Prevalence of Shoulder and elbow Dysfunction Among Gun Shooters

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ABSTRACT

Background: *Shooting is an extremely precise sport involving control of one's body motions for peak performance. The shoulders and wrist muscles must be worked in order to stabilize the gun. Purpose: to investigate the prevalence of Shoulder and elbow dysfunction in gun shooters at Giza –Egypt and determine the correlation between numbers of years practicing shooting and shoulder and elbow dysfunction in gun shooters.* ***Subjects& Method****: one hundred subjects from both sexes gun shooters were participated in this study, with ranging ages from 25-70 years and Body Mass Index (BMI) ranging from 18 to 25 kg/m² Gun shooting trainers for 1 to more than 30 years, The study was conducted at (shooting club Dokki, shooting club Sun sporting and Military shooting club)in Giza, pain intensity level was evaluated by visual analogue scale, pain pressure threshold was evaluated by pressure algometry and Functional disability was evaluated utilizing the Disability of the Arm, Shoulder and Hand questionnaire (DASH questionnaire). Result prevalence of shoulder dysfunction with 40% ,elbow dysfunction with 35% and without dysfunction with25% assured that there was no correlation between number of practicing years and lateral pectoral and there were correlation between number of practicing years and anterior deltoid and biceps brachii Conclusion: there were non-significant correlation between the numbers of practicing years and pain intensity, pain threshold as well as functional disability.*

Key words: *Gun shooters; prevalence; shoulder and elbow dysfunction.*

INTRODUCTION

Shooting needs complete control over every movement of the body. Shooting performance can be affected by multiple factors. It is generally accepted that the shooter's static balance impacts the gun's movements and, also by performance (1).

Stabilizing the gun, which is linked to the shooter's capacity to move their body's numerous kinetic lines, is also crucial. The gun's vertical and lateral motions have been linked to the X-axis (often linked to body motions) and Y-axis (generally associated with control of shoulder and wrist motions) COP movements, respectively. When shooters keep their horizontal motions to a minimum, they are more capable of stabilizing their gun (2).

Movements induced by muscular tremors (3), which are associated with several variables and different forms of muscular contractions, are another component that impacts shooting performance. Additionally, the shooter's physiological status, levels of anxiety, as well as fluctuations in anxiety levels might impact the preparation heart rate patterns along with heart rate variability (HRV) before shooting, which in turn affects this tremor (4).

Muscle activation in the forearm and shoulder determines the gun's stability. Minimizing muscular tremors allows shooters to better stable their wrists and guns, which may be achieved with the proper co-contraction of the hand muscles (5).

Maintaining proper posture is essential for precise arm movement control during shooting. Aiming as well as pointing tasks demand the coordination of numerous degrees of freedom (DOF), a combination of posture along with control of the upper limbs (6).

The shooter must essentially align the barrel of the gun with the object being shot to attain accurate aiming. To control the gun's alignment with the target, it is necessary to efficiently limit and coordinate the repetitive kinematic arm joint movements (7).

Actors need quick reactions and exacting accuracy for fast-fire pistol shooting and similar activities. One can anticipate that theoretical approaches that handle speed-accuracy difficulties will make a significant impact when thinking about the control and execution of motions made throughout the event. Shooting also requires strong wrists and deltoid muscles (8).

This study was conducted to examine the prevalence of Shoulder and elbow dysfunction in gun shooters at Giza –Egypt, and determine the correlation between number of years practicing shooting and shoulder and elbow dysfunction in gun shooters of Giza – Egypt.

MATERIALS AND METHODS

Study design

A cross sectional study was done and designed to investigate the prevalence of shoulder and elbow dysfunction among different ages in Egyptian Gun shooters at Giza.

Participants: One hundred male and female gun shooters ranging in age from 18 to 70 years old and with a BMI between 18 and 25 kg/m² were included in this study. The participants all complained of shoulder and elbow dysfunction. In this study: the mean Age, height, weight as well as BMI were 31.78 ± 8.30, 173.12± 8.35cm,78.03 ± 13.98 kg, 25.85 ± 3.67kg/m², respectively. There were 74 (68.51%) males and 34 (31.48 %) females.

Gun shooting trainers for 1 to more than 30 years, the subjects were taken from shooting centers and shooting clubs (shooting club Dokki, shooting club sun sporting club) and was conducted as one shot. They were divided into 6 subgroups according to their number of practicing years. • (I) less than 5 years, (II) 5-9 years, (III) 10 – 14, (IV) 15-19 (v) 20-24, (vI) more than 24.

Patients were excluded from the study Acute trauma, injury, or fracture, Severe underlying disease.

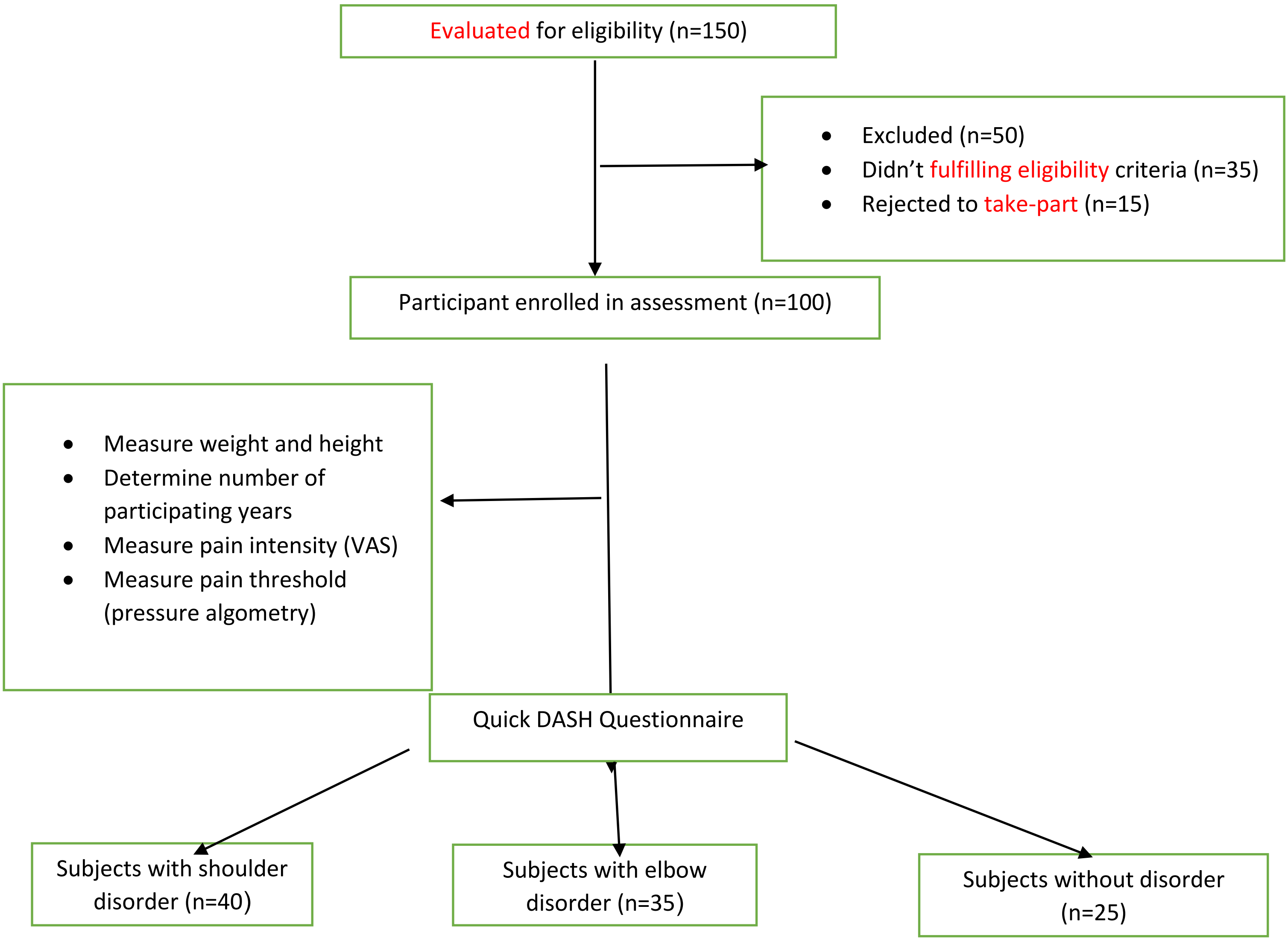

Figure (1): flowchart of the study

Measurement procedures:

Data on medical history and initial examination were collected directly from the participants at baseline to detect the availability of the inclusion criteria to the participants. First, the subject's weight and height were measured, then the pain intensity were measured using {VAS}, the pain threshold using pressure algometry and the function and disabilities of shoulder and elbow were measured using DASH.

Visual Analogue Scale (VAS) was utilized for measurement pain intensity. The validity and reliability of VAS for assessing pain of different origins was confirmed in several studies (9). the VAS is a continuous scale measuring 100 mm in length, it has two verbal indicators on either end, one of them for each extreme of each symptom: "no pain" at the farthest left edge of the line (a scoring of 0) along with "pain as severe as it might be" or "worst possible pain" (a scoring of

30 items. A simple average of the values provided to each response is calculated to get a score out of 5. After that, we take this number and multiply it by 25 to get a score out of 100. Greater disability is indicated by a higher score. The DASH has been demonstrated to be sensitive to actual change and to have satisfactory levels of validity and reliability. Fifteen individuals were asked to document the level of pain and functional impairment they had experienced throughout the past seven days (11).

Pressure algometry:

Algometry is a tool for determining the force and/or pressure that causes a pressure-pain threshold to be activated. According to research on pressure-pain thresholds, the most reliable results are obtained when the rate of physical force application is consistent. Manually pressing down on a force plate (500-Hz sampling rate) was used to test the

100/100 mm scale) at the farthest right edge." (Appendix II). To prevent a score clustering around a desired numerical value, scores in between the two ends were eliminated (10).

DASH:

The Disability of the Arm, Shoulder, as well as Hand questionnaire (DASH), was used for measuring functional disability.15-17 The functional state of the patient over the past week is assessed using the DASH, a 30-item questionnaire with scores ranging from 1 to 5. The purpose of the questionnaire is to assess the following: the extent to which problems with the arms, shoulders, or hands make it difficult to perform various physical activities (21 items); the intensity of pain, activity-concerned pain, numbness, weakness, as well as stiffness (5 items); and the influence of the disorder on social interactions, work, along with self-image (4 items). Toto get a score, you have to finish at least 27 out of the

construct validity as well as the reliability of an algometry (1000-Hz sampling rate) in this investigation (12).

Ethical consent: All Gun shooters were offered a detailed description of procedures, purpose of the study and they signed informed consent, which includes their agreement to participate in the study. The Research Ethics Committee of the Faculty of Physical Therapy has given its approval to this study's protocol (NO:P.T.REC/012/004424)

Data Analysis:

The G-power analysis was used to determine the sample size of this study: Software from SPSS, Inc., Chicago, IL, version 20 will be used for statistical analysis. The threshold for statistical significance will be ($p< 0.05$). For this study, one hundred participants were the ideal number. Using the VAS score as the primary outcome, this calculation was made to show that there was a 0.5 effect size, with an alpha of 0.05, as well as 80% power.

The collected data were statistically analyzed utilizing:

Descriptive statistics (mean, standard deviations in addition to percentage).

Inferential statistics; Pearson correlation coefficient was utilized to analyze the relation among the number of working years and shoulder and elbow dysfunction in gun shooters.

Statistical analysis was carried-out utilizing SPSS for Windows, version 20 (SPSS, Inc., Chicago, IL). Statistical significance was set at the ($p < 0.05$).

RESULTS

1-Demographic Data: 100 Egyptian Gun shooters were recruited in this study, Demographic data of the gun shooters who participated in the study (the mean Age, height, weight as well as BMI) were 31.78 ± 8.30, 173.12± 8.35cm,78.03 ± 13.98 kg, 25.85 ± 3.67 kg/m², respectively. There were 74 (68.51%) males and 34 (31.48 %) females.

2- Prevalence of shoulder and elbow with and without dysfunction

	Prevalence (%)
Shoulder dysfunction	40%
Elbow dysfunction	35%
Without dysfunctions	25%

Table 1: prevalence of shoulder and elbow dysfunction

3-Number of participating years:

Means of number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 2.15±1.02, 6.73±1.28, 10.90±1.22, 15.50±97, 20.66±1.15.

4-Visual Analog Scale (VAS):

Means of visual Analog Scale (VAS) regarding the number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 1.55±1.58, 2.73±2.14, 3.61±2.39, 2.40±2.17, 3.66±3.21, 31.33±1.52 respectively.

5- DASH:

Means of DASH regarding the number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 20.27±6.91, 14.80±6.66, 17.97±6.59, 18.50±5.67, 20.83±9.46, 13.33±3.81 respectively.

6-DASH 2:

Means of DASH2 regarding the number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 21.55±7.96, 22.80±8.90, 19.64±7.83, 24.00±9.06, 23.33±10.40, 15.16±4.75respectively.

7-Correlation between the numbers of participating years with VAS, DASH 1, and DASH 2:

As demonstrated on the table (2) it revealed thatno significant correlation was detected among the numbers of participating years with VAS, DASH, and DASH 2 (p>0.05).

Table 2 Correlation between the numbers of participating years with VAS, DASH, and DASH 2

				No o2 practicing years	vas	DASH	DASH_2
No of practicing years	Pearson Correlation			1	.135	-.160	-.069
	Sig. (2-tailed)				.165	.101	.478
	N			100	100	100	100
	Bootstrap[c]	Bias		0	-.004	-.006	-.002
		Std. Error		0	.103	.082	.091
		95% Confidence Interval	Lower	1	-.049	-.304	-.225
			Upper	1	.327	.039	.154
Vas	Pearson Correlation			.135	1	.123	-.155
	Sig. (2-tailed)			.165		.208	.111
	N			100	100	100	100
	Bootstrap[c]	Bias		-.004	0	-.004	.002
		Std. Error		.103	0	.091	.097
		95% Confidence Interval	Lower	-.049	1	-.097	-.334
			Upper	.327	1	.295	.064
DASH	Pearson Correlation			-.160	.123	1	.070
	Sig. (2-tailed)			.101	.208		.475
	N			100	100	100	100
	Bootstrap[c]	Bias		-.006	-.004	0	.003
		Std. Error		.082	.091	0	.090
		95% Confidence Interval	Lower	-.304	-.097	1	-.093
			Upper	.039	.295	1	.277
DASH_2	Pearson Correlation			-.069	-.155	.070	1

Sig. (2-tailed)			.478	.111	.475	
N			100	100	100	100
Bootstrap[c]	Bias		-.002	.002	.003	0
	Std. Error		.091	.097	.090	0
	95% Confidence Interval	Lower	-.225	-.334	-.093	1
		Upper	.154	.064	.277	1

8-Trigger point of Shoulder Muscles (Anterior Deltoid and Lateral Pectoral):

Anterior Deltoid

The shoulder Joint muscles trigger point were measured by the algometry device. As demonstrated on the table (3) the means of anterior deltoid regarding the number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 5.10±1.66, 6.30±2.81, 6.42±1.58, 6.10±3.14, 4.50±1.32, 9.83±2.92 respectively.

Lateral Pectoral

Table (3) represent the means of Lateral Pectoral regarding the number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 6.31±1.75, 6.61±2.33, 6.45±2.12, 5.95±1.89, 5.66±2.51, 7.00±1.00 respectively.

Table 3 means of anterior deltoid regarding the number of the participating years

Anterior Deltoid					
	N	Minimum	Maximum	Mean	Std. Deviation
less_5_years	45	3.00	8.50	5.1000	1.66037
6_to_9	20	3.50	13.00	6.3077	2.81097
10_to_14	19	3.00	9.00	6.4286	1.58340
15_to_19	10	3.00	14.00	6.1000	3.14289
20_to_24	2	3.50	6.00	4.5000	1.32288
more_25	2	6.50	12.00	9.8333	2.92973
Valid N (listwise)	2				
Lateral Pectoral					
less_5_years	45	3.00	10.00	6.3111	1.75580
6_to_9	20	4.00	12.00	6.6154	2.33370
10_to_14	19	3.00	10.00	6.4524	2.12076
15_to_19	10	4.00	11.00	5.9500	1.89224
20_to_24	2	3.00	8.00	5.6667	2.51661
more_25	2	6.00	8.00	7.0000	1.00000
Valid N (listwise)	2				

9- Trigger point of Elbow Muscles (Biceps Brachii):

The Elbow Joint muscles trigger point were measured by the algometry device. Means of Biceps Brachii regarding the number of the participating years in this study: fewer than 5 years, 5-9 years, 10 – 14, 15-19, 20-24, more than 24 were 4.64±1.67, 6.38±2.94, 6.40±1.76, 6.25±2.78, 4.66±1.75, 10.66±3.68 respectively

10-Correlation between the numbers of participating years with Shoulder and Elbow Muscles:

Shoulder Muscles

As demonstrated on the table (4) there were a significance correlation between the numbers of participating years and anterior deltoid muscle [CI: .047 to .473; p=0.01]

On the other hand there were no significance correlation between the numbers of participating years and lateral pectoral muscle.

Table 4 Correlation between the numbers of participating years with Shoulder muscles

				No of practicing years	TP.AD	TP_Lat_pectoral
No of practicing years	Pearson Correlation			1	.288**	.007
	Sig. (2-tailed)				.002	.939
	N			100	100	100
	Bootstrap[c]	Bias		0	-.012	-.001
		Std. Error		0	.103	.079
		95% Confidence Interval	Lower	1	.047	-.160
			Upper	1	.473	.180
TP.AD	Pearson Correlation			.288**	1	.005
	Sig. (2-tailed)			.002		.956
	N			100	100	10
	Bootstrap[c]	Bias		-.012	0	.005
		Std. Error		.103	0	.086
		95% Confidence Interval	Lower	.047	1	-.152
			Upper	.473	1	.196
TP_Lat_pectoral	Pearson Correlation			.007	.005	1
	Sig. (2-tailed)			.939	.956	
	N			100	100	100
	Bootstrap[c]	Bias		-.001	.005	0
		Std. Error		.079	.086	0
		95% Confidence Interval	Lower	-.160	-.152	1
			Upper	.180	.196	1

**. Correlation is significant at the 0.01 level (2-tailed).

Elbow Muscles

As demonstrated on the table (5) there were a significance correlation between the numbers of participating years and Biceps Elbow Muscles [CI: .148 to .567; p=0.01]

Table 5 Correlation between the numbers of participating years with Elbow muscles

				No o2 practicing years	TP.BB
No o2 practicing years	Pearson Correlation			1	.390**
	Sig. (2-tailed)				.000
	N			100	100
	Bootstrap[c]	Bias		0	-.017
		Std. Error		0	.100
		95% Confidence Interval	Lower	1	.148
			Upper	1	.567
TP.BB	Pearson Correlation			.390**	1
	Sig. (2-tailed)			.000	
	N			100	100
	Bootstrap[c]	Bias		-.017	0
		Std. Error		.100	0
		95% Confidence Interval	Lower	.148	1
			Upper	.567	1

**. Correlation is significant at the 0.01 level (2-tailed).

Summary of the results:

There was non-significant correlation among the numbers of practicing years and pain intensity, pain threshold as well as functional disability as for the correlation between the number of practicing years and its impact of the shoulder and elbow muscles there were correlation at anterior deltoid muscle and biceps brachii and non-correlation at lateral pectoral.

SUMMARY

Based on the findings of this study, we detected that there was non-significant correlation among the numbers of practicing years and pain intensity, pain threshold as well as functional disability as for the correlation between the number of practicing years and its impact of the shoulder and elbow muscles there were correlation at anterior deltoid muscle and biceps brachii and non-correlation at lateral pectoral. Shooting is an extremely precise activity that demands complete control of one's body motions for optimal performance (1).

Muscle tremors, which can be generated by a variety of factors and multiple types of muscular contractions, are another component that impacts shooting performance (3).

When shooters minimize muscular tremors, which may be caused by the proper co-contraction of the hand muscles, they are more capable of stabilizing the gun and the wrist, which is guided by the muscular effort of the shoulder and forearm (5).

Shooting sports as well as archery necessitate a prolonged period of stationary arm and hand posture, with repetitive strain on the wrist, elbow, shoulder, back, as well as neck as a result of biomechanical considerations (13).

To keep a steady firing stance in the standing, unassisted mode, upper-body power and endurance are essential. A shoulder-fired weapon's butt must be fixed in the shoulder pocket to attain a stable firing posture. This is accomplished by drawing the gun close to the shoulder and reducing the elbow angle by concentric contraction of the elbow flexor muscles. The stable firing position can only be maintained by the continuous isometric contraction of the elbow flexors (7).

Thirteen air pistol competitors took part in the recording sessions that took place at the 10-meter shooting range, as reported in the study by Pellegrini and Schena (2005). throughout the aiming phase, an optoelectronic motion-capturing system was used to gather kinematic data of the neck, shoulder, elbow, wrist, as well as gun. The data showed that slow drift movement primarily affected lateral movements, and every part were equally concerned, suggesting that it likely originated in postural body sway. Vertical displacements may be described as tremors in the wrists and shoulders that exhibit characteristics common to physiological tremors. Scientific evaluation and training in competing precision shooting could be formed by quantitatively characterizing segment displacements during the targeting phase (14).

This study explains our results that there was correlation between the number of practicing years and its impact of the shoulder muscles. The study by Mon-López et al., 2019 agree with our study, which examined the impact of maximum isometric shoulder force as well as maximal finger flexor forces upon female air pistol shooting performance in order to validate the relationship among gun stability—a critical component of Olympic air pistol shooting performance—and the muscular effort of the shooter's shoulder as well as forearm(2)

The findings were direct relationship among relative isometric shoulder abduction strength as well as shooting performance in a competitive setting. According to the study published by (Evans et al., 2003), who recommended that, there was no relationship between fitness measures as well as shooting performance, as we found that non-significant correlation between the numbers of participating years with VAS, DASH, and PPT. (15)

Rifle shooting causes a rapid counterforce across the body via the anterior shoulder, that can cause traumatic injuries in soldiers, according to our study and the study of Cho et al. (2012). Rifle shooters are at increased risk for developing posterior instability of the shoulder, which can manifest as pain and lead to radiological results that are compatible with a posterior Bankart lesion. (1) Before the event, a pre-event questionnaire was distributed to the athletes, and they were asked to fill it out during one-on-one interviews. Injuries such as strains and muscle tears were the most common during training, while tendinitis, sprains, and strains were the most common during competition. Injuries to the shoulder, calf-thigh, hand, and wrist were the most common during training, according to the data; injuries to the foot and ankle became the most common during competition. this study showed that there were 3 trigger muscle's points , two of them related to shoulder (anterior deltoid trigger point which located at anterior aspect of shoulder in the middle of the muscle , lateral pectoral trigger point which located at lateral third of the chest just below clavicle bone , and one was for elbow which was biceps brachi trigger point which located at lower third of the muscle belly , In air rifle as well as target shooting, the element of clean triggering was found, while in pistol shooting, it was absent. The fact that the pistol shooting study neglected to include a crucial cleanness of triggering variable may explain why there is no cleanness of triggering element in pistol shooting (16).

Conclusion

Based on the findings of this study, the correlation between the number of practicing years and it's impact of the shoulder and elbow muscles therewere a significance correlation between the numbers of participating years and anterior deltoid and biceps brachii muscle , andnon-significantcorrelation between the numbers of participating years and lateral pectoral muscle.

Conflict of Interest

None

Acknowledgments

None

REFERENCES

1. Cho, J. H., Chung, N. S., Song, H. K., & Lee, D. H. (2012): "Recurrentposterior shoulder instability after rifle shooting". Orthopedics, 35(11), e 1677– e 1679.
2. Mon-López, D., Zakynthinaki, M. S., Cordente, C. A., &García-González,J. (2019): "The Relationship Between Pistol Olympic Shooting Performance, Handgrip and Shoulder Abduction Strength". Journal of human kinetics, 69, 39–46.
3. Lakie M. (2010): "The influence of muscle tremor on shooting performance".Experimental physiology, 95(3), 441– 450.
4. Kayihan, G., Özkan, A., Köklü, Y., Eyuboğlu, E., Akça, F., Koz, M., &Ersöz, G. (2014): "Comparative analysis of the 1-mile run test evaluationformulae: assessment of aerobic capacity in male law enforcement officersaged 20-23 years". International journal of occupational medicine andenvironmental health, 27(2), 165–174.
5. Mon-López, D., Bernardez-Vilaboa, R., Sillero-Quintana, M., & AlvarezFernandez-Balbuena, A. (2022): Air shooting competition effects on visual skills depending on the sport level. European journal of sport science, 22(3), 336–343.
6. Mon-López, D., Bernardez-Vilaboa, R., Sillero-Quintana, M., & AlvarezOrtega, E., & Wang, C. J. K. (2018): " Pre-performance PhysiologicalState: Heart Rate Variability as a Predictor of Shooting Performance".Applied psychophysiology and biofeedback, 43(1), 75–85.
7. Loh SK, Lim JZ, Pan JW, Aziz L, Lee M, Kong PW.(2021): "Air pistolshooting: upper limb muscle activation between training and simulatedcompetition". Sports Biomech. 20:1-12.
8. Mon-López, D., Tejero-González, C. M., de la RubiaRiaza, A., &Calvo, J.L. (2020): "Pistol and Rifle Performance: Gender and Relative Age EffectAnalysis". International journal of environmental research and publichealth, 17(4), 1365.
9. Bijur P. E., Silver W. and Gallagher E. J., (2001): "Reliability of the VisualAnalog Scale for Measurement of Acute Pain". Acad. Emerg. Med. 8(12),1153–1157.
10. Boonstra AM, Schiphorst HR, Reneman MF, (2) et al., (2008): "Reliability and validity of the visual analogue scale for disability in subjects

with chronic musculoskeletal pain". Int J Rehabil Res. 31(2):165-169.

11. Mohseni-Bandpei, M. A., Keshavarz, R., Minoonejhad, H., Mohsenifar, H., &Shakeri, H (2012): "Shoulder Pain in Iranian Elite Athletes: The Prevalence and Risk Factors". Journal of Manipulative and Physiological Therapeutics, 35(7), 541–548.
12. Kinser, A. M., Sands, W. A., & Stone, M. H. (2009): Reliability and validity of a pressure algometer. Journal of strength and conditioning research, 23(1), 312–314.
13. Trasolini, N. A., Nicholson, K. F., Mylott, J., Bullock, G. S., Hulburt, T. C.,& Waterman, B. R. (2022): "Biomechanical Analysis of the ThrowingAthlete and Its Impact on Return to Sport". Arthroscopy, sports medicine,and rehabilitation, 4(1), e83–e91.
14. Pellegrini, B., &Schena, F. (2005): "Characterization of arm-gun movement during air pistol aiming phase". The Journal of sports medicine and physical fitness, 45(4), 467–475
15. Evans, R. K., Scoville, C. R., Ito, M. A., & Mello, R. P. (2003): "Upper body fatiguing exercise and shooting performance". Military medicine, 168(6), 451– 456.
16. Hawkins GA, Milan S, Kendzerska T, (1) et al., (2011): "Measures of Adult Pain Visual Analog Scale for Pain". Arthritis Care Res (Hoboken). 63Suppl (11), S240-S252.