

Open Access Maced J Med Sci electronic publication ahead of print,  
published on June 30, 2019 as <https://doi.org/10.3889/oamjms.2019.477>

ID Design Press, Skopje, Republic of Macedonia  
Open Access Macedonian Journal of Medical Sciences.  
<https://doi.org/10.3889/oamjms.2019.477>  
eISSN: 1857-9655  
*Clinical Science*



# Assessment of Allergic Rhinitis among Children after Low-Level Laser Therapy

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## Abstract

**Citation:** Moustafa Y, El Nady HG, Saber MM, Dabbous OA, Kamel TB, G. Abel-Wahhab KG, Sallam SF, Zaki DA. Assessment of Allergic Rhinitis among Children after Low-Level Laser Therapy. Open Access Maced J Med Sci. <https://doi.org/10.3889/oamjms.2019.477>

**Keywords:** Allergic rhinitis (AR); C-reactive protein (CRP); National Institute of Laser Enhanced Sciences (NILES); 5-point scale (FPS); High-sensitivity-C-reactive protein (hs-CRP)

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**Received:** 11-Mar-2019; **Revised:** 22-May-2019; **Accepted:** 23-May-2019; **Online first:** 30-Jun-2019

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**Funding:** This research did not receive any financial support

**Competing Interests:** The authors have declared that no competing interests exist

**BACKGROUND:** Allergic rhinitis (AR) represents one of the most common global health problems with seriously increasing incidence over the last decades. The goal of the treatment of rhinitis is to prevent or reduce the symptoms caused by the inflammation of affected tissues. Intranasal steroids and oral antihistamines are recommended as first lines of treatment. Acupuncture had reported a significant improvement in daily symptoms and an increase of symptom-free days in many studies enrolling adults' patients.

**AIM:** This study aimed to evaluate the laser acupuncture effect on the treatment of children AR in comparison to the effect of the medication and to assess the anti-inflammatory effect of laser acupuncture through measurement of serum inflammatory marker (hs-CRP).

**METHODS:** Sixty patients with allergic rhinitis their age group ranged from 4 to 18 years were divided randomly into two groups. Group 1 enrolled 30 patient that received AR in the form of intranasal steroids, antihistaminic, leukotriene antagonists while group2 thirty patients received 12 laser acupuncture sessions (2 sessions a \ week) on specific traditional Chinese acupuncture points.

**RESULTS:** There was a significant improvement in the severity score symptoms in both groups through and by the end of the study. High Significant improvement in the levels of the inflammatory marker in both groups, especially in the group which receive laser acupuncture sessions.

**CONCLUSION:** Laser acupuncture is a reliable, painless and non-invasive successful technique, which may be used as a complementary treatment for pediatric allergic rhinitis.

## Introduction

Childhood Allergic Rhinitis (AR) is a very common allergic condition which may pass undiagnosed or untreated [1]. It is the most frequent allergic disease in Western Europe that interferes with school attendance and performance, with a prevalence rate of 20-30% [2]. Very few studies of the epidemiology were done about the prevalence of allergic rhinitis in Egypt. In the Middle East, Egypt, the AR prevalence was 9 % [3], [4]. The management plan of AR is quite the same in both adult and children

[5] including allergen avoidance, Pharmacotherapy, acupuncture, soft laser phototherapy and immune-therapy [6]. Oral H1 antihistamines and intranasal corticosteroids are the two major pharmacological agents used in the management of allergic rhinitis as monotherapy or in combination, depending on the predominant symptoms and the patient's response to therapy [7]. AR may also be associated with co-existing conditions as bronchial asthma, sinusitis, upper respiratory tract infection, otitis media with effusion and nasal polyposis, which will require further medications.

C-reactive protein (CRP) is an acute phase

reactant; it is produced by the liver and considers a highly conserved plasma protein which participates in the systemic response to inflammation. Its plasma concentration increases during inflammatory states and is a highly sensitive marker of inflammation, infection and tissue damage, which contributes to host defence against infection by activating the complement pathways [8]. High-sensitivity-C-reactive protein (hs-CRP) is a well-known systemic inflammatory marker that is easy and inexpensive to measure, together with ESR, serum Ig-E and total eosinophil count that measured as laboratory markers in the studied groups. According to the World Health Organization "WHO" reports, acupuncture was ranked among the efficient methods for the treatment of allergic rhinitis and other allergic conditions as bronchial asthma [9], [10]. Acupuncture has an immune-modulator therapeutic technique; and examined for its effect on both cellular and humoral components of the immune system [11], [12]. It can stimulate the release of  $\beta$  endorphin, which, coupled to the release of adrenocorticotrophic hormone (ACTH) that acts on the adrenal cortex to stimulate the release of cortisol, which is responsible for its anti-inflammatory effect [13]. Acupuncture involves the stimulation of specific points located along the lines of meridians corresponding to the flow of energy through the body [14]. Traditionally, these acupoints were stimulated using fine needles. Modern acupuncture has evolved to include the application of pressure, the use of electric current or the use of a low-intensity laser to stimulate these points [15]. Acupuncture has been reported to be beneficial in several clinical studies on allergic rhinitis, which reported a significant improvement in daily symptoms and an increase of symptoms-free days [16], [17].

So this study aimed to compare the effect of Low-Level Laser Therapy (LLLT) versus the effect of medications on symptoms of allergic rhinitis through a sample of Egyptian children.

## Patients and Methods

A prospective comparative study enrolling 60 children diagnosed as allergic rhinitis patients according to ARIA score [18], were recruited from the outpatient laser acupuncture clinic at Centre of Excellency at the National Research Centre and laser clinic at the National Institute of Laser Enhanced Sciences (NILES) of Cairo University.

Children were divided into 2 groups; Group 1 was subjected to laser acupuncture therapy (LLLT) while Group 2 enrolling 30 children randomly assigned to the different medical treatments in the form of oral antihistaminic, nasal decongestant, intranasal corticosteroids (ICS) and leukotriene antagonist. Children with chronic inflammatory diseases,

congenital malformations of the nasal cavity, acute infection, children receiving antibiotic therapy in the last month and parent refusal to join the study, all were excluded from this study.

After the approval of this study from the Ethical Committee of NILES and NRC, informed written consent was obtained from parents of all enrolled children after explaining the objectives of the current study and the possible side effects of the low-level laser therapy. A full Medical history was taken with special stress on the severity of symptoms and medications received in the last attack.

Symptoms were recorded on a 5-point scale (FPS) [19]. These five points are a 1-Nasal mucosal condition by anterior rhinoscopy. 2-Nasal obstruction 3-Nasal secretion 4-sneezing attacks 5-subjective estimation of therapeutic effect. Scoring system for the anterior rhinoscopy was recorded by the physician according to mucosal reddening and swelling of the inferior turbinate as score: 0 = normal, 1 = slightly changed and slight turbinate hypertrophy, 2 = moderately changed that partially obscuring the middle turbinate, 3 = severely changed and hypertrophy that completely obscures the middle turbinate while 4 = most severely changed. Subjective Symptom Scores (complaints) were determined retrospectively from the patients as follows, (nasal obstruction) congestion and (nasal secretion) rhinorrhea were evaluated using the following scale: 0 = free of symptoms, 1 = slight but noticeable symptoms, not interfering with daily activities, 2 = moderate symptoms, hardly interfering with daily activities and sleep, 3 = severe symptoms, clearly interfering with daily activities and sleep, and 4 = most severe symptoms, substantially interfering with daily activities and sleep. Then sneezing attacks were classified into three categories: 0 = no sneezing attacks, 1 = rare sneezing attacks, (1-2 sneezing attacks per day), and 2 = frequent sneezing attacks with more than three attacks per day. Finally, Subjective Estimation of the Therapeutic Effect was recorded as 1 = improved and 2 = unchanged or worsened.

Low-level laser acupuncture sessions were used among group 1 children as follows: The laser applied was diode laser Model "Medical-Italia LIS 1050" (made in Italy) which emits laser at 904 nm wavelength and output power of 100 mw. Each acupuncture point of rhinitis was stimulated for 12 sessions (2 sessions weekly) with calculated energy according to the World Association of Laser Therapy. Both patients and doctor used protective goggles. Technical parameters applied are shown in Table 1.

**Table 1: Technical parameters of laser applied**

Irradiation parameter	Unit of measurement
Energy	6J
Power	100 mw
Beam spot size	1 cm <sup>2</sup>
Irradiation time	1 min. per point
Treatment interval	2 sessions per week

Nasal mucosal condition by anterior rhinoscopy was done by the otolaryngologist, and its score was sent to the paediatrician who recorded the other subjective points of the 5-point scale (FPS) to avoid any bias. Any child that miss 2 successive laser sessions was excluded from the study and replaced by another until we reached the target number aimed in this study.

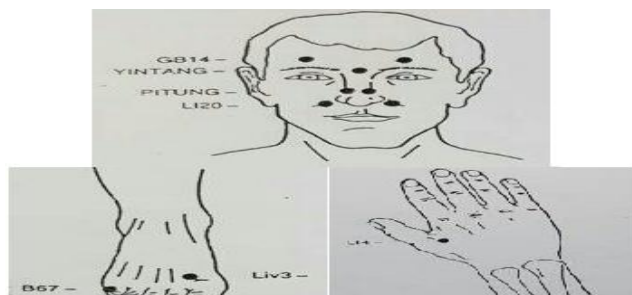


Figure 1: Acupuncture stimulated points [6], [21]

To allow standardisation and comparability, all patients were acupunctured at the same points which were chosen by the rules of TCM. Laser acupuncture was inserted bilaterally at the following points: LI 4, LI 20 (on the large intestine meridian), GB14, GB 20 on the gall bladder meridian, YIN TANG (at the root of the nose midway between the inner ends of the eyebrow), PITUNG (at the top of the groove above the, nostril), liv3, B67 and EX-HN5) [20], [21]. Reassessment of these patients was done by the end of 12<sup>th</sup> Low-Level Laser acupuncture session.

Group 2, patients diagnosed as allergic rhinitis and receiving medication were examined as a control group. Medication used was in the form of oral antihistaminic (once daily), intranasal steroids (twice daily), leukotriene antagonist (once daily at night). Both groups gave two blood samples for laboratory investigations that included: ESR, Eosinophil count, Ig-E and hs-CRP.

### Statistical Methods

Data were analysed using Med Calc© version 18.2.1 (Med Calc© Software, Ostend, Belgium). Normally distributed numerical variables were presented as mean  $\pm$  SD and inter-group differences were compared using the unpaired t-test. Nominal variables were presented as number and percentage and differences were compared using the Pearson chi-squared test or Fisher's exact test. Ordinal data were compared using the chi-squared test for trend. Two-sided p-value < 0.05 was considered statistically significant.

## Results

A total of 36 male and 24 female children diagnosed as allergic rhinitis patient were enrolled in this study. Children were grouped according to management regimen into laser acupuncture therapy (group 1) children and Medication therapy (group 2) children, characteristics of each group are shown in Table 2. There were no significant differences between the study groups concerning sex ratio, type of AR, bronchial asthma association or family history of AR.

Table 2: Characteristics of patients in both study groups

Variable	Laser acupuncture therapy (n = 30)	Medication therapy (n = 30)	t(58)/ $\chi^2$ (1)	p-value*
Age in years (mean $\pm$ SD)	8.2 $\pm$ 3.3	10.2 $\pm$ 3.9	-2.183	0.033#
Gender				
Male	18 (60.0%)	18 (60.0%)	0.000	1.000
Female	12 (40.0%)	12 (40.0%)		
Type of AR				
Seasonal	18 (60%)	9(30%)	0.659	0.417#
Perennial	12(40%)			
Associated asthma				
AR only	14 (46.7%)	15 (50.0%)	0.067	0.796
AR + BA	16 (53.3%)	15 (50.0%)		
Family history of AR				
Negative	9 (30.0%)	13 (43.3%)	1.148	0.284
Positive	21 (70.0%)	17 (56.7%)		

Data are mean  $\pm$  SD or number (%); \*Pearson chi-squared test unless otherwise specified; #Unpaired t-test.

As present in Table 3 at the end of laser acupuncture sessions, 20% of group 1 cases become symptom-free of nasal rhinorrhea and secretion; meanwhile, 60% of them reported no sneezing attacks. On the other hand, no more severe nasal rhinorrhea and secretion was found in this group, and only 2 cases stated sneezing attacks after completing the sessions.

Table 3: Clinical scores of studied groups before and after treatment

	Group1=Laser acupuncture therapy (n = 30)		Group2=Medication therapy (n = 30)		$\chi^2$	p-value
	Before laser acupuncture	After laser acupuncture	Before treatment	After treatment		
Rhinorrhea	0 (0)	6 (20%)	1 (3.3%)	5 (16.7)	0.734*	0.392*
Free	6 (20)	12 (40%)	9 (30%)	7 (23.3)		
Slight	8 (26.7)	8 (26.7%)	6 (20%)	9 (30)		
Moderate	12 (40)	4 (13.3%)	10 (33.3%)	8 (26.7)	2.486**	0.115**
Severe	4 (13.3)	0 (0%)	4(13.3%)	1 (3.3)		
Most severe						
Sneezing						
NO	7 (23.3%)	18 (60%)	4 (13.3%)	11 (36.7%)	0.153*	0.696*
Rare = (1-2 attack/day)	13 (43.3%)	10 (33.3%)	21 (70.0%)	17 (56.7%)		
Frequent = > 3 attacks/day	10 (33.3%)	2 (6.7%)	5 (16.7%)	2 (6.7%)	2.134**	0.144**

\*comparing 2 studied groups before treatment; \*\* Comparing 2 studied groups after treatment.

According to the level of hs-CRP, there were non-significant differences between the studied groups at the beginning of the study while after treatment a considerable statistically significant decrease occurs in laser group hs -CRP level than

group 2  $p < 0.0001$  (Table 4).

**Table 4: Comparison of the rhinorrhea-congestion score in laser received group before and after laser acupuncture therapy**

Rhinorrhea-congestion score after laser acupuncture						
Rhinorrhea-congestion score before laser acupuncture	Slight to moderate	Severe to most severe	Total	Difference	95% CI	Significance
Slight to moderate	14	0	14 (46.7%)	-40.00%	-57.53 to -22.47	P = 0.0005
Severe and most severe	12	4	16 (53.3%)			
<b>Total</b>	<b>26 (86.70%)</b>	<b>4 (13.30%)</b>	<b>30</b>			

McNemar test.

As regards the levels of laboratory markers after treatment in both studied groups, there were highly statistically significant differences in the level of hs CRP ( $p < 0.05$ ) between 2 groups, but there was no statistically significant difference in other laboratory parameters as shown in Table 6.

**Table 5: Comparison of the sneezing score in laser received group before and after laser acupuncture therapy**

Sneezing score after laser therapy						
Sneezing score before laser therapy	No/Rare attacks	Frequent attacks	Total	Difference	95% CI	Significance
No/Rare attacks	20	0	20 (66.7%)	-26.67%	-42.49 to -10.84	P = 0.0078
Frequent attacks	8	2	10 (33.3%)			
<b>Total</b>	<b>28 (93.30%)</b>	<b>2 (6.70%)</b>	<b>30</b>			

McNemar test.

Table 7 absolute decrease in laser group before and after the sessions, a statistically significant difference after laser acupuncture therapy in the objective scores including ESR level, Ig E, eosinophil count and the level of hs – CRP as regards the absolute decrease in their levels among children receiving laser acupuncture.

**Table 6: Laboratory assays in both studied group**

	Group1 Mean ± SD		Group2 Mean ± SD		Difference	95% CI	P-value
	Before laser acupuncture	After laser acupuncture	Before treatment	After treatment			
ESR (mm/h)	12.8 ± 8.2	7.0 ± 6.7	7.2 ± 4.4	5.0 ± 2.6	-5.6*	-9.0 to -2.2*	0.002*
IgE (IU/ml)	135.2 ± 209.9	93.9 ± 157.2	83.1 ± 93.6	72.8 ± 85.2	-52.1*	-136.1 to 31.9*	0.145**
Eosinophil count (%)	4.5 ± 2.4	2.5 ± 1.5	3.7 ± 2.3	3.1 ± 2.2	-21.1**	-86.5 to 44.3**	0.521**
hsCRP (ng/ml)	598.4 ± 349	292.5 ± 231.4	609.8 ± 263.9	580.1 ± 262.1	-0.7*	-1.9 to 0.5*	0.229*
					0.6	-0.3 to 1.6**	0.196**
					11.4	-148.6 to 171.4*	0.887*
					287.7	159.9 to 415.4**	< 0.0001**

\*Before sessions or treatment; \*\*After sessions or treatment.

## Discussion

The International Study of Asthma and Allergies in Childhood (ISAAC) phase three studies (1999 – 2004) revealed an average prevalence of rhinitis of 8.5% (range 1.8 – 20.4%) in 6 to 7-year-old children and 14.6% (1.4 – 33.3%) for 13 to 14 years old children [22].

**Table 7: Absolute decrease in the levels of markers of inflammation after treatment in laser received groups**

Variable	Before laser acupuncture		After laser acupuncture		Z	p-value*
	Median	IQR	Median	IQR		
ESR (mm/h)	11	7-15	7	3-8	-4.629	< 0.001
IgE (IU/ml)	44.4	10.0-208.0	28.4	5.4-180.0	-4.361	< 0.001
Eosinophil count (%)	4.2	2.1-6.3	2.1	1.3-3.0	-4.753	< 0.001
hsCRP (ng/ml)	626	298-915	228	115-472	-3.775	< 0.001

Data are median and interquartile range (IQR); IQR = interquartile range; Z = Z statistic; \*Wilcoxon signed ranks test.

Untreated, AR can predispose to adverse consequences as rhino-sinusitis, otitis media up to secondary hearing impairment, which in turn may affect sleep, cognitive and school performance of young children. Achieving adequate symptom control is pivotal to successful AR management. Numerous management options exist for AR; Laser acupuncture provides new non-invasive treatment options in children [23] excluding infection risk caused by needle prick injuries [24].

Asthma frequently co-exists with AR being seen in half to three quarters of children and teenagers with asthma in a range of studies [25]. Allergic rhinitis, but not non-allergic rhinitis, in early childhood, is a risk factor for developing asthma in later childhood and adulthood [26], [27].

Lasmar et al., a study which included 126 asthmatic children and adolescents showed that the prevalence of AR was high in combination with asthma severity, constituted the major risk factor for emergency care attendance [28]. Also, Burgess et al. proved that the occurrence rate of asthma in hyper-responsiveness rhinitis children patients is 2 to 7 times higher than that of common people [29].

In this study 65% of cases were diagnosed as seasonal allergic rhinitis with no significant difference in the type classification between the studied groups, this finding differs from most epidemiologic data that found the prevalence of seasonal AR widely ranges from 1 to 40% [30]. Our study is similar to the study of Crown et al., in which Seventy-nine per cent of the total study sample (80,534 allergy patients) was classified as SAR and 21% as PAR [31].

As regards to AR symptoms, nasal secretion (rhinorrhea) and sneezing attacks were the most frequent complaint in the enrolled children. After the laser acupuncture sessions, 20% of children recorded rhinorrhea free period while 40% mentioned slight attacks of rhinorrhea. This improvement although not significantly differ from group 2 (children using traditional medication), it goes with high quality randomised, sham-controlled trials by Xue et al., which used a total of 16 acupuncture sessions, twice a week for 8 weeks and observed greater decrease rhinorrhea with acupuncture [32]. In the same aspect sneezing attacks disappeared in 60% of children and become rare in about 33% of this group (laser acupuncture – group 1) by the end of their sessions, this is similar to what Zhang et al., mentioned about small but statistically significant improvement in sneezing and quality of life in the acupuncture group

after eight weeks therapy, performed in a multicentre randomized controlled trial in which subjects of this group were treated weekly for 5 to 10 in a clinic and perform three times daily therapy at home using a pacifier, for a 10 seconds session [33]. Allergic rhinitis in early childhood is mainly an Ig E-mediated reaction to various allergens in the nasal mucosa while sensitisation to indoor allergens in children less than 2 years old or outdoor allergens in children older than 4-6 years. In this study, as regards the laser acupuncture group, there was a significant decrease in the serum Ig-E level" after the 12 laser acupuncture sessions" ( $p < 0.001$ ). Low-level laser acupuncture involves the application of photic energy to acupuncture points with the objective of augmentation of the normal healing process and pain relief. The usual wavelengths of lasers, which most commonly used in acupuncture are those that penetrate most deeply due to low absorption in the principal constituent in soft tissues and water [34].

Low-level laser photic energy shortens the inflammatory phase, accelerating the repair process, and remodelling after tissue injury [35]. A study found that there are photoreceptors at the molecular level that, when triggered; activate several biological reactions such as DNA/RNA synthesis, increased cAMP levels, protein and collagen synthesis, and cellular proliferation. The result is rapid regeneration, normalisation, and healing of damaged cellular tissue. Thus, light is a trigger for the rearrangement of cellular metabolism [36].

In this study, thirty patients (group 1) were acupunctured at the same points which were chosen in accordance to the rules of traditional Chinese medicine (TCM) twelve sessions of Laser acupuncture was performed 2 sessions per week according to a meta-analysis that expressed as acupuncture was safe and valid for the treatment of allergic rhinitis<sup>37</sup>.

Our study goes on accordance to Jung et al. study which suggests an anti-allergic effect as the underlying mechanism of acupuncture in treating allergic rhinitis, based on reducing the expression of substance P, STAT6, NFkB, and iNOS from studying mice models [38]. More studies were advised in this aspect, in both animal and human models [39]. In a double-blind, randomised study, it was found that there was 70% improvement of clinical symptoms of allergic rhinitis after intranasal illumination by low-energy narrow-band phototherapy at 660 nm 3 times a day for 14 consecutive days [40], [41]. High sensitive CRP (Hs CRP) can be used to assess the grade of inflammation in allergic patients, as inflammation is one of the major characteristics of respiratory allergic diseases [42]. In this study, hs-CRP decreased in both groups after treatment, but the laser group children showed lower hs-CRP levels compared by group 2 medication group children. In the same aspect laser group children showed a statistically significant decrease in their serum hs-CRP levels after the laser acupuncture sessions. Other

study results demonstrated that children with respiratory allergic diseases had greater concentrations of hs-CRP in serum as compared with healthy children [8].

In conclusion, the application of laser acupuncture may be used as an alternative treatment for pediatric allergic rhinitis. Further studies should be done with a bigger sample size to confirm the effectiveness of laser acupuncture as an alternative treatment in childhood allergic rhinitis, especially in compliant patient to conventional medical therapy.

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