International Journal of Contemporary Pediatrics
Dash DK et al. Int J Contemp Pediatr. 2017 Jan;4(1):215-221
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20164607

Original Research Article

Association of dietary pattern on asthma and allergic disorders: an observational hospital based study

Dillip Kumar Dash*, Mrutunjaya Dash, Bibhudatta Dash, Mamata Devi Mohanty, Swarup Kumar Bisoi

Department of Pediatrics, IMS and SUM Hospital, Bhubaneswar, Odisha, India

Received: 31 October 2016
Accepted: 28 November 2016

***Correspondence:**
Dr. Dillip Kumar Dash,
E-mail: drdillipdash10.10@gmail.com

ABSTRACT

Background: Asthma is an increasing global health burden, especially in the western world but now a day not uncommon in developing countries like India. With rapid changes in diet being one of the hallmarks of westernization, nutrition may play a key role in affecting the complex genetics and developmental pathophysiology of asthma. People consume a combination of foods from various groups that form a dietary pattern. Studying the role of dietary patterns in asthma is an important emerging area of research. The aim of this study was to review dietary patterns and asthma outcomes in children, also to maternal diet and child asthma. With all the studies that have been undertaken, some clearly state the protective effects/adverse effects of certain foods, while others deepen the dilemma. The objective of this study was to establish association between dietary habits and Asthma (and allergic disorders) in children.

Methods: A questionnaire obtained from the International study for Asthma and Allergy in Children questionnaire was used to evaluate the dietary habits and disease status of the 834 children attending to pediatrics OPD/IPD for varying disease condition of eastern Odisha region over a period of 2 years. Children aged 4 to14 years with diagnosis of asthma were eligible for the study. The clinical criteria for diagnosis of asthma were based on the recommendations of the British Thoracic Society Guidelines, October 2014. The diagnosis of asthma was made if all the following criteria were met: (i) recurrent episodes (>3) of one or more of the following symptoms - wheeze, cough, breathing difficulties and chest tightness, particularly at night or in the early hours of the morning; (ii) respiratory symptoms improve spontaneously or after treatment (bronchodilators with or without corticosteroids); (iii) presence of triggers or aggravating factors such as exposure to allergens or irritants, physical exercise, weather changes or emotional stress; and (iv) personal history of atopy (allergic rhinitis or eczema) and/or family history of atopy (asthma, allergic rhinitis or eczema) in first-degree relatives. The children/ parental had to fill the questionnaire under teachers' guidance.

Results: Present study reveals asthma and allergic disorders were more prevalent in those consuming a lacto ovo vegetarian diet. Other significant association was seen with Junk food {significantly correlated (OR: 1.643, P <0.005)}, positive family history (P < 0.005) and as well as with obesity (P < 0.005).

Conclusions: Although it is common belief that vegetarians are less affected by asthma and other allergic disorder which is backed up by numerous previous studies which reveals a vegetarian diet to be protective against asthma. But our study shows a different picture. The school of thought that considers vegetarian diet tobe 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, Non-vegetarian

INTRODUCTION

Asthma, particularly among children, has grown in prevalence and as a worldwide public health burden, but simultaneously needs urgent public health interventions. A diet rich in antioxidant mainly Vitamin C, Vitamin E, Vitamin D, lycopene, manganese, beta carotene, selenium 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.[1-3] Therefore, if the diet is supplemented with these ingredients since childhood asthma can be prevented.[9,10,12] Others have inconclusive results as far as the role of dietary pattern in asthma prevention and treatment is concerned.[14,16] Although there have been numerous studies more population based study are required to established the association asthma, allergy and diet. 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 non-vegetarians. The diet of people varies in Odisha from the districts to districts. Our study is concerned about 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. Genetic factors alone cannot responsible for the rapid increase in the prevalence of asthma.[6] It has been hypothesized this increase is largely caused by environmental changes (e.g. urbanization) and modification of lifestyle behaviors (e.g. dietary transition).[8] Interestingly, the transition from a traditional to a modern diet is characterized by an increased intake of preserved foods, salt, refined sugar, and saturated fat, and a decreased intake of fruit, vegetables, milk, and dietary fiber.[11]

METHODS

This study is a hospital based observational study. The study is a questionnaire based evaluation among children. The questionnaire is used from the International study for Asthma and Allergy Diseases in Childhood (ISAAC) Questionnaire.[18]

ISAAC was an epidemiological study following a survey of 2 million children worldwide to evaluate the prevalence of atopic disease in various ethnic backgrounds. The Q is self-reported by parents and children to evaluate asthma, allergic rhinitis and eczema in childhood. Link to the questionnaire (if available) http://isaac.auckland.ac.nz/resources/tools.php?menu=tools1. It was also structured to analyse the environment factor association with allergy i.e. Pollution, pet ownership and passive smoking. The validity of the ISAAC questionnaire was well documented in previous studies.

After discussing the topic of asthma and allergy with the children and the parent's questionnaires were distributed to the children. The questionnaire was then filled by the children under the guidance of their parents. Children having an evidence of physician diagnosed asthma were considered asthmatic for the purpose of this study. A vegetarian diet included vegetables and dairy products and egg (lacto ovo vegetarian diet) and a non-vegetarian diet mainly included mutton, pork, chicken, lamb, beef, and 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.

RESULTS

A total of 834 children were enrolled in the study with a mean age 9.12±1.82 years (Table 4). A total of 366 children was asthmatic (physician diagnosed) and 468 were non-asthmatic with a mean age of 10.38±1.01 years and 9.04±1.24 respectively (Table 1).

Table 1: Association between dietary habits and asthma.

Dietary habit	Asthmatics	Non asthmatics	Total	% asthmatics in vegetarian	% asthmatics in non-vegetarian
Vegetarian	200	98	298	67.11 (p value<0.005)	30.97 (p value>0.005)
Non vegetarians	166	370	536		
Total	**366**	**468**	**834**		

Table 2: association between dietary habits and asthma in family.

Family	Asthmatics	Non asthmatics	Total	% Family asthmatics in vegetarian	% Family asthmatics in non-vegetarian
Vegetarians	105	221	326	32.20 (P value<0.005)	14.96 (P value>0.005)
Non vegetarians	76	432	508		
Total	**181**	**653**	**834**		

Among the asthmatics, a total of 200(67.11%) were vegetarians, and 98 (30.97%) were non-vegetarians (Table 1). Asthma was found to be significantly associated with a vegetarian diet (lacto ovo vegetarian) with P <0.005%. With regards to other parameters, a positive family history was significantly associated with asthma, with 32.20% of children having a positive family history (P < 0.005%) (Table 2).

Table 3: Association between patient characteristics variables and asthma severity.

Variables		Asthmatics	Non asthmatics	Total	% Asthmatics in selected variable groups	% non-Asthmatics in selected variable groups	P value
Family history		181	653	834	32.20	14.96	(P value<0.005)
Pet owner ship		104	66	232	61.17	38.82	(P value<0.005)
Passive smoking		88	43	131	67.15	32.82	(P value<0.005)
Fast food		302	104	-	74.38	25.61	(P value<0.005)
BMI	>25	178	54	-	76.72	23.27	(P value<0.005)
	18-24	240	258	498	48.19	51.80	(P value>0.005)
	<18	70	44	121	61.40	38.59	(P value>0.005)

Table 4: Characteristics of the study population.

Age in year	Sex		Total	% Asthmatics in selected variable groups
	Male	Female		
4-7	146	111	256	30.69
8-10	256	165	421	50.47
11-14	72	85	157	18.82

Table 5: Association between patient characteristics variables and asthma.

Variables	Asthmatics	Non asthmatics	Total	% Asthmatics in selected variable groups	% Non-asthmatics in selected variable groups	P value
Maternal smoking	22	10	32	68.75	31.25	(P value<0.005)
Gestational age <37 weeks	106	56	162	65.43	34.56	(P value<0.005)
Birth weight <2.5 kg	147	76	223	65.91	34.08	(P value>0.005)
Maternal education (under matric)	146	130	276	52.89	47.10	(P value>0.005)
Paternal education (under matric)	74	68	142	52.11	47.88	(P value>0.005)
Obesity	166	38	204	81.37	18.62	(P value<0.005)

In this study the consumption of fast food was significantly associated with asthma (P <0.005%).

Present study showing consistently the positive correlation between obesity (BMI>25%), Maternal smoking, preterm delivery, passive smoking and asthma (p<0.005) (Table 3 and 5). Percentage association in specific food consumption group with asthma is depicted in Table 6.

DISCUSSION

Seaton et al hypothesized that alteration in diet associated with westernization may be responsible for the increase in asthma prevalence.[13] Asthma is complex: comprised of a heterogeneous variety of diseases, initiated by different genetic and environmental factors, and unified by common symptoms such as airway constriction and wheeze.[15] Diet could modulate epigenetics, intestinal micro biota, physiological development, airway

remodeling, and immune maturation - factors highly relevant to the etiology of asthma. Despite all the facts literature on diet and asthma is scanty and hard to summarize in a systematic way.[17] Devereux et al found that increased maternal intake of vitamin E was associated with decreased proliferation of cord blood mononuclear cells in response to allergens, suggesting a beneficial effect of maternal nutrition against atopy.[19] Probiotics are dietary supplements that contain beneficial bacteria such as lactobacillus GG and may be effective in preventing early atopy in children through the modulation of intestinal micro biota and enhance IgA responses in the gut.[21,23]

Table 6: Association between dietary habits and asthma.

Food consumption >3/ weeks	Asthmatics	Non asthmatics	Total	% Asthmatics in selected food consumer group	% Non-asthmatics in selected food consumer group	P- value
Milk	204	230	434	47.00	52.99	>0.005
Vegetable	326	208	534	61.04	38.95	<0.005
Meat	34	48	82	41.46	58.53	>0.005
Fish	76	84	160	47.50	52.50	>0.005
Egg	85	60	145	58.62	41.37	<0.005
Soft drink	92	104	196	46.93	53.06	>0.005
Pulses	279	255	534	52.24	47.75	>0.005
Root	142	156	298	47.65	52.34	>0.005
Cereal	316	298	614	51.46	48.53	>0.005
Butter	98	88	186	52.68	47.31	>0.005
Nuts	112	117	229	48.90	51.09	>0.005

Moving beyond individual country studies, Ellwood et al conducted an ecological analysis on data from centers in 53 countries the International Study of Asthma and Allergies in Childhood (ISAAC), which not only looked at single countries, but also compared diet and asthma globally using asthma prevalence data from ISAAC and dietary data from the Food and Agriculture Organization of the United Nations.[25] Together, these data suggested an inverse relationship between asthma prevalence rates and intake of vegetables and foods of plant origin such as starch and cereals. However, a smaller study of dutch children found no clear association between fruit and vegetable intake and asthma symptoms.[27]

Despite a lot of cross-sectional data about fruits and vegetables, there is a lack of longitudinal studies to analyses a causal link between these foods and asthma prevalence. Obesity is a major factor of diet that may have a role in asthma. Its role has been controversial as, yet again, different studies have found contradicting results.[30] Epidemiologic studies have suggested that asthma is more prevalent among obese than lean individuals. It is unclear, however, whether obesity merely exacerbates the asthmatic symptoms, creates susceptibility to onset of asthma, or develops concurrently with the respiratory disease. Obesity could have potential biological effects on lung function and systematic inflammation while also sharing certain co-morbidities and etiologies with asthma.[32] The study done in China where no positive association was found between asthma and overweight subjects.[41]

In Western countries, overweight and smoking are positively related to asthma.[35] However, in studies on Asian children, no significant association has been obtained between asthma and obesity as well as smoking.[36] Nevertheless, the relationship between obesity and asthma remains an enigma despite several evidence. The study was carried out in china 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).[19] 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. Observations showed that consumption of foods rich in antioxidants had decreased in the United Kingdom diet while asthma prevalence rose. Thus the promising hypothesis was put forth that populations had become more susceptible to respiratory

disease due to dietary antioxidant omission. Recently, an association between dietary patterns and newly diagnosed chronic obstructive pulmonary disease (COPD) was reported in a large cohort of males and females in the USA.[38] "Prudent" pattern (high intake of fruits, vegetables, fish and whole grain products) was associated with a decreased risk, whereas a "Western" pattern (high intake of refined grains, cured and red meats, desserts and French fries) was associated with an increased risk.[38] As far as our study is concerned, there clearly exists a positive correlation between the lacto ovo vegetarian diet (wheat flour, rice, vegetables, eggs, and dairy products) and asthma with a $P < 0.005$ .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 numerous 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 non-vegetarian 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.[11,14]

However, not all studies on the role of antioxidants have been positive. A meta-analysis determined that dietary intake of antioxidants vitamins C and E and β-carotene does not significantly influence the risk of asthma.[29] A questionnaire based study was done among 2258 children of Taiwan, which compared the association of atopy, allergic rhinitis, and wheezing with non-vegetarian, moderately vegetarian and strictly vegetarian diets.[20] The study depicted increased history of rhinitis and increased prevalence diagnosed rhinitis (65.3% versus 59.1% and 35.1% versus 25.5%, P 0.05) in those consuming vegetarian diets. Furthermore, as depicted by a study antioxidants may be related to increased incidence of asthma and allergic disease.[34]

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. 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.[20] 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. There was also significant association between pet ownership and asthma in our study ($P < 0.005$). The results are contradictory to a study conducted in 75 asthmatic and 75 non-asthmatic school children of Serbia, demonstrated no increased risk of asthma in those children who had a cat/dog as pets.[40]

This may be related to the development of tolerance to the antigen on prolonged exposure much similar to the "hygiene hypothesis." 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 evaluated in a study and were found out to be 5.3% to 7.59% children were found to have asthma (in the last 12 months) and 8.4% wheezing in the past 1 year.[39] Our study not supports what most studies say regarding the association between diet and asthma. The controversy regarding association between diet and asthma is present since a long, and this need vast large scale population based researches in our country. The importance of our study is that it unveils the common belief of non-vegetarian have an associated with asthma and other allergic disorder.

CONCLUSION

In view of common perception that non-vegetarian diet is more associated with allergic disorder our study pointed out the other side of the coin i.e. vegetarian diet. Although it is a questionnaire based study & more population based study is required to corroborate the findings of our study to stand by it. It questions the common belief that a non-vegetarian diet predisposes us to the development of allergic diseases. The correlation being significant in the present study, it prompts us to look at the significance of vegetarian diet also.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Masoli M, Fabian D, Holt S, Beasley R. Global initiative for asthma (GINA) program the global burden of asthma: executive summary of the GINA dissemination committee report. Allergy. 2004;59(5):469-78.
2. Asher MI, Montefort S, Bjorksten B, Lai CK, Strachan DP, Weiland SK, Williams H. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC phases one and three repeat

multicountry cross-sectional surveys. Lancet. 2006;368(9537):733-43.
3. Greer FR, Sicherer SH, Burks AW. Effects of early nutritional interventions on the development of atopic disease in infants and children: the role of maternal dietary restriction, breastfeeding, timing of introduction of complementary foods, and hydrolyzed formulas. Pediatr. 2008;121(1):183-91.
4. British Thoracic Society. British Guideline on the Management of Asthma, 2014. Available at https://www.brit-thoracic.org.uk/document-library/clinical-information/asthma/btssign-asthma-guideline-quick-reference-guide-2014/.
5. Hoffmann PR. Selenium and asthma: a complex relationship. Allergy. 2008;63:854-6.
6. Skadhauge LR, Christensen K, Kyvik KO, Sigsgaard T. Genetic and environmental influence on asthma: a population-based study of 11,688 Danish twin pairs. Eur Respir J. 1999;13(1):8-14.
7. Molinas LJ, Zapata EM. Frequency of sea fish consumption and symptoms of allergic diseases in adults from Rosario. Rev Esp Nutr Comunitaria. 2010;16:120-7.
8. Kim JH, Ellwood PE, Asher MI. Diet and asthma: looking back, moving forward. Respir Res. 2009;10:49.
9. Devereux G. Session 1: allergic disease: nutrition as a potential determinant of asthma. Proc Nutr Soc. 2010;69:1-10.
10. McKeever TM, Lewis SA, Cassano PA, Ocké M, Burney P, Britton J, et al. Patterns of dietary intake and relation to respiratory disease, forced expiratory volume in 1 s, and decline in 5 years forced expiratory volume. Am J Clin Nutr. 2010;92:408 15.
11. Torres-Borrego J, Moreno-Solis G, Molina-Teran AB. Diet for the prevention of asthma and allergies in early childhood: much ado about something? Allergol Immunopathol (Madr). 2012;40(4):244-52.
12. Varraso R, Kauffmann F, Leynaert B, Le Moual N, Boutron Ruault MC, Clavel Chapelon F, et al. Dietary patterns and asthma in the E3N study. Eur Respir J. 2009;33:33-41.
13. Seaton A, Godden DJ, Brown K. Increase in asthma: a more toxic environment or a more susceptible population? Thorax. 1994;49(2):171-4.
14. Hooper R, Heinrich J, Omenaas E, Sausenthaler S, Garcia Larsen V, Bakolis I, et al. Dietary patterns and risk of asthma: results from three countries in European Community Respiratory Health Survey II. Br J Nutr. 2010;103:1354-65.
15. Holgate ST. Pathogenesis of asthma. Clin Exp Allergy. 2008;38(6):872-97.
16. Bakolis I, Hooper R, Thompson RL, Shaheen SO. Dietary patterns and adult asthma: population based case control study. Allergy. 2010;65:606-15.
17. Tricon S. Nutrition and allergic disease. Clin Exp Aller Rev. 2006;6(5):117-88.
18. Isaac NP. Background and methods. Eur Resp Journal. 1996;9:410.
19. Devereux G, Barker RN, Seaton A. Antenatal determinants of neonatal immune responses to allergens. Clin Exp Allergy. 2002;32(1):43-50.
20. Huang SL, Lin KC, Pan WH. Dietary factors associated with physician diagnosed asthma and allergic rhinitis in teenagers: analyses of the first nutrition and health survey in Taiwan. Clin Exp Allergy. 2001;31:259-64.
21. Kalliomaki M, Salminen S, Arvilommi H, Kero P, Koskinen P, Isolauri E. Probiotics in primary prevention of atopic disease: a randomised placebo-controlled trial. Lancet. 2001;357(9262):1076-9.
22. Burns JS, Dockery DW, Neas LM, Schwartz J, Coull BA, Raizenne M, et al. Low dietary nutrient intakes and respiratory health in adolescents. Chest. 2007;132:238-45.
23. Penders J, Stobberingh EE, Brandt PA, Thijs C. The role of the intestinal microbiota in the development of atopic disorders. Allergy. 2007;62(11):1223-36.
24. Kawai M, Hirano T, Higa S, Arimitsu J, Maruta M, Kuwahara Y, et al. Flavonoids and related compounds as anti-allergic substances. Allergol Int. 2007;56:113-23.
25. Ellwood P, Asher MI, Bjorksten B, Burr M, Pearce N, Robertson CF. Diet and asthma, allergic rhino-conjunctivitis and atopic eczema symptom prevalence: an ecological analysis of the International Study of Asthma and Allergies in Childhood (ISAAC) data. ISAAC Phase One Study Group. Eur Respir J. 2001;17(3):436-43.
26. Sackesen C, Ercan H, Dizdar E, Soyer O, Gumus P, Tosun BN, et al. A comprehensive evaluation of the enzymatic and nonenzymatic antioxidant systems in childhood asthma. J Allergy Clin Immunol. 2008;122:78-85.
27. Tabak C, Wijga AH, de Meer G, Janssen NA, Brunekreef B, Smit HA. Diet and asthma in dutch school children (ISAAC-2). Thorax. 2006;61(12):1048-53.
28. Kalayci O, Besler T, Kilinç K, Sekerel BE, Saraçlar Y. Serum levels of antioxidant vitamins (alpha to copherol, beta carotene, and ascorbic acid) in children with bronchial asthma. Turk J Pediatr. 2000;42:17-21.
29. Gao J, Gao X, Li W, Zhu Y, Thompson PJ. Observational studies on the effect of dietary antioxidants on asthma: a meta-analysis. Respirol. 2008;13(4):528-36.
30. Garcia-Marcos L, Canflanca IM, Garrido JB, Varela AL, Garcia-Hernandez G, GuillenGrima F, et al. Relationship of asthma and rhino-conjunctivitis with obesity, exercise and mediterranean diet in Spanish schoolchildren. Thorax. 2007;62(6):503-8.
31. Kaur B, Rowe BH, Ram FS. Vitamin C supplementation for asthma. Cochrane Database Syst Rev. 2001;4:CD000993.
32. Shore SA. Obesity and asthma: possible mechanisms. J Allergy Clin Immunol. 2008;121(5):1087-93.

33. Trenga CA, Koenig JQ, Williams PV. Dietary antioxidants and ozone induced bronchial hyper responsiveness in adults with asthma. Arch Environ Health. 2001;56:242-9.
34. Murr C, Schroecksnadel K, Winkler C, Ledochowski M, Fuchs D. Antioxidants may increase the probability of developing allergic diseases and asthma. Med Hypotheses. 2005;64:973-7.
35. Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma: a meta-analysis of prospective epidemiologic studies. Am J Respir Crit Care Med. 2007;175:661-6.
36. Henkin S, Brugge D, Bermudez OI, Gao X. A case control study of body mass index and asthma in Asian children. Ann Allergy Asthma Immunol. 2008;100:447-51.
37. Bidad K, Anari S, Tavasoli S, Nazemi L, Moayeri H. Dietary intakes in asthmatic and non-asthmatic female pupils of Tehran. Acta Med Iran. 2011;49:468-71.
38. Varraso R, Fung TT, Hu FB, Willett W, Camargo CA. Prospective study of dietary patterns and chronic obstructive pulmonary disease among US men. Thorax 2007;62:785-90.
39. Varraso R, Fung TT, Barr RG, Hu FB, Willett W, Camargo CA Jr. Prospective study of dietary patterns and chronic obstructive pulmonary disease among US women. Am J ClinNutr 2007;86:488–495.
40. Sharma BS, Kumar MG, Chandel R. Prevalence of asthma in urban school children in Jaipur, Rajasthan. Indian Pediatr. 2012;49:835-6.
41. Medjo B, Atanaskovic Markovic M, Nikolic D, Spasojevic Dimitrijeva B, Ivanovski P, Djukic S. Association between pet keeping and asthma in school children. Pediatr Int. 2013;55:133-7.
42. Shi Z, Yuan B, Wittert GA, Pan X, Dai Y, Adams R, et al. Monosodium glutamate intake, dietary patterns and asthmain Chinese adults. PLoS One. 2012;7:e51567.

Cite this article as: Dash DK, Dash M, Dash B, Mohanty MD, Bisoi SK. Association of dietary pattern on asthma and allergic disorders: an observational hospital based study. Int J Contemp Pediatr 2017;4:215-21.