COMBINED EFFECT OF DIET THERAPY AND AEROBIC EXERCISE ON CONTROLLING THE SEVERITY OF ATOPIC DERMATITIS IN CHILDREN

Yousef S. Salem[1], Manal Salah Eldien Abdel Wahab[2], Gehan Mosaad Abd El-Maksoud[2], Amal Mohamed Abd El Baky[3], Osama Hussein Abdelsalam[4], Ragaee Saeed Mahmoud[5]

Article History: Received: 20.05.2023 **Revised:** 22.06.2023 **Accepted:** 26.06.2023

Abstract

Background: Atopic eczema or atopic dermatitis (AD) is the most common type of eczema that causes skin to become itchy, dry, and cracked. The onset of AD is frequently seen in infants and young children, often before the first birthday. **Objectives:** To determine the combined effect of diet therapy and aerobic exercise on controlling the severity of AD in children. **Methods:** Sixty children (27 boys and 33 girls) diagnosed with AD participated in this study, aged from 8 to 16 years. The participants recruited in this study randomly assigned, equal numbers in to three groups (A, B and C). Children in the three groups received their ordinary medical treatment prescribed by the dermatologist. Group (A) treated by diet therapy, group (B) treated by diet therapy & aerobic exercise, and group (C) treated by medical treatment only. Before and after 12-weeks of treatment program, the children were examined by the Eczema Area and Severity Index (EASI) for detecting the degree of severity of the eczema and also the Six-Minute Walk Test (6-MWT) was used for detecting their functional capacities. **Results:** There were statistically significant differences of all outcome measures in each group after treatment ($P < 0.05$). Similarly, there were statistically significant differences between the three groups in favor of group (A) ($P < 0.05$). **Conclusion:** Diet therapy proved more beneficial than diet therapy combined with aerobic exercise on controlling the severity of AD in children.

Keywords: Aerobic exercise, Atopic dermatitis, Children, Diet therapy.

[1]*Department of Physical Therapy, Benha Fever Hospital, Qalyubia, Egypt.*
[2]*Department of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Cairo University, Giza, Egypt.*
[3]*Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Giza, Egypt.*
[4]*Department of Dermatology, Faculty of Medicine, Benha University, Egypt.*
[5]*Department of Physical Therapy for Pediatrics, Faculty of Physical Therapy, South Valley University, Qena, Egypt.*
Corresponding Author: Ragaee Saeed Mahmoud, **Email:** ragaeesaeedpt@yahoo.com

1. INTRODUCTION

Atopic dermatitis (AD) is the most widespread chronic skin inflammation in infancy and children growing stages. It's the starting point of the atopic progression and might manifest in a number of different ways. Some children with AD outgrow their symptoms as they become older, while others may develop respiratory allergies including asthma and rhino conjunctivitis **(1).**

The AD is a common presenting symptom in primary care settings, and the therapy for these cases can be stressful for their parents. The therapist's role for these conditions is to help the patient make informed decisions about both conventional and nontraditional treatment options **(2).**

Changing the diet of many children having AD is a common practice, and it has been used effectively in the last few years to address the skin conditions that affect many AD patients. Diet counseling practitioners asked patients to adjust their eating habits as a part of their treatment **(3).**

It was suggested that there was a probable link between severity of the eczema and low vitamin D levels, there was also increasing research on the role of vitamin D in potentially modulating immunological responses in eczema and in preventing atopic disorders by changing the immunological responses **(4).**

Aerobic exercise has already been proven to improve atopic dermatitis which might cause changes on the inflammatory immune responses in the skin, and it was found that regular exercise over a long period seems to bring more immune benefits compared to those of short bouts of high intensity activity **(5,6).**

Fuller, **(7)** reported that aerobic exercises have positive mental health benefits, as it can release endorphins that make the individual feels good, and may help in getting a better night's sleep. It also can be used as a tool to reduce stress and improve mood, which in turn can benefit the skin. Also, **Lim et al. (8)** added the lack of physical activity can have long-term harmful effects on health, but

few studies have examined the exercise habits of teenagers with AD.

Medical treatment can be used regularly for individuals with AD **(9,10),** it can alleviate symptoms, but it may not be enough for children with severe conditions who are resistant to treatment **(11).**

The main goal of this study was to find out the efficacy of diet therapy alone, or when it accompanied by aerobic exercise which is more effective in controlling the severity of AD children.

2. SUBJECTS AND PROCEDURES

2.1. Study design:

This study was a randomized controlled trial that was conducted at the department of physical therapy, Benha Fever Hospital, Qalyubia, Egypt, after the approval of the ethical committee of faculty of Physical Therapy Cairo University (P.T.REC/012/003054) from March 2021 to April 2022.

2.2. Participants:

Sixty children (27 boys and 33 girls) diagnosed with AD, participated in this study. They were selected based on the following inclusion criteria: a) their ages were between 8 and 16 years **(12),** b) they able to stand and walk, c) stable medically and d) mentally able to understand and follow the study's procedures. Children having **(13):** (1) heart problems, (2) lung diseases, (3) musculoskeletal, or any neurological disorders that could affect their ability to complete the exercise test, or (4) children with obvious physical or mental disabilities and communication difficulties were excluded from the study.

Sample size was detected by using the statistical software G*POWER (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany), twenty children for every group were determined to be the minimal viable sample size for this study. Using Alpha=0.05, Beta=0.2, effect size =0.4, & allocation ratio N2/N1 =1.

The selected children were randomly assigned into three groups of equal numbers. The three groups received the same ordinary medical treatment prescribed by the dermatologist. Group (A) consisted of 20 children engaged in diet therapy, group (B) consisted of 20 children underwent diet therapy combined with aerobic exercise, whereas group (C) received medical treatment only. The duration of treatment program was 12 consecutive weeks, three sessions weekly.

Parents or legal guardians were provided with a consent form after the therapist explained the study's aim and procedures in details. The authors received informed consent in writing from the parents of the children who participated in the trial by outlining the study's purpose, anticipated benefits, and protocol. Children were given the devices after trust was established and parents were given assurances that their children's confidentiality would've been protected.

As shown in the flow chart in (Figure 1), eighty children were eligible in this study and 20 children dropped out due to their far residence. The remaining sixty AD children were allocated randomly using the Block Stratified Randomized Software program (windows version 6.0 of randomization program (Rand.exe), block sizes 4, 8, 2, 6, and 10, and in this randomized program, it is difficult to place samples in 3 groups equally with the same numbers when there are multiple stratified variables **[14]**).

2.3. Outcome measures:

2.3.1. Evaluation of Eczema Area and Severity Index (EASI): Evaluation was done using EASI, it is used for evaluation as it combines the size of the affected area and the severity of the lesions to provide a single score. Assessment was done under supervision of the dermatologist and by following the instructions of **(15)** as follows:

a- Detection of area of Involvement: The first step is to physically assess the extent of involvement in four regions of the body: the head & neck, the upper extremities, the trunk, as well as the lower extremities, and to provide a score to each region: 1 (1%–9%), 2 (10%–29%), 3 (30%–49%), 4 (50%–69%), 5 (70%–89%), as well as 6 (90%–100%). The lower extremities consist of the feet and buttocks, whereas the axilla and groin comprise the trunk.

b- Intensity of Lesions: After that, each area was investigated on its own for four signs: redness, swelling/population, excoriation, as well as lichenification. Each sign gets a score somewhere around 0 and 3 for how strong it is. A score of 0; sign is not there, 1; mild, 2; moderate, and 3; severe.

c- Region Score: Each region receives an adult (>8 years old) / pediatric multiplier according to its body surface area (BSA). The region score is determined by multiplying the total of the regional intensity score, regional area score, and region-specific multiplier.

d- Finally, EASI Score was calculated: The overall EASI score, which ranges from 0 to 72, was detected by adding the scores from the four regions. A score of 0; there is no eczema or it is clear, 0.1 to 1.0; nearly clear, 1.1 to 7; mild, 7.1 to 21; moderate, 21.1 to 50; severe, and more than 51; very severe.

2.3.2. Assessment of functional capacity using Six minute walk test (6-MWT): The 6-MWT is a valid and reliable way to measure sub-maximal exercise capacity in healthy children. The test was used to measure the distance covered by the child within 6 minutes following the guidelines of the American Thoracic Society (ATS, as before the exam, the child was informed about the starting and ending points and walked the full track with the examiner. Touch the long tape with the foot, turn around, then walk back; this was the instruction and demonstration given at both ends of the route. The children who took the test knew that its aim was to measure how far they could cover in 6 minutes. To get where they were going, they had to walk like they were in a hurry, but they were not permitted to run, skip, or leap. Children were not given a break during the test, as was recommended in the original ATS guidelines for those with heart or lung illness **(16).**

2.4. Treatment program:

Group (A): treated by diet therapy.

Group (B): treated by diet therapy combined with aerobic exercise. Treadmill aerobic activity was performed for 30 minutes, three times weekly. The treadmill used for the progressively maximal effort test allowed for a variety of alternative regimens. After a three-minute warmup at 5 km/h, the test began at 9 km/h and increased by 1 km/h every 3 minutes **(17).**

The test was conducted with a constant inclination of 1%. Continuous monitoring of heart rate (HR) was performed using a HR monitor. Children were urged orally to continue the test for as long as possible until they reached voluntary tiredness. Counted as accomplished when there are obvious symptoms of intense effort as (hyperpnea, face flushing, and uneven steps) were seen **(18).** There was a 3-minute cooldown at the end of the workout to eliminate any spasms that could have occurred. During the course of the program, each child was outfitted in loose-fitting clothes and shoes.

Group (C): treated by medical treatment under dermatologist instructions.

STATISTICAL ANALYSIS:

Chi-square test was used to detect sex distribution. All of the study's data were presented using means and standard deviations. The unpaired t-test was conducted for the comparison of subject characteristics between groups. The normal distribution of data was checked using Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. The study's variables were compared between groups by unpaired t-test and between pre- and post-treatment in each group by paired t-test. One-way analysis of variance (ANOVA) as well as a least-squares difference (LSD), post hoc test were used to determine whether or not there were significant differences between the three groups. The significance level for each test in this study is set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 22 for windows (IBM SPSS, Chicago, IL, USA).

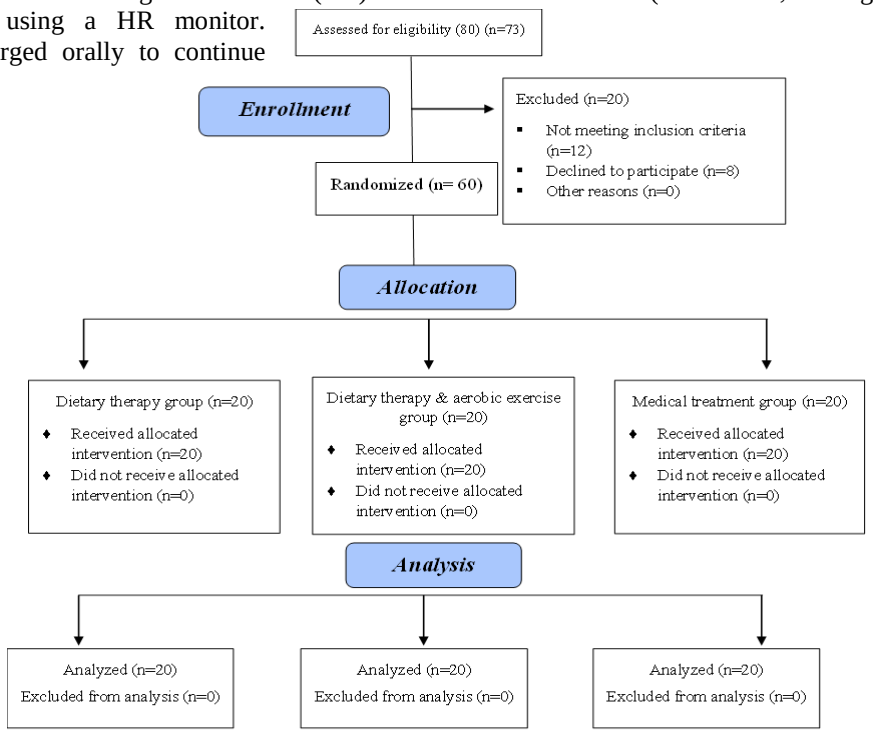

Figure (1): The flow chart of the study.

3. RESULTS

Demographic data:

The mean values regarding age for groups (A, B and C), there was no significant difference between the three groups ($p > 0.05$) **(Table 1).**

Table (1): Comparison of age between the three groups (A, B and C).

	Group (A) $\overline{X}$ ± SD	Group (B) $\overline{X}$ ± SD	Group (C) $\overline{X}$ ± SD	f-value	p-value
Age (years)	11.4 ± 2.46	11.5 ± 2.31	11.1 ± 1.89	0.17	0.841^{NS}

$\overline{x}$: Mean; SD: Standard Deviation; f-value: ANOVA test value; p-value: Probability value; NS: Non- significant.

According to the gender distribution data of boys to girls for groups (A, B and C), there was no significant variation among three groups ($p > 0.05$) **(Table 2).**

Table (2): Comparison the frequency distribution and chi squared test for comparison of gender distribution between the three groups (A, B and C).

	Gender distribution N (%)			X^2	p-value
	Group (A)	Group (B)	Group (C)		
Girls	11 (55%)	10 (50%)	12 (60%)	0.25	0.656^{NS}
Boys	9 (45%)	10 (50%)	8 (40%)		

X^2: Chi squared value; p-value: Probability value; NS: Non- significant.

Non significant differences ($p > 0.05$) were found between groups (A, B & C) on the pre-treatment mean values regarding EASI & 6-MWT, while after treatment there were statistically significant differences in each group and between the three groups of all measured variables ($p < 0.05$) **(Table 3).**

Table (3): Comparison of EASI and 6-MWT for the three groups (A, B and C).

		Group (A) $\overline{X}$ ± SD	Group (B) $\overline{X}$ ± SD	Group (C) $\overline{X}$ ± SD	f-value	p-value
EASI	Pre- treatment	28.96 ± 3.33	29.81 ± 3.06	30.47 ± 2.69	1.24	0.297^{NS}
	Post- treatment	20.29 ± 2.76	23.49 ± 2.68	26.66 ± 2.74	27.26	0.0001^{S}
	t-value	23.57	29.03	24.7	-	-
	p-value	0.0001^{S}	0.0001^{S}	0.0001^{S}	-	-
6-MWT	Pre- treatment	471.45 ± 16.09	464.4 ± 14.37	466.15 ± 14.29	1.21	0.306^{NS}
	Post- treatment	506.93 ± 18.08	495.27 ± 12.85	477.45 ± 14.29	18.99	0.0001^{S}
	t-value	31.56	21.45	22.29	-	-
	p-value	0.0001^{S}	0.0001^{S}	0.0001^{S}	-	-

$\overline{X}$: Mean; SD: Standard Deviation; f-value: ANOVA test value; t-value: Paired t- test value; p-value: Probability value; NS: Non- significant; S: Significant.

As presented in Table (4), when contrasting after treatment mean values regarding EASI & 6-MWT between groups (A & B), (A & C) and (B & C), significant differences were found of all measured variables ($p < 0.05$).

Table (4): Comparison post- treatment of EASI and 6-MWT between groups (A and B), groups (A and C) and groups (B and C).

Items	EASI					
	Group (A)	Group (B)	Group (A)	Group (C)	Group (B)	Group (C)
$\overline{X}$ ± SD	20.29 ± 2.76	23.49 ± 2.68	20.29 ± 2.76	26.66 ± 2.74	23.49 ± 2.68	26.66 ± 2.74
t-value	0.001		0.0001		0.001	
p-value	3.72		7.32		3.7	
Level of significance	S		S		S	
	6-MWT					
	Group (A)	Group (B)	Group (A)	Group (C)	Group (B)	Group (C)
$\overline{X}$ ± SD	506.93 ± 18.08	495.27 ± 12.85	506.93 ± 18.08	477.45 ± 14.29	495.27 ± 12.85	477.45 ± 14.29
t-value	2.35		5.72		4.15	
p-value	0.025		0.0001		0.0001	
Significane	S		S		S	

$\overline{X}$: Mean; SD: Standard Deviation; t-value: Un-paired t- test value; p-value: Probability value; S: significant.

4. DISCUSSION

The literature evaluation indicates that there is inadequate evidence to form definite conclusions regarding the usefulness of nutrition therapy or aerobic exercise in preventing or treating AD in children and to compare the efficacy of these two treatments.

Improvement of children treated by diet therapy only may be explained as the possibility of food allergies as a trigger for moderate-to-severe AD in children suggests that a full allergy workup should be performed. As a strict avoidance diet has been recommended for years for people whose eczema is worse by eating certain foods **(19).**

The improvement in group (A) patients may also be supported by **Caffarelli et al. (20)** who observed in their application of a study involving 15 children, a general diet therapy decreased the AD severity score by at minimum 70% in 60% of the children. All children with high total IgE, a positive radioallergosorbent test (RAST), and a positive skin prick test (SPT) responded positively to dietary therapy, showing that dietary interventions may be useful for people with food hypersensitivities.

Another short trial with only 13 patients found that all of AD children who finished the diet therapy improved, but that four of them went back to their regular diet without relapsing **(21).** The development of AD can be stopped or at least its severity minimized by taking certain dietary supplements. There needs to be more investigation into the processes through which dietary supplementation affects AD **(22).**

According to **Kim et al. (23)** who discovered that aerobic exercise enhances AD symptoms in BALB/c mice via boosting Ig and cytokine expression, there is a very substantial difference between before & post treatment scores for group (B). **Booth and Lees**, **(24)** argue that continuous physical activity declines the risk of a variety of diseases and enhances antioxidant activity and immunological function.

The post-treatment findings of group (B) are in line with those of **Williams et al. (25)** who revealed that training with children with AD may result in a decreased desire for physical activity due to intense exercise-induced itching. According to earlier research, exercise & sweating are substantial aggravating factors for AD in school-aged children. We discovered that after therapy, the children with AD were more likely to have a positive effect toward aerobic exercise, in contrast to the findings of **Custovic et al. (26)** who found that no children with AD had a positive result from applying aerobic exercise. This study's sample size is too small to draw any firm conclusions and the patients chosen for the study.

Improvement in patients of group (C), may be supported by a study result of **Brown et al. (27)** who found that adherence to medication instructions for AD was consistent with earlier published studies, indicating that adjustments to the usage of prescription drugs are widespread.

Significant improvement in patients in group (A) rather than group (B) may be supported by **Lonne-Rahm et al. (28)** who demonstrated that regular physical exercise improves health and reduces the risk of developing certain diseases. As Patients with AD typically report that the itch is made worse by sweating during exercise, which can discourage them from continuing to work out. Researchers have found that school-aged children with AD in Singapore report the most discomfort during training, hot weather, and perspiring **(29).**

The post-treatment findings in groups (B & C) agreed with those of **Cooper et al. (30)** and **Davison et al. (31)** who claimed that the hypothesis that the amount of mitochondrial oxygen intake is proportional to the formation of oxygen free radicals was the basis for the long-held belief that exercise is linked to oxidative stress and that oxidative stress markers are elevated during high-intensity exercise.

Dell et al. (32) confirmed that antihistamines can be a valuable aspect of multimodal therapy for canine atopic dermatitis by comparing the post-treatment results of groups (A & C). Also, a large percentage of the dogs showed improvement after following a healthier diet, as evidenced by the findings. The only treatment shown to result in complete clinical resolution of atopic dermatitis was allergen-specific immunotherapy.

The results of our study are consistent with the results reported by **Durovic et al. (33)** who found that sweating and a rise in skin temperature during exercise can make AD symptoms worse, decreasing the motivation and volume of exercise among these patients.

LIMITATIONS:

This study has a few limitations. First, it had a small sample size, which might limit the generalization of the results. Second, the effect of interventions was measured immediately after 12 weeks of intervention. Therefore, the outcomes of this study did not indicate the sustainability of the improvements after treatment.

STRENGTH:

The current study's use of an objective, valid, and trustworthy measurement tool could be seen as a point of strength in our attempt to determine the combined effect of diet therapy and aerobic exercise on controlling the severity of AD in children which previously did not report.

WEAKNESS:

No study comparing the combined effect of diet therapy and aerobic exercise on controlling the severity of AD in children could be viewed as a weak point.

CONCLUSION:

Children with AD benefit greatly from incorporating diet treatment and aerobic exercise into a structured physical therapy program. One possible argument for promoting food therapy over a combination of diet and aerobic exercise is that it has been shown to be more successful in reducing the severity of AD in children.

ACKNOWLEDGMENTS:

A special thank note goes to the study's participants and to the department of physical therapy, Benha Fever Hospital, for providing the chance to conduct the study procedures easily.

DISCLOSURE STATEMENT:

No financial funding has been provided for the current research work.

CONFLICTS OF INTEREST:

No conflict of interest has been declared by the authors of this academic work.

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