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International Journal of Pharmaceutical Research & Allied Sciences, 2019, 8(1):123-128

Research Article

ISSN : 2277-3657
CODEN(USA) : IJPRPM

Fatigue: Impact of Muscular Co-Ordination among Rifle Shooters

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ABSTRACT

It has been well reported that fatigue is an important factor which hinders performance. The resultant effect of it is loss of co-ordination and efficiency. The main aim of this investigation was to find out the effect of fatigue on muscular co-ordination among rifle shooters. Ten rifle shooters aged between 22-28 years were selected as subjects. The index of muscular co-ordination was tested with three series. A steadiness tester was used with the diameters of 0.5, 0.31, 0.25, 0.18, 0.15, 0.12, 0.10, 0.09, 0.07 inches and stylus of 0.062. Grip dynamometer was utilized for measuring local fatigue. The results indicated that 50% of rifle shooters were adversely affected by local fatigue of the arm, 80% of the subjects stated alteration in their muscular co-ordination after overall fatigue was induced. It was concluded that performance was substantially reduced when general fatigue was induced compared to local fatigue.

Key words: *Fatigue, Co-Ordination, Rifle, Performance*

INTRODUCTION

Fatigue is a common generic indicator connected with numerous health disorders. Fatigue has been explained as an excruciating feeling of exhaustion, the absence of vitality and the sense of tiredness. It has been associated to a strain in the execution of the controlled effort. Fatigue accrual, if not determined, results in overstrain, chronic fatigue syndrome (CFS), overtraining syndrome, endocrine ailments, immunity dysfunction, organic syndromes and a peril to the mortal health [1].

Fatigue has been categorized using different methods. Based on its period, fatigue has been divided into acute fatigue and chronic fatigue [2]. Acute fatigue is swiftly released by break or life-style alterations, while chronic fatigue is a state where there is a continuous exhaustion spread over months that cannot be improved by rest [3]. Further, fatigue has also been categorized as mental fatigue, which relates to the intellectual or perceptual features of fatigue, and physical fatigue, which points to the actualization of the motor structure [4].

Muscle fatigue is a symptom that decreases the ability of muscles to perform over time or a decline in capability of a muscle to create force. It has also been described as a reduction in the highest vibrant or power creation in reply to contractile motion. When fatigue is experienced, the force behind muscle movements decreases, resulting in a feeling of weakness [5]. It has been understood that exercise is a common source of muscle fatigue; in addition, the symptom can be the product of other health disorders, too. It can also be an outcome of dynamic exercise, but abnormal fatigue may be produced by blockades to or interloping with the various periods of muscle contraction.

Fatigue can set in at diverse stages of the motor pathway, and is generally grouped into central and peripheral modules. Peripheral fatigue is created by the deviations at or distal to the neuromuscular intersection. Central fatigue starts at the central nervous system (CNS), and reduces the neural energy to the muscle. Fatigue of the muscle is an ordinarily felt phenomenon that restricts physical accomplishments and various supplementary vigorous or sustained actions. Besides, it enhances and limits everyday activity under numerous pathological settings, along with neurological, muscular and cardiovascular ailments, together with aging and frailty [6].

A rifle is a protracted gun with a rifled barrel and entails the practice of both hands to grip and support alongside the shoulder through a stock in order to shoot progressively. They normally have a longer range and superior precision than handguns, and are prominently used for hunting. In shooting sports, bolt action or semi-automatic rifles are most frequently used for competitions all over the world [7]. In 1896 Athens Olympic Games, men's shooting was one of the ten events. During the 1900 Paris Games, live pigeons were used as moving marks. Later, pigeons were substituted with clay targets. International Shooting Sport Federation was formed during 1907, which took control of the sport and framed rules and regulations. One of the official rifle event is the 50 m rifle 3 positions men in which an athlete shoots at an expanse of 50 m or 54.68 yds.', in kneeling, prone and stand-up postures, by means of a 5.6 mm or 0.22 inches calibre rifle, with a full mass of 8.0 kgs, or 17.64 lbs. The middle of the mark is placed at 0.75 m over the floor and its entire breadth measures 154.4 mm. The width of the fourth ring is 106.4 mm, whereas the tenth ring measures 10.4 mm. The usage of specified apparel paraphernalia is permissible to increase the steadiness of the shooting positions. Another event called 10 m air rifle men has been also conducted in international competitions [8].

Shooting is a peerless sport since it doesn't entail remarkable strength, size, athletic or natural ability to become a champion. The academic elements are much more vital than the God-given ones [9]. Champion shooters come in all sizes and from all walks of life. There are, however, certain features which contribute to the improvement of a skilled shooter. Though, these abilities may differ from person to person, the most significant factors comprise: above average cleverness; knowledge to shoot at an early age; ample perseverance to the sport with firm goals and tactics; an atmosphere which offers the prospect for a person to train, acquire, improve and realize aims; the progress and training of the mental characteristics; and the supreme central quality for competitiveness - a craving and resolve to develop as the paramount. Lastly, a shooter must overcome the gruelling competitive environment, and prolong the subsequent fatigue to stay in the race for top honours [10].

Fatigue during running is likely to cause loss of coordination and efficiency and lead to poorer performance [11]. Several studies have observed that the effects of fatigue have mostly been descriptive, pointing out the changes that occur with fatigue, but they have not identified its effects on performance. A change due to fatigue does not affect all shooters in the same manner. A successful shooter is one who is analytical and methodical in his performance [12]. One step in the shooting process is the aim hold. The hold during shooting is the time taken to move the sight on to the target. This normally takes 5-10 seconds. At around 10 seconds and beyond, fatigue sets in and it is best not to attempt to shoot, but relax before starting again [13]. Fatigue is the inability to continue the essential anticipated force production. The psychological trauma may consciously or subconsciously hinder the shooters' willingness to tolerate pain. However, a less motivated shooter can end the exercise before the muscles get physiologically exhausted. Hence, the objective of this exploration was to scrutinize the influence of fatigue on the muscular coordination of rifle shooters.

METHOD

The subjects selected for this study were 10 elite male competitive rifle shooters who were undergoing a coaching camp before their participation in an International Tournament. They were between 22-28 years of age. A three-series trial was conducted in this investigation which was as follows: 1. Index of muscular co-ordination .2. Index of muscular co-ordination inducing local fatigue. 3. Index of muscular co-ordination inducing general fatigue. Hand steadiness tester was utilized as the tool to measure hand steadiness which consists of 9 holes with decreasing hole size. 0.5, 0.31, 0.25, 0.18, 0.15, 0.12, 0.10, 0.09, 0.07 inches were the diameters of the holes and the diameter of the stylus was 0.062. A grip dynamometer was used to induce local fatigue in the arm.

Description of three series

Series I

In this series of trial, the subjects were asked to insert the stylus in the holes of the steadiness tester taking care not to touch the sides of the hole. If the sides of the holes were touched, an error was recorded. The subject should have commenced the test by inserting the stylus from the biggest hole to the smallest. The subjects' score was the number of times the stylus did not touch the holes, and it was termed as the index of muscular co-ordination.

Series II

In this test, the participants were instructed to first grip the hand dynamometer for 2 minutes with stretched hands at the shoulder level. Immediately after the end of the time, the subjects were indicated to commence the inserting of the stylus into the holes as described in series I. They were also instructed to use the same hand in which the hand dynamometer was held. At the end of the test, the index of muscular co-ordination was recorded

Series III

In this series, the participants were asked to grip the dynamometer as tightly as possible and perform sit ups as fast as possible for a period of 2 minutes. At the end of the 2 minutes, the subjects were asked to start inserting the stylus into the holes as in series I. The index of muscular co-ordination was noted.

The subjects were strictly instructed not to relax after inducing fatigue in series II & III, and the same hand was used to discover the index of muscular co-ordination all through the investigation.

RESULTS

Table 1: The performance in 3 series

Condition	Mean	SD	Median
Series I: Index of muscular co-ordination	5.0	0.82	5
Series II: Index of muscular co-ordination inducing local fatigue	4.4	0.84	4
Series III: Index of muscular co-ordination inducing general fatigue	3.2	1.32	3

The results indicated that 50% of the members of the study were adversely affected by the local fatigue of the arm. But, in the other 50%, there was no effect of fatigue in their muscular co-ordination. After inducing general fatigue, the muscular co-ordination of 80% of subjects represented a change, however, while in 20%, there was not any effect observed on their muscular co-ordination. 10% of the participants of the study were found to have no change in the muscular co-ordination under both of the investigational settings. The median pointed out the index on the identical scale of each series below the scale one half of the scores fall. Table l also indicates that the median of the series I involving the muscular coordination was the 5^{th} hole, for the series II, encompassing index of muscular co-ordination inducing local fatigue was the 4^{th} hole, and for the series III, the index of muscular co-ordination inducing general fatigue was the 3^{rd} hole.

Supplementary examination was directed to search for the difference between the means of each series, and establish whether the local fatigue or the general fatigue declined the steadiness output. In this regard, the single group method for the correlated data was calculated. The standard sigma scores (z) were arrived at by converting the difference between means to get the corresponding z values. As far as the series I & II were concerned, the calculated z score was 2.85 (r =0.65) which was more superior than the critical value of 1.96 (p = 0.05) and 2.5 (p = 0.01) level, and the null hypothesis was overruled. There was a noteworthy decrease in the neuromuscular steadiness of the rifle shooters after inducing local fatigue. In the series I and III, the z value arrived at 4.70 (r = 0.41) which showed a substantial decrease in the steadiness index after the induction of general fatigue. Likewise, there was a significant difference in series II and III (r = 0.52) with regard to the index of neuromuscular co-ordination, and the index of steadiness when the subjects were affected with general fatigue (z = 3.43).

DISCUSSION

Fatigue is a complex concept that has kept researchers puzzled for decades. The literature about Fatigue is mystifying as many of the scientists have not been clear about its interpretations, and the investigational effort has been marginal [14]. It was observed by [15] that the effects of the fatigue are sensed instantly for some

intervals succeeding the task. The term fatigue has received a multitude of meanings, and has been studied with relation to sleep deprivation, muscle fatigue, central fatigue, cognitive fatigue, and exercise-induced fatigue [16, 17]. Due to these differences in interpretation, a clear and overarching definition has been lacking. Muscle physiologists, for example, have described fatigue as a reduction of muscle force, and proposed that this is what causes people to slow down. On the other hand, exercise scientists have defined fatigue as an exercise-induced performance decrement [16]. All the different types of fatigue mentioned above have been relevant to the operational performance. However, in the current study, the focus was on fatigue and its effects on the cognitive and perceptual-motor performance of rifle shooters.

The main concern of the rifle shooter and the coach would be to know whether the performance is subdued owing to fatigue as a momentary occurrence, or whether the inappropriate responses and deviation from probable performance was completely affecting the accomplishment of the rifle shooter [18]. During such time, a coach can contemplate to dismiss practice sessions, so that the effect of fatigue after lengthy training does not impede the learning of new skills. This is crucial as fatigue not only has physical ramifications but also brings about a change in the mental and emotional state. It has been observed that in the course of moderate fatigue, practicing tasks analogous to that of the real competition conditions may not harm, but instead may prove beneficial to cope with the fatigue. Previous studies have associated the decreased performance in the fatigue condition to the changes in the capacity of different muscle groups [19]. These changes can assign the combined effect of the capacity of utilization of elastic energy and change in the contractile activity [20, 21] and this information may vary for each muscle group considered.

The present study established the fact the muscular coordination has ramifications on the rifle shooters performance due to the local and general fatigue. These results were in line with the studies of [6] & [14]. [22] also found the same results when he conducted a study on the archers. [23] also corroborated the results of this study. [24] performed Counter Movement Jump (CMJ) on ten athletes without muscle fatigue and found a high value of active state favouring the positive work. Further, the study revealed that during fatigue, there could be a partial compensation of the performance due to the increasing activity of the contractile elements, although the activation sequence undergoes significant changes. They concluded that the changes in performance would be mainly associated with the decrease in the capacity to transmit power in the proximal-distal direction due to fatigue. Their study also favoured the results of the present investigation.

The performance of the rifle shooter was reduced considerably when general fatigue was felt than when there was local fatigue. These results also were in line with the studies of [22]. While the study by [25] found that the subjects' dart throwing efficiency and performance were negatively affected by fatigue. Thus, the above studies validated the results of the present enquiry making it very clear that the fatigue of the total body can adversely affect the performance of the rifle shooters than the fatigue felt in one part of the body.

CONCLUSION

This study demonstrated that the index of muscular coordination was affected considerably with local as well as general fatigue. The study also witnessed the performance in the series before fatigue was better than the performance after fatigue. Besides, the performance output was reduced substantially when general fatigue was induced in contrast to local fatigue. The index of muscular co-ordination showed that the persons differed in proneness to fatigue, and correspondingly their performance fluctuated from individual to individual. The rifle shooters performed below par when the general fatigue was induced than when the local fatigue was felt. However, this research was not profound enough to signify how performance result due to fatigue modifies with experience and skill levels of the rifle shooter.

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