INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 6.078
(Volume 6, Issue 4)
Available online at: https://www.ijariit.com

SpO2 measurement and analysis for improvement in shooting performance

Tejas
tejas.kri@gmail.com
RV College of Engineering, Bengaluru, Karnataka

K. N. Subramanya
knsubramanya@rvce.edu.in
RV College of Engineering, Bengaluru, Karnataka

ABSTRACT

SpO2 is a parameter that is widely used to measure the oxygen saturation level in the blood. During times of COVID 19 too, SpO2 was being used widely to assess the wellbeing of a patient. The concept of SpO2 is now applied to shooting sport to find the right timing of the shot. This timing is dependent on the individual shooter as each person's capacities would be different. The principles outlined here could be used to understand about the optimal triggering time of any shooter.

Keywords: *SpO2, Shooting sport*

1. INTRODUCTION

1.1 Sports

The word sport can be seen from various perspectives. It is one platform that provides various perspectives such as leisure, healthy routine, entertainment, competition and career. There is no doubt that sports helps to keep one fit, but also teaches many aspects of life to a person. Attributes such as focus, concentration, confidence, teamwork, leadership, hard work, commitment, responsibility, time and pressure management etc. can be effectively learnt from participation in sports. These attributes also help people to be efficient in their daily activities.

Sports provide various benefits such as improved cardiovascular endurance, general fitness to the body, good flexibility, and enhanced muscular strength. In terms of mental health, the benefits of participating in sports are improved concentration and reduce stress and depression. The opportunities provided in sports in terms of career are coaching, umpiring, event organization, commentators, equipment manufacturing, production and marketing etc.

India has been actively participating in international sporting events and hold a good position. Some of the most successful athletes of India are Sachin Tendulkar (Cricket), Virat Kohli (Cricket), P V Sindhu (Badminton), Saina Nehwal (Badminton), Achanta Sharath Kamal (Table Tennis), Manika Batra (Table Tennis), Abhinav Bindra (Shooting), Milkha Singh (Athletics), Hima Das (Athletics), Mary Kom (Boxing) etc. Definitely there are more names that have made our country proud.

Technology plays a very important role in modern sports. It can be seen in various aspects of sports such as broadcasting, performance analysis, data statistics, Equipment etc. In this project, we have used engineering principles to implement technology into sports and help the athletes to analyse, monitor and improve their performance.

1.2 Shooting Sport

Shooting as a sport has been practiced for hundreds of years in European countries, with some German shooting clubs dating back more than 500 years. The popularity of the game grew in English-speaking countries with the formation of the National Rifle Association in 1859, which originally met in Wimbledon, London, and thereafter the National Rifle Association (USA) in 1871.

There are 15 events within the Olympic programme, divided into three different groups: rifle, pistol and shotgun. The rifle and pistol competitions are shot in shooting ranges, where marksmen aim at targets at distances of 10, 25 and 50 meters. In the shotgun event, competitors shoot at clay targets propelled at a series of various directions and angles.

Marksmen need to be as steady as possible to be accurate. In order to achieve this, they use relaxation techniques to drop their heartbeat to half its normal rate, fire between heartbeats and use blinkers to hit a bull's-eye (more about these aspects have been discussed in the subsequent chapters). Indeed, the size of a 10m target bull's-eye is just .5mm. At a distance of 10m, a person with the best of eyesight cannot see it. On the contrary, the world record stands at 60/60 shots hitting the 10. This gives us an insight into the level of precession and accuracy that the shooters are chasing.

As an example of overcoming adversity, it is worthy to mention about Karoly Takacs. He was a part of Hungary's world champion pistol-shooting team in 1938, when a military grenade exploded, crippling his right hand. Ten years later, having taught himself to shoot with his left, he won two gold medals within the rapid-fire class. The current challenges

arising from Covid-19 too can be overcome by sheer persistence, hard work and determination. The lessons learnt in this sport can be applied over a wide spectrum of fields. The stories of each athlete regardless of the level that they are competing are unique and are full of lessons to be learnt.

1.3 Air rifle shooting technique

The shooting technique consists of four elements:

- Shooting position
- Aiming
- Pulling the trigger
- Breathing

In this paper we shall be focusing on optimizing the pattern of breath in order to achieve a best level of hold of the rifle and SpO2 level of the blood.

2. BACKGROUND

With passing time, being in shooting position, the relaxation of the body increases and the area of hold gets smaller and the speed of rifle movement reduces. But we also need to be aware that the body is continuously using the oxygen when we stop breathing at the respiratory pause to pull the trigger. As we the breathing is also stopped for a brief period of time prior to trigger, the oxygen is not getting replenished. The offset of symptoms due to the decrease in oxygen level in the blood occurs gradually with time. As the shooter is completely focused on the process of the shot, the shooter many times will not be able to recognize that SpO2 levels are decreasing therefore releasing the shot when the vision, concentration is not optimal.

In order to overcome this, we need to practice to time the triggering such that we are releasing the shot before the SpO2 falls below a level where it can have a negative impact on the vision, concentration and other parameters.

2.1 SpO2

The oxygen saturation is that the fraction of oxygen-saturated hemoglobin relative to total hemoglobin (unsaturated + saturated) within the blood. The physical body requires and regulates a really precise and specific balance of oxygen within the blood. Normal blood oxygen saturation levels in humans are 95–100 percent. Arterial blood oxygen levels below 80 percent may compromise organ function, like the brain and heart, and will be promptly addressed. Continued low oxygen levels may cause respiratory or asystole. Oxygen therapy could also be wont to assist in raising blood oxygen levels. Oxygenation occurs when oxygen molecules enter the tissues of the body. For example, blood is oxygenated within the lungs, where oxygen molecules travel from the air and into the blood. Oxygenation is usually wont to ask medical oxygen saturation.

In general medical terms, the following medical terms are corelated with respective SpO2 levels-

Table 1: SpO2 level medical terms

Body Condition	SPO2 Level
Normal	>=95%
Hypoxic	85%-94%
Severely Hypoxic	<85%

Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level. Hypoxia may be classified as either generalized, affecting the whole body, or local, affecting a region of the body. Although hypoxia is often a pathological condition, variations in arterial oxygen concentrations can be part of the normal physiology, for example, during hypoventilation training or strenuous physical exercise.

2.2 Basic facts about breathing

- Breathing is automatic. We breathe without needing to exert a conscious effort.
- The body has a natural breathing cycle:
- The chest and diaphragm expand, pulling air into the lungs;
- The chest and diaphragm relax, pushing air out of the lungs.
- Breathing while firing the shot hurts accuracy because it increases the movement of the aligned sights on the target (wobble area).

The best time to control the breathing cycle is during what's called the "respiratory pause." This is when we are done exhaling, but it isn't something we should have to think about. Don't force air out, because forcing air out makes us contract our chest muscles…which is the last thing you want. During the respiratory pause, our chest muscles are relaxed, and we can stop breathing longer without feeling uncomfortable. If we try to stop breathing while your lungs are filled with air, we'll begin to experience muscle discomfort sooner than if our lungs are mostly empty and the muscles involved with breathing are relaxed.

How long can we extend the respiratory pause? That depends on our physical condition and state of mind. Under normal circumstances, a shooter can extend a respiratory pause for eight seconds, 10 at the most. Problems begin to occur in several areas when breathing is stopped for longer than that period. Visual acuity is the first victim of the lack of oxygen. Instead of a true image of sight alignment and sight picture, we see a burned-in image of what existed at the time vision began to fail. Another concern with overextending the respiratory pause is your body starts crying for air, which makes you stop paying attention to your sight alignment/sight picture and start paying attention to your need to breathe. Measuring the SpO2 levels during the process can arrive at the idea about the condition of the body during the respiratory pause

2.3 Breathing in shooting

The air that we breathe, food that we eat and the water that we drink are the sources of energy for the body. Oxygen fuels our cells and helps provide the basic building blocks that our bodies need to survive. Our cells combine oxygen with nitrogen and hydrogen to produce various proteins that build new cells. When oxygen is combined with carbon and hydrogen, you get carbohydrates that provide energy to our bodies that is necessary for us to do what we live. Oxygen is also necessary for constructing replacement cells for our bodies. Every day, about seven hundred billion cells in our bodies wear out and must be replaced. Without oxygen, our bodies cannot build these new cells. For a sport like shooting where the main feedback to make a decision about taking a shot by pulling the trigger is visual feedback. The performance of the eye is very important. Finally, it is important to note that the human eye is in particular need of oxygen to function well. However, the eye receives oxygen in a manner that is unique from the rest of the body. Few blood vessels travel to the eye, so our eyes absorb much of the oxygen they need directly

through the cornea. The cornea is built in such a way to diffuse oxygen directly into the body from the air. If the air has traveled through (air purifiers) first, it can enter the eye without causing irritation.

3. EXPERIMENT

A general SpO2 sensor (Pluseoxy meter) is mounted on to the index finger of the shooter, and another person is recording the time, while the shooter is shooting as he would usually in any training. The current study is based on myself, a member of the Indian Shooting Team in 10m Air Rifle shooting. Here we record the time taken for Spo2 levels to fall below the mark of 94% from the time of complete exhalation. We also make note of the actual time taken by the shooter to take the shot after the last exhalation in order to compare and see if the shot was taken before or after the SpO2 falls below 94%.The measurement of SpO2 is done using a pulse Oximeter. Time is measured using a Digital Stop Watch.

Table 2: Observed measurements

Shot Number	Time taken for SpO2 to fall below 94%	Shot time	Difference	Status
1	9.2	10.2	+1	NOT OK
2	8.6	12.1	+2.5	NOT OK
3	8.9	8.1	-.8	OK
4	8.3	8.2	-.1	OK
5	8.9	8.6	-.3	OK
6	8.5	8.1	-.4	OK
7	9.3	8.4	-.9	OK
8	9.6	12.4	+2.8	NOT OK
9	8.5	7.9	-.6	OK
10	8.7	8.0	-.7	OK

Mean time taken for SpO2 to fall below 94% = 8.8

4. RESULTS AND DISCUSSIONS

SpO2 was found out to be a key parameter in betterment of performance. Prior to SpO2 analysis, the time taken for each shot was not consistent as increasing the aiming time gave the shooters better stability and the rifle was more settled. The better settlement of the rifle on the target was could be observed by the shooter, however, the above failed to observe the continuous decrease in the overall oxygen levels of the blood due to the fact that the breathing of the shooter is paused during the time of aiming.

Upon the analysis of the Spo2 levels during shooting, it was observed that an average of 8.6 seconds was recorded for the body to reach the levels of SpO2 less than 94%, upon complete exhalation

The actual changes observed after this reinforcement was positive in terms of the results that was observed. Earlier, the mind was taking its own time to decide the trigger timing, but with a reinforcement to complete the shot before 8.6 seconds, the mind has a clear goal as to when to complete the shot.

The other observations during the experiment were blurred vision, delay in decision making, and increased muscle tremors with delay in the shots, which were the reaction of the body towards reduced SpO2 levels. Hence, these unfavourable reactions of the body were avoided, when the shooting process was completed before the state of oxygen depletion was reached. The above stated is another positive outcome of the experiment.

5. CONCLUSION

From the above experiment we can conclude that the athlete was taking 30% of the shots after 94% SpO2 levels were reached. Therefore we can infer that 30% of the shots were taken when the oxygen level in the blood was not optimal.

The concept of using SpO2 measurement to assess the timing of the shot opens a whole new dimension of training, During training, under a supervised environment, the athlete needs to practice to take the shot much before he reaches point where SpO2 falls below 94%. This ensures right condition of the body while taking the shot. By repetitive practice to time the shot, muscle memory is built which executes the shot at the optimal time.

6. REFERENCES

[1] Chugunov. J. L. “The determination of the shooter-gun system stability for the selection of the gifted shooters.” Theory Proc. Phys. Cdr., vol. 9, pp. 59-61.

[2] Niinimaa V, McAvoy T, “Influence of exercise on body sway in the standing rifle shooting position”, Canadian Journal of Applied Sport Science, vol. 8, no. 1, 1983, pp. 30–33.

[3] P Helin T Sihvonen. “Timing of the triggering action of shooting in relation to the cardiac cycle”, British Journal of Sports Medicine, vol. 21, no. 1, 1987, pp. 33-36.

[4] Vladamir M A.V Aktov, “Biomechanics of highly precise movements: the aiming process in air rifle shooting.” Journal of Biomechanics, vol. 23, no. 1, 1990, pp. 35-41.

[5] Kevin A Ball, Russell J Best, “Body sway, aim point fluctuation and performances in rifle shooters: Inter- and intra-individual analysis.”, Journal of Sports Sciences, vol. 21, no, 7, 2003, pp. 559-566.

[6] Ihor Z, Yuliya K and Volodymyr M, “Specificity of shooting training with the optoelectronic target”, Acta of bioengineering and biomechanics, vol. 11, no. 4, 2009, pp. 63-70.

[7] Ayşegül Yapıcı, Çiğdem Bacak, Eylem Çelik, “Relationship between shooting performance and motoric characteristics, respiratory function test parameters of the competing shooters in the youth category”, European Journal of Physical Education and Sport Science, vol. 4, no.10, 2018.

[8] Gallicchio, Finzenzeller, Sattlecker, linginger, Hoedlmoser, “The influence of physical exercise on the relation between the phase of cardiac cycle and shooting accuracy in biathlon”, European Jornal of Sport Sciences, vol. 9, no. 5, 2019, pp. 567-575.

[9] K. Mononen, N. Konttinen , J. Viitasalo , P. Era, “Relationships between postural balance, rifle stability and shooting accuracy among novice rifle shooters”, Scandinavian Journal of Medicine and Science in Sports, vol. 17, no. 2, 2007, pp. 180-185.

[10] Daniel Mon, Maria S. Zakynthinaki, Santiago Calero, “Connection between performance and body sway/morphology in juvenile Olympic shooters”, Journal of Human Sport and Exercise, vol. 14, no. 1, 2019, pp. 75-85.

[11] Jean A Coleman, “Personality and stress in the shooting sports”, Journal of Pychosomatic Research, vol.24 no.5, 1980, pp. 287-296.

