

Nutritional Demand in Juvenile Asthmatics: A Procession

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ABSTRACT

Introduction: Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation. This review focuses on the impact of nutritional status in pediatric asthma patients, the role of dietary factors in the development and prevention of asthma and also focuses on the trends of nutrition status in various population and age groups.

Material and Methods: This literature review is based on the informations from IDIS (Iowa Drug Information Service), Delnet, Pubmed, Micromedex, Lexicomp and various other online databases during 2016-2017 period.

Results: Nutrition assessment in children is very important as it paves the way to reach the full physical and mental functioning in their lifetime. The current review concentrates mainly upon the influence of various nutrients on childhood asthma. The results from the studies in the review suggest that diet rich in fruits and vegetables have a lower risk of producing respiratory infections.

Conclusion: On the basis of these evidences, it is advisable to promote a well-balanced diet consist of fruits, vegetables, whole grain foods rich in vitamins, selenium, magnesium, flavonoids, polyunsaturated fatty acid to children.

Keywords: Asthma, Nutrition, Vitamins, Minerals, Fatty Acids, Breastfeeding

INTRODUCTION

Asthma is a chronic lung disease in which the prevalence shows a hiking range from 3-5% in pediatric population in India.^{1,2} The problem is quite higher in urban areas because of higher exposure to the environmental pollutants due to urbanization and industrialization than in rural areas.³ Studies shows that there is significant difference in prevalence is seen among boys with a linear trend in their raising age⁴ and it was observed that the prevalence is more observed in those with a positive family history and other risk factors.⁵ Several studies show evidence of environmental factors in the etiology of asthma and the role played by dietary factors in the pathogenesis of asthma such as antioxidant vitamins, minerals and fatty acids.⁶ The nutritional harmonization method helps to slowly reload different vitamins and minerals which renovate the immune response to stay away from the allergic reactions.

The anthropometric quantification of weight, height or length found to be the principle factors in evaluating the nutritional status and child growth for a better child care. Proper nutrition forms the core to achieve betterment in cradle lifetime.⁷ Malnutrition is a condition that shows an inadequate, misproportioned or an extreme utilization

of nutrients and is explicit in the form of undernutrition, overnutrition and micronutrient malnutrition, which forms an obstruction in childhood growth.⁸ India is considered as one of the highest ranking countries in having children with malnutrition and is ranked 20th place by the Global Hunger Index.⁹ In general, children in low-income families are at more risk of malnutrition than those in high-income families. When coming to the various socio-economic provinces, under-nutrition is more prevalent in rural areas than in urban areas. Overall, both sexes are equally likely to be malnourished.^{10,11} Therefore, the foremost aim is to perceive undernourished child at their early age of life in order to give them a better life.

The Indian Academy of Pediatrics (IAP) criteria were used to grade under-nutrition of children in India which shows three degrees of malnutrition: Grade I, Grade II, Grade III, and in addition recently Grade IV has been added. Another method is the use of z-score or SD (Standard Deviation) for grading undernutrition which is recommended by the WHO. This method classifies undernutrition as stunting, wasting, and severely undernourished.⁸ As India is in a stage of evolving nutrition trends, it is advisable to adopt newer techniques to withstand the malnutrition and thus, IAP and WHO recently forms a combined 'Boy's and Girl's 0-18 IAP and WHO combined charts height and weight' (Figures 1 and 2) which represents a most modern contemporary growth charts for use in Indian children.¹²

Nutrition Trends in Various Populations

A study conducted in five districts of south-west, west, north-west, north-east and northern region of Delhi reported 26.1% underweight, 42.2% stunted and 15.4% wasted children of less than 5 years of age. The gender inequalities in these regions cause a greater prevalence of malnutrition in females as they are deficient of healthy foods.¹³ Children belonging to slum areas of Allahabad, Uttar Pradesh are at greater exposure to under nutrition. The overall under nutrition in Varanasi was 63.97% and that of severe malnutrition was 5.24%.⁷ The medical camp in the Humla and Mugu district of Nepal shows 28.2% and 29.4% stunted children of less than 5 years of age, whereas, 22.4% and 29.4% thinness at the age of 5-15 years.¹⁴ The female children were more

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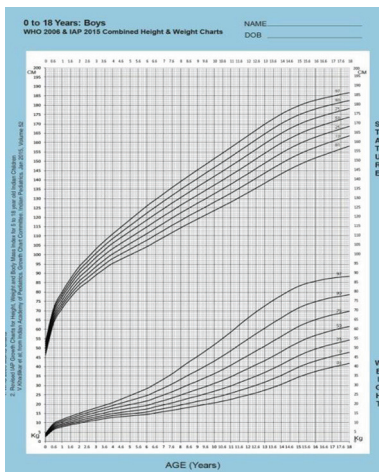


Figure-1: Boy's 0-18 Years IAP and WHO combined charts height and weight chart

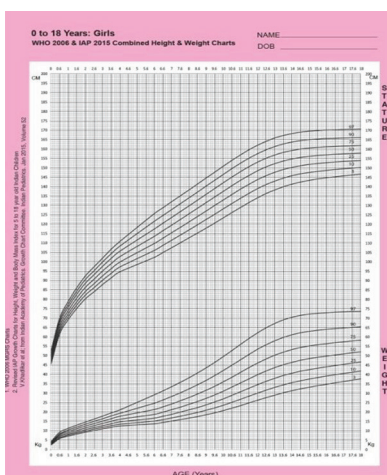


Figure-2: Girl's 0-18 Years IAP and WHO combined charts height and weight chart

undernourished in a West Bengal community based cross-sectional study. A 52.23% of various grades of malnutrition in children were reported in a cross-sectional study of urban slums of Nagpur in which the Grade IV under nutrition predominates only on females.¹⁵

A lowest percentage of underweight children according to z score are seen in Goa, Kerala and Punjab. The prevalence of malnutrition associated with anemia was 53.2% in pre-school children of rural areas of Kerala. Childhood obesity was seen in school children of Ernakulam district of Kerala from 2003-2005.

India establishes 3-5% of the global burden towards childhood asthma. About 139.45 billion Indian rupees has been estimated for the asthma treatment per year, while, it is 802.02 billion Indian rupees for nutrition deficiency management. From the last few years, nutrition appears to be the governing factor of asthma. Over one-third of child mortality is due to under-nutrition and is strongly associated with the increased severity of the disease. This much burden is seen in our society and that encouraged us to make a review on nutritional status assessment in pediatric asthma patients. This review focuses on the impact of nutritional status in pediatric asthma patients, the role of dietary factors in the

development and prevention of asthma and also focuses on the trends of nutrition status in various population and age groups.

MATERIAL AND METHODS

An extensive search of the scientific literature by using IDIS (Iowa Drug Information Service), Delnet, Pubmed, Micromedex, Lexicomp and various other online databases were performed to identify studies on the relationship between diet, asthma and nutritional status. Various research articles were collected based on the study subject and is reviewed for a period of three months. Each article was screened for relevant informations like nutrition, their sources and their role in pediatric asthma patients.

RESULTS

Vitamin C and Vitamin E

Reports from the previous studies shows that Vitamin C supplementation has an inverse effect on asthma severity and frequency, exercise-induced bronchospasm and airway responsiveness. Vitamin C protects against endogenous as well as exogenous oxidants by acting as a free radical scavenger present in intracellular and extracellular lung fluids. Whereas, Vitamin E which is present in extracellular lung fluid and lipid membrane abolish the neutrophil migration and arrest Ig-E production.

Vitamin A, Carotenoids

Vitamin A is a fat soluble vitamin, in which its deficiency causes asthma in both children and adults. Children with asthma had shown an increased cellular demand to retinol. Vitamin A / β -Carotene had a shielding effect on asthma by preventing lipid oxidation by their antioxidant action.

Flavonoids

Flavonoids and flavones are virgin antioxidants, which have the mast cell stabilizing property and is mostly seen in fruits and red wine. Flavonoids shows positive effect on asthma as it was a powerful antioxidant and anti-allergic nutrient that inhibit the release of chemical mediators, synthesis of Th2 type cytokines and inverse effect on chronic cough and breathlessness.

Magnesium

Some of the anti-asthmatic drugs pared down the magnesium levels in the body and in order to cope up with the asthmatic symptoms, magnesium itself shown to decrease their concentrations. So, the upping of magnesium level is thus beneficial for the better lung function in asthmatics. Magnesium has an inhibitory action on smooth muscle contraction and histamine release from mast cell and acetylcholine release from cholinergic nerve terminal. The magnesium produce bronchodilatory effect on intravenous administration in acute severe asthma.

Sodium and Potassium

Dietary sodium increases airway reactivity and cause bronchoconstriction. Dietary sodium causes fluid retention which causes inflammation whereas potassium contributes muscle strength in which its deficiency causes muscle

fatigue, weakening diaphragm muscle and ultimately leads to shallow and difficulty breathing. There exist a relationship between the potassium intake and asthma that an inclusion of more amount of potassium in diet helps to enhance lung function in children with asthma. But excessive potassium supplementation too causes breathing difficulty.

Selenium

Selenium is an important mineral which is strongly related to asthma in which selenium intake modulate oxidative stress in various tissues like lungs that decrease asthma pathology. Thus selenium deficiency has a greater possibility for producing asthma. A delay in selenium supplementation greatly influence the serum level in asthmatic patients.

Polyunsaturated Fatty Acid

The polyunsaturated fatty acid shunts the eicosanoid production from arachidonic acid pathway and thus decrease production of bronchoconstrictive leukotriene. The dietary fatty acid has a predominant role in asthma in which omega-3 fatty acid shows an advantageous and omega-6 fatty acid shows harmful effect on asthma.

Breastfeeding

A complete breastfeeding for about 3-4 months help to protect children from wheezing in early life and there exist a strong relationship between the timing of introduction of complementary foods and development of atopic diseases in children.

Fruits and Vegetables

There are some vitamins and minerals which are needed in the childhood diet in a certain amount and their major sources were found to be in fruits and vegetables (Table 1). A positive cross-sectional association was found between the higher fresh fruits and vegetables intake and prevalence of asthma. Higher amount of fruits and vegetables intake shows a rise in FEV₁. The antioxidant present in a range of fresh fruits and vegetables had a glowing effect toward asthma.

Whole Diet

A diet higher in fruits, vegetables and antioxidants was associated with positive lung function. A 'Mediterranean diet' is recommended as it has a positive effect on the

prevalence of asthma.

DISCUSSION

Various studies were conducted on effect of dietary factors like vitamins and minerals, which were abundantly seen in fruits, vegetables and other sources. The physiological importance of these nutrients and minerals in pediatric asthma patients were critically evaluated and reported in various studies conducted in various parts of the universe. From the results obtained from different studies, there were positive and negative correlation found with nutrition among pediatric asthma patients. The effect of Vitamin C, Vitamin E, Vitamin A/ β -carotene, Flavonoids, Magnesium, Sodium, Potassium, Selenium, Polyunsaturated fatty acid and Breastfeeding in pediatric asthma patients were studied as follows:

Vitamin C and Vitamin E

Many of the studies are focusing on the effect of antioxidant on pulmonary function. But some of the interventional studies provide no positive outcome with Vitamin C¹⁶ and Vitamin E¹⁷ on asthma. A case-control study on 118 asthma patients and 121 subjects found no significant difference between case and control on intake of Vitamin C and Vitamin E.¹⁸ A cross-sectional study shows a positive influence of antioxidant on pulmonary function by reporting that Vitamin C reduce the asthma symptoms and Vitamin E inversely associated with plasma Ig-E levels.¹⁹ Further studies also state that Vitamin C and Vitamin E had a positive influence on lung function. A low concentration of Vitamin C in blood serum can be seen in severe asthmatic patients when compared to mild and non-asthmatic. But in case of Vitamin E deficiency, it contributes about 40% childhood asthma and it was supported by the study on allergic rodent model which shows a decline in Vitamin E concentration in their result.²⁰

Vitamin A, Carotenoids

A cross sectional study in 35 asthmatic children follows a low serum Vitamin A level in severe persistent asthmatics as compared with mild intermittent asthma.²¹ The Morgen study had shown an encouraging evidence on FEV₁ with β -Carotene and thus β -Carotene shows a positive effect on lung function.²²

Dietary constituent	Source
Vitamin C	Papaya, guava, orange, grapes, lemon, mango, tomato, peas, cauliflower, dark green leafy vegetables like spinach
Vitamin E	Papaya, mango, wheat, almond, tomato, red chilli, spinach, the raw seed of sesame, pumpkin or sunflower
Vitamin A, Carotenoids	Grape, mango, watermelon, milk, sweet potato, carrot, coriander, tomato, pumpkin, green leafy vegetables, fish (tuna, salmon), liver (chicken/mutton)
Flavonoids	Lemon, orange, apple, berries, peas, soy beans, onions, red wine, tea, green tea, cocoa, dark chocolates, milk
Magnesium	Almond, banana, spinach, pumpkin seed, dark chocolates, yogurt, salmon
Selenium	Banana, orange, mango, grapes, whole-wheat bread, brown rice, oatmeal, pumpkin seed, sunflower seed, spinach, mushroom, pork, beef liver, chicken, egg, sardines tanned
Polyunsaturated fatty acid	Cloves, mustard seed, pumpkin seed, green beans, dark green leafy vegetable like spinach, sea foods like tuna and salmon, soy food, melon, pomegranate

Table-1: Various sources for vitamins and minerals

Flavonoids

Experimental studies conducted in animals with allergic asthma shown a reduction in airway inflammation and a lesser bronchoconstriction with the administration of flavanoids.⁶ A study conducted in ovalbumin immunized asthma model suppresses the eosinophilic inflammation upon oral administration of flavanoids.²³

Magnesium

A study on children shows a linear relationship of magnesium with lung function.²⁴ Lower administration of dietary magnesium had declined lung function and shown a negative effect on bronchial smooth muscle in severe asthmatics.⁶ But a prospective study showed a negative association between magnesium and lung function.²⁵

Sodium and Potassium

A case-control study in 154 Kenyan children believed that the intake of supplemental salt causes a 60% risk of asthma in children.²⁶ A low intake of potassium in asthmatic children shown to affect children airway flow and reduced lung function and the effect of lower sodium intake flows in opposite direction.²⁴

Selenium

The findings for selenium provides encouraging evidences in its protective effect towards lung function. But the issue of Thorax 2007, reported a negative effect of selenium on quality of life of asthmatic patients.²⁷

Polyunsaturated Fatty Acid

The fish oil supplements has a positive effect on the exercise-induced bronchoconstriction in asthma.²⁸ Thus there is a lower lifetime prevalence of wheezing is seen with fish intake. Consumption of fish was recommended in childhood asthmatics in order to reduce the prevalence of wheezing in them.¹⁹

Breastfeeding

Children who fed solids earlier produce asthma if they have positive family history. Exclusive breastfeeding for 4-6 months and thereafter solid introduction is recommended.²⁹ Prolonged and exclusive breastfeeding in children reduces the prevalence of asthma in children.³⁰

Fruits and Vegetables

Some of the studies arrived with a positive association between apple consumption and asthma. Children who consume 5 or more apples per week had higher FEV₁ since apples are a greater source of flavonoids and antioxidants they prevent lipid oxidation.²⁵ Thus there is strong evidence in protective effect of fruits and vegetables in respiratory health.

Whole Diet

A study was conducted to examine the impact of whole diet separately that gains a positive result and also report that a diet consist of fruits, alcohol and whole grain would have a greater beneficial effect.³⁰ Another study suggested that undernourished population can only have the benefit of dietary supplement so, it is advised to have a well balanced diet in asthmatic patient. Consumption of single nutrients

separately possess an independent beneficial effects and a diet meeting all of these would have a greater beneficial effect.²⁸

CONCLUSION

In conclusion, it was found that diet is associated with asthma but the causality of association cannot be confirmed because of the observational nature of most of the studies. The prevalence of malnutrition is relatively high and is varied among different populations. From the previous reports it was suggested that diet rich in fruits and vegetables have a lower risk of producing asthma and 'Mediterranean diet' provide protection against asthma. The revised most modern contemporary growth charts IAP and WHO combined growth charts could be used to measure the growth pattern of children in India where major changes in nutrition status has been witnessed. A long-term assessment of nutritional relevance among the pediatric population should be carried out to eradicate the possible dismissive nutritional health outcomes in childhood population.

ABBREVIATIONS

WHO, World Health Organization; SD, Standard Deviation; IAP, Indian Academy Of Pediatrics; IDIS, Iowa Drug Information System; Ig-E, Immunoglobulin E; FEV₁, Forced Expiratory Volume in 1 second; Th 2 cell, Type 2 T-helper cell; UK, United Kingdom

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