment	26	31.15±12.108	30.00	20	-7.424	*1.31E-09
Control	26	-3.08±20.153	0.00	30	Difference is significant	

*p value significant at 2.78E-07

Table 3: Comparison of BHT(Sec) 'before' and 'after' among study group:

BHT(Sec) difference	N	Mean	Std. Deviation	Median	IQR	Unpaired T test	p value
Experiment	26	5.00	3.150	5.00	5	-5.934	*2.78E-07
Control	26	-0.62	3.656	0.00	4	Difference is significant	

*p significant at3.62E-05

Table 4: Comparison of respiratory rate(per min) 'before' and'after' among studygroup:

DifferenceRR (per min)	N	Mean	Std. Deviation	Median	IQR	Unpaired T Test	
Experiment	26	-2.50	1.838	-2.00	3	2.582	*0.013
Control	26	0.19	4.988	0.00	6	Difference is significant	

*p value is significant at0.013

Table 5: Comparison of Pulserate (per min)'before' and 'after' among study group:

Pulse ratedifference (Beats/min)	N	Mean	Std. Deviation	Median	IQR	Unpaired T Test	
Experiment	26	-3.23	2.997	-3.00	3	3.847	*3.40E-04
Control	26	0.85	4.496	1.00	6	Difference is significant	

*p value is significant at3.40E-04

DISCUSSION

The result of the present study indicates that the shooting performance of the experimental group improved significantly. The credit for this significant result can be given to many parts of the training along with the Anulom Vilom (Alternate nostril breathing). Left nostril breathing draws Ida energy and right nostril breathing draws Pingla energy. In medical terms these energies can be compared with sympathetic and parasympathetic systems. So with the help of the alternate nostril breathing the equilibrium can be achieved between the energies which in turn results in mental balance, which is consistent with the study of Telles S et al 1994 and leads to improved quality of the performance. Also, improved agility of the tasks and the speed of the mental processing are the results of Yogic breathing through single nostril[12] can be the reason for this result.

Similarly, like Alternate nostril breathing, recurrent chanting of 'Om' by shooters during research also proved to be beneficial in improving their performance, indicating the earlier findings that Pranayama or Om Pranayama leads to autonomic changes in the body resulting in increased mental alertness.[13] These results accord with those of Smriti Kapoor[1]

PEFR by definition is maximum expiratory peak flow i.e. the greatest rate of airflow that can be obtained during forced exhalation which can be easily calculated by Mini's Wright peak flow meter and these calculations are highly alveolar pores of Kohn, in total resulting in increased lung volume. The increase in PEFR can be seen along with FEV_1[14,15] (forced expiratory volume in 1 sec.) after continuous practice of Pranayama Shivesh Prakash.[16] Yogis had significantly better PEFR as compared to sedentary workers and athletes.[16]

In Pranayama, the phase Kumbhaka plays an important role in achieving this result. As it is known that during breath holding (Kumbhaka) the heat is generated in the body and blood supply to the brain is increased because of the temporary mild anoxia to the brain. Anoxia is caused due to build-up of CO_2 and depletion of Oxygen in the body, which

is why there is urging to breath. But with the regular practice of Kumbhaka the individual's central and peripheral chemoreceptor's gets adapted to the anoxia, this result is achieved by the body by causing hypo metabolism. Thus, reflecting as prolonged breath hold and decreased urge to breathe while doing so. In addition to this, the training of the stretch receptors in the respiratory muscles, chest wall and also walls of the alveoli support the breath holding. The autonomic or the reflex mechanism of the respiration is far more powerful than the control from the higher centres.[17] That is why after a particular stage it is not possible to hold the breath further .W. A. Whitelaw, B. McBride and G. T. Ford (1987) supports the study, they did the analysis of the pressure waves made by diaphragm contractions during breath holds at various lung volumes. Which shows large lung volume lessens the discomfort of breath holding[18-20] reliable, means that it can be reproduced easily. Maximum expiratory flow depends on the initial lung volume, which is increased by practicing pranayama, because during normal breathing the alveoli's are not fully open. During pranayama and prolongs breath-hold time.

Decrease in respiratory rate (RR) is because of over all reduction in the consumption of oxygen by the body for any activity after regular practice of Pranayama, supported by the finding deep inspiration opens all the alveoli's and also kaviraja alveoli's and also of Kaviraja udup[21], Madanmohan[22] and the breath holding phase (Kumbhaka) helps in opening the interbronchiolar channels of Martin, bronchiole-alveolar channels of Lambert and Raju et al. Decrease in Pulse rate (PR) is because of modulation of both right and left heart ventricular performance by increasing parasympathetic activity and decreasing sympathetic activity Ravinder Jerath et al and also decrease in QT/QS2 and this indicates a decrease in cardiac sympathetic activity Udupa et al. all results are after prolonged practice of Prnayama.

Shooting highly depends on the posture of the individual. Accurate and targeted shooting require firm and steady posture. All the respiratory muscles, being a part of the trunk participates as an accessory supporter of the trunk stability. This accessory activity of respiratory muscles can have a hindering effect on the respiration. That's why it is very crucial to improve the strength and coordination of the respiratory muscles. Pranayama is the great way to get this effect. The study done in the past put forward the fact that intercostal and accessory respiratory muscles stabilize the arms and torso, obstructing the chest-wall movement and there is shift of respiratory load from these muscles to the diaphragm.[23]

This collective effect of improved mental stability, focus, concentration, improved breath holding time, decrease heart rate and respiratory rate is brought about by the modulation of sympathetic and parasympathetic activity and improved strength of the respiratory muscles.

Limitations: 1.Thesample size was small. 2. The Age range was limited. 3. Only Air Rifle shooters were included in the study.4. Shooting performance was recorded for standing position only.

CONCLUSION

This study concludes that the practice of Pranayama enhances breath-holding time (BHT) which gives shooters enough time to take the targeted shot without urging for oxygen in between the shooting rounds. In addition, steady practice of these breathing can result in improved respiratory muscle strength and adaptation at the cellular levels in alveoli, leading to improved peak expiratory flow rate (PEFR) and harmonization of the sympathetic and parasympathetic causing decrease in the physiological parameter like respiratory rate and pulse rate; all these desirable factors work towards end result, improved shooting performance. So because of this lucrative end result practice of Pranayama should be included in the training regimen of shooters.

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Conflict of interest: Nil

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