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Diet and asthma: An observational study

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Abstract

Introduction: Asthma as we know has multiple etiologies and risk factors. Among the noncommunicable diseases, asthma remains a global giant, a disease that has numerous predictors some proven and some under scrutiny. Linking diet with asthma has been crucial and treacherous for long. With all the studies that have been undertaken, some clearly state the protective effects/adverse effects of certain foods, while others deepen the dilemma. This study has been undertaken in order to enlarge the spectrum of studies performed in this regard. The study evaluates the dietary habits (vegetarian and nonvegetarian) as a whole of 554 school going children and categorizes them into asthmatics (along with allergic disorders) (both physician diagnosed) and nonasthmatics. **Aims and Objectives:** The aim was to establish the correlation between diet and physician diagnosed asthma (and allergic disorders) in school going children. **Materials and Methods:** A questionnaire inspired by the International study for Asthma and Allergy in Children questionnaire was used to evaluate the dietary habits and disease status of the 554 school going children of urban areas of Jaipur. The children had to fill the questionnaire under parental/teachers' guidance. **Results:** Asthma and allergic disorders were found to be more prevalent in those consuming a lacto-ovo vegetarian diet (odds ratio [OR]: 0.289, P - 0.004). Junk food was also significantly correlated (OR: 1.643, P - 0.004), as well as a positive family history (OR: 0.585, P - 0.002). **Conclusion:** Although studies linking a vegetarian diet to be protective against asthma are numerous, our study shows a different picture. The school of thought that considers vegetarian diet to be protective may lay its basis on the high antioxidant levels in the blood, which according to a new hypothesis, on the contrary may be related to increased risk of allergies too.

Keywords: Antioxidant levels, asthma, junk foods, lacto-ovo vegetarian

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Introduction

"Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation can be associated with airway hyper responsiveness, that leads to recurrent episodes of wheezing, breathlessness, chest tightness, coughing, particularly at night or in the early morning, these episodes are usually associated with widespread or variable airflow obstruction within the lung" (Global Initiative for Asthma). Currently, there is an "asthma epidemic," the chronic condition is growing globally and has around 300 million people worldwide under its clutches. As opposed to an earlier school of thought, there has been an increase in the incidence of asthma in developing countries, due to urbanization on a rise. ^[1] As estimated by a recent study (February 2013) ^[1] the prevalence of self-reported asthma in India is 1.8% in men and 1.9% in women with higher numbers seen in urban than rural areas. The study also depicts wide regional variations in the geographic distribution of asthma.

Apart from family history, allergy, atopy, infections and other environmental factors, today diet is also looked upon as an important contributory factor in the development of asthma. ^[1] A diet rich in antioxidant mainly Vitamin C, Vitamin E, Vitamin D, lycopene, manganese, beta carotene, selenium ^[2] has a protective effect on the lungs epithelium, it has also been found that fish consumption (at least 1/month) may be a preventive approach for asthma. ^[3] Therefore, if the diet is supplemented with these ingredients since childhood asthma can be prevented. ^[4]

Although on one hand, studies say that dietary factors play a significant role in asthma prevention and amelioration, ^{[5],[6]} others have indecisive results as far as the role of dietary pattern in asthma prevention and treatment of asthma ^{[7],[8]} is concerned.

Although there have been plentiful studies to evaluate the linkage between diet and asthma, the available studies are not enough, and the results are varied. Although, we know that certain foods prevent asthma and allergy and some foods do not. However on a larger perspective, we can look at the diets of people and its effect on asthma by dividing them into lacto-ovo vegetarian and nonvegetarians. The diet of people varies from country to country and in India from the state to state. My study is important as it evaluate the cumulative effect of diet on asthma, as combinations of different nutrients consumed varies widely among people, and each nutrient may alter the bioavailability of the other.

Materials and methods

The type of study is a community-based observational study. The study is a questionnaire based survey among school children. The questionnaire is inspired from the International study for Asthma and Allergy Diseases in Childhood (ISAAC) Questionnaire. ^[9] It was also structured to analyze the environment the child has been dwelling in, the terms of pollution, pet ownership and passive smoking. The validity of the ISAAC questionnaire was well-documented in previous studies. Before distributing the questionnaires to the children; the topic of asthma and allergy was well-discussed with the children. The questionnaire was then, given to them to be filled at their home under the guidance of their parents. Children having an evidence of physician diagnosed asthma were considered asthmatic for the purpose of this study.

On a broader sense, a vegetarian diet included vegetables and dairy products and egg (lacto ovo vegetarian diet) and a nonvegetarian diet mainly included chicken, lamb, beef, mutton, pork, fish along with dairy products. Fast foods (foods that contribute more toward calories and have less nutritional value, in India precisely pizzas, burgers, pop corns, soda, noodles, pasta, and other fried items taken primarily as a full meal) consumption was also enquired. According to the ISAAC protocol schools were used as the sampling units, the survey was done in urban areas of Jaipur. As Jaipur is divided into 12 zones, a school was selected from each zone, then a single school was shortlisted from zone 10 (Shri Agrasen Public School). A survey was then conducted among 554 children of 6th to 12th standards in Sri Agrasen Public School after permission from the school authority. The sample size was calculated on the basis of the prevalence of asthma in the previous studies in school children and also the prevalence of asthma among vegetarians and nonvegetarians.

Data analysis

The continuous data were expressed in the form of mean and standard deviation. Categorical data were expressed in the form of proportions. Chi-square test was performed to analyze the difference in proportions, and odds ratio (OR) was calculated. Multiple logistic regressions were done to analyze the effect of predictors of asthma status among children. The level of significance was 95% for all statistical analysis.

Results

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A total of 554 children was enrolled in the study with a mean age 14.85 ± 1.93 years. A total of 314 children was asthmatic (physician diagnosed) and 240 were nonasthmatic, with a mean age of 14.73 ± 2.04 years and 15.02 ± 1.77 respectively. Among the asthmatics, a total of 203 (34.64%) were vegetarians, and 111 (20.04%) were nonvegetarians. Asthma was found to be significantly associated with a vegetarian diet (lacto-ovo vegetarian) with OR of 0.289 with $P < 0.004\%$. With regards to other parameters, a positive family history was significantly associated with asthma, with 26.90 of children having a positive family history, the OR was 0.589 and the $P < 0.002\%$. The association of fast food and asthma has been long studied; in my study the consumption of fast food was significantly associated with asthma, with an OR of 1.643 and $P < 0.004\%$. Though asthma was also reported in males as compared to females, it can also be correlated to a higher ratio of males enrolled in the study [Table 1],[Table 2] and [Table 3].

Dietary Habit	Children	Total
Vegetarian	203 (36.46%)	229 (41.33%)
Non-vegetarian	111 (20.04%)	125 (22.40%)
Total	314 (56.50%)	354 (63.73%)

Table 1: Diet and Asthma

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Family History	Children	Total
Positive	84 (15.16%)	94 (16.95%)
Negative	470 (84.84%)	460 (83.05%)
Total	554 (100%)	554 (100%)

Table 2: Family history and Asthma

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Predictor	Children	Mean Age (SD)	OR	P	CI
Gender	314	14.85 (1.93)	0.589	0.002	0.001-0.003
Family History	203	14.73 (2.04)	0.589	0.002	0.001-0.003
Dietary Habit	111	15.02 (1.77)	0.289	0.004	0.001-0.005
Fast Food	111	15.02 (1.77)	1.643	0.004	0.001-0.005
Vegetarian	203	14.73 (2.04)	0.289	0.004	0.001-0.005
Non-vegetarian	111	15.02 (1.77)	1.643	0.004	0.001-0.005
Total	314	14.85 (1.93)	0.289	0.004	0.001-0.005

Table 3: Other predictors of Asthma

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Discussion

The association between diet and asthma has long been studied and remains unclear with many studies depicting indecisive results. As far as our study is concerned, there clearly exists a positive correlation between the lacto-ovo vegetarian diet (wheat flour, rice, vegetables, eggs, dairy products) and asthma with a $P = 0.004$ [Figure 1]. This study is one of its kind in which a higher significant prevalence of asthma has been found in lacto-ovo vegetarians. There have been voluminous studies, which have analyzed the diet in terms of a causative perspective of asthma, and have clearly demonstrated an increased prevalence in those consuming a nonvegetarian diet. [10] Many articles have also mentioned in depth the reason of decreased prevalence of asthma in vegetarians, being the increased levels of antioxidants (Vitamin A, Vitamin C, Vitamin E, selenium, beta carotene. [11],[12],[13],[14] On the contrast however, there have umpteen studies, which have found inconclusive results between diet and asthma [2],[15],[16],[17],[18] as also the role of anti-oxidants as protective factors for the lung and asthma prevention.

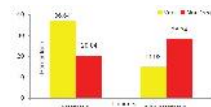


Figure 1: Association between diet and asthma graph

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The study was carried out in china [19] done in 2012 to establish a correlation between asthma and diet in the four groups of people one consuming "traditional food pattern" (described as high loadings of rice, wheat flour, vegetables), vegetable rich pattern (raw vegetables, fruits), meat pattern (rich in meat and alcohol) and sweet tooth pattern (high loadings of cake, yoghurt, milk). There was found a significant correlation between the traditional food pattern and asthma (OR: 2.25, confidence level [CL]: 1.45-3.51) and no correlation was found between asthmatics and those consuming a vegetable rich diet (OR: 0.80, CL: 0.50-1.47), or meat pattern (OR: 0.79, CL: 0.31-2.00). The increased prevalence of asthma in those consuming a traditional diet in china was explained by the study on the basis that traditional diet in china is more likely to be associated with increased intake of animal fat (mentioned in the study). Furthermore, increased exposure to chemicals such as pesticides was anticipated in the population consuming traditional diet in china.

A questionnaire based study was also done among 2258 children of Taiwan, [10] which compared the association of atopy, allergic rhinitis, and wheezing with nonvegetarian, moderately vegetarian and strictly vegetarian diets. The study depicted increased history of rhinitis and increased prevalence diagnosed rhinitis (65.3% vs. 59.1% and 35.1% vs. 25.5%, $P = 0.05$) in those consuming vegetarian diets. There was also found decreased prevalence of recent wheezing in those consuming moderately vegetarian diet. In the light of these results, the study declared that vegetarian diet may have a causal relationship with asthma. Although, dose-response relationship between a vegetarian diet and allergic disease cannot be established. In the view of decreased prevalence of wheezing in moderately vegetarian diet consuming population, and increased prevalence of rhinitis in strict vegetarian diets in the study, the study came up with the fact that strict vegetarian diet may be nutritionally inadequate, and the bioavailability of different nutrients may be interrelated for protecting against asthma. More so, in those claiming to be moderately vegetarian in the study, may consume more "animal fat" on some days as compensation.

The increased prevalence of asthma in vegetarians in my study may be a result of positive family history which has been very significant in those with symptoms of asthma (OR: 0.585 $P = 0.002$) [Figure 2]. Apart from this, the transition of diet from nonvegetarian to a vegetarian diet might have been recent, following a diagnosis of asthma, which might have promoted this population to make this transition toward consuming more fruits and vegetables. Furthermore, as depicted by a study [20] antioxidants may be related to increased incidence of asthma and allergic disease. As we all know, increased amounts of Vitamin A, Vitamin C, Vitamin E, and selenium are found in raw fruits and vegetables, as per the

above hypothesis they might have been responsible for the increased prevalence of diagnosed asthma in these cases. According to this hypothesis, much similar to the "hygiene hypothesis," which states that decreased exposure to infections and sophisticated background may predispose an individual to future allergic problems, there is a thought that states that increased levels of antioxidants prevents the stimulation of Th1 helper cells. Also, since Th1 helper cells and Th2 cells have a negative regulatory feedback for each other, the Th2 cells start multiplying giving rise to various allergic problems and possibly asthma. This is also supported by the fact that, the correlation between consumption of "protective foods" (apples, tomatoes, onions, raw fruits and vegetables) and asthma in the present study was insignificant. Although this cannot be said conclusively as the same study showed significantly increased prevalence of asthmatics in those consuming fast foods more than thrice weekly (OR: 1.643, $P = 0.004$), stating the increased prevalence related to high-fat intake among these pupils. Although high on fat, these foods are also a source of high sodium, which has been quoted as positively correlated with asthma in previous studies. [10] Therefore, apart from the dietary influences, certain unrecognized environmental influences may also be the cause of increased prevalence in the vegetarian population in the study.



Figure 2: Association between family history and asthma

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Apart from the above predictors, my study failed to show a positive association between smoking as well as obesity with asthma (OR: 0.890, $P = 0.05$; OR: 0.940, $P = 0.05$). The study done in china [19] also had a similar picture where no positive association was found between asthma and overweight subjects. In Western countries, overweight and smoking are positively related to asthma. [21] However, in studies on Asian children, no significant association has been obtained between asthma and obesity as well as smoking. [22] There was also no significant association between pet ownership and asthma in my study (OR: 0.647, $P > 0.05$). The results are similar to a study conducted in 75 asthmatic and 75 nonasthmatic school children of Serbia, demonstrated no increased risk of asthma in those children who had a cat/dog as pets. [23] This may be related to the development of tolerance to the antigen on prolonged exposure much similar to the "hygiene hypothesis." However, as the population studied in this research may not be representative of the Asian population, more studies are required to be done, to be able to draw any conclusion in this regard.

The prevalence of asthma in India is 1.8% in men, and 1.9% in women. The prevalence of physician diagnosed asthma in children in the urban neighborhood of Jaipur recently [24] evaluated in a study and was found out to be 5.3%. 7.59% children were found to have asthma (in the last 12 months) and 8.4% wheezing in the past 1 year. The high prevalence of physician diagnosed asthma may be related to the prevailing environment near and around the school. The school lies in the heart of the city and has very crowded and noisy surroundings. Also, an unpredictably high prevalence may be related to a small population size which might not be representative of the school children in urban Jaipur.

Our study refutes what most studies declare regarding the association between diet and asthma or more so between high antioxidant levels and asthma. It reverberates with the studies done in China and Taiwan, countries much similar to India as far as the economy is concerned, the status of the population and their risk and exposures can be compared.

As we all know, lifestyle modification for the treatment of any disease is but the quintessential part. The dilemma regarding association between diet and asthma is decade old, and this arena awaits numerous dedicated and large scale researches in India as well as countries like India so that their contribution can be acknowledged and well utilized. Our study clearly depicts a high association between diet and asthma; it also uncovers the less visited aspect of this discussion that a vegetarian individual/population cannot be regarded as being protected against asthma. Here lies the importance of our study.

Conclusion

Although a questionnaire based study, in the light of many previous studies, this study begs to differ. It questions the common belief that a nonvegetarian diet predisposes us to the development of allergic diseases. While more studies are needed to corroborate the findings of our study. The correlation being significant in the present study, it prompts us to look at the other side of the coin.

Strengths

As we see there have been numerous studies to depict the correlation between asthma and various components of diet, example selenium, Vitamin D, Vitamin C, Vitamin A, and Vitamin E, studies predicting the cumulative effect of diet on asthma are lacking. My study compares the most common diet consumed by the people of Jaipur (Lacto-ovo vegetarian) with those consuming nonvegetarian diet and finds out the prevalence of asthma in each. This is similar to the study done in China where they compare the population consuming their traditional diet and those consuming meat. The importance lies here, because it seeks to find out the prevalence of asthma in the population by evaluating their diet as a whole taking into consideration the interactions between certain foods and also the changes in bio availability due to this interaction.

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Dietary habit	Children		Total
	Asthmatic	Nonasthmatic	
Vegetarian	203 (36.64)	83 (14.98)	286 (51.62)
Nonvegetarian	111 (20.04)	157 (28.34)	268 (48.38)
Total	314 (56.68)	240 (43.32)	554 (100.00)
$\chi^2=49.240$, $df=1$, $P=0.001$, $OR=0.289$, $95\% CL=0.203-0.413$. CL - Confidence level, OR - Odds ratio			

Family history	Children		Total
	Asthmatic	Nonasthmatic	
Present	149 (26.90)	57 (10.29)	206 (37.18)
Absent	165 (29.78)	183 (33.03)	348 (62.82)
Total	314 (56.68)	240 (43.32)	554 (100.00)
$\chi^2=9.260$, $df=1$, $P=0.002$, $OR=0.585$, $95\% \text{ CL}=0.414\text{--}0.828$. CL - Confidence level, OR - Odds ratio			

Predictor	Asthmatics 314 (<i>n</i> =56.68)	Nonasthmatics 240 (<i>n</i> =43.32)	OR	<i>P</i>	CL
Lacto ovo vegetarian diet	203 (36.64)	83 (14.98)	0.289	0.002	0.203-0.413
Nonvegetarian diet	111 (20.04)	157 (28.34)			
Family history	149 (26.90)	57 (10.29)	0.585	0.002	0.414-828
Fast food	108 (19.49)	111 (20.04)	1.643	0.004	1.163-2.316
Pet ownership	69 (12.45)	37 (6.68)	0.647	0.05	0.417-1.005
BMI	21 (3.79)	17 (3.07)	0.940	0.05	0.485-1.824
Smoker at home	42 (7.58)	29 (5.23)	0.890	0.05	0.536-1.477
Sex					
Males	248 (44.76)	193 (34.84)	1.093	0.05	0.719-1.661
Females	66 (11.91)	47 (8.48)			
Protective foods	238 (42.96)	196 (35.38)	1.422	0.05	0.938-2.158

CL - Confidence level, OR - Odds ratio, BMI - Body mass index

Percentage

Veg Non Veg

36.64

20.04

28.34

14.98

Asthmatic

Patients

Non asthmatic

