Research Paper: Investigating the Range of Motion and Balance Symmetry Between the Dominant and Non-dominant Arms in the Classic Female Wrestlers

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ABSTRACT

Introduction: The purpose of this study was to investigate the Range of Motion (ROM) and balance symmetry between dominant and non-dominant arms in classic female wrestlers.

Materials and Methods: In this cross-sectional study, 13 members of the Iranian Women's National Classic Wrestling Team participated voluntarily. The shoulder ROM was measured by a goniometer and dynamic balance was assessed by the Y-balance test. Data analysis was done by running a paired t-test, with a 0.95 confidence level ($\alpha<0.05$).

Results: There was no significant difference between dominant and non-dominant upper extremities in flexion (P=0.162), extension (P=0.264), abduction (P=0.077), internal rotation (P=0.972), and external rotation (0.945). A significant difference was found in the Y-balance test in medial (P=0.026) and inferior-lateral directions (P=0.047), but no significant difference in superior-lateral direction (P=0.715) and composite score (P=0.071).

Conclusion: Based on the results, it seems that the balance in the dominant arm is better than that in non-dominant arm in the athletes so the non-dominant arm may be at more risk for injury development. We, therefore, recommend that the coaches and trainers pay particular attention to these findings in designing the injury prevention programs.

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1. Introduction

Wrestling is one of the first ancient Olympic games and one of the most popular sports in the modern Olympics that requires high physical fitness [1]. Agility, flexibility, aerobic and anaerobic capacity, and the strength of upper and lower limbs are the most important factors to achieve the desired results in wrestling competitions [2]. Therefore, wrestlers try to have a high ability in these areas [3].

Injury is an integral part of physical activities and wrestling is no exception and different parts of the body are injured in this sport [4]. Since the high prevalence of wrestling injuries has been reported, injury prevention is the most crucial objective for training and match sessions [5]. A high prevalence of shoulder and ankle sprain injuries in wrestling has been reported due to their frequent use in wrestling techniques [6]. Since most wrestling techniques are involved with shoulder and trunk, it is quite evident that the glenohumeral joint has a key role in this sport [7].

Sports injuries can be divided into two main types: contact and noncontact. The reason for injuries in many athletes may be a lack of physical fitness, a faulty movement pattern, overuse or impairment of normal alignment of limbs [8]. The wrestling also has a lot of contact and non-contact injuries. Non-contact injuries can be prevented by adopting appropriate and effective precautionary measures [8]. Limbs asymmetries are common causes of these types of injuries [3].

Symmetry means equilibrium and harmony, as opposed to deviation, which is called asymmetry. The human body appears to be symmetrical [3]. It is estimated that in 96% of individuals, one limb is dominant [9], and the movements of the dominant limb are generally faster and more accurate than those of the non-dominant one [10]. Racket sports that use asymmetric techniques may result in an asymmetric distribution of muscle forces and imbalance. Besides, these movements may cause poor body posture and irregularities in the skeletal structure [11] resulting in the uncontrolled movement [12]. These consequences may impose a greater load on the joints and body structures and eventually lead to sports injuries [13].

Balance is essential for maintaining position in space and performing coordinated and controlled movements [14, 15]. Having a good balance plays an important role in the activities of the sports fields. Besides, imbalance increases the risk of falling, resulting in sports injuries [16, 17]. Studies have shown that balance improvement plays a key role in reducing the occurrence of sports injuries, and balance tests are considered as a good predictor of sports injury likelihood. Many takedown techniques of the wrestling require balance in the shoulder and poor balance of the shoulder may predispose their structures to further injuries [18].

Another component of physical fitness is flexibility, which refers to the range of joint motion and helps prevent injury by assisting in movement smoothness [19]. Previous studies have shown a relationship between the range of motion (ROM) and limb function, especially shoulder adduction, flexion, and rotation, which play an important role in upper limb function [20]. Since wrestling is a contact sport, the necessity of controlling the body in different situations exerts a great deal of stress on the joints. Therefore, flexibility plays a key role in preventing injury and improving performance in this field [21].

Various studies have investigated upper limb asymmetries in different fields. In one study, asymmetries in 16 active tennis players were investigated and a significant difference was observed in dominant and non-dominant arm muscles mass [22]. Another study was found asymmetry between the upper and lower limbs in volleyball players [23]. But, Butler et al. did not show a significant difference in the balanced symmetry between throwing and non-throwing arms of softball and baseball players [24]. Symmetry in upper extremities was also examined in overhead sports [25].

However, no study has been directly conducted on the classic female wrestling athletes. Thus, the purpose of this study was to examine the symmetry of flexibility and balance between the dominant and non-dominant arms in the classic female wrestling athletes of the Iran national team.

2. Materials and Methods

Study participants

A comparative cross-sectional study was conducted on the classic female wrestling athletes of the Iran national team. After explaining the general study objectives and methods, 13 athletes were volunteered to participate in our study.

Inclusion and exclusion criteria

The study inclusion criteria were as follows: membership in the classic adult female wrestling national team, and no history of injury, such as severe upper limb injury, vestibular system, visual impairment, and head injury during the last two months that currently limit exercise and competition.

Study procedure

Before starting the study, the goals of the research were explained. The participants were assured that their information would be confidential and they could leave the study any time. They were asked to attend at the specified time to measure body height and test for balance and ROM. Participants were asked to abstain from eating and exercising 2 hours before the test. All tests were performed by the researcher.

Upper quarter balance assessments

Upper quarter Y-balance test (UQ-YBT) is a functional screening tool for assessing mobility and stability of upper limb stability in the closed kinetic chain [26]. For this test, a plate with three rods connected to medial, inferolateral, and superolateral directions was used [27]. In a previous study, high reliability has been reported for this test [24]. The dominant arm was determined using the information which arm the participant most likely tend to throw the ball [28].

To start the test, the participants were placed in the plank position with three contact points, including one hand and two legs with shoulder-width apart. All participants performed the test without shoes. They performed the test in the medial reach, inferolateral reach, and superolateral reach, respectively [29]. In this test, the balance was measured for the supporting arm. After 5 minutes of light warm-up, all participants performed the test once as a familiarization trial and three times as a test of balance [24]. There was a 120-s break between each attempt [30]. The farthest point that the participant could touch was recorded in centimeter as the test score.

The data were normalized for each direction. To normalize the data, the maximum reach distance in each direction was calculated and divided by the length of the limb and finally multiplied by 100. To obtain the composite score, the average of the three normalized attempts was measured, too. To measure the length of the upper limb, each participant was asked to stand upright and perform a 90-degree shoulder abduction on the frontal plane, in which case the distance of C7 vertebrae to the middle finger was measured [24]. The participants were asked to observe the following things while performing the test: the support arm and feet stay in contact with the ground, the test arm should not be put on the floor until the test is completed, and the box should not be pushed roughly [29].

Range of motion assessments

A universal goniometer with high validity and reliability was used to examine the ROM of the shoulder in degree [31]. To assess shoulder flexion ROM, each participant was asked to sit on a chair with the upper back straight and raise his or her hand as far as possible. The goniometer fulcrum was positioned on the inferolateral portion of the acromion and the stable arm parallel to the trunk and the movable arm parallel to the longitudinal axis of the humerus [31]. To measure shoulder abduction ROM, the participants were in the same position and asked to raise their arms on the coronal plate as far as possible with the thumb above.

The goniometer fulcrum was positioned in the midposterior part of the glenohumeral joint and the stable arm parallel to the trunk and the movable arm parallel to the longitudinal axis of the humerus [31]. To measure shoulder medial and lateral rotation ROM, the participants were asked to be in the supine position, with the shoulder in 90 degrees of abduction, elbow in 90 degrees of flexion, and wrist in normal position, and to perform maximal medial and lateral rotation. Auxiliary movements were controlled by the examiner's assistant. The goniometer fulcrum was positioned on the outer epicondyle of the humerus and the stable arm in the vertical axis and the movable arm in line with the ulnar styloid process [32].

To measure shoulder extension ROM, a goniometer fulcrum was placed over the greater trochanter, the stable arm along the axillary line, and the movable arm along the outer longitudinal middle line of the arm, and each participant was asked to perform maximal extension without forward bending of the trunk [33]. All ROM measures were performed three times and the average score of each test was used as the study data.

Statistical analysis

First, the normality of the data distribution was determined using the Shapiro-Wilk test. Then, the data were analyzed using the paired t test. Statistical analysis was

performed using SPSS v. 20 at the significance level was set at 95% or P<0.05.

3. Results

Table 1 presents the demographic information of the participants. The paired t-test results for comparing ROM measures showed no significant differences between dominant and non-dominant arms in flexion, extension, abduction, medial rotation, and lateral rotation ROM of shoulders (P<0.05) (Table 2).

As shown in Table 3, there was a significant difference (P<0.05) in the Y-balance test results between the two arms (P<0.05) in medial and inferolateral directions. No statistically significant differences were observed in the superolateral direction and the composite score between the two arms (P<0.05).

4. Discussion

This study investigated the symmetry of ROM and balance in the dominant and non-dominant arms of the female wrestlers in the Iranian national team. No significant difference was found between two arms in terms of ROM in shoulder flexion, extension, abduction, medial rotation, and lateral rotation. Also, the balance of two arms was evaluated using the Y-balance test, which

Table 1. Demographic characteristics of the participants (Mean±SD)

Variable	Age (y)	Height (cm)	Mass (kg)	BMI (kg/m²)	Dominant Hand Length (cm)	Non-Dominant Hand Length (cm)
Mean±SD	21.30±2.17	160.46±3.92	62.61±9.01	22.83±2.77	82.57±3.12	82.65±3.54

JMR

Table 2. Comparison of the ROM of dominant and non-dominant arms

Variables	Mean±SD		t	P
	Dominant Arm	Non-dominant Arm		
Flexion ROM (degree)	169.96±3.88	171.88±5.78	-1.49	0.162
Extension ROM (degree)	49.38±14.01	46.30±11.72	1.172	0.264
Abduction ROM (degree)	174.30±11	176.76±9.53	-1.42	0.077
Internal rotation ROM (degree)	61.73±12.37	61.65±10.57	0.036	0.972
External ROM (degree)	69.11±9.30	76.26±10.47	0.071	0.945
External to internal rotation ROM ratio (degree)	14.65±11.56	14.61±10.77	0.015	0.989

JMR

Table 3. Comparison of the balance of dominant and non-dominant arms

Directions (cm)	Mean±SD		t	P
	Dominant Arm	Non-dominant Arm		
Medial	115.30±16.75	108.53±16.82	2.54	0.026
Inferolateral	90.92±18.98	78.23±10.63	2.21	0.047
Superolateral	70.76±22.93	79.69±21.51	-0.374	0.715
Composite score	11.69±21.54	104.23±16.27	1.97	0.071

JMR

showed a significant difference in medial and inferolateral directions, but no significant difference in composite balance score and superolateral direction.

Numerous studies have been conducted comparing the symmetry of the shoulder ROM in athletes. By examining the ROM between dominant and non-dominant arms of athletes and non-athletes, Daneshmandi et al. found a significant difference in shoulder medial and lateral rotation ROM in dominant and non-dominant arms in handball and volleyball players. However, no significant difference was observed in terms of shoulder flexion, extension, and abduction ROM [34]. Although the findings of many studies [35-38] showed a significant difference in the ROM of dominant and non-dominant arms, the results of this study found no significant difference in the ROM of dominant and non-dominant arms.

Considering the studies conducted in this regard, the results of this study are not consistent with the findings of other studies, which may be due to differences in the sports fields studied such as the study of Daneshmandi et al. in volleyball and handball [33, 34], as well as differences in the age range and sex of the study populations [38]. The symmetry of the ROM in this study may be due to the wrestler needs to use both arms in exerting more power, and therefore the ROM test must be applied in both arms.

The Y-balance test is one of the most common tests to evaluate unilateral balance in a closed kinetic chain movement that allows researchers to compare between the two limbs. Several studies have examined the upper extremities balance by using the Y-balance test [24, 26, 29, 39]. Some of these studies have reported no significant difference in dominant and non-dominant arms [26, 28]. Similarly, German et al. did not observe a significant difference between the dominant and non-dominant arms of male and female athletes [26]. In another study, no significant difference was observed between wrestlers and baseball players concerning the performance of dominant and non-dominant arms [39]. In swimmers, there was no significant difference between the limbs in performance on the upper quarter Y-balance test [29]. In a study conducted on university baseball and baseball athletes, there were no significant differences in performance on the YBT-UQ between throwing and non-throwing limbs as well as between throwing and non-throwing arms [24].

The results of the present study are not consistent with the findings of other studies. The reason for this difference can be attributed to differences in the sports studied, for example, Butler et al. [29] studied swimming and also their another study was conducted on softball and baseball athletes [24] as upper extremity performance is different in these fields. Besides, this difference can be attributed to age differences [39]. YBT-UQ function is also related to a combination of spinal joint mobility, motor control, and proprioception [39].

Since poor balance is associated with an increased risk of injury in many sports [40, 41]; therefore, it seems that balance exercises may effectively reduce the risk of injury [42]. In the same way, a previous study showed that balance exercises alone may reduce injury occurrence in athletes [43]. However, it might not be as effective as when it combines with other exercises [42]. The effect of balance exercises on upper extremities balance has not been investigated so far, but one study showed that using warm-up exercises before the main wrestler training significantly improved dynamic balance and possibly reduces the incidence of injury resulting from a weak balance [44].

However, previous studies have shown that asymmetry is one of the risk factors for limb injury [45]. It should be noted that training with asymmetries in the body may have negative effects on the athletes and subsequently may impose them to further injuries. For example, numerous studies have observed the positive effects of symmetrical exercises on improving techniques and motor coordination [22]. Also, bilateral practice due to transfer of learning can prevent an increment of lateral asymmetries and thus compensate for performance differences between the two body sides [46]. Moreover, training of the non-dominant side can also improve the performance of the dominant side, practice with the non-dominant side is useful during an injury-break, a blockade due to technical difficulties, or avoidance of overtraining [47].

The main limitation of this study was the low sample size. This study was conducted on adults and, it is therefore recommended that further studies be carried out on both adolescents and young adults. Since this study is based on classic wrestling, it is advisable to include other types of wrestling like Greco-Roman wrestling. The lack of a control group was another limitation of this study.

5. Conclusion

Based on the results of this study, the balance in the dominant arm is better than that in non-dominant arm in the athletes so the non-dominant arm may be at more risk for injury. Therefore, we recommend that the coaches and trainers pay particular attention to these findings in designing the injury prevention programs.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages; they were also assured about the confidentiality of their information. Moreover, they were allowed to leave the study whenever they wish, and if desired, the results of the research would be available to them.

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Authors' contributions

All authors contributed in preparing this article

Conflict of interest

The authors declared no conflict of interest.

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