JPJO 6 (2) (2021) 182-188

Jurnal Pendidikan Jasmani dan Olahraga

Available online at:
https://ejournal.upi.edu/index.php/penjas/article/view/31630
DOI: https://doi.org/10.17509/jpjo.v6i2.31630

The Effects of Progressive Muscle Relaxation on Concentration and Performance Scores of 10m Shooters

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Article Info

Article History :
Received January 2021
Revised March 2021
Accepted June 2021
Available online Septemeber 2021

Keywords :

Air Pistol, Air Rifle, Concentration, Progressive Muscle Relaxation, 10m shooting

Abstract

Shooting skills are very complex, and often athletes have to be faced with situations that require one shot to get a perfect score and need to maintain concentration and the pull of the trigger. This study aimed to analyze the difference in progressive muscle relaxation (PMR) exercise on increasing concentration and performance scores of 10-meter shooting. A total of 12 athletes (seven female dan five males) in Purwakarta were recruited for this study. They were randomly assigned to the two groups, the PMR group (n = 6) and the control (n = 6). The instruments used were the Concentration Grid Test to measure concentration while the 60 shots of both men and women of 10-meter shooting scores for a performance test. Data analysis using MANCOVA was performed using shooting scores and concentration as the dependent variable and covariates to determine their performance. They can be differentiated based on conventional training methods, progressive muscle relaxation, and the interaction of these factors. The results of the MANCOVA indicated a significant main effect for exercise methods, and it was revealed that differences in exercise methods had a significant effect on concentration and shooting scores. When athletes are faced with the demands of top performance, PMR training is a very economical but efficient and effective strategy for dealing with several problems. This helps athletes self-control and focus their attention during stressful situations and can be used to maintain physical, technical, and mental balance.

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INTRODUCTION

Concentration is a mental aspect of the sport that plays an important role in the success of achievement. For example, the ability to concentrate as a form of mental success contributes psychologically to the toughness and excellent results of the 10m air pistol and rifle shooters. In this context, disruption of concentration during a sporting activity, especially during competition, will cause problems, affecting expected results (Robazza, Ruiz, Robazza, & Ruiz, 2018; Tams, Thatcher, & Grover, 2018). Moreover, concentration is the athlete's ability to focus on attention in a competitive environment (Pierpaolo & Antonia, 2018; Yoshiwara & Tsuchiya, 2019). The quality of an athlete's performance will also be influenced by various aspects, such as physical, psychological, and mental (Gould, Guinan, Greenleaf, Medbery, & Peterson, 1999; Jackson, Thomas, Marsh, & Smethurst, 2001).

The 10m air pistol and rifle shooting is a competitive sport that involves proficiency in accuracy and being practiced by any individual for recreational and professional engagement (Soodan, Kaur, & Kumar, 2017). Consequently, it is indicated that the shooting athletes must combine the skills to aim and pull the trigger at once. Unfortunately, their attention is divided between gun position, breathing, aiming, and pulling the trigger. As a result, athletes usually fail to perform a technique because the level of attention and concentration is disturbed when several stimuli occur simultaneously (Koch & Tsuchiya, 2007; Wilson, Peper, & Schmid, 2006). Disruption of concentration is also a form of sports anxiety, which can reflect what athletes believe, such as the perception of not being able to do something smoothly, unsatisfactory results in a competition, and a feeling of failure when showing the performance (Singh & Gaurav, 2011). These problems are enacting concentration as one of the psychological factors that affect the performance of shooting athletes.

Before the shooter experiences an anxious situation, relaxation exercises must be given regularly in the training process, particularly while facing various pressured situations to relax in a shorter time before their performance. One of the well-known relaxation exercises is the Progressive muscle relaxation exercise (PMR), which Edmund Jacobson developed in 1930, a method that involves tensing muscles throughout the body before relaxing. The rationale of this exercise is that tension and anxiety will not occur when all muscles are relaxed, so the PMR techniques work by including systematic tension relief followed by releasing stress in body groups (Fateme et al., 2019; Tsitsi, Charalambous, Papastavrou, & Raftopoulos, 2017). This exercise is believed to be the mainstay for the shooting athletes to build up their focus, produce their composure when shooting, and achieve a better target.

In the same way, a shooter must learn good mental skills for shooting, including concentration. It is hoped that the specific mental skills of shooting athletes can influence the achievement that has been determined. When they make a shot, they must focus on the target and ignore any distractions. Besides, shooters tend to feel anxious, so they need to be able to concentrate fully, catch their breath to aim, and get the perfect shot (Cote, 2008; Nichols, 2017). Shooters must be accustomed and able to distinguish between muscles in a tense and relaxed state. (Karlsson, 2017; Kuan, Morris, Kueh, & Terry, 2018). For this reason, high concentration is needed, while a shot accompanied by a good mental state and technique will most likely be on the expected target.

Psychological skills techniques that athletes have used have been disclosed in various reviews relating to the sports psychology literature and agreed that competitive disruption of concentration plays a major role in an athlete's performance. So it suggests that an effective strategy is needed to deal with pre-match anxiety for better performance results (Behan & Wilson, 2008; Hanton, Sciences, & 2002, 2002; Magyar & Feltz, 2003). Based on their consistent efficacy in competitive sports and there is a substantial effect on increasing concentration, this study aims to analyze the effects of progressive muscle relaxation on concentration and performance scores of 10m shooters.

METHODS

This research presents a quasi-experimental study with a non-equivalent control group design to ensure the effectiveness of the treatment given and produce program effect claims generated by current program evaluations.

Participants

The subjects of this study were all 12 shooting athletes in one of the cities in Indonesia; the total sampling technique was used. The research subjects were divided into two groups; the first group received progressive muscle relaxation (PMR) exercise, and the second group received conventional exercise as a control group. The intervention was given 17 times in six weeks period (three times/week).

Procedure

The concentration variable was measured using the Concentration Grid Test (CGT). This method requires a number block containing two-digit numbers ranging from one to 99. Besides, this method aims to scan a specified number with a period of one to two minutes. Therefore, while marking with a line that connects from the smallest to the largest number, athletes who possess good concentration level will be proficient at scanning and using the relevant keys so that they might obtain scores above 20 and 30, as many as possible how many numbers the athlete could find in 1 minute. While the validity of the concentration grid test is 0.912, and the reliability value is 0.803.

Performance variables were measured using an international standard shooting scoring test, where male and female shooters took 60 shots in 75 minutes as in a real match within almost perfect reliability 0.999 for air pistol and 0.998 for air rifle (Mon-López & Tejero-González, 2019). Meanwhile, ten shots in each series are considered to determine the score of athletes that could be achieved. Furthermore, the analysis used in this study is a multivariate analysis of covariance (MANCOVA) to examine whether differences exist.

Data Analysis

In this study, A MANCOVA was performed to determine differences between the two exercise methods (PMR and conventional) using the post-test score of concentration and shooting results as the dependent variable. While the covariate included pre-test and shooting and concentration variables that demonstrated relationships between these variables.

RESULT

The mean shooting score in the control group was 529.5 (SD=29.6), while the mean shooting score in the PMR group was 521.0 (SD=34.1). In addition, the average concentration score in the control group was 16.3 (SD=3.9) while in the PMR group the average concentration score was 16.1 (SD=3.2) which can be seen in Table 1.

Table 1. Descriptive Statistics

Dependent Variable	Method	Mean	SD	N
	Control	529.50	29.656	6
Shooting Pre-Test	PMR	521.00	34.123	6
	Total	525.25	30.802	12
	Control	16.33	3.933	6
Concentration Pre-Test	PMR	15.83	2.639	6
	Total	16.08	3.204	12

Each variable (concentration and shooting) and each group (experimental and control) indicate that the two variables' initial statistical abilities are not much different. This can be guaranteed that if different treatments are given to the two variables, then if there is a difference in the mean, so it can be said that the difference occurs solely because of the effect of the treatment given.

The null hypothesis is that the observed covariance matrices of shooting and concentration-dependent variables are equal across groups. The results of the covariate homogeneity assumption test showed that the assumptions are fulfilled with a significance result of 0.758 (Sig $\geq \alpha$ (0.05)).

Main Analysis

The Multivariate Test shows the results of the Multivariate significance test analysis. The differences in the centroid scores in the two groups for the Control group and PMR on the shooting scores were seen from the value of Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root. The F test is significant at $\alpha \leq 5\%$ in the shooting and concentration category. Because this variant test includes more than one independent variable, there are three main effect tests.

Table 2. Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
Shooting Post-test	3.296	1	10	0.100
Concentration Post-test	0.399	1	10	0.542

Table 3. Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Intercept	Pillai's Trace	.038	.137[b]	2.000	7.000	.874	.038	.275	.064
	Wilks' Lambda	.962	.137[b]	2.000	7.000	.874	.038	.275	.064
	Hotelling's Trace	.039	.137[b]	2.000	7.000	.874	.038	.275	.064
	Roy's Largest Root	.039	.137[b]	2.000	7.000	.874	.038	.275	.064
Exercise_Method	Pillai's Trace	.892	28.886[b]	2.000	7.000	.000	.892	57.771	1.000
	Wilks' Lambda	.108	28.886[b]	2.000	7.000	.000	.892	57.771	1.000
	Hotelling's Trace	8.253	28.886[b]	2.000	7.000	.000	.892	57.771	1.000
	Roy's Largest Root	8.253	28.886[b]	2.000	7.000	.000	.892	57.771	1.000
Shooting_Pretest	Pillai's Trace	.992	410.339[b]	2.000	7.000	.000	.992	820.678	1.000
	Wilks' Lambda	.008	410.339[b]	2.000	7.000	.000	.992	820.678	1.000
	Hotelling's Trace	117.24	410.339[b]	2.000	7.000	.000	.992	820.678	1.000
	Roy's Largest Root	117.24	410.339[b]	2.000	7.000	.000	.992	820.678	1.000
Concentra-tion_Pretest	Pillai's Trace	.938	52.941[b]	2.000	7.000	.000	.938	105.882	1.000
	Wilks' Lambda	.062	52.941[b]	2.000	7.000	.000	.938	105.882	1.000
	Hotelling's Trace	15.126	52.941[b]	2.000	7.000	.000	.938	105.882	1.000
	Roy's Largest Root	15.126	52.941[b]	2.000	7.000	.000	.938	105.882	1.000

a. Design: Intercept + Exercise_Method + Shooting_Pretest + Concentration_Pretest
b. Exact statistic
c. Computed using alpha = ,05

Table 4. Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	Shooting_Posttest	10326.117[a]	3	3442.039	250.027	.000	.989	750.082	1.000
	Concentration_Posttest	104.283[b]	3	34.761	32.211	.000	.924	96.634	1.000
Intercept	Shooting_Posttest	.416	1	.416	.030	.866	.004	.030	.053
	Concentration_Posttest	.101	1	.101	.094	.767	.012	.094	.058
Exercise_Method	Shooting_Posttest	253.500	1	253.500	18.414	.003	.697	18.414	.962
	Concentration_Posttest	7.795	1	7.795	7.223	.028	.474	7.223	.655
Shooting_Pretest	Shooting_Posttest	7806.565	1	7806.565	567.064	.000	.986	567.064	1.000
	Concentration_Posttest	.007	1	.007	.007	.936	.001	.007	.051
Concentration_Pretest	Shooting_Posttest	.372	1	.372	.027	.873	.003	.027	.052
	Concentration_Posttest	81.197	1	81.197	75.241	.000	.904	75.241	1.000
Error	Shooting_Posttest	110.133	8	13.767					
	Concentration_Posttest	8.633	8	1.079					
Total	Shooting_Posttest	3321087.000	12						
	Concentration_Posttest	3217.000	12						
Corrected Total	Shooting_Posttest	10436.250	11						
	Concentration_Posttest	112.917	11						

a. R Squared = ,989 (Adjusted R Squared = ,985)
b. R Squared = ,924 (Adjusted R Squared = ,895)
c. Computed using alpha = ,05

The results shown in table 3 show that the conventional method and PMR each influence the results of shooting and concentration. Based on the Multivariate Table, the Partial Eta Squared value can also be seen, explaining the total variance of each independent variable. The femininity category describes a total variance of 6%. While the masculinity category can explain the total variance of 25.7%. The variant test is seen from the results of Levene's test in table 2, which is the sig value that shows insignificant results (p value> 0.05). This indicates that the three dependent variables' variants are equal so that the homogeneity assumption is fulfilled.

Test of Between - Subjects Effect results in table 4 show significant results if $\alpha \leq 0.05$. So it can be seen that there are differences in shooting scores and concentration scores before and after being given treatment.

Exercise Methods

The results of the MANCOVA indicated a significant main effect for exercise methods, Wilks' Lambda = 0.108; F (2,7) = 28.886; p = 0.000 (≤ 0.05); η2 =

0.892. Based on the univariate analysis, it was revealed that differences in exercise methods had a significant effect on shooting scores, $F (1,8) = 18.414$; $p = 0.003$ (≤ 0.05); $\eta 2 = 0.697$. It was also revealed that difference in exercise methodes had a significant effect on concentration scores, $F (1,8) = 7.223$; $p = 0.028$ (≤ 0.05); $\eta 2 = 0.474$.

Concentration

The results of the MANCOVA indicated a significant main effect for Concentration, Wilks' Lambda = 0.062; $F (2,7) = 52.941$; $p = 0.000$ (≤ 0.05); $\eta 2 = 0.938$; Based on the univariate analysis, it was revealed that there was a significant effect on the concentration before and after being given treatment, $F (1,8) = 567.064$; $p = 0.000$ (≤ 0.05); $\eta 2 = 0.986$.

Shooting Score

The results of the MANCOVA indicated a significant main effect for shooting score, Wilks' Lambda = 0.008; $F (2,7) = 410.339$; $p = 0.000$ (≤ 0.05); $\eta 2 = 0.992$; Based on the univariate analysis, it was revealed that there was a significant effect on the shooting score before and after being given treatment $F (1,8) = 75.241$; $p = 0.000$ (≤ 0.05); $\eta 2 = 0.904$.

DISCUSSION

The results indicated that there was a significant difference between the concentration variables and the athlete's performance before and after the progressive muscle relaxation intervention was given (Table 4). Accordingly, differences in concentration were interfered with by PMR. The progressive muscle relaxation technique was significantly effective in reducing anxiety and increasing concentration than the control group. Research showed that the tension felt by the athlete physiologically can be reduced by doing relaxation training methods. In particular, relaxing the muscles progressively (Hazliza et al., 2017; Komarudin, 2017). The PMR training method presumes to relax the muscles so that participants can distinguish between their muscles' tense and relaxed state (Charalambous et al., 2016). However, other studies have concluded that efforts to reduce pre-competition anxiety and athletes' self -confidence can be effectively carried out by the intervention of relaxation techniques (Sakhare, Sharma, & Syal, 2018).

The relaxation response is expected to influence decreased arousal of the autonomic nervous system and central nervous system and increased parasympathetic activity, decreasing musculoskeletal and cardiovascular tone and restoring normal neuroendocrine function (Sakhare et al., 2018). On the other hand, shooting techniques, including gun hold stability, aiming accuracy, trigger pull, and postural balance, also contribute to the performance (Karlsson, 2017). Other bodily functions that are not directly related to the body's stability but still affect the results of the shot are the focus on brain and heart activity (Skyttesportförbundet, 2013). In addition, an unrelaxed muscle state might be causing physiological tremors, Thus shooting performance in athletes who experience stressful environmental conditions will be influenced by changes in such physiological mechanisms (Lakie, 2010).

The shooter's attention to the best target is one of the critical roles of concentration, while the accuracy of aiming, steady body movement of breathing, and pulling the trigger is required at once. The results of this study indicate that concentration has a sizeable effect on performance. This is in line with research that reveals the beneficial role of positive emotions. In any situation, to place the most important things requires concentration as mental effort (Dereceli, 2018). As a negative emotion, anxiety most athletes perceive as something that weakens performance and thus affects perceptions resulting in decreased sports performance (Weinberg & Gould, 2011). By concentrating, athletes can perform well because they can control stress, anxiety and focus on the factors controlling their performance.

As an effortful awareness during a relaxed state, control is the ability to maintain performance without being overwhelmed by other external factors when trying to manage various situations (Dereceli, 2018). This ability might maintain self-confidence despite failures, not give up in front of opponents, and show stability, dedicating oneself to pursuing goals (Crust & Clough, 2011). This is closely related to the efforts and goals of achieving predetermined goals even though experiencing difficulties. The previous study showed that relaxation techniques significantly affect anxiety both cognitively and physiologically and will affect shooting performance. It was also found that the concentration level greatly affected the accuracy of the shot (Gillet, Vallerand, Amoura, & Baldes, 2010).

CONCLUSION

The results showed a significant positive relationship between the use of progressive muscle relaxation methods and shooting performance. In other words, the higher the use of progressive muscle relaxation, the higher the level of sports performance. Furthermore, the effectiveness of muscle relaxation exercises can reduce and overcome the symptoms of stress, anxiety, both physiological and psychological symptoms and accelerate the athlete's recovery process. Besides, PMR techniques can be a powerful technique for lowering oxygen metabolism, breathing, blood pressure, muscle tension, and negative thoughts.

The significant difference between PMR training and conventional training in athletes' concentration and performance may suggest that PMR can be combined in an athlete's shooting training program. Since the concentration and skill of 10m pistols and rifle shooting cause severe anxiety and affect shooting performance, PMR training is a very economical but efficient and effective strategy for dealing with some of the problems athletes often face when performing at their best. PMR technique exercises help athletes self-control and focus their attention during stressful situations and can be used to maintain physical, technical, and mental balance. Thus, the progressive muscle relaxation training method is important in sports that require concentration because it significantly impacts concentration and performance results.

ACKNOWLEDGEMENT

Our deepest gratitude to all the Purwakarta shooting athletes and coaches that contributed to this research.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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