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Effect of an Injury Prevention Program on Traumatic Factors and Athletic Performance in juniors Judokas: the SLSTs Intervention

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Abstract

Background: Judo has a higher risk of traumatic injuries during training. Thus, efficient training programs should be accomplished to decrease injury risk and improve performance.
Objectives: Given the necessity of developing injury prevention approaches in programming the training, this study aimed at investigating the effect of an Injury Prevention Program on Traumatic Factors and Athletic Performance in junior Judokas.
Methods: 46 subjects were randomly classified into 2 groups of experimental (N: 23) and control (N: 23) groups. For eight weeks, the experimental group attended a specific Judo functional training program designed by the researchers. The control group participated in the usual judo training program presented by the coaches. The exercises were accomplished 3 times per week for 90 minutes each session. The subjects participated in pre-and post-tests. To approve the data normality and compare the variables, Shapiro-wilk, ANCOVA analysis was implemented at the significant level of $p< 0.05$ using SPSS (version 21).
Results: The outcomes showed that the scores of functional movement screening ($p = 0.001$), upper extremity Y balance test ($p = 0.001$), vertical jump ($p = 0.001$), and special judo fitness test ($p = 0.001$) significantly increased among the experimental group.
Conclusions: This intervention can modify or decreases the injury risk factors and improves athletic performance and offers more efficiency and effectiveness rather than the common judo training programs.

Keywords: Traumatic injury, Functional Training, Functional Movement Screening.

Introduction

Currently, Judo is the world's most desired martial arts.[1] Of the 204 countries members of the International Olympic Committee, 201 are members of the International Judo Federation, and it is estimated that over 40 million people participate in judo exercises all over the world.[2] Currently, it is one of the sports used by military forces. Judo includes grappling, throwing, and light sudden strokes, and uses the upper limb more than other martial arts.[3] Besides throwing techniques, there are grappling techniques in sitting and lying positions as well that include techniques for holding the opponent on the ground, choking (temporary obstruction of the neck's vital arteries), and locking the elbow joint.[4] Like any other contact sport, there is the concern about injuries and trauma in Judo.[5] Given the large number of participants in judo exercises, the contact nature of Judo, and the variety of throwing techniques in this sport, which increase the risk of injury, the development of training methods is important to injury prevention and improving the performance of athletes. Accordingly, it is essential to propose preventive strategies and provide training programs to reduce the risk of injury by conducting studies to identify the risk factors of injury.

Lack of sufficient falling skills, pressing on the mat due to falling of attacker on the opponent,[6] performing some techniques with a high risk of injury,[7] gripping style,[8] and improper execution of the techniques[7] have been enumerated as the most important causes of judokas Injury. Also, higher injury risks during training have been reported compared to the competition.[4]

Since the injury mechanism is multifactorial, a preventive program should include a variety of interventions.[9] These interventions should not exclusively focus on the body segments that have roles in specific sport functions, and also should not be independent of technique but the parameters affecting athletic performance should be practiced in a balanced combination.[10] Moreover, to increase the neuromuscular effectiveness of the exercises, the activity has to focus on the overall movement, not on the individual muscles and must be done as specific as possible in similar patterns and within the context of the specific tasks.[11]

In this regard, functional training is described as special exercises that have a positive effect on well-being, doing daily routine activities, occupation or exercise, and injury prevention.[12] These exercises include goal-oriented movements, located within the athletic functional list and focusing on specific exercise patterns. According to the principles of functional training, exercise should, as far as possible, develop the motor capabilities, skills, and readiness required through the main task. Also, the interventions should be focused on the drills that have the most transmission.[12] Accordingly, technical training as a significant part of functional training could be considered in designing the training programs. Regarding the similarity of functional training with the sport-specific activities, these exercises can have a higher potential for trainers' acceptance and be more effective in injury prevention.[13]

In recent years, gaining low scores in some of the functional tests has been introduced as a risk factor for injury. Nowadays, Functional Movement Screen (FMS) and the Y Balance Test (YBT) as two functional tests are widely used to measure modifiable risk factors among military, professional and amateur athletes, and even non-athletes.[14] Both tests are designed with sufficient validity and reliability to evaluate the flexibility, balance, and functional movement patterns, and both of them are associated with an increased risk of injury to athletes.[14] It should be mentioned that the YBT is a general test and is not specific to Judo risk factors for injury. But this test is widely used for assessing athletes in different sports. Previous studies showed that although functional tests are reliable and valid for predicting the risk of musculoskeletal injuries, they are not suitable for evaluating athletic performance.[15] Researchers have used Special Judo Fitness Test (SJFT), vertical jump, and throwing medicine ball to evaluate the athletic performance of judokas.[16,17] SJFT is important to highlight some of the limitations of metabolic and neuromuscular needs that occur during the fight.[18] Moreover, throwing a medicine ball and vertical jump tests are widely used to evaluate the strength of the upper and lower extremities.

Objectives

Assessing injury risk factors and effective variables on athletic performance can be a good criterion for evaluating the effectiveness of injury prevention training programs and the promotion of athletic performance. The purpose of this study was to investigate the effect of a specific Judo functional training program on injury risk factors and athletic performance of junior Judokas.

Materials and Methods

The study was quasi-experimental with a pretest-posttest design. The population was all non-elite Judo athletes in Tehran (with at least Q5, purple belt, and at the most dan-1-black belt) in the age range 13-17 years. Totally, 46 eligible Judo athletes were selected using a purposive and random sampling method. They were divided into two experimental and control groups (each group consisted of 23 subjects).

The inclusion criteria were: male gender, age range from 13 to 17 years, at least one year of training experience, having a specific level of skills required for participating in this study (including minimum Q5 and maximum dan 1), three sessions of continuous training a week and lack of any injuries or limb fractures that would limit their ability to participate in exercises. Exclusion criteria were the unwillingness of the athlete (or their parents) to participate in the study, not attending the pre-test or post-test, two consecutive absences or three alternate sessions, any type of injury or complication that limit their ability for accomplishing the exercises or participating in the tests.

In this research, individual characteristics including demographic information like birth date, height, weight, history of exercise, strong limb (strong hand and foot), and history of injury were collected. They were also asked to sign the consent form. Moreover, Seca brand medical scales (with an accuracy of 0.1 kg), stadiometer and tape meter (with an accuracy of 0.1 cm), and Beurer (Made in Germany) heart rate monitor were also used to measure heart rate in the Special Judo Fitness Test (SJFT).

The training program was designed to manage a full training session. The exercises included three ninety-minute

sessions each week over eight weeks. The experimental group underwent a research intervention under the supervision of the researcher (Table-1), and the control group continued to practice common Judo training according to the programming of the coach. Both groups were asked not to participate in other sporting activities. All the subjects in the research took part in FMS, upper and lower limb Y balance test, SJFT, vertical jump, and medical ball throwing in a sitting position 24 hours before and after the training period.

According to the research objectives, the following mandatory frameworks were considered for the design of training intervention:

1. Exercise on both sides of the body (dominant and non-dominant guard),
2. Performing standing Techniques (Tachi Waza) in a static and dynamic situation using the Judo body movement principles (Taisabaki)
3. Two-person Uchikomi (Repetition training), without lifting the opponent from the ground
4. Two-person Uchikomi, with lifting the opponent from the ground (controlled picking-without throwing)
5. Performing throwing techniques (Nage Waza)
6. Ground techniques repetition training (Ne Waza Uchikomi)
7. Performing Randori (one-on-one free sparring)

To select techniques for the Uchikomi, a general template was used named “Single Leg, Standing Technics" (SLSTs). However, the program did not focus on a particular technique or group of techniques, and selecting the above technique was accomplished to determine the overall pattern of the exercise.

The experimental group trained under these mandatory frameworks and subjects should be conducted the exercises based on targeted repetitions. Determining the minimum and maximum repetitions of training were selected based on the interview with the instructor and the average number of repetitions of practice that was applied by the coach in each session. Based on the principle of overload, it was added in a stepwise method for eight weeks. Accordingly, the number of repetitions of uchikomi, throws, time, and repetition of randori in the first two weeks were selected similar to the training routine of the class, and the researchers did not change it. During the third and fourth weeks, fifth and sixth weeks, seventh and eighth weeks the training load was increased, respectively 10%, 20%, and 10%.

The main differences between the training program of the control group and the experimental group were including; optional grappling (guard) selection during training and non-obligation to perform bilateral exercises (in both right and left guards) in all parts of the training, no-obligation to performing two-person uchikomi with controlled lifting the opponent in static and dynamic positions, non- determine any overall pattern to choosing techniques, Steadiness of uchikomi repetitions and Randori timing in the training sessions..

Data analysis: The sample size was determined by using G Power 3.0.10 software. Shapiro-Wilk test was used to confirm the normality of the data and independent t-test was applied to determine the difference between individual characteristics in study groups. ANCOVA test was used to compare the mean of data in the studied variables. The significance level in the whole study was 95% with alpha less than 0.05. Inferential statistics were analyzed using SPSS (Version 21).

Ethical considerations: All subjects (or their parents) completed the consent form and informed consent to participate in this study. They could leave the study whenever they wished. The subjects were informed of the test results. Moreover, the subjects' information was kept confidential by the researchers.

Results

The mean and standard deviation of the anthropometric and demographic variables of the subjects are presented in Table-2.

Table-3 shows the difference between the mean of the variables of the groups in the pre-test and post-test.

According to the results, after 8 weeks of training, both groups showed improvement in the determined indices, with a significant increase in FMS (p=0.001), upper extremity Y balance (p=0.001), vertical jumps (p=0.001), and SJFT (p=0.001) in the experimental group.

Discussion

The purpose of the study was to examine the effect of eight weeks of Judo's specific training on the risk factors of trauma and the performance of non-elite male Judo athletes.

The findings of the previous studies showed that after the functional training intervention, FMS significantly improved. In terms of the consistency of the findings, our results are consistent with those reported in other studies.[19,20]

In a related study, it was concluded that the patterns of movements covered by FMS are connected to many aspects of Mixed Martial Arts exercises, and FMS can help coaches identify and improve the functional movement disturbances using a standard practice intervention program. This approach provides the opportunity to implement more effective training programs for martial art instructors.[20]

Table-1. Specific Judo Injury Prevention Program (SLSTs)

Warm up (General & specific) -15 minutes					
Exercise status	Techniques	Total repetitions of each technique per session*			
		Weeks 1-2	Weeks 3-4	Weeks 5-6	Weeks7-8
Dynamic (with Taisabaki)	SLSTs** without lifting	40	44	53	58
	SLSTs with lifting	20	22	26	29
	PT*** without lifting	20	22	26	29
	PT with lifting	10	11	14	16
Static (withoutTaisabaki)	SLSTs without lifting	60	66	80	88
	SLSTs with lifting	30	33	40	44
	PT without lifting	20	22	26	29
	PT with lifting	10	11	14	16
Dynamic / Static Throwing (Nage Waza)		10	11	13	14
Randori		3 rounds (3 min)	3 rounds (3.30 min)	3 rounds (4 min)	3 rounds (4.30 min)
Ne Waza Uochi komi		5 min	5.30 min	6.30 min	7 min
Cool down -10 minutes					

* The number of repetitions written in the table is related to the total number of repetitions in two guards. The maximum continuous repetition of uchikomi for each person in each guard was 10. At the end of each set (10 rep), the opponent starts their uchikomi. This procedure would continue to reach the targeted number.

** The techniques used in this program were: Uchi Mata, Harai Goshi, Sode Tsurikumi Goshi, Morte Seoi Nage, Tai O toshi, O soto Gari, Ippon Seoi Nage, O Goshi, Koshi Guruma, And Sasaei Tsurikomi Ashi.

*** Personalized technique (PT) refers to a technique that an athlete selected as her/his main skill and focuses more on it.

Table 2. Demographic characteristics of the subjects by research groups

Variable	**Groups**	**Pre-test**	
		Mean	SD
Age (year)	Experimental group	14.17	1.10
	Control group	14.13	0.82
Height (cm)	Experimental group	1.61	0.112
	Control group	1.62	0.076
Weight (kg)	Experimental group	56.95	9.46
	Control group	61.47	7.76
Exercise history (month)	Experimental group	19.69	6.25
	Control group	23.08	5.96
BMI (Kilograms per square meter)	Experimental group	21.74	2.6
	Control group	23.29	1.22

Table-3. Value of the variables in pre-test and post-test

Variable	Groups	Pre-test	Post-test			
		Mean±SD	Mean±SD	F	Sig.	Eta square
FMS	Experimental group	14.17±1.1	16.6±1.1	52.39	0.001*	0.55
	Control group	14.13±0.8	15.02±1			
Upper extremity Y balance (cm)	Experimental group	93.27±12.8	96.37±12.4	14.33	0.001*	0.254
	Control group	93.83±12.7	95.05±13			
Lower extremity Y balance (cm)	Experimental group	88.38±12.4	89.33±14.2	0.079	0.871	0.002
	Control group	88.60±13.2	89.83±12.7			
Medical ball throw (cm)	Experimental group	265.95±17.7	266.08±70.3	0.149	0.701	0.004
	Control group	264.56±65.5	266.43±56.6			
Vertical jump (cm)	Experimental group	32.26±8.9	36.56±9.2	40.49	0.001*	0.491
	Control group	28.69±5	29.78±5			
SJFT	Experimental group	14.16±1.2	13.74±1	37.87	0.001*	0.474
	Control group	14.82±0.7	14.63±0.6			

Considering the compulsory framework governing the training intervention of the study (especially the practice in both the dominant and non-dominant guards), these significant differences in FMS score can be attributed to increased coordination and muscular synergy. These changes could be interpreted in improving the components of functional movement and reducing the risk factors for injury and trauma.

The upper extremity Y balance test simultaneously involves the core stability and shoulder stability, so in addition to the stability of the trunk, it also requires neuromuscular control, proprioception function, strength, and a wide range of motion in the shoulder joint. For this reason, this test is efficient and comprehensive for assessing shoulder function, strength, or mobility impairment.[21]

Therefore, the significant increase in the score of this test can be attributed to the improvement of these factors and the effectiveness of the intervention. Consistent with our findings, other studies reported that exercising in specific sport patterns and mastering of main skills is very important for exercising and learning and activates core muscle in the same way as during the competition.[22,23]

Athletes who reach out-of base of support distances in their activities have better dynamic balance than athletes whose main motor-sensory system tries to maintain balance within the base of support.[24] In Judo, there are various techniques performed by the lower limb (Ashi Waza) which require reaching out-of-base of support and acting out of the postural balance zone. Given that these techniques are typically present in the judokas' training program and their technical choices, the lack of significant difference in the overall score of lower limb Y balance may be related to the technical nature of Judo.Studies have shown that improvements in power following the short-term training are due to neuromuscular adaptations.[25] Considering that the subjects of the present investigation were trained persons, it seems that the training variables used in this study were not sufficient to create long-term adaptations, and there is not a significant change in the throwing medicine ball test between groups. Thus, complementary exercises should be used to achieve upper limb power improvement.

Improvement in the experimental group vertical jump test is probably related to this research intervention. As parts of this intervention included throwing techniques in both static and dynamic positions, and also performing techniques with the controlled lifting of the opponent (without throwing), perhaps the significant difference in height vertical jump can be justified to improve the strength of the core muscles and lower extremities. Studies have shown that strengthening the core muscles improves the height of the jump and other components of motor fitness.[26] It is argued that core exercises should not be excluded from the athletic training program as central these muscles have a decisive role in the transmission of force to the limbs from the body.[26] Besides, there is sufficient evidence to conclude that resistance exercise interventions can increase muscle strength and enhance performance components like vertical jump in youth athletes.[27]

Successful performance in judo depends on a combination of neuromuscular and metabolic readiness. During the fight,

a series of dynamic changes occur constantly in proportion to the athlete's movements, and the judo athlete needs a combination of strength and endurance to control these changes.[28] Prolonged muscle contraction time and sequence of action and reaction in fighters to implement various techniques may cause adverse effects on motor control and imprecise movement due to environmental fatigue and impairment in the function of chemical receptors. This will further undermine optimal athletic performance while increasing the risk of injury. As in fatigue conditions, the control of fast movements of the body depends on the information of the sensory system, if during such activities the static and dynamic joint stabilizers cannot properly stabilize the joint, the risk of injury and trauma increase.[29] Therefore, some part of the intervention of this study including an increase in the number of repetitions of practice and the duration of fights without increasing the total training time-within eight weeks can be attributed to a significant difference in the score of SJFT and improvement of the metabolic and neuromuscular readiness of the experimental group.

Conclusions

According to the results of the present study, this program is probably more effective than conventional training methods and the mandatory frameworks included in this training intervention, reduce or modify the injury risk factors, and also improve the athletic performance of judokas. Since there is no non-technical, intangible or unfamiliar movement pattern in this program for coaches and athletes and it does not require any additional equipment, it is suggested them to use this program and the mandatory frameworks introduced in it for training.

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None.

Authors' Contribution

All authors pass the four criteria for authorship contribution based on the International Committee of Medical Journal Editors (ICMJE) recommendations.

Conflict of Interests

The authors declared no potential conflict of interests with respect to the research, authorship, and/or publication of this article.

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