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The effect of preparation period trainings on respiratory muscle strength of hearing impaired judokas

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Background & Study Aim: The delay in the motor development of disabled people results from a lack of experience, rather than a loss of an ability. Thus, disabled people should be provided with suitable exercise environment, motivated to participate in physical activities and even encouraged to do sports for rehabilitation. The purpose of this study is the effect of 4-week-long preparation period of the judo training programs on the respiratory functions, inspiratory and expiratory muscle strength of male and female hearing impaired judokas.

Material & Methods: A total of 27 hearing impaired judokas, 13 male and 14 female, participated in the study voluntarily. Measurements were made 2 days before the training program started and 2 days after the training program ended. The indicators obtained from these measurements were maximal inspiratory pressure (MIP), maximal expiratory pressure (MEP), vital capacity (VC), tidal volume (TV), forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC, forced inspiratory vital capacity (FIVC), maximal voluntary ventilation (MVV) and respiratory rate (RR). A paired samples t-test was used for pre-test post-test differences, while an independent samples t-test was used for differences between genders.

Results: Statistical significance was found in all respiration indicators measured in the analysis of pre-test and post-test differences within groups ($p<0.05$). No statistically significant difference was found in analysis results between groups in terms of gender. A 4-week-long preparation period training program had a positive effect on the respiration indicators and respiratory muscle strength of male and female athletes. A training program had similar effects on the examined indicators in terms of the variable of gender.

Conclusion: Since the individuals with hearing impaired formed the experimental group, the benefits of judo training applied to individuals with hearing impaired will be important for the literature and may inspire other researchers in the future.

Keywords: aerobic training • Deaf National Tea • respiratory frequency • tidal volume • vital capacity

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Aerobic training – *noun* training that increases the body's capacity for aerobic exercise [38].

Endurance training – *noun* exercises designed to increase an athlete's level of aerobic fitness [38].

Motor skill – a skill for which the primary determinant of success is the quality of the movement that the performer produces [39].

Motor skills – *plural noun* the ability of a person to make movements to achieve a goal, with stages including processing the information in the brain, transmitting neural signals and coordinating the relevant muscles to achieve the desired effect [38].

Muscle strength – essential and basic physical capacity in combat sports by which the body is moving status is modified [40].

Physical activity – **noun** exercise and general movement that a person carries out as part of their day[38].

Pulmonary – *adjective* relating to the lungs [38].

Respiratory system – *noun* a series of organs and passages that take air into the lungs and exchange oxygen for carbon dioxide [38].

Skeletal muscle – *noun* a muscle that is attached to a bone and makes a limb move [38].

INTRODUCTION

People with disabilities undertake sports and exercise to increase their quality of life; however, they do not have as many opportunities as able-bodied individuals. It has been accepted that the delay in the motor development of disabled people results from a lack of experience, rather than a loss of an ability. Thus, it has been suggested that disabled people should be provided with suitable exercise environment, motivated to participate in physical activities and even encouraged to do sports for rehabilitation [1].

People with hearing loss have lower physical ability levels than able-bodied individuals. Those with hearing impaired were observed to have postural defects, poor balance and deficiencies in muscle strength. Also, the absence of verbal communication in infancy and early childhood has been shown to cause some changes in airway pressure and this, in turn, may cause a decrease in pulmonary function [2-4].

The physiological responses were given by the respiratory system after training are similar in athletes with hearing impaired and healthy athletes. During exercise, athletes breathe in and out thousands of times, and just like the other skeletal muscles, respiratory muscles also need enough O_2 to work regularly [5]. When it is considered that 16% of the O_2 taken in during intense exercise is spent by respiratory muscles, it can be seen that effective respiratory muscle strength is important in compensation exercise needs [6].

Of the individuals with a hearing impaired, those who do not play sports do not have the chance to improve their physical exercise, since they do not get feedback and thus have difficulties in understanding differences in speed and time and they generally exercise slowly. Motoric skills such as grapping, throwing, jumping and walking should be the priority for skills development in this group [7, 8]. When considered from this point of view, judo is an important sport for the development of basic motor skills of individuals with hearing impaired.

In general, as individuals with hearing impaired have weaknesses in speed, strength, agility and heart and respiration endurance, programs and activities are needed to support these deficiencies [9, 10]. Development of the respiratory system is significant in ensuring continuity of physical activity is and thus judo training, which supports motor skills, is very useful for individuals with hearing impaired.

The purpose of this study is the effect of 4-week-long preparation period judo training programs on the respiratory functions, inspiratory and expiratory muscle strength of male and female hearing impaired judokas.

MATERIAL AND METHODS

Participants

Thirteen male (age: 19.23 ±1.64 years) and 14 female (age: 18,79 ±2.01 years) judokas with a hearing loss threshold of at least 55dB (decibels) who were athletes in Deaf National Team and special sports clubs participated in the study voluntarily.

Design of the research

The judokas who participated in the study were informed about the objective and the method of the study by an expert who knew sign language, they were shown videos of the tests to be conducted, and pilot measurements were made for respiratory function and respiratory muscle strength. Pre-tests were conducted two days before the preparation camp started, while the post-tests were completed two days after the training program finished. All the measurements were made at the same time of day (between 10.00 and 12.00 a.m.).

Procedure

Training program: Judokas participated in 90-minute training sessions for 5 days a week, during a 4-week-long preparation period. This program included endurance training once a week, which contained aerobic runs, strength training two days a week and judo basic techniques training two days a week.

Respiratory Function Tests: SPIROLAB III (Medical International Research, Rome, Italy) was used for respiratory function tests. Vital capacity (VC), tidal volume (TV), forced vital capacity (FVC), forced expiration volume in 1 second (FEV1), FEV1-FVC ratio (FEV1/FVC), forced inspiration vital capacity (FIVC), maximal voluntary ventilation (MVV) and respiratory frequency (RR) measurements were performed [11-14].

MIP and MEP measurement: A MicroRPM (CareFusion Micro Medical, Kent, UK) intraoral barometer was used to find out MIP and MEP indicators. For MIP measurement, after suitable filter and holders were fixed, the nasal airway was closed with a clip. The test was completed when the subject was standing with residual volume, the holder was taken into the mouth, and maximal inspiration was made at maximal speed for 1-3 seconds.

For MEP measurement, the same method was applied as in MIP. However, unlike residual volume, the test was started at total lung capacity. The measurement was repeated between the two best measurements until 10 cmH_2O difference was left and the best result was recorded in cmH_2O [15].

Table 1. Mean and standard deviations (±) of indicators characterising judo athletes.

Variables (indicator)	Pre-preparatory training		Post-preparatory training	
	mean ±			
	male	female	male	female
Age (years)	19.23 ±1.64	18.79 ±2.01	19.23 ±1.64	18.79 ±2.01
Height (cm)	181± 0.09	160.7 ±4.20	181 ±0.09	160.7 ±4.20
Weight (kg)	81.8± 15.81	63.6 ±12.10	79.2 ±8.50	60.8 ±9.80
BMI (kg/m^2)	24.72 ±2.70	24.60 ± 3.40	24.11 ±20	23.43 ±2.90

Table 2. The comparison of the pre-test and post-test data of the judokas in the study.

Indicator & research stage mean SD		Male (n = 13)			Female (n = 14)		
		mean difference	p	mean SD	mean difference	p	
MIP (cmH_2O)	pre-test	125.54 ±42.65	0.55%	0.022*	93.14 ±20.48	0.77%	0.019*
	post-test	126.23 ±42.62			93.86 ±20.55		
MEP (cmH_2O)	pre-test	136.62 ±41.60	0.50%	0.022*	102.86 ±24.30	0.48%	0.003*
	post-test	137.31 ±41.75			103.36 ±24.33		
VC (L)	pre-test	4.99 ±0.61	0.40%	0.018*	4.14 ±0.85	0.72%	0.034*
	post-test	5.01 ±0.60			4.17 ±0.87		
TV (L)	pre-test	1.95 ±0.48	0.51%	0.047*	1.31 ±0.61	1.50%	0.013*
	post-test	1.96 ±0.50			1.33 ±0.62		
FVC (L)	pre-test	5.92 ±1.18	0.50%	0.023*	3.45 ±1.15	0.58%	0.015*
	post-test	5.95 ±1.18			3.47 ±1.15		
FEV1 (L)	pre-test	5.58 ±1.29	0.36%	0.004*	3.32 ±1.12	0.30%	0.015*
	post-test	5.60 ±1.29			3.33 ±1.11		
FEV1/FVC (%)	pre-test	80.72 ±18.94	0.30%	0.013*	76.64 ±12.06	0.52%	0.009*
	post-test	80.96 ±18.95			77.04 ±11.76		
FIVC (L)	pre-test	6.71 ±1.35	0.30%	0.006*	3.81 ±1.46	0.78%	0.029*
	post-test	6.73 ±1.34			3.84 ±1.44		
MVV (L/min)	pre-test	216.66 ±54.22	0.26%	0.046*	105.41 ±44.50	0.87%	0.031*
	post-test	217.23 ±54.36			106.34 ±44.16		
RR (ins./min)	pre-test	64.92 ±15.55	−1.44%	0.040*	48.57 ±11.97	−1.63%	0.035*
	post-test	64.00 ±15.48			47.79 ±11.68		

*p<0.05

Table 3. The analysis of the difference between pre-test and post-test results of the values of respiratory function test and respiratory muscle strength regarding gender.

Indicator	Gender	Mean SD	p
MIP (cmH_20)	Male	−0.69 ±0.95	0.954
	Female	−0.71 ±0.99	
MEP (cmH_20)	Male	−0.69 ±0.95	0.515
	Female	−0.50 ±0.52	
VC (L)	Male	−0.03 ±0.03	0.630
	Female	−0.04 ±0.06	
TV (L)	Male	−0.02 ±0.03	0.815
	Female	−0,02 ±0.02	
FVC (L)	Male	−0.02 ±0.03	0.880
	Female	−0.02 ±0,03	
FEV1 (L)	Male	−0.02 ±0.02	0.793
	Female	−0,02 ±0.02	
FEV1/FVC (%)	Male	−0.24 ±0.29	0.329
	Female	−0.39 ±0.48	
FIVC (L)	Male	−0.01 ±0.02	0.241
	Female	−0.03 ±0.05	
MVV (L/min)	Male	−0.55 ±0.94	0.449
	Female	−0.93 ±1.45	
RR (ins./min)	Male	0.92 ±1.44	0.793
	Female	0.79 ±1.25	

Statistical analysis

The SPSS IBM 21.0 program was used for statistical analysis. The data were presented as mean, standard deviation (±) and percentage differences. Normality assumption of the data was checked with a Shapiro-Wilk test. A paired samples t-test was used to analyse the difference between the pre and post test results of the male and the female groups, while an independent samples t-test was used to find out the difference regarding gender. Statistical results were assessed at a significance level of $p<0.05$.

RESULTS

Descriptive information of the judokas in the study is presented in Table 1. Statistical significance ($p<0.05$) was found in all the indicators of male and female judokas with hearing disability between the pre-test and post-test results (Table 2). No statistical significance ($p>0.05$) was found in respiratory function test and respiratory muscle strength indicators between male and female judokas with hearing disability (Table 3).

DISCUSSION

In this study, as a result of the 4-week-long preparation period judo training program for male and female athletes, statistical significance was found between all the respiratory indicators measured between pre-test and post-test results ($p<0.05$). However the judokas were compared regarding gender, that was not found out ($p>0.05$).

A great number of studies have mentioned the physiological benefits of martial arts especially cardiorespiratory fitness [16, 17]. In previous studies shown that regular exercise was found to cause positive changes in respiratory functions and respiratory muscle strength [17, 18-20]. Khalili and Elkins [21] found out that the aerobic

training program used for 44 mentally disabled children for 8 weeks had significant effects on pulmonary functions. They stated that the FVC value was got to increase by 330 ml at the end of the training period when compared with the control group, while FEV1 value was found to increase by 160 ml when compared with the control group [21]. In their study, Renno et al. [22] stated that 8-week-long regular exercise developed MIP and MEP indicators. Hsieh et al. [23] reported that regular exercise increased respiratory muscle strength.

In order to provide the necessary oxygen for the increasing metabolism during exercise, respiratory volume increases. As exercise becomes regular, respiratory muscles will develop and progress [24]. The increase in oxygen intake and outlet in cells during training depends on the development of cardiovascular system [25]. It is widely accepted that with suitable training for respiratory muscles, the strength and endurance of respiratory muscles can be increased and the lung volume-capacity, which is closely related with effort, can be increased [26, 27].

Combat sports and martial arts (budo) [28-31] or defence arts, e.g. aikido [32-34] and also fun forms of martial arts [35-37] can improve physical fitness indicators in both healthy and disabilities individuals. Although the effects of judo training on performance indicators were researched, there are no studies conducted on the effect of judo training on respiratory functions and respiratory muscle strength individuals with hearing impaired.

CONCLUSIONS

The 4-week-long preparation period judo training program had positive effects on the respiratory indicators which include lung volume and capacity and respiratory muscle strength of male and female individuals with hearing impaired. Since the individuals with hearing impaired formed the experimental group, the benefits of judo training applied to individuals with hearing impaired will be important for the literature and may inspire other researchers in the future.

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