

Selected Innate Immune System Response to Aerobic Exercise Training in Obese Down Syndrome Children

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Abstract:

Background: Many studies have reported that individuals with Down syndrome (DS) have been prone to develop infectious, malignant and abnormality of the immune function.

Objective: This study was designed to measure response of selected innate immune system to aerobic exercise training among obese DS children.

Materials and Methods: Forty DS obese male and female children participated in this study, the range of their age 12 to 16 years and were enrolled in 2 equal study groups; the first group practiced aerobic exercise training for 3 months, whereas the second group received no intervention.

Results: The measured parameters of the first group who received aerobic exercise training revealed that mean values of C3, C4 and BMI has been reduced significantly, in the other hand, the changes in the parameters of the second group who received no intervention showed non-significant changes. In addition, the differences between both groups at the end of the study were significant.

Conclusion: Aerobic exercise training improves innate immune system response in DS obese children.

Keywords: Aerobic exercise; Down syndrome; Innate Immune System; Obesity.

I. Introduction

Down syndrome (DS) is a chromosomal disorder resulting in various abnormalities such as mental retardation, immunodeficiency and physical abnormalities. Especially, abnormality of the immune function is important pathological features in this syndrome, and leads to increased susceptibility to viral or bacterial infections [1].

Down syndrome is characterized by several congenital malformations and dysmorphic criteria and congenital malformations, including congenital heart disease and gastrointestinal disease, as well as increased respiratory morbidity. DS also associated with various immunologic impairments [2, 3]. A chronic low-grade inflammation and immune system activation are associated with abdominal obesity and may precipitate in having the metabolic disorders that are related to the obesity [4,5]. Adipose tissue is an important source for cytokines which are considered as an important mediator for the systemic inflammation and immune system activation associated with obesity [6-8].

Obesity has also been associated with decreased immunocompetence and deterioration of immune system response which is usually correlated with the degree of obesity [9] that increases the risk of infections in obese subjects than that of non-obese individuals [10-16]. Moreover, about 25–40% of some malignancies usually associated with obesity [17]. Many previous studies like *Moulin et al.*, showed in their study that obesity is associated with alteration in immune system parameters [18]. A state of chronic inflammation and increased count of WBCs, monocytes and neutrophils have been reported in obese individuals [19-22]. Also, an elevated number of lymphocytes, macrophages, CD3 and CD4 have been found to be positively correlated with the body mass index [23, 24].

Several immune system defects have been reported among DS subjects, which are responsible for increased risk for respiratory system infections, autoimmune disorders and hematologic cancer [25]. In the other hand, aerobic exercise was proved to improve body resistance to several infections and protect against many types of malignancy [26, 27]. However, as there is limitation in research handling the impact of exercise training on immune system among DS children, this study was designed to measure the response of selected innate immune system to aerobic exercise training among obese DS children.

II. Materials and methods

1.1. Subjects:

Forty Down syndrome subjects (21 boys and 19 girls) with age ranged between 12-16 years and IQ level ranged from 55-65% were enrolled in the present study and assigned into two equal groups. Group (A) received aerobic exercise on treadmill 3 times per week for successive three months, while group (B) received no

intervention and was considered as a control group. Patients with musculoskeletal, neurological, cardiac or respiratory disorders were excluded from the study.

1.2. Methods:

Evaluated parameters

A. Chemical Analysis: Overnight fasting blood sample was taken from all participants, where K2EDTA was added and the sample centrifuged to separate the blood serum which was stored frozen at -20° until the level of C3 and C4 serum protein was measured.

B. Body Mass Index (BMI): Body weight of participants in both groups were measured (HC4211, South Korea) while wearing hospital gowns and undergarments. Where the height was measured using digital stadiometer (JENIX DS 102, Dongsang) which was computed as BMI= Body weight/Height².

Procedures:

1. The training group (Group A): Participants were administered aerobic exercise training to complete a 12-week treadmill aerobic exercise (Enraf Nonius, Model display panel Standard, NR 1475.801, Holland). Exercise program included warming up for 5 minutes (range motion and stretching exercises) followed by training for 30 minutes with intensity equal to 60-70% of the individualized maximal heart rate and ended with 10 minutes of cooling down phase, three sessions / week for 3 months duration.

2. The control group (Group B): Participants received no intervention.

III. Statistical analysis and results

The mean values of the investigated parameters were detected at the beginning and at the end of three months of study for both groups and they were compared by student paired "t" test. While, the unpaired" test used to compare between the two groups (P<0.05).

The measured parameters of the first group who received aerobic exercise training revealed that mean values of C3, C4 and BMI has been reduced significantly, on the other hand, the changes in the parameters of the second group who received no intervention showed non-significant changes (Table 1&2). In addition, the differences between both groups at the end of the study were significant (Table 3). These results show that aerobic exercise training improves innate immune system response in DS obese patients.

Table (1): Comparison of measured variables of group (A) before and at the end of the study.

	Mean +SD		t-value	Significance
	Before	After		
C3(mg/dl)	170.82 ±7.93	161.67 ± 6.95*	5.27	P <0.05
C4(mg/dl)	36.58 ± 4.61	33.75 ± 4.36*	4.32	P <0.05
BMI (kg /m²)	34.45 ± 3.88	31.13 ± 3.78*	4.92	P <0.05

BMI= Body Mass index; C3= C3 serum protein of the complement system; C4= C4 serum protein of the complement system; (*) indicates a significant difference, P < 0.05.

Table (2): Comparison of measured variables of group (B) before and at the end of the study.

	Mean +SD		t-value	Significance
	Before	After		
C3(mg/dl)	169.75 ± 6.88	168.45 ± 7.82	1.21	P >0.05
C4(mg/dl)	35.87 ± 4.23	34.41 ± 5.12	1.11	P >0.05
BMI (kg /m²)	35.56 ± 3.94	35.43 ± 3.98	0.97	P >0.05

BMI= Body Mass index; C3= C3 serum protein of the complement system; C4= C4 serum protein of the complement system.

Table (3): Comparison of measured the measured variables between the group (A) and group (B) before and at the end of the study.

	Mean +SD		t-value	Significance
	Group (A)	Group (B)		
C3(mg/dl)	161.67 ± 6.95*	168.45 ± 7.82	4.36	P <0.05
C4(mg/dl)	33.75 ± 4.36*	34.41 ± 5.12	3.54	P <0.05
BMI (kg /m²)	31.13 ± 3.78*	35.43 ± 3.98	3.77	P <0.05

BMI= Body Mass index; C3= C3 serum protein of the complement system; C4= C4 serum protein of the complement system; (*) indicates a significant difference, P < 0.05.

IV. Discussion

Down syndrome is proved to be associated with insufficiency and poor performance of immune system, so the present study was designed to measure response of selected innate immune system to aerobic exercise training among the obese DS children.

The main results of our the study indicated that aerobic exercise training improved innate immune system parameters (C3 and C4) as consequence of modulation of body composition that was evident by reduction of body mass measured by BMI, and these results were in agreement with many previous researches[28-30]. For example *Woods and colleagues* proved that, three months of continuous exercise training of moderate intensity improved immune system parameters among elderly subjects [28]. In addition, *Pedersen et al.* reported that long term moderate intensity rather than high intensity aerobic exercise improved immune system biomarkers [29]. Moreover, *Wasinski et al.*, stated that weight reducing program included exercise training added to diet regimen led to reduced number of CD4+ T and CD8+ T cells in mice [30]. The possible mechanism of modulation of innate immune system response following reduction of weight could be due to reduced level of inflammatory cytokines and induced by reduction of adipose tissue [31-33].

V. Conclusion

Based on results of present study it may be concluded that Aerobic exercise training improves innate immune system response in DS obese children. So it is recommended to include an aerobic exercise protocol as a routine program in those children as they are immunocompromised due to various reasons, which may help to improve their immune system.

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