Research Article

iMedPub Journals
http://www.imedpub.com

Journal of Clinical Nutrition & Dietetics
ISSN 2472-1921

2017
Vol. 3 No. 2: 16

DOI: 10.4172/2472-1921.100050

Assessment of Nutritional Status of Patients Suffering from Asthma

Priyanka Jain[1], Surya Kant[2] and Rachna Mishra[3]

1 Department of Pathology, National Institute of Nutrition, Hyderabad, Telangana, India
2 Department of Pulmonary Medicine, Chhatrapati Shahuji Medical University, Lucknow, Uttar Pradesh, India
3 Department of Nutrition, Isabella Thoburn College, Lucknow, Uttar Pradesh, India

Corresponding author: Dr. Surya Kant

skantpulmed@gmail.com

Department of Pulmonary Medicine, Chhatrapati Shahuji Medical University, Lucknow, Uttar Pradesh, India.

Tel: 91-522-2258961
Fax: 91-522-2258962

Citation: Jain P, Kant S, Mishra R. Assessment of Nutritional Status of Patients Suffering from Asthma. J Clin Nutr Diet. 2017, 3:2.

Abstract

Background and aim: Several studies have suggested that increasing prevalence of asthma could be associated with nutrients intake. These nutrients can play beneficial as well as detrimental role in asthma and may affect the nutritional status of asthma patients. This case-control study was undertaken to assess the nutritional status and differences in dietary intake between a population with and without asthma.

Methods: A case-control study was carried out in clinically and spirometrically diagnosed asthma patients and (n=143, average age 29.35 ± 8.64 years) and age, sex and socioeconomic status matched healthy volunteers (n=143, average age 29.54 ± 8.61 years) to assess and evaluate the nutritional status of asthmatics. Anthropometric measurements (BMI, MUAC, and TSF), biochemical investigations (Hb, total and differential leucocyte counts and serum calcium and protein and serum IgE), pulmonary function test, nutrient intake (3 day diary method and food frequency questionnaire) and subjective global assessment were used as standard nutritional assessment tools. Results were considered statistically significant if the observed two-sided significance level (P-value) was not greater than 0.05.

Results: The present study results found that the majority of cases were significantly overweight or obese on the basis of body mass index (p=0.01), mid upper arm circumference (p=0.01) and triceps skin fold thickness (p=0.01) than controls. Hb, serum protein and serum calcium, levels were significantly lower in asthma cases in comparison of non-asthmatic controls (p=0.01, 0.01, 0.01 respectively) and TLC, eosinophils, monocytes and serum Ig E levels were significantly higher in asthmatics in comparison to nonasthmatics (p=0.01, 0.01, 0.01 and 0.00 respectively). Daily intake of fat was significantly higher whereas protein intake was significantly lower in asthmatics than in non-asthmatic subjects (p=0.01 and p=0.01 respectively). Significant decrease in daily intakes of thiamine, riboflavin, vitamin C, calcium and iron was noticed in asthmatic than non-asthmatic subjects (p=0.01, p=0.02, p=0.01, p=0.01, p=0.01, p=0.00). Based on subjective global assessment rating scale, significant difference was observed between the groups (p=0.04) as 48.9% and 21.7% of the asthmatics and 23.6% and 47% of the non-asthmatics were moderately malnourished and well-nourished respectively.

Conclusion: It can be concluded that overall nutritional status of asthma patients was poor based on the standard tools used. Most of them were obese, had unbalanced nutrient intake and were not well nourished. Thus the time may be close for consideration of dietary advice as per recommended and modified dietary allowances followed by intervention trials.

Keywords: Anthropometric measurement; Biochemical parameters; Pulmonary function test; Diet history; Asthma

Received: February 09, 2017; **Accepted:** May 10, 2017; **Published:** May 15, 2017

Introduction

Asthma is a disease in which the airways become blocked or narrowed. These effects are usually temporary, but they cause shortness of breath, breathing trouble and other symptoms [1]. The prevalence of asthma has increased dramatically in many countries over recent decades, demonstrating that environmental exposures play a dominant role in the etiology of this disease [2,3]. There is not only an apparent increase in general prevalence in several geographic areas, but also in the number of cases of difficult, refractory and fatal (or near fatal) asthma [4].

Worldwide 130 million people have asthma [5]. The prevalence is 8-10 times higher in developed countries than in the developing countries and the prevalence is higher in low income groups [1]. In Indian scenario approximately 15-20 million populations is asthmatic [6]. Moreover, there are complex and confounding associations and relationships with asthma. Several studies have revealed that certain risk factors are associated with increased incidence of bronchial asthma, such as age, smoking habits [7], and occupational exposure [1], but the role of food allergy in asthma is well recognized but poorly quantified.

Recent studies suggest that an association may exist between low intake of certain nutrients and asthma [8]. Changes in dietary habits, such as increasing salt intake, decreasing intake of fruits and vegetables and changing fatty acid composition of the diet, were suggested to contribute to the rise in asthma and Chronic Obstructive Pulmonary Diseases (COPD) mortality and morbidity [8,9]. Diet is relatively, recently recognized potential risk factor for asthma although the evidence to date is conflicting [10]. There is increasing evidence from observational study that there are strong relationship between diet and respiratory disease. For omega-3 PUFAs intake an unfavorable association is observed in asthmatics, but intake of proinflammatory omega-6 Polyunsaturated Fatty Acids (PUFAs) are more likely to be beneficial [11]. Generally, nutritional assessment and risk is estimated on the basis of Body Mass Index (BMI), serum proteins, Mid Upper Arm Circumference (MUAC) and Triceps Skin Fold thickness (TSF) [12]. However these parameters are not sufficient to predict the future progression of nutrition deterioration which determines the likelihood of developing complications. SGA overcomes these limitations by evaluating a dimensionless progression of factors which can alter nutritional status [13,14].

However in India, there isn't enough data about nutritional status of asthma patients, so this study was aimed to assess the nutritional status of patients suffering from asthma.

Material and Methods

This study was carried out on 143 cases (clinically and spirometrically diagnosed asthma patients) and 143 controls (of comparable age, sex, SES and without any family history of asthma) with age group between 15-40 years old, selected from out patients' clinic of King George Medical University, Hospital, India. Patients having any associated illness, Chronic Obstructive Pulmonary Disease (COPD), pregnancy, physical or mental impairment, diabetes or hypertension and those receiving treatment for any acute illness were excluded from the study.

Anthropometric assessment

To eliminate the inter-examiner error, only one person took all the anthropometric measurements. Standard protocol for anthropometric measurement was followed as given by National Centre for Health Statistics [15]. Measurements were compared with standards recommended by World Health Organization, 1983 [16]. Socio-economic status was assessed according to Kuppuswamy scale 1985 [17].

Laboratory investigations

Blood samples were collected and analyzed for the determination of Haemoglobin (automated cyanmethemoglobin method), total and differential leucocyte count (immunocompetence), total serum Immunoglobulin E (ELISA using Elagen total Ig E, ADALTIS, Italy), serum protein and serum albumin (Biuret and Bromocresol method respectively) and serum calcium was assessed spectrophotometrically by Calcium Arsenazo III.

Recognition of asthma

Clinically and Spirometrically diagnosed cases of asthma were enrolled in the study. Pulmonary function testing was performed using spirometer (P.K. Morgan's Spiro 232 Pulmonary System) after adjusting for age and sex as per the requirements of the American Thoracic Society [18]. Reversibility of airway obstruction was measured in response to administration of an aerosol bronchodilator (400 µg of salbutamol) [19].

Nutrient intake

For nutrient calculation three days diet diary method and food frequency questionnaire [20,21] were used to assess the nutrient intake. The average daily intake of all the nutrients both major and minor was analyzed and compared with Recommended Dietary Allowances (RDAs) [22] given by Indian Council for Medical Research and National Institute of Nutrition, expressed as mean (SD). Patients were classified as well nourished, moderately (or suspected of being) malnourished and severely malnourished on the basis of subjective global assessment [14].

Statistical Analysis

Statistical analyses were performed by using the SPSS statistical package version 21.0 (SPSS, Chicago, IL, USA). The Clinical characteristics of cases/asthmatics and controls/non-asthmatics are expressed as mean/ frequency and Standard Deviation/ percentages. U-test was used to evaluate the non-normal data. Categorical data of both the groups was evaluated using the chi-square test and continuous normal values were tested by t-test as appropriate. Results were considered statistically significant if the observed two-sided significance level (P-value) was not greater than 0.05.

Results

Table 1 shows general characteristics and demographic profile of the study population. The present study results did not find any

significant difference between cases and controls with respect to age, sex, smoking, socioeconomic and residential status. This shows that cases and control group subjects were nicely matched in general characteristics. The prevalence of atopy defined according to the results of the prick test was significantly higher in cases (66.4%) than controls (53.8%).

From anthropometric measurements (**Table 2**) it could be noticed that there was no significant difference in height of cases and controls (p=0.44) whereas weight of asthmatics was significantly higher than controls (p= 0.01). However, BMI value of patients was significantly higher than controls. By classifying BMI, it could be noticed that the majority of cases were either overweight or obese (p=0.01). Mid upper arm circumference and TSF was significantly higher in cases than controls (p=0.01 and p=0.01 respectively).

Table 3 shows there were significant differences in most of the biochemical measures between asthmatics and healthy subjects. Hb, serum protein, serum calcium, levels were significantly lower in asthmatics in comparison of non-asthmatics (p=0.01, 0.01, 0.01 respectively) and TLC, eosinophils, monocytes and serum Ig E levels were significantly higher in asthmatics in comparison to healthy controls (p=0.01, 0.01, 0.01 and 0.00 respectively).

Table 4 shows that FEV1/FVC and PEFR% change were significantly lower in asthmatics than in the control group (p=0.01 and p=0.01 respectively) but FEV1% change was higher in asthmatics than non-asthmatics (p=0.01).

Table 1: General characteristics of the study subjects (*Values significant (5% level of significance)).

General Characteristics	Asthmatics	Non-asthmatics	p-value
	(N=143)	(N=143)	
Age in years (Mean ± SD)#	29.35 ± 8.64	29.54 ± 8.61	0.85
Sex N (%)			
· Male	65 (45.5)	69 (48.3)	0.64
· Female	78 (54.5)	74 (51.7)	
Socio Economic Status N (%)			
· Upper	4 (2.8)	3 (2.1)	0.94
· Upper-Middle	21 (14.7)	18 (12.6)	
· Lower-Middle	47 (32.9)	52 (36.4)	
· Upper-Lower	46 (32.2)	43 (30.1)	
· Lower	25 (17.5)	27 (18.9)	
Family History of asthma N (%)			
· Yes	117 (81.8)	0 (0)	-
· No	26 (18.2)	143 (100)	
Smoking N (%)			
· Ex-smoker	19 (13.3)	22 (15.4)	0.8
· Current smoker	3 (2.1)	2 (1.4)	
· Never smoker	121 (84.6)	119 (83.2)	
Residence N (%)			
· Rural	35 (24.5)	40 (28.0)	0.5
· Urban	108 (75.5)	103 (72.0)	
Duration of asthma (in years) N (%)			
· 1-5	56 (39.2)	0 (0)	-
· 5-10	33 (23.1)	0 (0)	
· 10-15	34 (23.8)	0 (0)	
· 15-20	12 (8.4)	0 (0)	
· 20-25	5 (3.5)	0 (0)	
· >25	3 (2.1)	0 (0)	
Age of onset in years N (%)			
· 0-5	21 (14.7)	0 (0)	-
· 5-10	38 (26.6)	0 (0)	
· 10-15	26 (18.1)	0 (0)	
· 15-20	27 (18.8)	0 (0)	
· >20	31 (21.7)	0 (0)	

Table 5 presents mean of nutrients intake of cases and controls. Total energy and nicotinic acid intake was of no significant difference between asthmatics and non-asthmatics. Daily intake of fat was significantly higher whereas protein intake was significantly lower in asthmatics than in non-asthmatic subjects (p=0.01 and p=0.01 respectively). Significant decrease in daily intakes of thiamine, riboflavin, vitamin C, calcium and iron was noticed in asthmatic than non-asthmatic subjects (p=0.01, p=0.02, p=0.01, p=0.01, p=0.01, p=0.00). **Table 6** shows

Table 2: Anthropometrics measurements of asthmatics and non-asthmatics (*Values significant (5% level of significance); BMI: Body Mass Index; MUAC: Mid Upper Arm Circumference; TSF: Triceps Skin Fold thickness).

Anthropometrics measurements	Asthmatics (n=143) Mean ± SD	Non-Asthmatics (n=143) Mean ± SD	p-value
Height (cm)	158.19 ± 7.88	157.25 ± 11.97	0.44
Weight (kg)	60.48 ± 11.22	57.75 ± 12.23	0.01*
BMI (kg/m^2) Underweight (>18.5 kg/m^2) Normal weight (18.5-25 kg/m^2) Overweight (25-30 kg/m^2) Obesity (more than 30 kg/m^2)	25.92 ± 5.33 18 (12.6) 27 (18.9) 33 (23.1) 65 (45.5)	23.47 ± 4.47 23 (16.1) 79 (55.2) 13 (9.1) 28 (19.6)	0.01* 0.01*
MUAC (cm)	12.61 ± 0.63	11.66 ± 1.13	0.01*
TSF (mm)	24.90 ± 9.51	14.72 ± 2.37	0.01*

Table 3: Biochemical measurements/Laboratory tests of asthmatics and non- asthmatics (*Values significant (5% level of significance); TLC: Total Leucocyte Count; DLC: Differential Leucocyte Count; IgE: Immunoglobulin E; P: Polymorphs; L: Lymphocytes; E: Eosinophils; M: Monocytes).

Biochemical measurements	Asthmatics (n=143) Mean ± SD	Non-asthmatics (n=143) Mean ± SD	p-value
Haemoglobin (g/dl)	9.73 ± 1.24	12.57 ± 1.21	0.01*
TLC (per cu.mm)	14468.21 ± 7987.72	7415.21 ± 1512.49	0.01*
DLC (%) P L E M	66.30 ± 9.58 28.84+9.88 9.10 ± 5.38 5.30 ± 4.77	66.26+13.81 27.16+9.13 4.11 ± 1.80 1.81 ± 2.80	0.33 0.14 0.01* 0.01*
Serum Protein (g/L)	61.54 ± 7.90	65.51 ± 7.36	0.01*
Serum Calcium (mmol/L)	2.31 ± 0.13	2.81 ± 0.36	0.01*
Serum Albumin (g/L)	41.54 ± 2.31	40.93 ± 3.30	0.12
Serum IgE (mg/dl)	660.32 ± 423.06	104.37 ± 34.69	0.00*

Table 4: Pulmonary function test of asthmatics and non-asthmatics (*Values significant (5% level of significance); FVC: Forced Vital Capacity; FEV_1: Forced Expiratory Volume in 1 second; PEFR: Peak Expiratory Flow Rate).

Pulmonary Function Test	Asthmatics (N=143) Mean ± SD	Non-asthmatics (N=143) Mean ± SD	p-value
FVC%	83.18 ± 16.48	85.43 ± 17.73	0.04
FEV1% change	17.16 ± 5.08	11.86 ± 4.83	0.01*
FEV1/FVC	65.46 ± 13.83	83.33 ± 15.55T	0.01*
PEFR % change	30.06 ± 28.61	84.49 ± 26.28	0.01*

Table 5: Nutrient intake of asthmatics and Non-Asthmatics (*Values significant (5% level of significance)).

Nutrients	Asthmatics (N=143) Mean ± SD	Non-asthmatics (N=143) Mean ± SD	p-value
Energy (cal/d)	2074.67 ± 326.43	2042.27 ± 436.87	0.48
Protein (g/d)	42.24 ± 7.63	51.43 ± 6.46	0.01*
Fat (g/d)	23.86 ± 4.70	20.98 ± 4.35	0.01*
Thiamine (mg/d)	0.77 ± 0.15	1.00 ± 0.84	0.02*
Riboflavin (mg/d)	1.00 ± 0.19	1.27 ± 0.18	0.01*
Nicotinic acid (mg/d)	13.52 ± 1.84	13.62 ± 1.83	0.66
Pyridoxine (mg/d)	1.53 ± 0.16	1.43 ± 0.16	0.01*
Vit.C (mg/d)	34.51 ± 4.26	36.64 ± 3.11	0.01*
Folic acid (µg/d)	70.80 ± 8.69	73.09 ± 9.05	0.03
Vit. B12 (mg/d)	0.70 ± 0.09	0.73 ± 0.08	0.02
Calcium (mg/d)	304.10 ± 62.36	322.50 ± 62.20	0.01*
Iron (mg/d)	17.94 ± 4.97	19.83 ± 5.14	0.00*

the SGA rating scale of the patients suffering from asthma as compared to non-asthmatic patients. It was found that 29.4% of the asthmatics and 29.4% of non-asthmatics (same number) were severely malnourished. Overall, significant difference was observed between the groups (p=0.04) as 48.9% and 47.0% of the asthmatics and 23.6% and 21.7% of the non-asthmatics were moderately malnourished and well-nourished respectively. **Table 7** presents no significant difference between the 2 groups on basis of dietary pattern of asthmatics and non-asthmatics.

Discussion

The present study results did not find any significant difference between cases and controls with respect to age, sex, smoking, socioeconomic and residential status. The prevalence of atopy defined according to the results of the prick test was significantly higher in cases than controls (p=0.04). The prevalence of asthma was higher in females than in males (p=0.64). The mean age (29.35 ± 8.64 years) of subjects reported in the present study is in consistent with Chen et al. [23], who found that prevalence of asthma was higher in 20-29 years age group.

The findings of a survey based study [24] on adults showed that familial risk assessment can help identify people at highest risk for developing asthma. Positive family history of asthma is considered to be a host factor in asthmatics. Multiple genes are involved in the pathogenesis of asthma and different genes may be involved in different ethnic groups [25,26]. In support of these findings, the present study results also revealed most of the asthmatics had positive family history of the disease.

Varraso et al. [27] showed that 42% of men and 60% of women were never-smokers. The present study showed that majority of asthmatics attending Respiratory Medicine outpatient department were non-smokers and this finding is in contrast to the study of Hublet et al. [28], who reported more prevalence of smoking in non-asthmatics (17.9%) when compared with 20.5% in asthmatic adolescents.

More number of the patients suffering from asthma were from urban area in comparison to rural area (p=0.50). It is reported that asthmatic symptoms to be 2-3 times more common in a developed urban environment than in rural areas [1]. Our observation that asthma is more common in the city than in the rural villages gave us an opportunity to investigate dietary and other risk factors across the whole population in what appeared to be an evolving situation. It is generally thought to be due to lifestyle factors. Before initiation of this study it was assumed that were substantial differences in diet as well as in other lifestyle factors between the two groups, the rural people rely more on locally grown fresh foods and less on imported and processed foods.

In order to be acquainted with the nutritional status of asthmatics, anthropometric assessment should be incorporated in the diagnostic work up. In an agreement with our findings Schachter et al. [29] and Mohamed [30] found that asthma was related to higher BMI, but Shore [31] and Vortmann and Eisner [32] detected no association, it can be inferred that patients may have obesity before asthma was diagnosed. A study [33] proved that obesity is one of the risk factors of asthma. The occurrence of obesity among asthma patients may be due to long term use of asthma medications especially corticosteroids that can have many side effects including weight gain.

The present study result shows that 23.1% and 45.5% of asthmatics were overweight and obese corresponding to the prevalence of overweight and obesity, 28% and 44% respectively reported by Flaherman and Rutherfpord [33]. In the present study the mean value of MUAC was above the normal thus supporting the overweight observed in the group. The cohort of patients in this study showed TSF values above the reference level that served

Table 6: Subjective global assessment of asthmatics and non-asthmatics (SGA: Subjective Global Assessment; *Values significant (5% level of significance)).

SGA rating	Asthmatics (N=143) N (%)	Non-asthmatics (N=143) N (%)	p-value
Well nourished Moderately (or suspected of being) malnourished Severely malnourished	31 (21.7) 70 (48.9) 42 (29.4)	67 (47.0) 34 (23.6) 42 (29.4)	0.04*

Table 7: Dietary pattern of asthmatics and non-asthmatics (p values not significant (>0.05) for any of the parameters).

Dietary Pattern	Cases (N=143) N (%)	Controls (N=143) N (%)	p-value
Apetite Poor Fair Good	26 (18.2) 60 (42.0) 57 (39.9)	22 (15.4) 59 (41.3) 62 (43.4)	0.76
Skip meals Yes No	85 (58) 60 (42)	86 (60.1) 57 (39.9)	0.72
Dietary habit Vegetarian Non-vegetarian Eggetarian	41 (28.7) 97 (67.8) 5 (5)	36 (25.2) 103 (72) 4 (4)	0.74

as certification of patients being overweight/ obese. The findings meet the criteria described by Figueroa-Muñoz et al. [34], who used BMI and sum of skin fold thickness as two indicators of fatness to assess the association between obesity and asthma. The indicators were strongly and significantly associated with asthma in women but not in men. BMI was more consistently associated with asthma than the sum of skin folds i.e., skin fold thickness odds ratios were lower than BMI in the representative sample. A study [35] done on adults found mean BMI and triceps skin fold thickness were higher in asthmatics corroborating the present study [36,37].

Hb, serum protein, serum calcium, levels were significantly lower in asthmatics in comparison of non-asthmatics and TLC, eosinophils, monocytes and serum Ig E levels were significantly higher in asthmatics in comparison to healthy controls. Recently Boyd et al. [38] and Lewis et al. [39] found lower haemoglobin and elevated white blood cells concentrations in asthmatics when compared with non-asthmatics. The disparity with regards to serum protein and serum calcium levels in blood among the two groups may be due to fewer intakes of calcium and protein rich food items in their diet. Brehm et al. [36] described that the [Ca^{2+}] I concentration in patients with bronchial asthma is significantly higher than in normal subjects. Al Obaidi et al. [37] found serum calcium is higher in asthma exacerbation than stable asthma and control group. Shore [31] found no significant difference in serum protein level in cases and control group. Eosinophils has a crucial role in the pathogenesis and course of asthma, as most allergic and non-allergic asthmatic patients, including those with mild asthma, has a bronchial eosinophilia and there is significant association between eosinophils activation and asthma severity as well as bronchial hyper responsiveness. Tissue eosinophilia was found to be significantly greater in fatal asthma [40] than in patients with chronic asthma. Although eosinophil cells protect the body against parasites and other infectious agents, its high levels is also responsible for the allergic reaction and worsen asthma state [41]. Earlier studies have also reported that larger number of patients with asthma had high serum IgE levels [42-44]. A study done on female adults showed that IgE molecules play a crucial role in allergic respiratory diseases and possibly cause chronic airway inflammation in asthma through activation of effector's cells via high affinity (Fc RI) or low affinity (Fc RII) IgE receptors46. In the present study, some patients with asthma had normal total serum IgE concentration. This is consistent with other studies [45-48] which failed to demonstrate increased mean total serum IgE concentration. The symptoms of these patients were probably based on other immunological or non-immunological mechanisms [49,50]. However parameters of biochemical evaluation of various body fluids, in the past documented as indicator of nutritional condition cannot be considered precocious, consistent and discriminating marker of nutritional status at present times. They are principally noticeable in the later stage of pulmonary disease, when the influence of inactivity, persistent contagious exacerbation or deprived nutritional intake plays an important role. This is perhaps owing to the fact that the drop in these indices lags much behind the commencement of change in nutritional status. The assessment of immune-competence is also significant due to apparent correlation between nutritional state and immunity [49]. The total lymphocyte count was found to be normal in this study and like visceral protein; it can be affected by many factors other than nutrition [50].

The study results indicate that FEV1% change, FEV1/FVC and PEFR% change were significantly lower in asthmatics than non-asthmatics. In favour of the present study, several studies [51,52] revealed average of basal FVC, FEV1, PEF and FEF25-75 measurements, (represented as percent of expected values), were lower in the study group as compared with the control group, and this was statistically significant. However, the averages of FEV1/FVC ratio of the two groups were similar. Several studies [53,54] have also demonstrated that as a group, asthma patients are physically unfit thus physical unfit thus affecting the outcome of PFT to a certain extent.

Very few studies have investigated the intake of nutrients in asthma patients. In relation to nutrients intake, the findings of this study demonstrated that asthmatic patients could not satisfy their requirements from protein, thiamine, riboflavin, pyridoxine, vitamin C, folic acid, vitamin B12, calcium and iron. The deficiency of these nutrients would worsen the health status of asthma patients as studies [30,55,56] reported lower dietary intake of protein, calcium and normal vitamin C. Daniel Antonio56 concluded asthmatics have normal fat intake, lower intake of vitamin C, thiamine, and folic acid but higher intake of niacin, B12 and calcium. Inadequate nutrients intake was partially responsible for the aggravation of asthma. A study [57] found a protective effect of vegetables and fruits consumption and a negative effect for butter and margarine use on wheezing symptoms in children on wheeze(during the past 12 months). A protective effect was also seen in children who frequently consume nuts and citrus fruits on wheezing. Hemila [58] suggested that vitamin C is the major antioxidant substance in the airways so it can be hypothesized that the core reason for prevalence of vitamin C deficiency in asthmatics may be due to misconception that less intake of fruits and vegetables may aggravate their condition. In adults, it was found [59] that there is an increase in bronchial reactivity associated with lower intake of vitamin C. In the present study fat intake was higher in asthmatics in comparison of non-asthmatics. Increased fat intake is causative agent in the weight gain and obesity. A study [60] revealed that high intake of PUFA and linoleic acid was associated with high incidence of chronic lung disease. The omega-3 PUFA have a specific role in controlling inflammation, but are easily replaced by omega-6 PUFA, which exert the opposite activity [61]. However, a complete explanation for the biological mechanism that involves PUFA on airway inflammation has not been found [62]. Similarly the role of saturated fats in airway inflammation remains unknown [63,64] Results from the first nutrition and health survey in Taiwan suggested an increase of the risk of asthma in teenagers corresponds to an increased intake of saturated fats, while MUFA fats were inversely related with asthma [65]. Although nutritional epidemiology often focuses on the intake of specific nutrients, it is important to study

diet in relation to asthma at the food or food group level as well. The results indicate that the subjects were capable of consuming foods that would just meet the demands, to maintain the nutritional status according to their age [66]. But not that much as required by asthmatics in accordance with Modified Dietary Allowances (MDA's). Also, it is the balanced diet that provides all the essential nutrients that contribute to overall nutrient intake.

A study done in cancer patients used the same tool and methodology inferred that SGA is a good predictor of adverse outcomes in Indian cancer patients [67]. Based on the subjective global assessment rating scale, significant difference was observed in our study between the groups (p=0.049) as most of the asthmatics were moderately malnourished (48.9%) and (47.0%) of the asthmatics were well nourished. It was also found that same number (29.4%) of the asthmatics and non-asthmatics were severely malnourished. Thus it is suggested to incorporate SGA rating scale as a measure for nutritional assessment along with other standard tools. Thus it is novel information on the association between subjective global assessment rating scale and nutritional status of asthma patients.

Though food frequency questionnaires and 3 day diet diary method provides useful information on nutrient intake in groups and are taken as a reasonable basis for comparisons, but there are chances of errors in self-reported intakes, omission of foods due to memory lapse, inadequate estimation of the portion sizes recorded in household measures to gram weight for analysis, altering the records for simplification (or) pleasing the investigator may be considered as the drawback or limitation of the present study.

Our current research is investigating prospectively the influence of the diet in aggravating asthmatic condition in adults suffering from asthma. We believe the time may be close for consideration of intervention trials. These should probably be based on dietary advice to increase specific food items (e.g. fruit and vegetables) and nutrient intake. Thus the findings are consistent with previous studies in adults and with the hypothesis that change in diet has been a determinant of increases in asthma and allergies.

Statement of Authorship

Each author has participated sufficiently, intellectually or practically, in the work to take public responsibility for the content of the article, including the conception, design, and conduction of the experiment and for data interpretation. Dr. Priyanka Jain carried out the study, performed the statistical analysis and drafted the manuscript. Dr. Rachna Mishra participated in the design and coordination of the study, and helped to draft the manuscript. Dr. Surya Kant conceived designed and coordinated the study and revised the manuscript critically.

Acknowledgements

We gratefully acknowledge the Indian Council of Medical Research (ICMR), New Delhi for research grant (grant no. 5/9/49/2006-RHN). All the authors mentioned have made substantial contribution. Dr. Priyanka Jain, Dr. Rachna Mishra the conception and design of the study or acquisition of data, or analysis and interpretation of data, drafting the article or revising it critically for important intellectual content and Dr. Surya Kant for final approval of the version to be submitted.

References

1 World Health Organization (WHO) (2016) Asthma Fact sheet N°307.

2 Kelly FJ, Fussell JC (2011) Air pollution and airway disease. Clin Exp Allergy 41: 1059-1071.

3 Miller RL, Ho SM (2008) Environmental epigenetics and asthma: current concepts and call for studies. Am J Resp Crit Care Med 177: 567-573.

4 Aggarwal AN, Chaudhry K, Chhabra SK, Souza AD, Gupta D, et al. (2006) Prevalence and Risk Factors for Bronchial Asthma in Indian Adults: A Multicentre Study. Indian J Chest Dis Allied Sci 48: 13-22.

5 Global Burden of Disease Study 2013, Collaborators (2015) Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 386: 743-800.

6 Jindal SK (2011) Textbook of pulmonary and critical care medicine. New Delhi: Jaypee Brothers Medical Publishers p: 242.

7 Thomson NC, Spears M (2005) The influence of smoking on the treatment response in patients with asthma. Curr Opin Allergy Clin Immunol 5: 57-63.

8 Nurmatov U, Devereux G, Sheikh A (2011) Nutrients and foods for the primary prevention of asthma and allergy: Systematic review and meta-analysis. J Allergy Clin Immunol 127: 724-733.

9 Cruz AA (2007) Global surveillance, prevention and control of chronic respiratory diseases: a comprehensive approach. World Health Organization.

10 Raviv S, Smith LJ (2010) Diet and asthma. Curr Opin Pulmon Med 16: 71-76.

11 Scott HA, Gibson PG, Garg ML, Wood LG (2011) Airway inflammation is augmented by obesity and fatty acids in asthma. Eur Resp J 38: 594-602.

12 Jones JM (2002) The methodology of nutritional screening and assessment tools. J Hum Nutr Diet 15: 59-71.

13 Jeejeebhoy KN (1994) Clinical and functional assessments. In: Shils ME, Olson JA, Shike M, Eds. Modern Nutrition in Health and Disease, 8th ed. Philadelphia: Lea and Febiger pp: 805-811.

14 Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, et al. (2008) What is subjective global assessment of nutritional status? Classical Article Nutr Hosp 23: 400-407.

15 http://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf

16 Metropolitan Life Insurance Company (1983) New weight standard for men and women. Stat Bull Metrop Life Found 64: 1-4.

17 Patro BK, Jeyashree K, Gupta PK (2011) Kuppuswamy's Socioeconomic Status Scale 2010-The Need for Periodic Revision. Indian J Pediatr.

18 American Thoracic Society (1987) Standards for the diagnosis and care of patients with chronic obstructive pulmonary disease (COPD) and asthma. Am Rev Respir Dis 16: 225-244.

19 American Thoracic Society (1995) Standardization of spirometry-1994 update. Am J Respir Crit Care Med 152: 1107-1136.

20 Jain P, Kant S, Mishra R (2011) Perception of dietary food items as food allergens in asthmatics individuals in north Indian population. J Am Coll Nutr 30: 274-283.

21 Thompson FE, Subar AF (2015) Dietary assessment methodology national cancer institute, Bethesda, Maryland Chapter 1, pp: 3-22.

22 Gopalan C, Rama Sastri BV, Balasubramanian SC (1989) Food composition tables. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India pp: 45-91.

23 Chen Y, Dales R, Jiang Y (2006) The association between obesity and asthma is stronger in nonallergic than allergic adults chest 130: 890-895.

24 Liu T, Valdez R, Yoon PW, Crocker D, Moonesinghe R, et al. (2009) The association between family history of asthma and the prevalence of asthma among US adults: National health and nutrition examination survey, 1999-2004. Genet Med 11: 323-328.

25 Elward, Douglas G, Kurtis S (2010) Asthma. London: Manson Pub pp: 27-29.

26 Martinez FD (2007) Genes, environments, development and asthma: a reappraisal. Eur Resp J 29: 179-184.

27 Varraso R, Siroux V, Maccario J, Pin I, Kauffmann F, et al. (2005) Asthma Severity Is Associated with Body Mass Index and Early Menarche in Women Am J Respir Crit Care Med 171: 334-339.

28 Hublet A, De Bacquer D, Boyce W, Godeau E, Schmid H, et al. (2007) Smoking in young people with asthma. J Public Health 29: 343-349.

29 Schachter L, Salome C, Peat J, Woolcock A (2001) Obesity is a risk factor for asthma and wheeze but not airway hyperresponsiveness. Thorax 56: 4-8.

30 Mohamed MS (2008) Assessment of nutritional status of adult patients with asthma. Pak J Nutr 7: 266-272.

31 Shore SA (2008) Obesity and asthma: possible mechanisms. J Allergy Clin Immunol 121: 1087-1093.

32 Vortmann M, Eisner MD (2008) BMI and health status among adults with asthma. Obesity 16: 146-152.

33 Flaherman VG, Rutherfpord W (2006) A meta analysis of the effect of high weight on asthma. Arch Dis Childhood 91: 334-339.

34 Figueroa-Muñoz JI, Chinn S, Rona RJ (2001) Association between obesity and asthma in 4-11 year old children in the UK. Thorax 56: 133-137.

35 Sood A, Ford ES, Camargo CA (2006) Association between leptin and asthma in adults. Thorax 61: 300-305.

36 Brehm JM, Celedón JC, Soto-Quiros ME, Avila L, Hunninghake GM, et al. (2009) Serum vitamin D levels and markers of severity of childhood asthma in Costa Rica. Am J Respir Crit Care Med 179: 765-771.

37 Al Obaidi AHA, Aky J, Al Samarai AGM, Al Janabi JM (2007) Biochemical Changes in Patients with Asthma. J Clin Diagn Res 1: 396-403.

38 Boyd JH, Macklin EA, Strunk RC, DeBaun MR (2006) Asthma is associated with acute chest syndrome and pain in children with sickle cell anemia. Blood 108: 2923-2927.

39 Lewis SA, Pavord ID, Stringer JR, Knox AJ, Weiss ST, et al. (2001) The relation between peripheral blood leukocyte counts and respiratory symptoms, atopy, lung function, and airway responsiveness in adults. CHEST J 119: 105-114.

40 Guill MF (2004) Asthma update: clinical aspects and management. Pediatr Rev/American Academy of Pediatrics 25: 335.

41 Jacobsen EA, Ochkur SI, Lee NA, Lee JJ (2007) Eosinophils and asthma. Curr Allergy Asthma Rep 7: 18-26.

42 Zuberbier T, Edenharter G, Worm M, Ehlers I, Reimann S, et al. (2004) Prevalence of adverse reactions to food in Germany-a population study. Allergy 59: 338-345.

43 Satwani H, Rehman A, Ashraf S, Hassan A (2009) Is serum total IgE levels a good predictor of allergies in children? JPMA.

44 Ozol D, Koca C, Mete E, Yigitoglu R (2008) Influence of atopy on asthma severity in adult female patients. J Investig Allergol Clin Immunol 18: 36.

45 Kabesch M, Schedel M, Carr D, Woitsch B, Fritzsch C, et al. (2006) IL-4/IL-13 pathway genetics strongly influence serum IgE levels and childhood asthma. J Investig Allergol Clin Immunol 117: 269-274.

46 Gould HJ, Sutton BJ (2008) IgE in allergy and asthma today. Nat Rev Immunol 8: 205-217.

47 Barnes PJ (2008) Immunology of asthma and chronic obstructive pulmonary disease. Nat Rev Immunol 8: 183-192.

48 Venables KM, Chan-Yeung M (1997) Occupational asthma. The Lancet 349: 1465-1469.

49 Chandra RK (1990) The relation between immunology, nutrition and disease in elderly people. Age Ageing 19.

50 Kuzuya M, Kanda S, Koike T, Suzuki Y, Iguchi A (2005) Lack of correlation between total lymphocyte count and nutritional status in the elderly. Clin Nutr 24: 427-432.

51 Lusuardi M, De Benedetto F, Paggiaro P, Sanguinetti C M, Brazzola G, et al. (2006) A randomized controlled trial on office spirometry in asthma and COPD in standard general practice: data from spirometry in asthma and COPD: a comparative evaluation Italian study. CHEST J 129: 844-852.

52 Brouwer AF, Roorda RJ, Brand PL (2006) Home spirometry and asthma severity in children. Eur Respir J 28: 1131-1137.

53 Hynninen MJ (2007) Factors affecting health status in COPD patients with co-morbid anxiety or depression. Int J Chron Obstruct Pulmon Dis 2: 323-328.

54 Coultas DB, Mapel D, Gagnon R, Lydick EVA (2001) The health impact of undiagnosed airflow obstruction in a national sample of United States adults. Am J Respir Crit Care Med 164: 372-377.

55 Woods RK, Walters EH, Raven JM, Wolfe R, Ireland PD, et al. (2003) Food and nutrient intakes and asthma risk in young adults. Am J Clin Nutr 78: 414-421.

56 Chang HH, Chen CS, Lin JY (2009) High dose vitamin C supplementation increases the Th1/Th2 cytokine secretion ratio, but decreases eosinophilic infiltration in bronchoalveolar lavage fluid of ovalbumin-sensitized and challenged mice. J Agric Food Chem 57: 10471-10476.

57 Farchi S, Forastiere F, Agabiti N, Corbo G, Pistelli R, et al. (2003) Dietary factors associated with wheezing and allergic rhinitis in children. Eur Respir J 22 : 772-780.

58 Hemilä H (2014) Vitamin C and asthma. J Allergy Clin Immunol 134: 1216.

59 Shaheen SO, Sterne JA, Thompson RL, Songhurst CE, Margetts BM, et al. (2001) Dietary antioxidants and asthma in adults: population-based case-control study. Am J Respir Crit Care Med 164: 1823-1828.

60 Allan K, Devereux G (2011) Diet and asthma: nutrition implications from prevention to treatment. J Am Diet Assoc 111: 258-268.

61 Calder PC (2006) n−3 polyunsaturated fatty acids, inflammation, and inflammatory diseases. Am J Clin Nutr 83: S1505-S1519.

62 Kim JH, Ellwood PE, Asher MI (2009) Diet and asthma: looking back, moving forward. Respir Res 10: 49.

63 McLachlan CR, Poulton R, Car G, Cowan J, Filsell S, et al. (2007) Adiposity, asthma, and airway inflammation. J Allergy Clin Immunol 119: 634-639.

64 Sutherland TJ, Cowan JO, Young S, Goulding A, Grant AM, et al. (2008) The association between obesity and asthma: interactions between systemic and airway inflammation. Am J Respir Crit Care Med178: 469-475.

65 Huang SL, Pan WH (2001) Dietary fats and asthma in teenagers: analyses of the first Nutrition and Health Survey in Taiwan. Clin Exp Allergy 31: 1875-1880.

66 Epler E (1992) Estimated energy, protein and fluid requirements In: Manual of Nutritional Care (4th edn.). Vancouver BC, British Columbia Dieticians' and Nutritionists Association pp: 89-96.

67 Shirodkar M, Mohandas KM (2005) Subjective global assessment: a simple and reliable screening tool for malnutrition among Indians. Indian J Gastroenterol 24: 246.