Does Shooting Performance Increase With Exercises

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THE EFFECT OF HAND AND FINGER EXERCISES ON SHOOTING ACCURACY

VPLIV VAJ ZA ROKE IN PRSTE NA NATANČNOST STRELJANJA

ABSTRACT

This study aimed to investigate whether hand and finger exercises had an effect on shooting accuracy and if they did, determine the shot grouping of these exercises and analyze its relationship with shooting statistic data. In this study, to obtain the findings of the investigation, a model with a pretest and a posttest was implemented on an experimental and a control group. A total of forty teenage girls in the 15-18 age group having no shooting experience before participated in the study. Participants were divided into experimental and control groups. The experimental group regularly participated in hand and finger exercises for a total of 10 weeks, 3 days a week, 1 hour a day. Within the scope of the investigation, to determine the shooting accuracy of subjects, the SCATT Shooting Training System was utilized. In order to evaluate the data obtained from the sample group, a package program SPSS (Statistical Package for Social Sciences) was used. The level of significance was considered to be 0.05 in statistical analysis. The investigation showed that there was a significant variance ($p<0.01$) between hand and finger exercises and shooting score, diametrical dispersion, mean length of aiming trace, and stability of aiming in pretest-posttest measurements of the experimental group. Outcomes of our study have indicated that hand and finger exercises have a positive effect on shooting accuracy. In this study administered on subjects with no shooting experience before, we speculate that hand and finger exercises affect performance to such an extent that they will enhance shooting performance when combined with technical and mental training, and we recommend that shooters should specifically include hand and finger exercises in their training program.

Keywords: Shooting, Hand Exercise, Finger Exercise, Shooting Accuracy, SCATT

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IZVLEČEK

Namen študije je bil raziskati, ali vaje za roke in prste vplivajo na natančnost streljanja in če vplivajo določiti razvrščanje strelov v skupine teh vaj in analizirati njihovo povezavo s statističnimi podatki o streljanju. V tej študiji smo za pridobitev izsledkov raziskave implementirali model s pred testom in post testom na eksperimentalni in kontrolni skupini. V raziskavi je sodelovalo štirideset najstnic v starostni skupini od 15 do 18 let, ki pred tem niso imele strelskih izkušenj. Udeleženke so bile razdeljene v eksperimentalno in kontrolno skupino. Eksperimentalna skupina se je 10 tednov redno udeleževala vadb za roke in prste tri dni na teden po eno uro na dan. V okviru preiskave je bil za ugotavljanje natančnosti streljanja udeležencev uporabljen strelski vadbeni sistem SCATT. Za vrednotenje podatkov pridobljenih od vzorčne skupine, je bil uporabljen statistični program SPSS ((Statistical Package for Social Sciences). Pri statistični analizi je bila upoštevana stopnja pomembnosti 0.05. Raziskava je pokazala, da je med vajami za roke in prste ter rezultatom streljanja, diametralno disperzijo, povprečno dolžino ciljne sledi in stabilnostjo ciljanja pri pred testnih in post testnih meritvah eksperimentalne skupine obstajala pomembna razlika ($p<0.01$). Rezultati študije so pokazali, da vaje za roke in prste pozitivno vplivajo na natančnost streljanja. V tej študiji, ki je bila izvedena na osebah brez predhodnih strelskih izkušenj, domnevamo, da vaje za roke in prste vplivajo na uspešnost do te mere, da bodo v kombinaciji s tehničnim in mentalnim treningom izboljšale strelsko uspešnost, zato priporočamo, da strelci v svoj program usposabljanja posebej vključijo vaje za roke in prste.

Ključne besede: streljanje, vaje za roke, vaje za prste, natančnost streljanja, SCATT

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INTRODUCTION

Shooting is a competition sport in which one aims and shoots on fixed or moving targets with a pistol, rifle, or shotgun rendered for sports, and it is performed for performance as well as recreational purposes.

The control of weapon stability is a distinctive feature in this sport. Tang et al. emphasized that a controlled grip of the weapon and hand in harmony is the most essential fundamental for shooting accuracy.[1] Handgrip is one of the elements that complement shooting techniques for pistol and rifle shooters.[2] But a good grip and taking aim at a target do not completely guarantee success.[3] According to Rauch, good and effective hits are made with perfect trigger control, not with perfect sight control. Even when the sights are aligned and you have a perfect sight picture, you will miss the target if you yank the trigger.[4]

The juncture of trigger implementation is the split second right before starting to pull the trigger. In the meantime, the resultant of the forces applied on the pistol (in a vectorel sense) should be in the direction of the bull's eye. The bullet will leave the muzzle in the direction of the resultant of these forces at the very moment when the trigger is pulled.[5]

Regarding the trigger finger and the action that the trigger finger has to perform when shooting, two main observations can be made: First, it is next to impossible to move the first phalanx (the most remote phalanx from the palm of the hand) of a finger without moving another phalanx. Second, the muscles needed to move a finger or a finger phalanx are on one side attached to the moving phalanx and on the other side to the bones of the underarm.[6]

When assuming a good grip on an air pistol, there is a good contact between the palm and the grip surface. Any movement of the trigger finger and the consequent subcutaneous action of the tendons will exert force on the grip. This force causes a deviation from the line of sight because the forces are multiple and depend on different points of contact of the palm and the anatomical characteristics of the related hand. The direction and amplitude of the deviation from the line of sight are not predictable. We require a solution that will reduce any unwanted forces resulting from moving the first knuckle.[7] The resultant deviation can be rendered minimal by limiting the movement of the trigger finger in the final stage of delivering a shot.[6] To ensure that the placement and force on the trigger are linear, the first knuckle should be straightened rather than bent.[7]

Constant body movement requires constant sight alignment. Unnecessary movement is the enemy of marksmanship. The discipline of the hands is the most difficult of the fundamentals of marksmanship.[8] Mobility of the trigger finger without moving other fingers is essential and requires a great deal of practice.[9,10,11] The natural movement of fingers is unlike how it is during training. Therefore, it takes a lot of training to improve this skill.[11]

As seen in the resources, all these conditions are about the hand and fingers holding the pistol and shows the importance of the hand and fingers holding the pistol. Sports scientists, researchers and coaches have to find new and efficient methods to enhance and maintain success by boosting the athlete's performance. In this context, we specifically aimed to investigate the effect of hand and finger exercises on shooting accuracy without using pistols.

METHODS

Participants

A total of 40 voluntary teenage girls in the 15-18 age group participated in the study and 20 of whom were in the experimental group, while the other 20 were in the control group. They were asked to sign "Informed Consent Form". Since they were under 18, their parents were also asked to sign the same form upon their approval.

The participants were first given safety information and then basic shooting training. They were introduced to tools and materials to be used in the study and informed about the Scatt Simulation Device and Hämmerli AP20 air pistol. Then, they trialed in sufficient numbers.

Additionally, a form that included subjects' birthday, their dominant eye, spectacles usage, health conditions, and other necessary information was taken from the participants.

Data Collection Tools

SCATT Shooting Simulation System

SCATT system (ZAO SCATT, Zelenograd, Russia) is a computer-aided training system that allows athletes to observe what is going on while aiming at a target, providing them the correct results regarding their shots.

Through SCATT training simulator, the characteristics of hand and finger exercises in shooting accuracy were assessed in a quantitive way.

HÄMMERLİ AP20 Air Pistol

In the shootings for measurements, Hämmerli AP20 Air Pistol was benefited in compliance with the air pistol regulations for the Olympics in terms of its specifications (pistol weight, trigger weight, barrel length).

Measuring Body Height and Body Weight

Heights of subjects (cm) were measured while standing in anatomical position and barefoot using a Seca brand stadiometer with a tolerance of 1 mm.

Weights of subjects (kg) were measured barefoot and with light clothes on as far as possible, using a Seca brand digital weighing scale with a tolerance of 100 gr.

Measuring Shooting Performance

Shooting success was assessed through total scores of bullets hit on the simulation target with a target center which was placed 1.40 meters above according to International Shooting Sport Federation (ISSF) rules.

Optical sensor was calibrated for each experimental subject. Each subject was made to test-fire three times from a distance of 10 m. under the supervision of the shooting trainer. Then 10 of the shots hit on the simulation target area were taken for assessment. No time restriction was put during shots. The one-handed shooting position without support hand was assumed as the shooting position. The participants freely stood up without support with their feet on the shooting point. Shots were made in a position that the pistol was held with one hand, which was dominant and the wrist was by no means supported. Shots were also made with both eyes open but the eye on the side of the nondominant hand was closed with a blinder. After pretest measurements of the experimental and control groups were taken, the experimental group continued with hand and finger exercises for 10 weeks, 3 days a week, and 1 hour a day (at the same hours). At the end of 10 weeks, posttest measurements were taken at the same time as the pretest, applying the same rules. After the pretest measurements, both groups did not do shooting training until the posttest measurements.

Hand and Finger Exercises

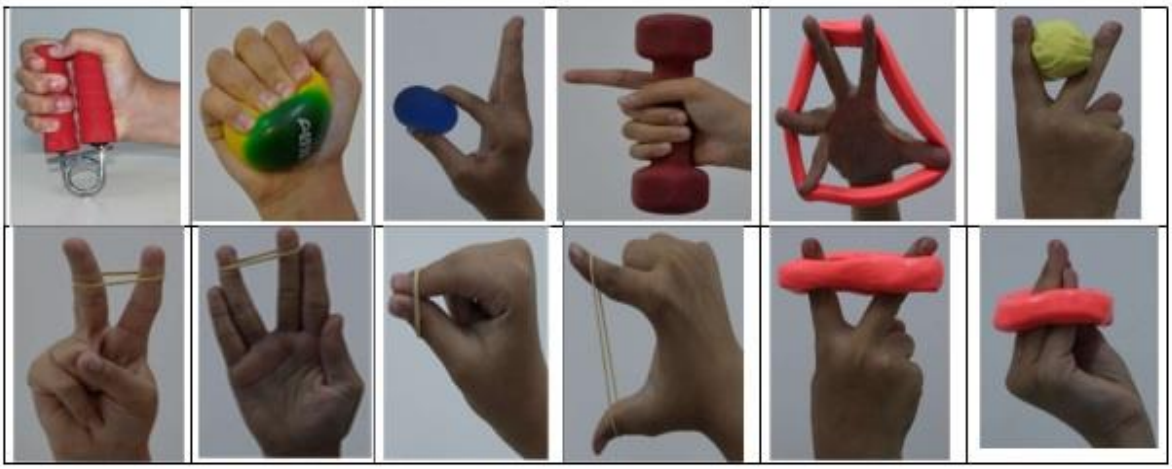
The experimental group regularly participated in hand and finger exercises for a total of 10 weeks, 3 days a week, 1 hour a day. Hand dumbbells, hand exercise doughs of different

intensities, handsprings, stress balls and rubber tires were used with the experimental group. Based on studies, it was aimed to work on and strengthen the fingers separately.

Each exercise program consisted of 10-15 minutes of special warm-up and 45 minutes of hand and finger exercises. Hand and finger exercises were planned and applied as adaptation training in the 1st and 2nd weeks. In the third and fifth weeks, the subjects performed the exercises as 3 sets with 50% of the maximum number of repetitions, 60% of the maximum number of repetitions in the sixth and eighth weeks, and 70% of the maximum number of repetitions in the ninth and tenth weeks.

Soft, medium and hard exercise doughs and exercise balls were used respectively. Rubber tires were used as single ply and double-ply according to the form of the exercise. Dumbbells were used as 1 kg, 1.5 kg, 2 kg and 2.5 kg, respectively, according to the form and intensity of the exercise.

Figure 1. Hand and Finger Exercises.



Statistical Analysis

SPSS package software was availed for the statistical analysis and assessment of the data.

The SCATT analysis method was utilized for the determination of shooting success. Some statistical values used in our investigation in SCATT analysis were as follows: success score, diametrical dispersion, average length of aiming trace, and stability of aiming.

In the statistical evaluations, nonparametric tests were used. The Mann-Whitney U test was used for between-groups evaluation. To determine the within-group differences, the Wilcoxon

Signed Ranks Test was applied. The significance level was considered to be $p<0.05$ in the statistical evaluations.

RESULTS

Table 1. General Physical Characteristics of the Subjects Participated in the Study.

VARIABLES	EXPERIMENT GROUP (n=20)	CONTROL GROUP (n=20)	p
Age (year)	16,55±1,146	16,30±0,923	0,517
Height (cm)	159,55±6,724	159,05±5,671	0,978
Body Weight (kg)	55,85±9,461	59,35±10,439	0,185

$p < 0,05$

As seen in Table 1, there are a total of 40 subjects, 20 in the experimental group and 20 in the control group, participated in the study. Age, height, and body weight are listed as descriptive statistics. These data are an indication that experimental and control groups are also homogeneous.

Table 2. Comparison of Between-groups Pretest and Posttest Measurements of Subjects in the Experimental and Control Groups.

	PRETEST				POSTTEST			
VARIABLES	Experiment Group (n=20)	Control Group (n=20)	z	p	Experimental Group (n=20)	Group Group (n=20)	z	p
Success Score	38,900±10,036	42,300±7,306	-1,070	0,285	51,050±10,164	42,600±8,419	-2,560	0,010*
Diametrical Dispersion (mm)	142,725±21,638	143,165±31,328	-0,406	0,685	99,380±20,941	146,505±19,878	-4,815	0,001**
Mean Length of Aiming Trace (mm)	470,280±77,769	431,205±134,587	-1,109	0,267	243,660±64,415	344,670±169,768	-1,298	0,194
Stability of Aiming (mm)	127,650±22,266	127,940±29,454	-0,027	0,978	82,730±20,694	127,135±22,532	-4,693	0,001**

*$p < 0,05$ **$p < 0,01$

In Table 2, looking at the effect of hand and finger exercises on shooting score, comparing between-groups pretest measurements of subjects in the experimental and control groups, a

statistically significant difference is seen in the posttest measurments of the experimental and control groups while a statistically significant difference is not seen in success score.

Table 3. Comparison of Within-group Pretest and Posttest Measurements of Subjects in the Experimental and Control Groups.

VARIABLES	EXPERIMENTAL GROUP (n=20)		z	p	CONTROL GROUP (n=20)		z	p
	PRETEST	POSTTEST			PRETEST	POSTTEST		
Success Score	38,900±10,036	51,050±10,164	-3,455	0,001**	42,300±7,306	42,600±8,419	-0,333	0,739
Diametrical Dispersion (mm)	142,725±21,638	99,380±20,941	-3,920	0,001**	143,165±31,328	146,505±19,878	-0,635	0,526
Mean Length of Aiming Trace (mm)	470,280±77,769	243,660±64,415	-3,920	0,001**	431,205±134,587	344,670±169,768	-2,128	0,033*
Stability of Aiming (mm)	127,650±22,266	82,730±20,694	-3,920	0,001**	127,940±29,454	127,135±22,532	-0,224	0,823

*p < 0,05 **p < 0,01

In Table 3, comparing within-group pretest and posttest values of subjects in the experimental and control groups, statistically significant differences are found between all parameters. In the control group, no statistically significant differences are found between pretests and posttests in all parameters except for average lenght of aiming trace.

Table 4. Analysis of Effects of Age, Height and Body Weight on Shooting Accuracy in the Experimental and Control Groups.

	VARIABLES	n	AGE		HEIGHT		BODY WEIGHT	
			k2 Chi-Square	p	k2 Chi-Square	p	k2 Chi-Square	p
PRETEST	Success Score	40	1,149	0,765	1,163	0,762	0,977	0,807
	Diametrical Dispersion (mm)		1,109	0,775	6,265	0,099	0,703	0,873
	Mean Length of Aiming Trace (mm)		4,222	0,238	5,336	0,149	0,677	0,879
	Stability of Aiming (mm)		5,731	0,125	5,952	0,114	4,851	0,183
POSTTEST	Success Score	40	2,856	0,414	1,275	0,735	0,493	0,920
	Diametrical Dispersion (mm)		1,665	0,645	0,778	0,855	6,278	0,099
	Mean Length of Aiming Trace (mm)		2,383	0,497	10,789	0,103	2,069	0,558
	Stability of Aiming (mm)		3,569	0,312	2,644	0,450	1,713	0,634

$p < 0,05$

In Table 4, looking at the effects of age, height, and body weight on shooting performance in the experimental and control groups, statistically significant differences are not seen between pretest and posttest values in all parameters ($p>0.05$).

Table 5. Analysis of Effects of Dominant Eye and Dominant Hand on Shooting Accuracy in the Experimental and Control Groups.

	VARIABLES	n	DOMINANT EYE			DOMINANT HAND		
			Mann-Whitney U Test	z	p	Mann-Whitney U Test	z	p
PRETEST	Success Score	40	67,000	-0,840	0,401	67,000	-0,840	0,401
	Diametrical Dispersion (mm)		82,000	-0,225	0,822	82,000	-0,225	0,822
	Mean Length of Aiming Trace (mm)		84,000	-0,143	0,886	84,000	-0,143	0,886
	Stability of Aiming (mm)		79,000	-0,348	0,728	79,000	-0,348	0,728
POSTTEST	Success Score	40	74,000	-0,553	0,580	74,000	-0,553	0,580
	Diametrical Dispersion (mm)		77,000	-0,429	0,668	77,000	-0,429	0,668
	Mean Length of Aiming Trace (mm)		51,000	-1,493	0,136	51,000	-1,493	0,136
	Stability of Aiming (mm)		87,000	-0,020	0,984	87,000	-0,020	0,984

$p < 0,05$

In Table 5, looking at the effects of dominant eye and dominant hand on shooting performance in the experimental and control groups, statistically significant differences are not seen between pretest and posttest values in all parameters ($p>0.05$).

DISCUSSION

A total of 40 subjects participated in the study, 20 as the experimental group, and 20 as the control group. Age, height, and body weight were listed as descriptive statistics. Assessing the findings obtained through the study (Table 1.); it was determined that the average age of the experimental group was 16.55±1.146 years, that of the control group was 16.30±0.923 years; the average height of the experimental group was 159.55±6.724 cm, that of the control group was 159.05±5.671 cm; and the average body weight of the experimental group was 55.85±9.461 kg, that of the control group was 59.35±10.439 kg. These data were an indication that experimental and control groups were homogeneous.

Looking at the effect of hand and finger exercises on shooting score (result), comparing between group's pretest measurements of subjects in the experimental and control groups (Table 2.), it was determined that success score of experimental group was 38.900±10.036, that of

control group was 42.300±7.306 and no statistically significant difference was found ($p>0.05$). It was realized that groups were similar as to success scores as a result of initial measurements. Comparing between group posttest measurements of subjects in the experimental and control group (Table 2.), it was determined that success score of experimental group was 51.050±10.164, that of the control group was 42.600±8.419 and a statistically significant difference was found at the level of $p<0.05$.

Comparing group pretraining and posttraining measurements of the control group (Table 3.), it was determined that success score pretest measurement was 42.300±7.306, posttest measurement was 42.600±8.419 and no statistically significant difference was found ($p>0.05$). Comparing group pretraining and posttraining measurements of the experimental group (Table 3.), it was determined that the success score pretest measurement was 38.900±10.036, posttest measurement was 51.050±10.164 and a significant difference between pretraining and posttraining measurements was seen in success score at the level of $p<0.01$.

It is possible to find studies in the literature that investigate the correlation between shooting competitions and shooting success. Scores are the result of shot groups (shot distribution) and everything we shot on the paper is the result of how we performed on the firing line.[12] Erdoğan et al. found in the study in which they investigated the effect of handgrip strength for shooting performance that as the handgrip strength of female student shooters increased, the scores they had in the competition also increased.[2] İskender stated that as consequence of a special training applied to the experimental group firearm shooters that percentage increase of slow-fire, rapid-fire, and total scores of the experimental group was higher than that of the control group. For an accurate shoot, keeping the pistol and hand under control in harmony is essential.[13] As it is seen, literature studies support our findings as well.

The increase in total scores indicates an increase in shooting success. As a result of the exercises performed for 10 weeks, the increased wrist and finger force and the increased static force and coordination in particular revealed a positive improvement in final measurements.

Looking at the effect of hand and finger exercises on diametrical dispersion (shot group size), comparing particular group pretest measurements of subjects in the experimental and control groups (Table 2.), it was seen that the diametrical dispersion was 142.725±21.638 mm in the experimental group and 143.165±31.328 mm in the control group. Based on the predetermined significance level, these values do not imply a statistically significant difference ($p>0.05$). It was realized that the groups were similar as to diametrical dispersion as a result of the initial

measurements. Comparing between-group posttest measurements of subjects in the experimental and control groups (Table 2.), it was seen that the diametrical dispersion was 99.380±20.941 mm in the experimental group and 146.505±19.878 mm in the control group, and a statistically significant difference was found at the level of $p<0.01$.

Comparing group pretraining and posttraining measurements of the control group (Table 3.), it was seen that the diametrical dispersion was 143.165±31.328 mm in the pretest measurements, 146.505±19.878 mm in the posttest measurements. The numerical difference between pretest and posttest measurements in the diametrical dispersion was not found statistically significant ($p>0.05$). Comparing group pretraining and posttraining measurements of the experimental group (Table 3.), it was seen that the diametrical dispersion was 142.725±21.638 mm in the pretest measurements, 99.380±20.941 mm in the posttest measurements. The difference between pretest and posttest measurements in the diametrical dispersion was found statistically significant ($p<0.01$).

A critical prerequisite for an accurate shot is the minimal movement of the gun barrel during the aiming phase. Effective gripping of the pistol relies on the correct pressure and distribution of this pressure on the grip as well as a firm wrist to aid in consistent recoil, thereby reducing the area of the target within which the shots are distributed.[14] The smaller the group (diametrical dispersion, mean length of aiming trace) is, the better shooting you are doing.[12] Mon et al. found significant correlations between performance at the competition and average and peak finger flexor forces in the study in which they investigated the relationship between performance and finger flexor force as well as shoulder abduction isometric force in senior male air pistol shooting and they reached the conclusion that finger flexor force influenced shooting performance.[15] These studies are also supportive of our findings.

Based on the increases seen in the experimental group, it can be said that hand and finger exercises performed by the experimental group have enhanced grip and pistol stability and affected the diametrical dispersion in a positive way providing a more balanced distribution of pressure on grip compared to pretest shots.

Based on the effect of hand and finger exercises on the average length of aiming trace, comparing between-groups pretest measurements of subjects in the experimental and control groups (Table 2.), it was seen that the average length of aiming trace was 470.280±77.769 mm in the experimental group and 31.205±134.587 mm in the control group and no statistically significant difference was found ($p>0.05$). It was realized that groups were similar to the

average length of aiming trace as a result of initial measurements. Comparing groups posttest measurements of subjects in the experimental and control groups (Table 2.), it was seen that the average length of aiming trace was 243,660±64,415 mm in the experimental group and 344.670±169.768 mm in the control group and no statistically significant difference was found ($p>0.05$). Although the difference between group average length of aiming trace was not found to be statistically significant, the average of the experimental group was less than that of the control group. In this case, we can say that the experimental group is more successful than the control group as to the average length of aiming trace.

Comparing group pretraining and posttraining measurements of the control group, the average length of aiming trace pretest measurement was found to be 431.205±134.587 mm and posttest measurement to be 344.670±169.768 mm. A statistically significant difference between pretest and posttest measurements was observed in the average length of aiming trace. Comparing group pretraining and posttraining measurements of the experimental group (Table 3.), the average length of aiming trace pretest measurement was found to be 470.280±77.769 mm and posttest measurement to be 243.660±64.415 mm. It was observed that there was a significant difference between pretraining and posttraining measurements in the average length of aiming trace at a level of $p<0.01$.

The higher the body fluctuation, the lower the performance and the greater the fluctuation of the target point.[16] As a general thing, shooters are encouraged to minimize movements in order to achieve a high score. Selva et al. found a correlation between body sway and movements of the gun barrel.[17] Tang et al. concluded in their study that the postural tremors of air pistol shooters are associated with the shooters' skill, and the elite shooters could optimize the control of the pistol-hand complex which strongly determines success in shooting.[18] A characteristic that distinguishes elite shooters from their novice counterparts is the amount of tremor in the limb holding the pistol or rifle. This tremor results in a wandering of the shooter’s aim across the shooting target before a shot is taken.[14] Hand is one of the most substantial elements that affect the upper extremity. As grip is a significant function for continuity of daily life activities among hand functions, grip force is accepted as an objective measure for evaluation of the performance of upper extremity. As well as handgrip force, measurement of finger grip force is often used for evaluation of hand functions.[19] Bao et al. reported that training hard with the stress of focus and static strength have positive effects on shooting, athlete's brain control, visual reaction time and vibration. Comparing the first and second measurements of the experimental group, İskender found out as a consequence of special training applied to firearm

shooters that the increase in hand claw forces exhibited a statistically ($p<0.01$) significant improvement.[13] A shooter has to control many of his/her extremities from feet to wrist, joints, and muscles to hold a rifle or a pistol in a desired position. Besides, all the given components continue to be held under control until a shot reaches the target.[2] Literature studies are supportive of our study as well.

Length of aiming trace is short in successful shots. As a consequence of hand and finger exercises performed by the experimental group, we speculate that the length of aiming trace has been shortened by the enhanced force of wrist, handgrip, and fingers which affect the complex of pistol-hand stability positively. This shortening was also found statistically significant.

Based on the effect of hand and finger exercises on the stability of aiming, comparing between-groups pretest measurements of subjects in the experimental and control groups (Table 2.), it was seen that the stability of aiming was 127.650±22.266 mm in the experimental group and 127.940±29.454 mm in the control group and no statistically significant difference was observed ($p>0.05$). It was realized that the groups were similar as to the stability of aiming as a result of initial measurements. Comparing group posttest measurements of subjects in the experimental and control groups (Table 2.), it was seen that the stability of aiming was 82.730±20.694 mm in the experimental group and 127.135±22.532 mm in the control group and a statistically significant difference was found at level of $p>0.05$.

Comparing group pretraining and posttraining measurements of the control group (Table 3.), the stability of aiming pretest measurement was found to be 127.940±29.454 mm and posttest measurement to be 127.135±22.532 mm. No statistically significant difference was observed between pretest and posttest measurements in the stability of aiming ($p>0.05$). Comparing within-group pretraining and posttraining measurements of the experimental group (Table 3.), the stability of aiming pretest measurement was found to be 127.650±22.266 mm and posttest measurement to be 82.730±20.694 mm. It was observed that the difference between pretraining and posttraining measurements in the stability of aiming was statistically significant at the level of $p<0.01$.

In the other researches conducted, it is said that the pressure points applied in the handgrip have minute precisions. It must be in a decreasing format from the little finger to the index finger. The pressure applied on the grip directly influences the performance and the muscle stresses down the entire hand.[21] The ability to stabilize the gun is crucial for performance in Olympic

pistol shooting and it is thought to be related to the shooters' muscular strength.[15] Kayıhan found out that the effect level of grip force values on shooting success was significant and determined that the effect level of grip force on shooting success was 5.9%.[22] Literature studies are supportive of our study as well.

We speculate that hand and finger exercises performed by the experimental group decreased the value of the stability of aim, affecting the pistol and hand stability in a positive way as a result of increased hand and finger force, and trigger finger flexor force in particular; thereby reducing unnecessary pistol vibration in the last one second before a shot. This case was also found statistically significant.

Based on the effect of age, height, body weight, dominant eye, and dominant hand on shooting success, analyzing the effect of variables in the experimental and control groups on shooting success in the pretest and posttest measurements, it was seen that there was not a statistically significant difference in the pretest and posttest measurements as to the effect of age, height and body weight (Table 3.4.), dominant eye and dominant hand (Table 3.5.) on shooting success (success point, diametrical dispersion, average length of aiming trace, and stability of aiming) in the experimental and control groups ($p>0.05$).

No significant correlations were found between performance and age, weight, height, or BMI by Mon et al.[15] In another study, no significant correlations were also found between the weight of the participants and performance by Mon at al.[23] Kalkan (2013) found out that there was no significant difference between total hitting scores of shooters based on age.[24] Kayıhan (2012), in his study, did not find out a statistically significant difference between shooting success and age, height, and body weight.[22] In the present study, it has been observed that demographic traits such as age, height, bodyweight; do not alter the shooting performance of dominant hand or dominant eye. In this case, it can be said that technical studies regarding the branch are more effective for shooting performance.

CONCLUSION

This study was conducted to investigate the effect of hand and finger exercises on shooting accuracy. As a consequence of hand and finger exercises performed for 10 weeks, 3 days a week, and 1 hour a day; an answer has been found to the hypothesis put forward in the light of the primary purpose of our investigation. According to the data acquired:

Hand and finger exercises have affected the shooting score (the accuracy), diametrical dispersion, average length of aiming trace, and stability of aiming in a positive way. It has been observed that a dominant eye, a dominant hand, age, height, and body weight do not affect shooting performance. It has been concluded that hand and finger exercises performed regularly have brought about positive developments. Findings of this study indicate that hand and finger exercises are requisite to enhance shooting performance consentaneously with experimental studies done on shooting.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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