LOWER LIMB AEROBIC VERSUS ANAEROBIC TRAINING IN DOWN'S SYNDROME REHABILITATION

Reham A.A. Abouelkheir, PhD1, Mohamed E. Khalil, PhD2.

1 Lecturer, Department of Physical Therapy for Pediatrics and its surgery, College of Physical Therapy, Misr University for Science & Technology, Egypt.

2 Assistant Professor, Department of Physical Therapy, College of Medical Rehabilitation, Qassim University, Saudi Arabia.

Correspondence to E-mail: m.khalil@qu.edu.sa

ABSTRACT

Objective: The aim of current study was to investigate the effect of the lower limb aerobic versus anaerobic training on the ventilatory functions in Down syndrome children.

Methods: 22 Down's syndrome children (boys and girls) participated in this research. They were divided into two equal-sized groups at random. (Group A) aerobic training (Treadmill training), while (Group B) received lower-limb anaerobic exercise (Strength training). The ventilatory functions were assessed by a Discovery spirometer: Vital Capacity (VC) and Forced Vital Capacity (FVC).

Results: Pre-treatment results showed no significant differences between the two groups in any of the recorded criteria, the post-treatment results revealed a significant improvement in both groups' pulmonary function (VC and FVC).

Conclusion: The lower limb aerobic and anaerobic training which used in this study can be worthy part in rehabilitation of the Down syndrome children for improvement of their ventilatory functions.

Keywords: Aerobic Training, Anaerobic Training, Down's syndrome, Rehabilitation, ventilatory functions.

I. INTRODUCTION

Down’s syndrome (DS) is the trisomy of chromosome 21. This is the most prevalent trisomy within live births. The syndrome was called first mongolism because of the mongoloid facial manifestation of patients with this syndrome. In this time, the term mongolism is Outdated [1]. Down syndrome has been known as one of the most substantial reason of disability. It is recognized by retard in evolution of motor role and mental lag.

Children with Down's syndrome have an excess of respiratory problems due to many contributing factors seen in Down's syndrome such as immune dysfunction, hypotonia, neuromuscular weakness of respiratory muscles, other causes include heart problems leading to increased intrapulmonary pressure [3]. Reduce cough effectiveness may lead to respiratory infection, decrease lung volumes and may contribute to shortage of pulmonary system to oxygenate the venous blood or eliminate the carbon dioxide from blood [4]. Children with Down syndrome are at hazard for pulmonary ailment with decrease lung sizes due to weak cough, due to generalized trunk and extremities impairment that may contribute to high incidence of recurrent respiratory infection [5].

Ventilatory function test is significant tool in the diagnosis, evaluation, and achievement of respiratory ailment in aged and older children. The ability to carry out the lung function testing on preschool children with the early onset of pulmonary ailment such as in cystic fibrosis would help in the estimation and follow-up of individual patients [6]. Ventilatory function testing is an important part of clinical medicine and serves a number of roles: (1) to establish the diagnosis of pulmonary disease and to assess its severity; (2) to document the effectiveness of the therapy for various pulmonary disorders; (3) to chart the course of a disease through serial testing; and (4) to educate patients and perhaps facilitate other alternations in lifestyle [7]. The American Association of Cardiovascular and pulmonary rehabilitation advised that all respiratory rehabilitation approaches continue to offer exercise, educational, and
psychosocial interventions. These involvements may include aerobic exercise, learning about drugs, and learning breath dominance [8]. Aerobic exercise considered as an important component of pulmonary rehabilitation program and it improves the patient's functional and physiological status [9]. Improvements in strength and coordination, as well as a reduction in pain, are the goals of this intervention. The weight-bearing joint systems should be inspected for wear and tear be used as a preventative measure [10]. Strength training has been shown to be just as successful as endurance training in terms of the exercise capability and improving overall health [11].

II. METHODS:

Study design:

Single blind, randomized, clinical trial was conducted at Cairo University hospitals and The National institute of for Research of Motor Disability in Children.

Randomization:

For this study, 35 children with Down syndrome were chosen; 3 children did not meet the inclusion criteria, and 10 children's parents rejected to continue in the study. Following the baseline measurements, qualified children were randomly assigned to one of two groups: A or B. Children were given a number from 1 to 22 in order. Then, using online graph pad software, 11 children were randomly assigned to each category.

Participants:

22 Down's syndrome children (14 boys and 8 girls) their age (12 to 15 years), they could understand and follow instructions. If a child had any of the following conditions, they were not allowed to participate: 1- Vascular anomalies. 2- Taking part in any form of sport. 3- Asthma, moderate to serious. The aims, methods, and benefits of data collection were thoroughly clarified to the participants' parents before data collection. Parents were given the opportunity to give their children's informed consent to participate in the study. This research was carried out in compliance with the Declaration of Helsinki guidelines for human studies.

The Ethics approval for this study was cleared by the Ethics approval Review Committee of the Faculty of Physical Therapy, Cairo University.

Outcome measures:

**Discovery Spirometer:**

Vital Capacity "VC" and Forced Vital Capacity "FVC" were assessed by Discovery Spirometer pre and post application of treatment for 3 times per week for 12 successive weeks to measure the pulmonary functions.

**Weight and Height Scale:**

It was employed to record the child's weight (in Kg) and height (in cm), these data are essential to fed the "Discovery spirometer “

Interventions:

Group A received Treadmill Training protocol as shown in Table (1), Group B received the strength training consisted of 3 exercises conducted in 3 sets of 10 repetitions, with a 60 seconds rest between sets and 3 minutes rest between exercises. All exercises with weights around the ankle and it were in form of: quadruped hip extension, straight leg raise exercise and lying leg curl. The first 3 sessions were used to adjust to exercises with light weights, and the weights used after that was determined by monitoring the subjects' abilities to do 10 exercise repetitions. The weight was gradually increased as the subjects' abilities to complete three sets of 10 complete repetitions improved.

**Table 1:** Treadmill Training protocol (Group A)

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>Children of this group were trained as follow: a. Walking at: 0 incline for 2 minutes then 1.5 incline for 2 minutes then back to 0 for 2 minute. b. Walking time 10 minutes (2 minutes walking and 1 minutes rest). c. Speed: below the thresholds of pain or breathlessness, the treadmill belt speed was set at 1 meter per second.</td>
</tr>
</tbody>
</table>
Children of this group were trained as follows: a. Walking at: 0 incline for 2 minutes then 3 incline for 2 minutes then back to 0 for 2 minutes. b. Walking time 12 minutes (2 minutes walking and 1 minute rest). c. Speed: below the thresholds of pain or breathlessness, the treadmill belt speed was set at 1.5 meter per second.

For both groups: Warm up for 5 min, before starting the processes and cool down for 5 min, after ending the procedures. The warm up and cool down phases consisted of stretching exercises for upper and lower extremities and also thoracic mobility exercises. The treatment schedule was provided to all participants in both groups for 30-40 minutes, 3 days/week, for successive 12 weeks.

Data analysis & statistical design

The significance of the results was determined by comparing pre and post care for both study groups using an unpaired T-test. The findings were discussed and interpreted, and then a final conclusion and set of recommendations were presented. The computer program SPSS (IBM SPSS, Chicago, IL, USA) version 20 was used to perform all statistical calculations.

III. RESULTS

Subject characteristics:

There were no significant differences in the demographic data between both groups as shown in Table (2) between the two groups (p > 0.05) (Table 2).

The pretreatment data of this study cleared that there were no considerable differences (p > 0.05) in all measured parameters among both groups of patients in the pulmonary functions as indicated in Table (3) which revealed that both groups were matched in the measured variables at the start of the study and the pulmonary functions (VC and FVC) were below the predicted values for these patients in relation to their ages, weights and heights. The post treatment findings showed that, there were improvement in both groups of the participants’ pulmonary function "VC and FVC " represented by significant differences between the pre- post-remediation and post-treatment pulmonary functions after 12 weeks as indicated in Table (3)(p < 0.005).

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>Mean± SD</th>
<th>G(A)</th>
<th>G(B)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age/year</td>
<td></td>
<td>13.2±1.6</td>
<td>12.9±2.2</td>
<td>0.136a</td>
</tr>
<tr>
<td>Weight/Kg</td>
<td></td>
<td>32.4±3.2</td>
<td>31.8±1.6</td>
<td>0.486a</td>
</tr>
<tr>
<td>Height/m</td>
<td></td>
<td>1.28±0.042</td>
<td>1.33±0.062</td>
<td>0.543a</td>
</tr>
</tbody>
</table>

SD: standard deviation; p-value: level of significance, a t test.

<table>
<thead>
<tr>
<th>Pretreatment</th>
<th>Post treatment</th>
<th>Pre vs Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>Group B</td>
<td>Group A</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>VC (L)</td>
<td>1.52±1.325</td>
<td>1.497±0.096</td>
</tr>
<tr>
<td>FVC (L)</td>
<td>1.43±0.169</td>
<td>1.39±0.195</td>
</tr>
</tbody>
</table>

Table (2): Demographic Data of Both Groups (group A), (group B):

Table (3): Statistical analysis of the VC (L) and FVC (L) for both Groups
IV. DISCUSSION

This study was conducted to compare the therapeutic efficiency of lower limb aerobic exercise on treadmill versus anaerobic training on the ventilatory functions in Down syndrome children. There were no major variations in all measured parameters in the ventilatory functions in both groups of patients in this study's pre-treatment results. According to these findings both groups had been resembled in the measured variables and ventilatory functions at the start of the study and the ventilatory functions of these patients were lower than expected for their ages, weights, and heights.

The post-treatment findings of this study showed that both groups of patients' ventilatory function (VC and FVC) improved significantly, as demonstrated by considerable variation between pre-treatment and post-treatment ventilatory functions after 12 weeks of training.

The amelioration of the post-remediation data of (Group A) can be referred to that during aerobic exercise oxygen consumption increases so the respiratory system provides more oxygen. Extra amounts of oxygen are provided to the blood during aerobic exercise through increasing ventilation linearly. The increase in ventilation is caused initially by an increase in both tidal volume and respiratory rate. However as exercise increases tidal volume reaches a plateau and the increase is then only due to increasing respiratory rate [12]. The enhancement in ventilatory function in children of group (B) may be due to the enhanced force of expiration by encouragement the training [13]. Through strength training muscles consume more oxygen and produce more carbon dioxide, and the respiratory reaction is specifically standardized to preserved balance of these gases in arterial blood [14]. Lactic acid, which is produced in working muscles, starts to circulate in the bloodstream. The lactate threshold is a metabolic acidosis caused by it. The lungs respond to lactic acidosis during exercise by enhancing ventilation, decreasing arterial partial pressure of carbon dioxide, and maintaining normal arterial blood pH [15]. Strength training in children with DS can be effective in improving physical ability during physical activities such as walking [16].

V. CONCLUSION

The lower limb aerobic and anaerobic training which used in this study can be worthy part in rehabilitation of the Down syndrome children for improvement of their ventilatory functions.

VI. ACKNOWLEDGMENT

The authors thank all the patients who participated in the study and their parents.

Author Disclosures:

[Authors report no conflict of interest]

No funding was received for this study. The authors certify that they have no financial affiliations or involvement with any commercial organization that has a direct financial interest in any matter or materials discussed in this manuscript.

REFERENCES