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# The Effect of Resistance Band Exercises on The Speed, Agility, Balance and Strength Required for Hit Shooting in Mounted Javelin Athletes

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**ABSTRACT**

The aim of this study was to determine the effect of resistance band training on javelin accuracy, speed, agility, balance and strength in mounted javelin athletes. In the study, a quasi-experimental design with pre-test post-test control group was used. Twenty-four mounted javelin athletes voluntarily participated in the study. All participants were homogeneously distributed into two groups as experimental group (n=12) and control group (n=12) according to the results of the target hitting pre-test. Both groups were subjected to mounted javelin training for 8 weeks. In addition to javelin training, the experimental group practiced strength training with resistance band for 8 weeks. In the study, the participants were administered speed, agility, balance, vertical jump tests as pre-test and post-test as well as the javelin accuracy test developed by the researcher. The SPSS package program was used in the analysis of the data obtained, the normality of the data was examined and non-parametric tests and pairwise comparison analyzes were performed according to their distribution. There were significant differences between the pre-test and post-test averages of the experimental group and between the experimental and control groups ($p<0.05$). As a result, it shows that strength training with resistance band in addition to javelin training improves speed, balance, vertical jump, agility and javelin accuracy in mounted javelin athletes.

## 1. INTRODUCTION

Language, customs and traditions, beliefs, artistic cultural artifacts constitute the social values of social societies from their past to the present [1]. Therefore, these values, which often characterize the daily lives and lifestyles of people and societies, go so far as to form the term culture [2]. Cultural characteristics distinguish societies from one another and give them national identity and self-awareness [3]. It can be said that the phenomenon of sports, which is one of the cultural characteristics mentioned, is one of the factors that contribute to the development of individuals and societies [4]. One of the most important elements that distinguish the Turkish nation from others is Turkish folk culture. In addition, traditions, which can be defined as a reflection of culture, are the common heritage of all Turkish communities. The basis of commonality is that countries sharing the same language and history use the same roots [5]. Sports and related physical activities belonging to the aforementioned common heritage structure of Turks are one of the basic elements of Turkish people and culture [6]. Traditional games and sports are an important part of Turkish culture and have been played at every stage of Turkish social structure and life [7]. Mounted javelin is one of the most important sports practiced by Turks before

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and after Islam. Javelin throwing is now defined as a traditional ancestral sport because it dates back thousands of years [8].

From the past to the present, many technical skills are needed while practicing the mounted javelin sport. Javelin accuracy is very important among these skills. However, there are many factors affecting the accuracy. Among these factors, the effect of strength is quite high. In this study, the effects of eight-week strength exercises with resistance band on parameters such as javelin accuracy, speed and agility were investigated.

## 2. MATERIALS AND METHODS

### 2.1. Research Group

In this study, quasi-experimental method with pretest and posttest model was used. The population of the study was licensed mounted javelin athletes. The sample size was decided with G*Power (version 3.1.9.7, Germany) power analysis program. When the effect size=0.5, α=0.05 and 1-β=0.80 were selected in the program, it was found that the sample size should be at least 24 people [9]. In the light of this result, 24 participants voluntarily took part in the study. The 24 mounted javelin athletes who constituted the sample group of the study were divided into 12 (30.58±9.30 years, 167.50±4.60 height and 72.58±4.27 kg) experimental group and 12 (30.92±4.42 years, 173.42±4.56 height and 75.67±5.65 kg) control group. The experimental group was randomly assigned by drawing lots from a bag. While the groups performed routine mounted javelin training, the experimental group additionally performed resistance band exercises planned within the scope of the study.

In resistance band training, in addition to javelin technique training, the participants were given 1.5 hours of strength training 2 days a week. Considering the different studies [10], the exercise intensity was applied for 30 seconds in each movement and the training repetitions were increased every two weeks. Adequate rest periods were given between movements and repetitions. The training program is given in Tables 1 and 2.

**Table 1.** Exercises for the lower extremities

| Exercises | Week 1 - 2 | Week 3 - 4 | Week 5 - 6 | Week 7 - 8 |
|---|---|---|---|---|
| Squat | 3x12 | 3x12 | 3x12 | 3x12 |
| Lunge | 3x12 | 3x12 | 3x12 | 3x12 |
| Side lunge | 3x12 | 3x12 | 3x12 | 3x12 |
| Monster walks | 3x12 | 3x12 | 3x12 | 3x12 |
| Calf raise | 3x12 | 3x12 | 3x12 | 3x12 |
| Cable Hip Abduction | 3x12 | 3x12 | 3x12 | 3x12 |
| Number of Sets | 1 | 2 | 3 | 4 |

**Table 2.** Exercises for upper extremity

| Exercises | Week 1 - 2 | Week 3 - 4 | Week 5 - 6 | Week 7 - 8 |
|---|---|---|---|---|
| Baseball Swing Move | 3x12 | 3x12 | 3x12 | 3x12 |
| Bending and Pulling the Resistance Band | 3x12 | 3x12 | 3x12 | 3x12 |
| Tape pulling | 3x12 | 3x12 | 3x12 | 3x12 |
| Long Turn | 3x12 | 3x12 | 3x12 | 3x12 |
| Bicep Curl | 3x12 | 3x12 | 3x12 | 3x12 |
| Triceps Press | 3x12 | 3x12 | 3x12 | 3x12 |
| Number of Sets | 1 | 2 | 3 | 4 |

### 2.2. Study Design

Before starting the study, ethics committee approval numbered 28/11/2022-051 was obtained from Mersin University Sports Sciences Ethics Committee. In line with the 8-week study, the training program was progressed by applying the planned training program without disrupting the training days and hours. In case of adverse weather conditions, compensatory training was performed. Before the study, the participants were informed about how the study would proceed by being ready on the field. Afterwards, pre-test measurements were taken. Only one horse was included in the study in order to prevent performance differences between horses during the application. The materials to be used in the

study were the same in each training and the same materials were used until the end of the study.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

### 2.3. Anthropometric and performance measurements

The height of the participants was measured with a Holtain brand height meter with an accuracy of ± 1 mm and their body weight was measured with a Seca brand weight meter with an accuracy of 100 g. The 30m sprint test was used to evaluate the speed characteristics of the participants, the pro-agility test was used to evaluate the agility characteristics, the vertical jump and standing long jump test were used for explosive strength measurement, the flamingo balance test was used for static balance measurement.

#### *2.3.1. Accuracy Measurements in Mounted Javelin*

As the application area used in the study, an mounted javelin field with a length of 140 meters and a width of 40 meters covered with 10 cm thick fine sand was preferred as shown in Figure 1. In the accuracy measurement test developed by the researcher; measurements were made according to the data to be obtained from the throws to the fixed target. After the athlete's horse left the procession stop, he/she ran his/her horse and threw the javelin stick in his/her hand to a fixed target when he/she reached a distance of 70 meters (Alay stop = 13 m + throwing area = 7 m, area where the horse will run in the playing field = 50 m) marked in the playing field. The center field line in the playing field is the forbidden area. The throws were made in such a way that not even one foot of the horse could pass. Javelin throws were made at distances of 10, 20, 30, 40 and 50 meters (5 different distances). Those who hit the inanimate target standing at the specified distances were considered successful, and those who did not hit were considered unsuccessful. Each athlete was given 3 shots and the best result of the three shots was evaluated. During the application, the resting time of the horse was taken into consideration so that the horse's performance would be the same for each athlete.

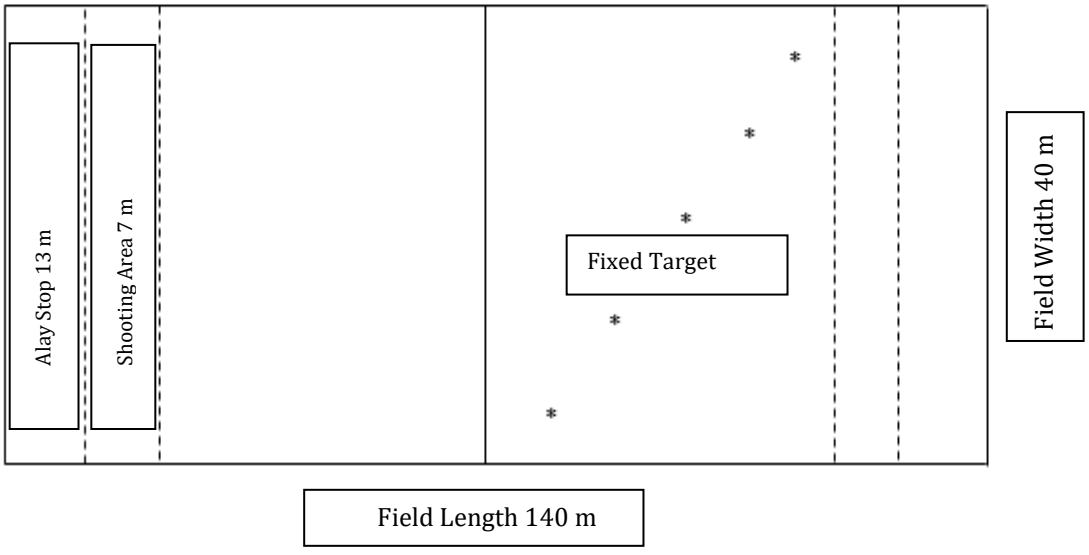


**Figure 1.** Sketch of the application site

### 2.4. Statistical Analysis

Frequency and percentage calculations were made to reveal the distribution of demographic information according to variables. Data were analyzed using SPSS 25.0 package program. Normality of the data was checked by Kolmogorov-Smirnov and Shapiro-Wilk tests. It was seen that the data did not show normal distribution and Wilcoxon Signed Ranks Test, one of the non-parametric tests, was used for intra-group comparisons and Mann-Whitney U test was used for inter-group comparisons. The significance level for the analyses was evaluated as $p<0.05$.

## 3. RESULTS

**Table 3.** 30m sprint, agility, vertical jump, filamingo balance test pretest-posttest Mann-Whitney U-Test results by group

| Variables | Group | Test | n | Rank Average | Rank Total | U | p |
|---|---|---|---|---|---|---|---|
| **30 m Speed Test** | Experiment | Pre-test | 12 | 11.00 | 132.00 | 54.00 | 0.29 |
| | Control | | 12 | 14.00 | 168.00 | | |
| | Experiment | Post-test | 12 | 9.33 | 112.00 | 34.00 | 0.02* |
| | Control | | 12 | 15.67 | 188.00 | | |
| **Agility** | Experiment | Pre-test | 12 | 11.38 | 136.50 | 58.50 | 0.43 |
| | Control | | 12 | 13.63 | 163.50 | | |
| | Experiment | Post-test | 12 | 8.58 | 103.00 | 25.00 | 0.00* |
| | Control | | 12 | 16.42 | 197.00 | | |
| **Vertical Jump** | Experiment | Pre-test | 12 | 12.92 | 155.00 | 67.00 | 0.77 |
| | Control | | 12 | 12.08 | 145.00 | | |
| | Experiment | Post-test | 12 | 17.42 | 209.00 | 13.00 | 0.00* |
| | Control | | 12 | 7.58 | 91.00 | | |
| **Flamingo Balance Test** | Experiment | Pre-test | 12 | 10.38 | 124.50 | 46.50 | 0.12 |
| | Control | | 12 | 14.63 | 175.50 | | |
| | Experiment | Post-test | 12 | 7.63 | 91.50 | 13.50 | 0.00* |
| | Control | | 12 | 17.38 | 208.50 | | |

*p<0.05.

According to Table 3, there was a significant difference in posttest measurements for all variables (p>0.05).

**Table 4.** Mann-Whitney U test results for 10m, 20m, 30m, 40m and 50m tests by pretest-posttest group

| Variables | Group | Test | n | Rank Average | Rank Total | U | p |
|---|---|---|---|---|---|---|---|
| **10 m Shooting Performance** | Experiment | Pre-test | 12 | 9.75 | 117.00 | 39.00 | 0.03* |
| | Control | | 12 | 15.25 | 183.00 | | |
| | Experiment | Post-test | 12 | 15.75 | 189.00 | 33.00 | 0.01* |
| | Control | | 12 | 9.25 | 111.00 | | |
| **20 m Shooting Performance** | Experiment | Pre-test | 12 | 11.00 | 132.00 | 54.00 | 0.24 |
| | Control | | 12 | 14.00 | 168.00 | | |
| | Experiment | Post-test | 12 | 15.46 | 185.50 | 36.50 | 0.02* |
| | Control | | 12 | 9.54 | 114.50 | | |
| **30 m Shooting Performance** | Experiment | Pre-test | 12 | 10.00 | 120.00 | 42.00 | 0.06 |
| | Control | | 12 | 15.00 | 180.00 | | |
| | Experiment | Post-test | 12 | 15.00 | 180.00 | 42.00 | 0.03* |
| | Control | | 12 | 10.00 | 120.00 | | |
| **40 m Shooting Performance** | Experiment | Pre-test | 12 | 10.46 | 125.50 | 47.50 | 0.12 |
| | Control | | 12 | 14.54 | 174.50 | | |
| | Experiment | Post-test | 12 | 15.92 | 191.00 | 31.00 | 0.00* |
| | Control | | 12 | 9.08 | 109.00 | | |
| **50 m Shooting Performance** | Experiment | Pre-test | 12 | 13.00 | 156.00 | 66.00 | 0.68 |
| | Control | | 12 | 12.00 | 144.00 | | |
| | Experiment | Post-test | 12 | 17.00 | 204.00 | 18.00 | 0.00* |
| | Control | | 12 | 8.00 | 96.00 | | |

*p<0.05.

When the different throwing distances of the experimental and control groups are compared in Table 4, it is seen that there is a significant difference in the pre-test and post-test measurements for 10m, and in the post-test measurements for 20m, 30m, 40m and 50m (p>0.05).

**Table 5.** Wilcoxon signed ranks test results of 30 m sprint, agility, vertical jump, filamingo balance test before and after the experiment

| Variables | Group | n | Pre-Test ($\bar{x}$±Sd) | Post-Test ($\bar{x}$±Sd) | z | p |
|---|---|---|---|---|---|---|
| **30 m Speed Test** | Experiment | 12 | 5.06±1.02 | 4.48±.84 | -3.269 | 0.00* |
| | Control | 12 | 5.31±.69 | 5.55±1.24 | | |
| **Agility** | Experiment | 12 | 3.72±.51 | 3.27±.51 | -4.164 | 0.00* |
| | Control | 12 | 3.89±.28 | 3.87±.28 | | |
| **Vertical Jump** | Experiment | 12 | 29.74±2.80 | 34.16±2.67 | -4.095 | 0.00* |
| | Control | 12 | 29.55±1.93 | 29.57±1.93 | | |
| **Flamingo Balance Test** | Experiment | 12 | 6.08±1.17 | 4.75±.97 | -3.127 | 0.00* |
| | Control | 12 | 6.75±.97 | 6.67±1.07 | | |

*p<0.05.

Table 5 shows a statistically significant change in the pre-test and post-test averages of the experimental group for all variables after the exercises (p<0.05). This change was observed as a decrease in speed, agility and balance values and an increase in vertical jump values in the experimentalgroup.

**Table 6.** Wilcoxon signed ranks test results of 10m, 20m, 30m, 40m and 50m test before and after the experiment

| Variables | Group | N | Pre-Test ($\bar{x}$±Sd) | Post-Test ($\bar{x}$±Sd) | z | p |
|---|---|---|---|---|---|---|
| **10 m Shooting Performance** | Experiment | 12 | .92±.67 | 2.17±.58 | -3.095 | 0.00* |
| | Control | 12 | 1.50±.52 | 1.50±.52 | | |
| **20 m Shooting Performance** | Experiment | 12 | 1.17±.72 | 2.25±.75 | -3.300 | 0.00* |
| | Control | 12 | 1.50±.52 | 1.58±.52 | | |
| **30 m Shooting Performance** | Experiment | 12 | .92±.79 | 2.17±.58 | -3.494 | 0.00* |
| | Control | 12 | 1.50±.52 | 1.67±.49 | | |
| **40 m Shooting Performance** | Experiment | 12 | .50±.67 | 1.75±.62 | -3.234 | 0.00* |
| | Control | 12 | .92±.67 | 1.00±.60 | | |
| **50 m Shooting Performance** | Experiment | 12 | .58±.52 | 1.83±.72 | -3.499 | 0.00* |
| | Control | 12 | .50±.52 | .75±.45 | | |

*p<0.05.

Table 6 shows a statistically significant change in the pre-test and post-test averages for all throwing distances of the experimental group after the exercises (p<0.05). This change was observed as an increase in the mean values of 10m, 20m, 30m, 40m and 50m throwing distances in the experimental group.

## 4. Discussion

There are no studies in the literature on mounted javelin athletes. For this reason, it was compared with the results of exercises performed with resistance bands in other sports branches.

The results obtained that resistance band training has a positive effect on 30m sprint performance are similar to some research results in the literature. For example, Mor et al. [11], in a study conducted with male soccer players aged 15-16 years, stated that resistance band training had a positive effect on 30m sprint performance in soccer players. Aloui et al. [12] reported that 8-week resistance band training had an effect on 30m sprint performance in their study with 30 male handball players. It was observed that the effect in question was positive on sprint performance and the post-test face scores of the control group improved. Aloui et al. [13], in another study, 29 male handball players were studied for 8 weeks and the effects of resistance band training were examined. As a result of the research, it was stated that resistance band training had a positive effect on 30m sprint performance. Hammani et al. [14] conducted a 10-week program with 26 female handball players and reported that resistance band training had a positive effect on 30m sprint performance. The study is similar to the results of the studies in the literature. It suggests that resistance band training may have increased speed due to the improvement of strength.

When the literature is reviewed, there are studies that support the result that resistance band training leads to a significant difference on agility

score obtained in our study. For example, Turan [15] applied an 8-week training program to 43 male tennis athletes between the ages of 18-24. According to the results of the research, it is seen that resistance band training increases the agility score. In other words, resistance band training positively affects the agility score. In another study conducted by Turan-Balkanlı, Şahan and Erman [16], an 8-week training program was applied with 43 volunteer men. According to the results of the research, it was stated that resistance band training had a positive effect on agility score. The effects of 10-week resistance band training on 26 female handball players were examined. According to the results of the study, it is seen that resistance band training causes a significant difference in agility score. Considering the difference in question, it is stated that it has a positive effect on agility score. It is thought that this similarity may be due to the positive effect of resistance band training on agility performance in sports branches.

When the studies involving the examination of vertical jump performance according to resistance band training are examined, studies that are similar to the results obtained in this study are seen. For example, in the study conducted by Coşkun [17], a 6-week research was conducted with 30 male football players playing active football. According to the results of the research, it was stated that resistance band training had a positive effect on vertical jump performance. In the study conducted by Gül [18] with 16 male tennis players for 8 weeks, resistance band training was practiced in addition to tennis training. Looking at the vertical jump post-test scores of the experimental group, it was stated that the scores of the experimental group working with resistance band training increased significantly. In addition, 20 female volleyball players participated in the study conducted by Agopyan, Ozbar, and Özdemir [19] and lasted 8 weeks. In the study, the effects of resistance band training were examined. According to the results of the study, it was stated that resistance band training increased the vertical jump score. It is thought that this similarity may be due to the development of muscle groups that may be effective on vertical jump performance among the effects of resistance band training.

The results obtained that resistance band training has a positive effect on flamingo balance performance are similar to some research results in the literature. For example, in the study conducted by Kılınç, Günay, Kaplan, and Bayrakdar [20] with swimmers aged 7-12 years, resistance band training was performed for 10 weeks in addition to swimming training. According to the research findings, it was stated that significant improvements were observed in the static balance performance of athletes working with resistance band training. In addition, Turan [15] investigated the effect of 8-week resistance band training on the static balance of individuals in a study conducted with 43 men. According to the research findings, it is seen that 8-week resistance band training has a positive effect on static balance. It is thought that this similarity may be due to the effects of resistance band training for strength and performance on static balance.

When the literature is reviewed, there are studies examining the effect of resistance band training on accurate shooting and similar to the results obtained in this study. For example, in the study conducted by Gül [18] with 16 male tennis players for 8 weeks, resistance band training was practiced in addition to tennis training. Looking at the accurate shot scores, it was stated that the scores of the experimental group working with resistance band training increased significantly. In the study conducted by Turan [15], an 8-week training program was applied to 43 male tennis athletes. According to the results of the research, it is stated that resistance band training has a positive effect on the accurate shooting rate. In another study conducted by Turan-Balkanlı, Şahan, and Erman [16], an 8-week training program was applied to 43 male volunteers. According to the results of the research, it was stated that resistance band training had a positive effect on the accurate shooting rate. Keskin, Ateş, and Kiper [21] examined the effect of resistance band training on accurate serving in their research conducted with a total of 18 tennis athletes, 9 boys and 9 girls, over a period of 8 weeks. As a result of the research, they stated that resistance band training had a positive effect on the accurate shot rate. In addition, Fernandez et al. [22] applied a 6-week training program to 30 male tennis athletes. According to the results of the study, it was stated that resistance band training increased the accuracy rate. It is thought that this similarity may be due to the arm muscle strength and strength that may have an effect on the accuracy of resistance band training and the comfortable stroke that the strength will reveal.

## 5. Conclusion

According to the results of this study, it is clearly seen that strength training with resistance bands increases the accuracy in mounted javelin sport as well as speed, balance, agility, vertical jump and balance parameters.

**Conflict of Interest**

No conflict of interest is declared by tehe authors. In addition, no financial support was received.

**Ethics Committee**

The study protocol was approved by the Ethics committee approval numbered 28/11/2022-051 was obtained from Mersin University Sports Sciences Ethics Committee.

**Author Contributions**

Study Design, OS, YGG; Data Collection, OS, YGG; Statistical Analysis, OS, YGG; Data Interpretation, OS, YGG; Manuscript Preparation, OS, YGG; Literature Search, OS, YGG. All authors have read and agreed to the published version of the manuscript.

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