Progress in Nutrition 2021; Vol. 23, N. 4: e2021217 DOI 10.23751/pn.v23i4.11274

Original article

Examination of the Effects of Archery Exercises on Some Physical Parameters of University Students

Mutlu Türkmen[1], *Murat Kul*[1]*, *Mevlüt Gönen*[1], *İsmail Karataş*[1], *Mehmet Ali Ceyhan*[1], *Ümit Yildirim*[2], *Üstün Türker*[1], *Mete Yusuf Ustabulut*[3]

[1]Bayburt University, Faculty of Sport Sciences, Bayburt, Turkey; [2]Bayburt University, Faculty of Arts and Design, Bayburt, Turkey; [3]Bayburt University, Faculty of Education, Bayburt, Turkey

Summary. The aim of this study was to examine the effect of eight-week modern archery training on some physical parameters of university students. In the study, one-group pretest-posttest design from the experimental research methods was used. The study group consisted of a total of 25 voluntary- students were chosen randomly 10 female and 15 male, undergraduate, and graduate levels during the fall semester of 2020-2021 academic year at Bayburt University, who have not received Olympic archery training before. The Wilcoxon Signed Ranks Test was applied to analyse the data of the study. Regarding female participants, within the scope of Wilcoxon Signed Ranks Test results; according to the analysis results of the variables "Index Finger", "Middle Finger", "Ring Finger", statistically significant differences were found between the pretest and posttest values for each variable. Regarding male participants, within the scope of Wilcoxon Signed Ranks Test results; according to the analysis of the results of the participants' "Back-Leg", "Index Finger", "Middle Finger" variables, statistically significant differences were found between the pretest and posttest values for each variable.

Key words: Student, Archery, Physical Parameters

Introduction

Archery is a highly static, fun and individual sport that requires the strength and endurence of the upper body, especially the shoulder girdle, which holds the forearm and beam close to the target. The highest point of skill in archery is to accurately send the arrow to a specific target within a specific time interval (1, 2). Arrow shooting takes its place in the literature as the ability to shoot the arrow well towards the target shown (2, 3, 4).

Archery sport is a type of sport in which people need to have many physiological, mental, psychological and dynamic elements together at every stage from beginner to professional level and the ability to use them at a high level. These factors indicate that special attention should be paid to some important details in the skill of shooting and using the bow. The biomechanics of the stages that need to be followed for an accurate and successful shot are important. These stages were initially designed in 3 steps as posture, traction and aiming, Nishuzuno and friends (1987), and then defined these stages in 6 steps as bow holding, traction, full traction, aiming, dropping and tracking (5). In the Sport Archery Modular Program (2012), a 9-stage technical design has been designed by the Ministry of National Education of the Republic of Turkey, including correct posture, attaching the arrow to the beam, holding the beam, pressing the handle, traction, references (intersection), aiming at the target, dropping and final transport (6). However, archery sport, which has been developing continuously since its primitive form in its source of existence, has been redesigned with the slogan of "Archery in 12 Steps" today. The steps of archery training, which was published by The Archers

Foundation (in 2019) and are planned to be taught in 12 stages in chronological order, are formed in the form of posture, arrow placement, bow grip, beam grip, preparation for shooting, bow traction, chin position, aiming, full traction, opening, dropping, final transport (7).

Another issue that must be mentioned in relation to Olympic archery sport and its theoretical knowledge for the purposes of the research is the physical, cognitive and psycho-motor development areas covered by developmental psychology. It is seen that archery sport has an important place in the physical, cognitive (mental), affective and psycho-motor development areas of human beings, as it includes many development factors such as power, reaction-speed, strength, coordination, attention, balance, endurance and flexibility. Even though individuals who have never met Olympic archery before have the opinion that physiologically it does not require a high level of effort, a proper posture, flexibility, strength, long-term motivation and body integrity are needed in training and competitions (8). In the Olympic archery sport, a basic posture position that is opened at shoulder width apart and loaded equally on the legs is important for the correct use of physiological and psychological conditions in an accurate and successful shooting to the target and during the pull, it is important to apply force to the spring body and the beam at a constant speed and ratio, and to stabilize the under-chin position (reference point) when the full traction position is reached. Also, It is important that the eye, beam, sight and target are intersected at the same point and that the body integrity is maintained steadily until the arrow reaches the target. In addition, due to gravity and the effort spent in the shooting time, the archer should land on the target towards the target center, starting from the point where the blue and black target rings intersect, not from the center.

As stated above, in order to make a correct and an accurate shooting in archery sport, a high level of body control and skill, as well as the ability to synchronously repeat all parts (posture, aiming, traction, and shooting) that make up the arrow shooting are required. During arrow shooting, how a change in postural movements occurs and how these changes differ as the rate of hit in arrow shooting increases is of great importance in terms of shot performance (9).

In this study; it was aimed to examine some physical parameter changes of university students with modern archery education.

Materials and Methods

Research model and study group

In this study, in order to examine the effect of modern archery training on some physical parameters of university students, Single Group Pretest-Posttest Technique from the experimental research methods was used.

The study group consists of a total of 25 students, 10 women and 15 men, who have studied at the undergraduate and graduate levels in the fall semester of the 2020-2021 academic year at Bayburt University, who have voluntarily participated in the study, who have been determined by random method, and who have not received Olympic archery training before.

Data collection tools

Body weight, body mass index values and body fat percentages of the experimental group included in the study were measured with Tanita SC-240 device and height measurements were measured with Mesilife-13539 device, and right and left finger grip strength measurements were measured with Baseline Hydraulic Pinch Gauge, Right and left hand claw strengths were measured with the Grip Strength Dynanometer, Back and leg strengths were measured with Back Strength Dynamometer measurement device, Chest subcutaneous fat was measured with a skinfold device, Shoulder and Biceps flexion-extension circumference measurements were measured with a tape measure. In addition, the gender, age and dominant hand information of the participants were determined with their identity information and participant statements. The average wing length of the modern springs used was 64 inches and applications were made with a total of 7 springs with a hardness of 24 libres (pounds).

Collection and analysis of data

By using data collection tools; after the personal information obtained from the experimental group and the pre-test laboratory measurements, the participants were provided with modern archery theoretical trainings, hardware introduction, "kepaze=soft bow" trainings, resistance rubber and body weight exercises and shooting training practices during 8 weeks of 3 days a week and one hour in a day. At the beginning

of the training, 10 minutes of warm-up exercises specific to modern archery and then "kepaze=soft bow" exercises were performed (3 sets 25 repetitions with right and left hands). Then, for 45 minutes, Olympic bows were shot at certain intervals of meters (5 meters.,10 meters., 18 meters.). After the training, body weight exercises (hands adjacent, shoulder-level and wide-angle push-ups) were performed for the muscles active in Olympic archery (3 sets 15 repetitions), and resistance rubber exercises (triceps extension, lateral raise, front raise, seated row and chest fly were performed) (1 set 15 repetitions) were applied, and finally, the Olympic archery training was completed with cooling movements after 5 minutes of training. After 8 weeks of these trainings, final test measurements were made in order to determine the changes in the physical parameters of the experimental group. The Wilcoxon Signed Ranks Test was applied to the study in order to reveal whether a significant difference occurred between the obtained data or not.

Results

In this part of the study, the results obtained as a result of analyzing the data in the context of male and female participants were presented and explained in the form of tables.

When Table 1 is examined, descriptive statistics of variables belonging to female participants can be seen. In this context, it is understood that the average age variable of female participants is 21.9 years and the standard deviation is 2.02 years. Also, the data of the variables in female participants are given in the table.

Table 1. Descriptive Statistics of the Variables of Female Participants

Variables	n	Average	Std. Deflection	Minimum	Maximum
Age (years)	10	21.9000	2.02485	20.00	26.00
BMI_Pretest (kg / height^2)	10	20.600	2.5811	17.8	24.3
BMI_Posttest (kg / height^2)	10	20.86	2.755	17	24
Back-Leg_Pretest (kg)	10	84.850	21.9849	58.0	132.5
Back-Leg_Posttest (kg)	10	106.300	26.4693	78.5	167.0
Claw (Right)_Pretest (kg)	10	31.000	4.7286	24.3	40.0
Claw (Right)_Posttest (kg)	10	31.920	5.0184	25.2	40.7
Claw (Left)_Pretest (kg)	10	30.160	4.9449	22.6	37.6
Claw (Left)_Posttest (kg)	10	30.76	5.331	23	40
Index Finger_Pretest (kg)	10	10.900	1.6633	9.0	14.0
Index Finger_Posttest (kg)	10	14.800	3.2931	10.0	20.0
Middle Finger_Pretest (kg)	10	11.000	2.4495	8.0	17.0
Middle Finger_Posttest (kg)	10	13.700	2.3594	10.0	19.0
Ring Finger_Pretest (kg)	10	9.000	1.8856	6.0	12.0
Ring Finger_Posttest (kg)	10	11.300	2.3118	7.0	14.0
Chest_Pretest (mm)	10	7.700	2.6687	4.0	14.0
Chest_Posttest (mm)	10	7.300	1.4944	5.0	10.0
Shoulder_Pretest (cm)	10	100.800	6.1065	92.0	110.0
Shoulder_Posttest (cm)	10	100.500	5.8926	92.0	110.0
Biceps FL_Pretest (cm)	10	26.400	2.0111	23.0	29.0
Biceps FL_Posttest (cm)	10	27.000	2.1082	24.0	31.0
Biceps EX_Pretest (cm)	10	26.300	2.5841	23.0	30.0
Biceps EX_Posttest (cm)	10	25.900	2.4698	23.0	30.0

When Table 2 is examined, descriptive statistics of variables belonging to male participants can be seen. In this context, it is understood that the average age variable of male participants is 25.2 years and the standard deviation is 4.7 years.

Table 3 shows the results of the Wilcoxon Signed Ranks Test conducted to reveal whether or not there was a significant difference between the values of the study variables before and after the 8-week archery training for female participants. In this context; according to the analysis results of the participants' " Index Finger", "Middle Finger", "Ring Finger", a statistically significant difference was found between the pretest and posttest values for each variable ($p < 0.05$). Again, in this context, all of the significant differences are in favor of positive ranks (posttest), and this result shows that archery training affects the values of these variables in an increasing way. In addition, it is understood that archery training has a great effect on the variables of "Index Finger", "Middle Finger" and "Ring Finger"(10, 11). However, no statistically significant differences were found between the pretest and posttest values of other variables ($p>0,05$).

Table 4 shows the results of the Wilcoxon Signed Ranks Test conducted to reveal whether or not there was a significant difference between the values of the study variables before and after the 8-week archery training for male participants. In this context; according to the analysis results of the participants' " Back-Leg", " Index Finger", "Middle Finger" , a statistically significant difference was found between the pretest and posttest values for each variable ($p < 0.05$). Again, in this context, all of the significant differences are in favor of positive ranks (posttest), and this result shows that archery training

Table 2. Descriptive Statistics of the Variables of Male Participants

Variables	n	Average	Std. Deflection	Minimum	Maximum
Age (years)	15	25.2667	4.78788	19.00	36.00
BMI_Pretest (kg / height^2)	15	25.133	3.8013	17.8	35.4
BMI_Posttest (kg / height^2)	15	25.09	4.014	18	36
Back-Leg_Pretest (kg)	15	145.367	31.1256	98.0	207.0
Back- Leg_Posttest (kg)	15	168.247	26.9908	124.5	212.0
Claw (Right)_Pretest (kg)	15	50.800	7.2467	38.5	62.8
Claw (Right) _ Posttest (kg)	15	51.427	6.9336	39.4	62.0
Claw (Left) _ Pretest (kg)	15	48.613	6.4427	38.8	60.7
Claw (Left)_Posttest (kg)	15	49.23	6.012	42	61
Index Finger_Pretest (kg)	15	14.533	3.2042	10.0	19.0
Index Finger_Posttest (kg)	15	17.067	2.3442	13.0	20.0
Middle Finger_Pretest (kg)	15	16.133	4.4700	10.0	24.0
Middle Finger_Posttest (kg)	15	18.933	3.8260	13.0	27.0
Ring Finger_Pretest (kg)	15	12.200	2.6780	8.0	17.0
Ring Finger_Posttest (kg)	15	13.967	3.8751	10.0	27.0
Chest_Pretest (mm)	15	11.467	6.2777	3.0	26.0
Chest_ Posttest (mm)	15	11.400	5.8652	3.0	26.0
Shoulder _ Pretest (cm)	15	121.400	6.2427	109.0	133.0
Shoulder _ Posttest (cm)	15	121.667	6.2754	109.0	133.0
Biceps FL_ Pretest (cm)	15	33.533	4.1208	24.0	40.0
Biceps FL_ Posttest (cm)	15	34.600	3.6606	24.0	40.0
Biceps EX_ Pretest (cm)	15	33.067	3.1275	26.0	38.0
Biceps EX_ Posttest (cm)	15	32.333	3.8668	23.0	38.0

Table 3. Results of the Wilcoxon Signed Rank Test of Female Participants

Variable	Posttest- Pretest	n	Average Rank	Rank Sum	z	P	Effect Size (r)
BMI	Negative Ranks	3	4.00	12.00	−1.246	0,213	---
	Positive Ranks	6	5.50	33.00			
	No Difference	one					
Back-Leg	Negative Ranks	2nd	4.50	9.00	−1.886	0.059	---
	Positive Ranks	8	5.75	46.00			
	No Difference	0					
Claw (Right)	Negative Ranks	2nd	6.50	13.00	−1.479	, 139	---
	Positive Ranks	8	5.25	42.00			
	No Difference	0					
Claw (Left)	Negative Ranks	4	3.63	14.50	−.949	, 343	---
	Positive Ranks	5	6.10	30.50			
	No Difference	one					
Forefinger	Negative Ranks	0	.00	.00	−2.689 *	, 007	-0,60
	Positive Ranks	9	5.00	45.00			
	No Difference	one					
Middle finger	Negative Ranks	0	.00	.00	−2.816 *	, 005	-0.63
	Positive Ranks	10	5.50	55.00			
	No Difference	0					
Ring finger	Negative Ranks	0	.00	.00	−2.530 *	, 011	-0,57
	Positive Ranks	8	4.50	36.00			
	No Difference	2nd					
Chest	Negative Ranks	3	3.50	10.50	.000	1,000	---
	Positive Ranks	3	3.50	10.50			
	No Difference	4					
	Positive Ranks	5	3.80	19.00			
	No Difference	4					
Shoulder	Negative Ranks	one	1.00	1.00	−1.000	, 317	---
	Positive Ranks	0	.00	.00			
	No Difference	9					
Biceps FL	Negative Ranks	one	8.00	8.00	-1.436	, 151	---
	Positive Ranks	7	4.00	28.00			
	No Difference	2nd					
Biceps EX	Negative Ranks	2nd	4.50	9.00	-.406	, 684	---
	Positive Ranks	3	2.00	6.00			
	No Difference	5					

* $p < 0.05$

affects the values of these variables in an increasing way. In addition, it is understood that archery training has a great effect on the variables of "Back-Leg", "Index Finger", "Middle Finger" (10, 11). However, no statistically significant differences were found between the pretest and posttest values of other variables (p>0,05).

Table 4. Wilcoxon Signed-Rank Test Results of Male Participants

Variable	Posttest-Pretest	n	Average Rank	Rank Sum	z	p	Effect Size (r)
BMI	Negative Ranks	5	6.30	31.50	−.589	.556	---
	Positive Ranks	7	6.64	46.50			
	No Difference	3					
Back-Leg	Negative Ranks	0	.00	.00	−3.408*	.001	−0,62
	Positive Ranks	15	8.00	120.00			
	No Difference	0					
Claw (Right)	Negative Ranks	6	7.75	46.50	−.767	.443	---
	Positive Ranks	9	8.17	73.50			
	No Difference	0					
Claw (Left)	Negative Ranks	3	11.00	33.00	−1.535	.125	---
	Positive Ranks	12	7.25	87.00			
	No Difference	0					
Forefinger	Negative Ranks	one	2.00	2.00	−2.921*	.003	−0,53
	Positive Ranks	11th	6.91	76.00			
	No Difference	3					
Middle finger	Negative Ranks	one	3.50	3.50	−2.800*	.005	−0,51
	Positive Ranks	11th	6.77	74.50			
	No Difference	3					
Ring finger	Negative Ranks	3	5.33	16.00	−1.811	.070	---
	Positive Ranks	9	6.89	62.00			
	No Difference	3					
Chest	Negative Ranks	4	4.38	17.50	−.070	.944	---
	Positive Ranks	4	4.63	18.50			
	No Difference	7					
Shoulder	Negative Ranks	0	.00	.00	−1.342	.180	---
	Positive Ranks	2nd	1:50	3.00			
	No Difference	13					
Biceps FL	Negative Ranks	2nd	3.75	7.50	−1.786	.074	---
	Positive Ranks	7	5.36	37.50			
	No Difference	6					
Biceps EX	Negative Ranks	5	4.00	20.00	−1.022	.307	---
	Positive Ranks	2nd	4.00	8.00			
	No Difference	8					

* $p < 0.05$

Discussion and Conclusion

As a result of the study, a statistically positive significant difference was found between the pretest and posttest values for each variable according to the analysis results of the variables of "Index Finger", "Middle Finger", "Ring Finger" of the female participants. It has been revealed that the effect of applied modern archery training on the variables of "Index Finger", "Middle Finger" and "Ring Finger" is great, and

it can be said that this difference is due to the effect of the training applied and the fact that the participants did not use these variables so actively before. As a result of the literature review on the subject; at the end of modern archery training, no other study has been found in which physical parameters of students have been measured and evaluated in such a comprehensive way. However, when similar studies on some or only one of these physical parameters were evaluated, it was seen that there were studies that supported the results we reached in our study. In the study conducted by Kul and his colleagues, which is one of these studies, a positive result was obtained in 10 students between the pretest and posttest values related to the analysis results of finger grip strength and right-hand variable of participants in traditional archery practices, and it is parallel to our study (12). The absence of statistically significant differences between the pretest and posttest values of other variables may have been caused by the fact that the spring pounds used were light and the spring was not used according to the motor characteristics of the person.

A statistically positive significant difference was found between the pretest and posttest values for each variable according to the analysis results of the variables of " Back-Leg", "Index Finger", "Middle Finger" of the male participants and it shows that modern archery training has an increasing effect on the values of these variables. In the study conducted by Kul and his colleagues, a positive result was obtained in 8 students between the pretest and posttest values related to the analysis results of finger grip strength and right-hand variable of participants in traditional archery practices, and it is parallel to our study (12). Moreover, it can be said that the effect of modern archery training on the variables of "Back-Leg", "Index Finger" and "Middle Finger" provides great strength development. In this respect, our study is similar to the research conducted by Roslan & Teng (2020), which concluded that archery training has a significant positive effect on upper and lower body muscle strength development (13). Again; in the study conducted by Kul and his colleagues, it was found that traditional archery practices positively affected the "back and leg" strength variable of male participants, 7 out of 10 participants, and it is parallel to our study (12). Among the technical features, postural stability is one of the important factors for performance. The postural stability of the archer in the moment of release affects the direction of the arrow on the target (14). Having strong back and leg muscles can eliminate this negative effect (15). In Baloğlu's (2019) study; Concentric and eccentric exercises have been observed to increase muscle mass, decrease fat ratio and increase the pain threshold in archers (16). Unlike female participants, there was no difference in the "ring finger" variable in male participants. This situation can be explained as follows; The female participants performed the three-finger grip technique more suitably, while male participants may have made traction with only the other two fingers. Because the spring stiffness used is of the same degree, it is expected to show more of its effect in female participants. The absence of statistically significant differences between the pretest and posttest values of other variables may have been caused by the fact that the spring pounds used were light and the spring was not used according to the motor characteristics of the person. In their 1990 study, Martin and colleagues stated that national and international coaches and athletes agreed on muscular contractions, especially the coordinated movements of the flexor and extensors of the fingers of the arm responsible for holding, pulling, releasing the beam and in addition, regardless of the release of the beam, coaches and athletes and journals published in the popular literature of that period stated that the basic principle taught first was the release of the beam with the relaxation of the muscles by maintaining the bent position of the fingers around the beam. So much so that, instead of trying to influence the release by actively extending the fingers with concentric muscle movement; in order to achieve extension, the force of the beam on the fingers should simply relax the flexor muscle (15, 17) These explanations support the finger strength development of both male and female participants as a result of our study. This logic shows that this relaxation process will result in a smoother release of the beam, because the active extension of the fingers will require the beam to be thrown from right to left, which will bring different performance from shot to shot (17). In particular, this is observed in beginner athletes, as the training process of athletes increases, the relaxation in extensors

becomes more balanced (15). From these expressions, it can be explained that the strength development will increase with the effect of stretching and relaxation movements of the fingers during arrow shooting.

As a conclusion; archery exercises, which has a very central place in the Turkish cultural life (18), found to have positive effects both on the variables of "Index Finger", "Middle Finger", "Ring Finger" in female students and on the variables of "Back-Leg", "Index Finger", and "Middle Finger" in male students.

Funding: This study was supported within the scope of Bayburt University Scientific Research Projects numbered 2019 / 01-69001-13, "Investigation of Physical Parameter Changes of Bayburt University Students with Modern Archery".

References

1. Mann DL, Littke N. Shoulder ınjuries in archery. Canadian Journal of Sport Sciences 1989; 14: 85–92.
2. Leroyer P, Hoecke JV, Helal JN. Biomechanical study of the final push-pull in archery. Journal of Sports Sciences 1993; 11: 63–69.
3. Ertan H, Kentel B, Tümer ST, Korkusuz F. Activation patterns in forearm muscles during archery shooting. Journal of Human Moandment Science 2003; 22: 37–45.
4. Çelikel BE, Sezer SY, Karadağ M. Effect of reaction time on target shot hit score in men's archery. Journal of Sports Education 2020; 4: 31.
5. Nishizono H, Shibamaya H, Izuta T. Analysis of archery shoting technics by means of electromyography. 5th International Symposium on Biomechanics in Sport 1987; 364–372.
6. Web 1: https://hbogm.meb.gov.tr/modulerprogramlar/programlar/spor/Okculuk.pdf Access Time: December 4, 2020 at 14:53.
7. Web 2: https://12adimdaokculuk.com/tr/temel-egitimler Access Time: November 27, 2020 at 18:10.
8. Ulusoy S, Ergun N. Comparison of the physical and anthropometric properties of disabled and non-disabled archers. Selcuk University Physical Education and Sports Science Journal 2011; 13: 84–89.
9. Şimşek D, Cerrah A, Ertan H. Comparison of olympic roller and traditional turkish archery balance skills. Niğde University Journal of Physical Education and Sport Sciences 2013; 7: 93.
10. Cohen J. Statistical power analysis for the behavioural sciences 2nd edition. New York: Academic Press 1988.
11. Cohen J. A power primer. Psychological Bulletin 1992; 112: 155–159.
12. Kul M, Türkmen M, Yıldırım Ü, Ustabulut MY, Türker Ü, Akova A. Examination of the effect of traditional archery training practices on physical parameter changes in university students. CBU Journal of Physical Education and Sports Science 2020; 15: 88–102.
13. Roslan NA, Teng NIMF. Muscle strength in male youth that play archery during leisure time activity. In Enhancing Health and Sports Performance by Design: Proceedings of the 2019 Movement, Health & Exercise and International Sports Science Conference Springer Nature 2020; 248.
14. Stuart J, Atha J. Postural consistency in skilled archers. Journal of Sport Sciences 1990; 8: 223–234.
15. Kolayiş İE. The effect of back exercises in archers on emg activities and performance in release. Kocaeli University Institute of Health Sciences Doctoral Thesis 2007; 58–59.
16. Baloğlu R. Functional evaluation of axentric and consentric exercises in 12–17 adolescent age group archers. Erciyes University Institute of Health Sciences Department of Physiology Master's Thesis 2019; vi.
17. Martin PE, Silver WL, Hoffman D. Electromyographic analysis of bow string release in highly skilled archers. Journal of Sport Sciences 1990; 8: 215–221.
18. Yönal G, Turkmen M. Arhery in turkish cultural life. Asos Journal 2017; 5: 523–533.

Correspondence
Murat Kul,
School of Physical Education and Sports,
Baberti Kulliyesi BESYO,
Bayburt, Turkey
E-mail: muratkul@bayburt.edu.tr