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Role of Diet in Management of Asthma in Children between age 5 to 12 Years

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ABSTRACT

Background: A high proportion of dietary non-vegetarian items and a low proportion of vegetables, fruits, legumes and grains have been associated with increased incidence of childhood asthma. Sub-optimal intake of antioxidant vitamins, mainly the vitamins A, C, and E and carotenoids in the diet, along with other antioxidants like selenium and flavonoids might have an adverse effects on the lung. High intake of these anti-oxidants is known to have beneficial association with asthma, wheezing symptoms and ventilation function of children.

Methods: The study included 60 children between 5 years and 12 years clinically diagnosed with asthma. All patients received standard asthma pharmacotherapy and were also advised diet rich in anti-oxidants and anti-inflammatory properties. These patients were assessed for their asthma control by Childhood Asthma Control Test(C-ACT) and by pulmonary function tests at the beginning of the study and also at the end of 12 weeks.

Result: C-ACT scores and PFT values (FEV_1, FVC and FEV_1/FVC) showed an increase after the special diet. However, the mean difference between C-ACT scores before and after the special diet was not statistically significant. Mean difference between FEV_1, FVC and FEV_1/FVC before and after the special diet were also not statistically significant.

Conclusion: The study concluded that there was no association between dietary pattern and control of asthma as per C-ACT scores and PFT values.

Keywords – Diet, anti-oxidants, anti-inflammatory, asthma, children

INTRODUCTION

Asthma is a common chronic disorder that involves the airways, which become inflamed and narrow, leading to the periods of obstruction of the airflow. The prevalence of asthma has been gradually increasing since 1980s. In 1980, the prevalence of asthma among children has been reported to be 3.5%.[1] The figure increased to 9.5% among 0-17 years old in a span of 44 years.[1,2]

When exposed to allergens, it leads to the recurrence of attacks of breathlessness, hyperreactivity of airway, wheezing, and coughing. During early phase and in mild allergic asthma, the supplementation of diet with long-chain polyunsaturated fatty acids (LCPUFA), mainly the fish oil-associated eicosapentaenoic (C20:5 ω-3) and docosahexaenoic acid (C22:6 ω-3), and apparently crop oil-derived fatty acids might help in providing a reliable treatment modality. [3]

Sub-optimal intake of antioxidant vitamins, mainly the vitamins A, C, and E and carotenoids in the diet, along with other antioxidants like selenium and flavonoids might have an adverse effects on the lung. High intake of these anti-oxidants is known to have beneficial association with asthma, wheezing symptoms and ventilation function of children. [4-6]

The present research has demonstrated that trends in nutrition during the early childhood years might have an impact on the human health at a later age especially on the respiration, gastrointestinal and immune systems. [7-9] Changes in dietary habits mainly the decreased intake of fresh fruit and vegetables and a higher intake of processed foods have previously been linked to an increasing prevalence of asthma. [10-12]

There is very little data available regarding the role of diet in the management of asthma among children. This study was done to determine the role of diet for the management of asthma in children aged 5-12 years.

MATERIALS AND METHODS

The study was a prospective cross sectional study conducted in a tertiary care hospital in North India from January 2020 to June 2021. The study included 60 children between 5 years and 12 years clinically diagnosed with asthma presenting to both out-patient department as well as those admitted to in-patient wards.

The exclusion criteria was patients with congenital lung disease, wheeze associated with irritation from scents and perfume, congestive heart failure, severe allergic reaction to insect bite or medication, emphysema, wheeze associated with foreign body inhalation, cystic fibrosis and viral associated wheeze.

After taking consent from the parents, the patients were enrolled in the study. All patients received standard asthma pharmacotherapy and correction of any nutritional deficiency as result of asthma. Besides, they were also advised diet rich in anti-oxidants and anti-inflammatory properties e.g.: omega 3 fatty acid, protein, vitamin C and items like (pumpkin seed, sunflower seed, flax seeds etc.). A detailed diet chart for each individual patient (Annexure 1) incorporating these food items was formulated with the help of dietician. Diet chart maintenance and strict daily monitoring was advised to the patient's parents. Allergy to any of the prescribed dietary products was thoroughly enquired.

These patients were assessed for their asthma control by Childhood Asthma Control Test(C-ACT) [13] and by pulmonary function tests at the beginning of the study and also at the end of 12 weeks. National Institutes of Health (NIH) Asthma Outcomes Workshop (2010) recommended the C-ACT as a measure of asthma control children for children 4–11 years of age. [14] It is a seven-item questionnaire which is designed and validated for children from 4–11 years of age. [15] The C-ACT is divided into two parts. The first part of questionnaire is filled by the child. It has 4 questions with four possible answers to each question These questions deal with perception of the child of coughing, nocturnal awakenings, limitations of activities and

asthma control. The answer score varies from 0 to 3. The second part is filled by the parent or caregiver. This consists of three questions on awakenings at night, daytime wheezing and daytime complaints. The answer score varies between 0 and 5. The C-ACT score is the sum of all scores of both part 1 and part 2 questionnaire. It ranges from a minimum score of 0 (very poorly controlled asthma) to 27 (well controlled asthma). A cut-off of ≤19 indicates poorly controlled asthma. [15]

Pulmonary Function Test was measured by spirometry. The spirometer used was EasyOne Pro with their patented TrueFlow technology. [16] Data obtained from spirometry included the forced expiratory volume in one second (FEV_1),forced vital capacity (FVC), and the ratio FEV_1/FVC.

Statistical Analysis

The data was entered into the Microsoft Excel Version 2017 (Microsoft Corporation, New York, USA). The statistical analysis was performed by Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Normality of each variable was assessed by using the Kolmogorov-Smirnov test. Quantitative data was expressed by mean and standard deviation or median with interquartile range. Difference between the two groups was tested by Student T test or Mann Whitney U test. Qualitative data was expressed in percentage and difference between the proportions was tested by Chi square test or Fisher's exact test. A 'p' value of less than or equal to 0.05 was considered statistically significant.

RESULTS

The study included 60 children between 5 years and 12 years clinically diagnosed with asthma, out of which 35(58.33%) were males and 25(41.67%). Socio-demographic variables of the study population is as shown in **Table 1.** The C-ACT scores and PFT values after the special diet prescribed is as shown in **Table 2 and Figure 1.** There was no significant difference in the C-ACT scores and PFT values (p-value >0.05).

Table 1: Socio-demographic variables of study population

Variables		**Number (n)**	**Percentage (%)**
Gender	Male	35	58.33
	Female	25	41.67
Place of residence	Urban	42	70.00
	Rural	18	30.00
Family History of asthma/atopy	Yes	38	63.33
	No	22	36.67
Exclusive breastfeeding in first 6 months	Yes	11	18.33
	No	49	81.67
Season with maximum symptoms	Winter	14	23.33
	Spring	26	43.34
	Summer	08	13.33
	Rainy Season	12	20.00
Excessive intake of processed/junk food	Yes	36	60.00
	No	24	40.00

TABLE 2: C-ACT Scores and PFT values after 12 weeks of special diet

	Minimum	Maximum	Mean	Std. Deviation	P value
Age	5	12	9.00	2.611	
C-ACT scores	12	19	16.28	1.996	0.159
	11	21	18.48	2.537	
FEV_1	38	62	53.52	7.325	0.068
	58	77	71.86	5.234	
FVC	58	76	54.36	5.422	0.235
	38	62	72.72	6.485	
FEV_1/FVC	65	81	73.30	4.845	0.068
	60	86	73.88	4.169	

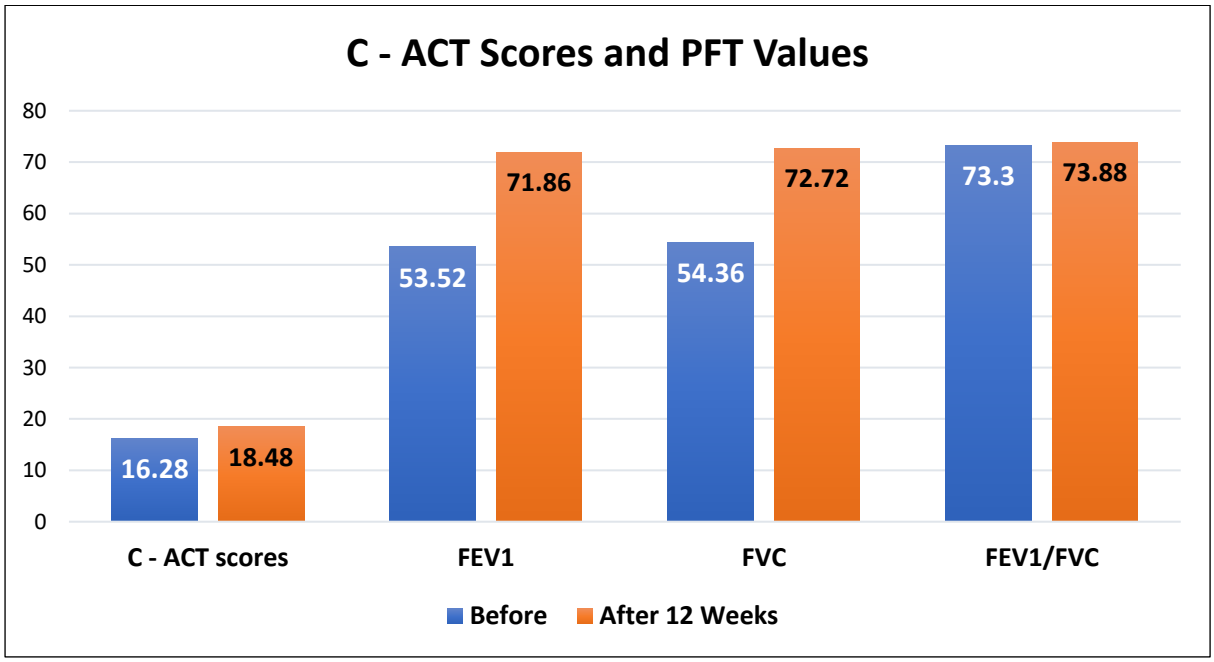

Figure 1: C-ACT Scores and PFT values before and after 12 weeks of special diet

DISCUSSION

Role of diet in management of childhood asthma is a recent hypothesis much talked about. The food items focussed upon are fruits, vegetables, long-chain polyunsaturated fatty acids and the antioxidants. Epidemiological studies in children show that intake of fruits, vegetables, dairy and whole grain products have shown inverse associations with control of asthma. Biltagi et al[17] in their observational study stated that Vitamin C which is an antioxidant free-radical scavenger present in intracellular and extracellular lung fluids and is positively related to lung functions. Tabak et al[18] stated that changed food habits in western societies may have a protective effect against asthma in children and could have led to the decreased prevalence of asthma in these countries. Their study suggested that a high intake of whole grain products and fish can lead to better outcomes in asthma in children and also play a protective role.

Valerie Julia et al [19] stated that medium-chain fatty acids (MCFAs) are saturated fatty acids that are found in oils, such as coconut oil. They found that MCFAs led to stimulating gut epithelial cells to produce more thymic stromal lymphopoietins like IL-25 and IL-33. These cytokines were shown to increase allergic sensitization and anaphylactic responses by promoting Th2 cell responses in the spleen. Studies indicate that diet supplementation with omega-3 PUFAs which are generally considered to be anti-inflammatory and omega-6 fatty acids pro-inflammatory might have beneficial effects in patients with allergic asthma. [20]

Intake of vegetables and fruits has been researched for their potential benefits in improving respiratory conditions like asthma because they comprise of positive nutrients like phytochemicals, antioxidants, dietary fibre, minerals and vitamins. Saadeh et al [21] also found in their study that intake of fresh fruits and cooked green vegetables also was associated with low prevalence of asthma and wheezing.

In the present study the mean age of the patients was 9.00±2.611 years. Biltagi et al[17] conducted a study to depict that nutritional intervention is an important tool to decrease the severity of bronchial asthma in children in which the mean age of study population was 8.37 ± 1.0004

years. In our study a total of 60 patients were enrolled of 5-12 years of age consisting of 25 females (41.66%) and 35 males (58,34%). In one study it was observed that the sex affects the development of asthma in a time-dependent manner. Before the age of 12, boys have more severe asthma than girls, with higher rates of hospital admission. [22]

Braithwaite et al. suggested that consumption of fast food may lead to increased incidence of various allergic diseases and also asthma. They explained that fast food/ processed food contains higher concentrations of trans fatty acids, saturated fatty acids, sugar, sodium, carbohydrates, and also preservatives which all may lead to immunomodulation reactions.[23]

Wang et al also found that reduced intake of fruits and vegetables will lead to negative impact on prevalence of asthma and its management. They concluded that this effect is due to the anti-inflammatory and antioxidative properties of fruits and vegetables. They found that increased intake of processed foods led to decreased intake of fruits and vegetables which are rich in protective nutrients.[24]

In our study, mean difference between the C - ACT scores before and after 12 weeks of advised diet was statistically not significant as p value was greater than 0.05. However, Biltagi et al [17] in their study concluded the beneficial effects of diet supplementation with omega-3 polyunsaturated fatty acids, vitamin C and Zn as mono supplements as well as all of the three given together. They found that there was significant improvement in the score in the treatment groups. In a study conducted by Moreira et al, there were no significant differences in FEV_1 values or Asthma Control Questionnaire (ACQ) scores in patients those who received n-3 PUFA supplementation or those who received placebo.[25]

In our study, it was found that the mean difference between the FEV_1 and FCV values before and after 12 weeks of advised diet, was not statistically significant as the p value was greater than 0.05. However, Tabak et al [18] in their study observed an inverse association of the intake of whole grain products with current wheeze and current asthma in children. Kan et al. observed

in their study that participants in the highest quintile of total fibre intake (median intake of 25 g/d) had higher FEV1, FVC, 0.4 percent higher FEV1/FVC ratio, 1.8 percent higher predicted FEV1 and 1.4 percent higher predicted FVC than those in the lowest quintile of fibre intake (median intake of 10.2 g/d). [26] Hence there was a statistically significant dose-response relation between lung function (FEV_1, FVC, FEV_1/FVC ratio, and percent predicted FEV_1 and FVC) and dietary fibre from all sources.

In another case-control study, children in the highest quartiles of dairy intake were compared with the children in the lowest quartiles and showed a positive association between frequent dairy consumption and the odds of developing asthma.[27] Woods et al[28] observed a positive association between asthma and concurrent consumption of low-fat cheese and ricotta. Haas et al [29] assessed the acute effects of different types of milk (whole milk/ skim milk) or water on lung function in patients with asthma. Milk consumption did not affect FEV_1 and forced expiratory flow at 50% vital capacity. However in asthmatic patients, after whole milk consumption, there was a progressive deterioration in pulmonary diffusing capacity of carbon monoxide ($P<0.001$).

Alwarith et al. [27] found that vegetarian diet which included primarily plant-based foods may prevent development of asthma and also improve symptoms of asthma. The effects of these plant-based foods are through their microbial composition, oxidation and systemic inflammation. Other modulations of dietary management include weight management, decreased intake of non-vegetarian items and increased intake of fruits and vegetables may influence immune responses, free radical damage and cytokine release which in turn will affect the development and course of asthma. Chatzi et al. [30] also found that a high consumption of vegetables (cucumber, zucchini, brinjal, green beans and tomatoes) and fruits was found to have positive effects on asthmatic patients. Atopic wheeze also showed significant decrease when intake of fruits and vegetables was increased. Similarly, increased consumption of fish

intake (≥ 60 g/day) also leads to decreased atopy. Patel et al in their study concluded that asthma patients were more symptomatic when they had a low dietary intake of fruit which led to decreased intake of manganese, vitamin C and other antioxidant nutrients. Low plasma vitamin C levels due to diet deficient in Vitamin C may be strong risk factor for the development of asthma. [31]

However, in this study, the mean difference between C-ACT scores after the dietary advice was started was not statistically significant. Mean differences between FEV_1 and FVC values were also not statistically significant. The present study thus showed no significant association between dietary supplementation and asthma control.

Limitation of the study was that it was a single hospital based study with limited population of children being studied. Secondly, the study could have been a randomised interventional study with a control group instead of a cross-sectional study. The study can be conducted in a larger population to have more conclusive results.

CONCLUSION

The present study concluded no association between dietary pattern and control of asthma. However there are studies showing synergistic effects of healthy diet can be an effective way to improve asthma outcomes. Hence, dietary interventions based on evidence-based guidelines including anti-inflammatory and anti-oxidant food sources maybe considered for routine clinical management of patients with asthma in order to achieve overall health benefits and disease control.

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Annexure 1

SAMPLE DIET CHART

Food Items	**Age Groups**	
	5-8 years	**9-12 years**
Eggs	1 egg per day	1 egg per day
Flax seeds/pumpkin seeds/sunflower seeds	10 gram or 1 teaspoon	15 gram or 1 tablespoon
Peanuts	10 gram or 1 teaspoon	15 gram or 1 tablespoon
Walnuts	1 walnut	2 walnuts
Soya chums	20 grams	30 grams
Canola oil	2 teaspoons	3 teaspoons
Fruits (apples, banana, kiwi)	1 fruit	2 fruits
Vegetables (spinach, carrots, sweet potato, tomato)	250 grams or 1 small katori	400 grams or 2 small katori