

The Effect of Aerobic and Core Stability Training Combination on Respiratory Volume and Balance of Children with Congenital Deafness

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Abstract

Introduction: According to previous studies, it has been shown that weakness in balance and low capacity of pulmonary capacity is one of the main problems in people with congenital deafness. There is a close and meaningful relationship between pulmonary function. Also, balance is one of the factors affecting the quality of life. Its improvement improves the quality of life. The simultaneous strengthening of respiratory and balance improvement functions should be emphasized in order to bring a quality of life closer to normal. The purpose of this study was to investigate the effect of a combination of aerobic training and central stability on respiratory volume and balance of congenital deaf students. **Methods:** This study was a single-blind clinical trial performed at a Deaf School in Qazvin, Iran. The present study was a post-test and pre-test design was performed on 24 congenital deaf students who were randomly assigned to the experimental and control groups (each group of 12). The experimental group performed exercises for 6 weeks and 3 sessions per week for 60 minutes. During the same period, the control group did not participate in any training program. Before and after training, the volume and pulmonary capacities were measured by a Spirometer, static balance using the (BESS) and dynamic balance test using Star Balance Test (SEBT) was measured. Data were analyzed by the independent samples t-test and ANCOVA test ($P \leq 0.05$). **Results:** According to the results of this study, there was a significant difference in the mean post-test of dynamic and static balance and respiratory functions after carrying out training program in the intervention group. **Conclusion:** It seems that the aerobic and core stability combination training can improve respiratory volumes as well as a static and dynamic balance in hearing impairment and can be used in conjunction with other training programs.

Keywords: Core stability, Diaphragm, Respiratory Volume, Balance, Congenital Deafness

Introduction

Hearing is an important sensation that makes it possible for us in part of our communication with the outside world. The child learns to speak with audible notes. If a child does not hear from the beginning, he will not be able to speak. Hearing impairment is a form of hidden disability and one of the most common abnormalities in the birthplace, and about %10 of the world's population is hearing impaired and 130 million people are moderate to severe. 65 million of these births are affected by this problem. Hearing loss can be one-way or two-way, mild to full, low or high frequencies, congenital or after birth. Its prevalence in our country is 5 per thousand. Deafness is called silent disability. In the results of Ali et al., Zwierzchowska et al., Lieberman et al., Zebrowska et al., and Houwen et al., low levels of cardio respiration and muscular endurance of the disabled have been reported in comparison with their healthy partners (Vali-Zadeh et al., 2014). The low level of aerobic fitness in deaf children has been explained by the lack of acquiring verbal skills that have a positive effect on the development of the lungs due to the use of lungs to sing or yell, obtaining lower aerobic fitness index (Zebrowska et al., 2007). In other words, natural breathing is done approximately and in a unique way by the diaphragm. During the breech operation, the diaphragm contraction causes lower levels of the lungs to come down during the exhalation, the diaphragm is only relaxed and the lung, chest wall and abdominal structure are pushed to the lungs, causing the air to flow out. However, during more intense breathing, the reactionary forces do not have enough power to create deep exhalation, as a result, additional force is needed by the abdominal muscle contraction, which pushes the internal structures of the abdomen up to the lower diaphragm surface and thereby causes pressure on the lungs (Hislop, 2002). Although the development of airways at birth is complete, the proliferation of alveoli continues continuously until 2-3 years of age. The volume of airways continues to rise to adolescence (Hislop, 2002). One of the factors that will affect the development of pulmonary function is exposure to several environmental factors such as cigarette smoke, ozone, infection, and a combination of these, and the importance of their effects on the growth of lung function is explored (Finkelstein and Johnston, 2004). The decrease in muscle strength affects the respiratory system and lung function and decreases spirometric variables in the deaf. This weakness may be due to a lack of pronunciation and no talking (Shadle and Mair, 1996). Problems with hearing impairment are often examined only in terms of communication. Although communication problem is the main defect caused by hearing impairment, other physical problems may also be associated with hearing impairment. This regard, delay in postural growth as well as motor development is a common sensory-motor disorder in deep deaf children. The vestibular extremities and the cochlea are both very close to each other both anatomically and functionally. Embryonic injuries, during birth or afterbirth, can damage the vestibular or the cochlea, or both. Vestibular system is essential for fixing the look (the ability to stare at something); therefore, damage to the Vestibular system causes disability in balance and stare functions (Pajor and Jozefowicz-Korczynska, 2008). Balance is an inseparable component of everyday activities and a key part of daily actions (Punakallio, 2005). Gambetta and Gary have argued that balance is the most important part of the ability of athletes and is involved in almost every form of activity (Gary and Gambetta, 2000). The balance is a complex motor skill that describes the body's postural dynamics in preventing falls (Hessari et al., 2011). The importance of postural and balance in independence in activities such as sitting, standing and walking from the point of view of the scientists is undeniable and under discussion. Different types of exercises are used to improve balance which can be referred to as deep-sensory exercises using the balance board. In recent years,

the core body and the exercises related to the strengthening and stability of this area has found many people in different fields. The lumbar-pelvic-leg area with its surrounding muscles is called the core area of the body. And considering that the anatomical position of the center of gravity is in this area, and human movements are caused by it, the stability of this area is very important. Core stability is known as the motor control and muscle capacity of the core area to maintain the stability of the area in various postures and external forces (Hessari et al., 2011). In fact, core stability is affected by three inactive, active and nervous systems which are in close communication and interaction so that if one of the systems gets disturbed, other systems are trying to compensate for the disruption. The central area instability occurs when the impairment does not resolve (Hessari et al., 2011). Studies have shown the role of core stability on improving performance and athletic performance as well as preventing injury. Clark et al. showed that core stability prevents the occurrence of false movement patterns by maintaining the posture and proper body position during functional activities, thereby improving exercise performance (Clark and Reuteman, 2000). The core stability of the body is considered to be one of the factors associated with lower limb injury (Leetun et al., 2004). In order to study the effect of core stability training on balance, Johnson et al. The effect of 4 weeks of trunk muscle strengthening program on the balance of healthy subjects and reported a significant effect on balance after the training program (Johnson et al., 2007). Most existing studies have examined the effect of the central stability training program on the balance of athletes and In addition, a different report is provided on the duration and type of exercise program (Samson, 2007). According to the research, we know that absolute and deep deaf people, Due to the inability to speak and participate in physical activity at childhood, it is weak in the diaphragm and is interrupted by decreasing respiratory capacity, and on the other hand, due to a defect in its vestibular system, the ability to maintain balance and control poorer posture than Have healthy people; And with an overview, it has been observed that no studies have been done to evaluate the effect of aerobic training on respiratory capacities of the deaf while deaf people, in comparison with those with normal hearing, are less responsive to respiratory capacity and balance, and maybe research in this sample More priority. Therefore, the present study was conducted to evaluate the effect of six weeks of combined aerobic training and central stability on respiratory and balance volumes in the deaf.

Materials and Methods

This study was a single-blind clinical trial performed at a Deaf School in Qazvin, Iran. The present study was a post-test and pre-test design and was conducted after obtaining permission from the Committee on Research and Ethics of Qazvin University of Medical Sciences, Iran. The statistical population of this study was all deaf students from Qazvin province. Of these, 24 qualified subjects were selected by non-randomized targeting method. After assessing the balance and respiratory capacity, based on the obtained score, they were matched and divided into two equal and experimental groups by the researcher. According to the medical records available at the school, the most important criteria are the absence of any neurological or harmful effects that affect the balance of function and the absence of diversions in the spine (such as scoliosis, kyphosis) and lower extremities (such as flat foot, short legs), Having a normal vision without the use of glasses (Ferber-Viart et al., 2007). Not having any illness in deep-vision and vision systems, not performing surgery and cochlear implantation, and not having an accident or falling from the height and fractures leading to skeletal injuries (Rinaldi and Barela, 2009). There was no history of diseases such as convulsion and lack of exercise history and regular physical activity; the subjects' premiums

were determined by the desire of the subjects to shoot soccer (Hessari et al., 2011). All subjects voluntarily participated in this study based on parental consent form and co-operation between teachers and principals of the Qazvin Exceptional School for Deaf.

Training program

Intervention group in aerobic exercise program, observing the safety tips and recommendations of the College of Sports Medicine (Colberg et al., 2010), under the supervision of the researcher. Before starting the training, the 10-minute warm-up program included aerobic exercises (3minute of fast walking and slowly running), and then static stretching. After the main workout, Cool Down was performed, which included slow walking and stretching movements. The aerobics training program included running exercises with an intensity of %50-70 heart rate reserve (Table 1). The target heart rate was calculated using the Caronen method (Hoffman, 2006).

Age (years) - 220 = Maximum heart rate

Rest heart rate - maximum heart rate = heart rate reserve

Resting heart rate + desired intensity × (heart rate reserve) = heart rate target

Progressive core stability training from the Jeffrey Core Exercise Program, which was made up of three levels and combined, was attended by 6 sessions per week and 3 sessions per session for 60 minutes each session (Jeffreys, 2002). The control group was engaged in normal study period (6 weeks), but the experimental group performed the planned training program, details of which are given in Table 1. Of course, after the completion of the study, the training program and its movements were taught to the control group and the program was used by the teacher for their training.

Table 1. Aerobic training program

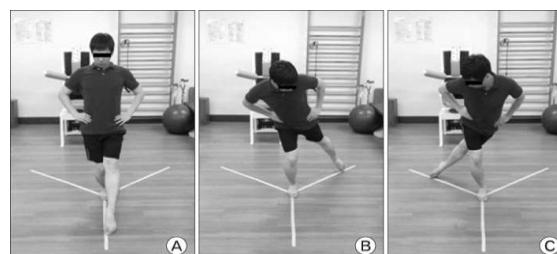
Week	Training period	Exercise intensity (percentage of heart rate reserve)
First	20	%50-60
Second	20	%50-60
Third	25	%50-60
Fourth	25	%60-70
Fifth	30	%60-70
Sixth	30	%60-70

Table 2. Core stability training program

	Week	First	Second	Third	Fourth	Fifth	Sixth
Training							
Plank		3 Rep	3 Rep	2 Rep	3 Rep	2 Rep	2 Rep
		10 S	15 S	30 S	30 S	45 S	45 S
Side Plank		3 Rep	3 Rep	2 Rep	3 Rep	2 Rep	3 Rep
		s 10	s 15	s 30	s 30	s 45	s 45
Crunch		1 Set	1 Set	1 Set	1 Set	2 Set	2 Set
		10Rep	15 Rep	20 Rep	25 Rep	15 Rep	20 Rep
Cycling		1 Set	1 Set	1 Set	2 Set	2 Set	2 Set
		15Rep	20 Rep	25 Rep	20 Rep	20 Rep	24 Rep
Oblique Crunch		1 Set	1 Set	1 Set	1 Set	2 Set	2 Set
		10 Rep	15 Rep	20 Rep	25 Rep	15 Rep	20 Rep

Test Star Excursion Balance

It is used to measure dynamic balance. This test is a valid and reliable tool for quantization of dynamic balance. In this test, 8 directions that are starred on the ground are aligned at 45 degrees. Because the similarity of the results of the balance tests Y with our balance test, we used the Y balance test (Cote et al., 2005). The subject stops at the center of the subject's directions in the center of the direction, then sets one on one and ends with the other leg to achieve the goal and returns to normal on two legs. The subject touches the farthest point in each of the designated directions; the distance from the contact point to the center is the distance to be measured, which is measured in centimeters. In order to minimize the learning effects of each subject, he trains this test in three directions (Figure 1).


Figure 1. Components of the balance test Y

To obtain a dynamic balance score in each direction, we use the following formula:

$$\text{Score: } \frac{\text{Achievement distance}}{\text{Length of limb}} \times 100$$

Balance Error Scoring System

In this test, which is used to measure static, six different situations have been considered, including three positions standing on the hard surface and three standing positions on the soft surface. Hard surfaces include carpet or flooring and a soft surface, including a padded foam cushion with a size of 41 x 50 x 6 centimeters. Standing positions also include standing on both legs in pairs, standing together on both legs, one way back and standing on the same. In all situations, the eyes of the subjects are closed and the hands stick to the sides. The subject performs each situation for 20 seconds and calculates the total number of errors that occur in these six states as his grade. Errors include: detaching the hands from the waist, opening the eyes, lifting the heel or toes, relying on the ground, attaching or abducting more than 30 degrees of thumb, a collision of the foot with the ground, or a collapse of balance for any reason. Before performing the test, each subject performs three tests to getting known with the test (Bressel et al., 2007).



Figure 2. Balance error test (BESS) in six different situations

Spirometry

Pulmonary static and pulsed dynamic volumes and capacities were measured by spirometry machine with Pony FX desktop spirometer labeled Italy with validity and reliability of 0.982; After exercising the subjects and emphasizing on maintaining the focus and severity of the maximum effort during maneuver testing or lung tests for each person three times with 1 to 2 minutes, spirometry (flow-volume curve) and after five minutes of rest two The load was performed with a 2 minute spirometric test (maximum voluntary ventilation), and the best pulmonary functions were recorded, recorded and stored (Attarzadeh et al., 2006).

In this study, Shaapiro-Wilk's statistical test was used to assess the normality of the data and then, the independent samples t-test and Ancova test were used for data analysis. All statistical tests were performed with SPSS version 23 and assumed significant $P \leq 0.05$.

Results

Descriptive characteristics of the research samples, including height, weight, and age by groups are presented in Table 3. The Independent t-test was used to determine the equality of groups in age, height and weight indices. The results of the field tests of these variables showed that there was no significant difference between the groups and the groups were equal in these variables.

Table 3. General Characteristics of Subjects (mean \pm SD)

Group	Number	Age	Height (CM)	Weight (kg)
Control	12	17.33 \pm 0.98	1.69 \pm 3.47	55.58 \pm 5.63
Experimental	12	17.41 \pm 1.37	1.73 \pm 5.41	56.50 \pm 5.40

According to the present research, ANCOVA analysis method was used to analyze the data and to control the pre-test effect. To analyze homogeneity of variance in two groups, Levin's variance analysis was used. As shown in Table 4, Levine's test was not statistically significant for any of the variables studied.

Table 4. Test of Homogeneity of Variances

Variable	Pre test group (F)	P
Anterior	1.597	0.219
Posteromedial	2.777	0.110
Posterolateral	0.591	0.450
BESS Balance	2.068	0.164
FVC	4.259	0.051
FEV ₁	0.754	0.394
MVV	2.916	0.102
VC	3.239	0.086

The Ancova test was used for comparing the mean scores of post-test, dynamic balance and static balance and respiratory function after controlling the pre-test effect in the two groups, its results are presented in Tables 5 and 6.

Table 5. Results of Ancova analysis for comparing post-test dynamic balance in two groups

Variable	Source	Sum of Squares	df	Mean square	F	sig
Anterior	Pretest	410.20	1	410.20	45.38	*0.000
	Group	113.59	1	113.598	12.569	0.002*
	Error	189.79	21	9.038	-	-
Posteromedial	Pretest	1587.492	1	1587.492	42.349	0.0001*
	Group	467.813	1	467.813	12.480	0.002*
	Error	787.201	21	37.486	-	-
Posterolateral	Pretest	1549.441	1	1549.441	143.217	0.0001*
	Group	256.485	1	256.485	25.363	0.001*
	Error	212.367	21	10.113	-	-

* Significance level is $P \leq 0.05$

As shown in Table 5, there is a significant difference between the mean scores of post-test dynamic balance in the anterior excursion after the elimination of the pre-test effect [(p = 0.002) and (F = 1, 21)]. There is a significant difference between the post-test scores for the Posteromedial excursion after the elimination of pre-test effect [(p = 0.002) and (F = 1, 21)], and post-test scores for Posterolateral excursion after the elimination of the pre-test effect were significantly [(p = 0.001) and (F = 1, 21)]; therefore, the mean scores of post-test the intervention group was significantly higher in the Y balance test than in the control group.

Table 6. Results of Ancova analysis for comparing post-test static balance in two groups

Variable	Source	Sum of Squares	df	Mean square	F	sig
BESS Balance	Pretest	9.375	1	9.375	9.623	*0.005
	Group	56.801	1	56.801	58.305	*0.001
	Error	20.458	21	0.974	-	-

* Significance level is $P \leq 0.05$

As shown in Table 6, there is a significant difference between the mean scores of post-test static balance after the elimination of the pre-test effect [(p = 0.002) and (F = 1, 21)].

Table 7. Results of Ancova analysis for comparing post-test respiratory functions in two groups

Variable	Source	Sum of Squares	df	Mean square	F	sig
FVC	Pretest	0.334	1	0.334	36.843	0.0005
	Group	0.566	1	0.566	62.476	*0.001
	Error	0.190	21	0.009	-	-
FEV ₁	Pretest	0.285	1	0.285	16.772	*0.001
	Group	0.290	1	0.290	17.052	*0.0004
	Error	0.357	21	0.017	-	-
MVV	Pretest	443.369	1	443.369	140.132	*0.001
	Group	102.340	1	102.340	32.346	*0.0001
	Error	66.443	21	3.164	-	-
VC	Pretest	0.412	1	0.412	32.978	*0.0001
	Group	0.282	1	0.282	22.582	*0.001
	Error	0.262	21	0.12	-	-

As shown in Table 7, there is a significant difference between the mean scores of post-test FVC after the elimination of the pre-test [(p = 0.001) and (F = 1, 21)]. Also, there was a significant difference in post-test FEV1 scores after the elimination of the pre-test (p = 0.0004) and [(F = 1, 21)], and post-test scores after eliminating the pre-test effects were significantly different [(p = 0.0001 (F = 1.21)); and finally, after the elimination of the pre-test,

there was a significant difference in the mean scores of the post-test VC; therefore, the mean scores of post-test the intervention group was significantly higher in the respiratory functions than in the control group.

Discussion

The purpose of this study was to investigate the effect of aerobic combination program and core stability on respiratory volume and balance of children with congenital deafness. The results showed that performing aerobic combined exercises and improving the core stability of respiratory capacities and maintaining the balance of congenital deaf individuals. Here, before examining the effect of aerobic combined exercises and core stability on respiratory volume and balance, first it is necessary to consider the relationship between deafness and balance and respiratory weakness of these individuals. The results of some researches show a significant relationship between the two categories it was mentioned (Rajendran and Roy, 2011). Congenital deaf people have similar physical, emotional and physical characteristics compared to those with normal hearing, but deaf people are normally deprived of the auditory system, a fact that in many cases limits their activities, especially during childhood. (For example, when playing), and ultimately their physical-motor development slowly slows down and delays (Rajendran and Roy, 2011). Fear of injury because of the incomplete understanding of the environment in deaf children, which is inspired by their parents, can be among the factors that reduce the depression of deaf children to heavy physical activity such as running, jumping, climbing and jumping, etc. In this period, it will affect the growth and coordination of the muscles. Continuing participation in physical activity can compensate for this delay in physical-motor development in the deaf. In general, many studies have investigated the effects of different exercises (balance, resistance, strength, core stability exercises, and the like) on the balance situation. Overall, their results indicate the positive effect of training and participation in sports activities on static and dynamic balance. Several studies have attempted to manipulate the sensory systems involved in the postural control process, but few studies have been conducted on posture control and balance of the disabled, and despite researches, there has been no research on the effect of aerobic combined exercises on respiratory capacities and balance in the deaf. Concerning the relationship of the results of the research with other studies that examined a specific type of exercises that focused on balance, with the results of Derlich et al. (2011), Johnson et al. (2007), Hessari et al. (2011), aligned; and with the results of Sato research that the exercise does not affect the improvement of balance, it is disagreeable that the possible differences in the results can be attributed to the specifications of the exercise (type of exercise, intensity and duration of training, how to perform exercises). In the Sato study, subjects were healthy, while subjects were hearing impaired people (Sato and Mokha, 2009). Among the respiratory maneuvers, MVV is more of a dynamic test of ventilation capacity, which reduces MVV in neuromuscular and cardiac patients, as well as those with airway obstruction or stenosis. Therefore, the amount of MVV depends on the individual's physical capacity and strength as well as on the limitation of the shortness of breath. An increase in the MVV of the hearing impairment in this study was aligned with the findings of Thaman et al. (2010). FVC and FEV1 maneuvers are one of the most important pulmonary functions. Any factor that changes the TCL and RV will also change the FVC values. Changes in airway obstruction or respiratory muscle weakness including diaphragm, intervertebral muscles, and abdominal muscle groups alter FVC and FEV1 levels. According to the findings of this study, FVC and FEV1 values increased significantly in the training group after participating in the training

program; these findings were matched to the results of Attarzadeh et al. (2006) and Huang and Osnesse (2005). Based on the findings of the FEV1 study, it has been introduced as an independent predictor of longevity and instrumentation as a general human health assessor (Huang and Osnesse, 2005). In general, exercise has increased metabolic activity and in order to respond to it, both ventilatory and cardiac devices should be activated by simultaneously increasing the ventilation and cardiac output (Schunemann et al., 2000). Kisner suggests that changes in the muscular, cardiovascular and pulmonary system occur as a result of aerobic exercises, which leads to an increase in the patient's tolerance. These changes include changes in circulation, increased heart rate, increased arterial pressure, increased oxygen demand, and increased respiratory rate and depth resulting from the onset of secondary respiratory muscles. Increased body temperature, increased stimulation of the muscles and joints stimulates the respiratory system during the first one of the exercise, which results in increased ventilation and increased frequency and total lung volumes. The positive impact of exercise on pulmonary volume can be attributed to the association between increased aerobic capacity and pulmonary volume (Kisner and Colby, 2002).

Conclusion

The results of this study showed that performing combined aerobic training and core stability can improve balance and respiratory volume in hearing impaired people. Although the results of this study were about hearing impaired people, according to most of the research findings, it has been shown that these exercises have a positive effect on the balance and respiratory volumes of individuals affected by any anomalies in the leg or respiratory tract. It was found that central stability exercises, in addition to strengthening muscles, by overloading on the transmission of information through the sensory systems of the central nervous system (Vestibular, Visual, Somatosensory), as well as the motor system, improved the sense of deepness and increased muscular coordination. And, as a result, improves in maintaining the balance of the individual. Finally, aerobic exercises increase blood circulation, speed and depth of respiration, as well as increased diaphragm, resulting in improved respiratory volume; Therefore, when a deaf person improves his respiratory rate by participating in a sports rehab program, he can better handle daily tasks.

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Conflict of Interest

The authors have not declared any conflicts of interest.

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