Vitamin D and asthma

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Abstract
Asthma is a common disease in Hong Kong. Vitamin D deficiency or insufficiency in early life may predispose children to preschool wheeze and reduced lung functions in adolescents. On the other hand, vitamin D supplement has been shown to be associated with atopy during adulthood. Paediatricians should be aware of the controversies between vitamin D and asthma in children.

Keywords: Asthma, Vitamin D

Asthma is common in Hong Kong, affecting up to 8 to 10% of children and adolescents.1 Multiple factors are related to the development and severity of asthma.2 Vitamin D deficiency is a worldwide health problem. It affects not only musculoskeletal health but also a range of acute and chronic diseases.3 A number of other diseases including asthma have been linked to vitamin D insufficiency.4

There are two sources of vitamin D: dietary intake and exposure to ultraviolet B light – the primary source. Ultraviolet B radiation activates precursor 7-dehydrocholesterol, which is converted in the liver to 25-hydroxyvitamin D (25[OH]D). 25[OH]D is believed to be converted to the active metabolite 1,25-dihydroxyvitamin D (1,25-[OH]2D) in the kidney but recent evidences suggest that most organs have the vitamin D receptor required to synthesize 1,25-[OH]2D.5 Serum 25[OH]D best reflects the vitamin status in the body. Deficiency can be defined by 25[OH]D level of less than 50 nmol/L.6,7 25[OH]D levels between 50-75 nmol/L are regarded as vitamin D insufficiency and levels between 75-100 nmol/L are regarded as normal.8

In vitro studies suggested that airway remodeling may be affected by vitamin D through different mechanisms. This included effect on growth and contractility, and inhibition on airway smooth muscle cell movement.9-11 Another in vitro study suggested that glucocorticoid bioavailability in bronchial smooth muscle cells were increased by vitamin D.12 Airway remodeling is an important feature of asthma. These data suggested that vitamin D may have an important role in the prevention and treatment of asthma.13

Vitamin D deficiency or insufficiency in early life may predispose children to pre-school wheezing. Mother with lower daily vitamin D intake had a higher risk of having a child with recurrent wheeze at the age of 3 in a Northeastern United States city.14 Another cohort in Scotland showed that children of mothers with lower vitamin intake had an increased risk of recurrent wheeze at 5.15 Further studies, however, needed to be performed in order to delineate the relationship between vitamin D and the pathogenesis of wheeze as association cannot prove association.

There is also an epidemiological link between vitamin D and asthma in children. There is a high prevalence of vitamin deficiency and insufficiency (54% and 86% respectively) among inner-city African American youth with asthma.17 Low serum vitamin D levels were associated with reduced lung function in adolescents.18 Increased serum vitamin D levels were associated with reduced hospitalisations and decreased markers of allergy such as total IgE and eosinophil counts in a group of Costa Rica children aged 6 to 14.19 Vitamin D insufficiency is common (35%) in a group of North American children with mild to moderate asthma and is associated with increased odds of severe exacerbation.20 Studies also showed that low vitamin D levels were associated with low FEV1, and low FEV1/FVC ratio, increased total IgE, decreased asthma control test (ACT) score, and more exercise induced...
bronchoconstriction. Other studies, however, suggested that vitamin D may be related to higher prevalence of atopic conditions. In a northern Finland cohort, the prevalence of atopy and allergic rhinitis in adulthood was higher in those who had regular vitamin D supplementation during infancy. Similar but non-significant association was observed for asthma.

Another study in the United Kingdom suggested that exposure to excess maternal concentrations of vitamin D could be associated with an increased risk of eczema at 9 months and asthma at age 9. However all these studies were observational and causal relationship could not be deduced. Interventional studies with vitamin D supplementation are necessary in order to delineate the relationship between vitamin D and asthma in children.

Inhaled corticosteroid is the mainstay of treatment in asthma. Steroid resistance may hinder the effectiveness of asthma treatment. There is no consensus on the definition of steroid resistance and the mechanism of steroid resistance in children is largely unknown. In the study of childhood asthma in Costa Rica, the increase in vitamin D levels was associated with reduced odds of anti-inflammatory medications use in the previous year. Searing et al also showed that there is an inverse correlation between vitamin D levels and the use of inhaled steroid, use of oral steroids and total steroid dose. The author suggested that vitamin D could enhance the action of glucocorticoid in peripheral blood mononuclear cells from asthma patients. It may also enhance the immunosuppressive function of dexamethasone in vitro.

There is an important role of viral respiratory infections in asthma and asthma exacerbations. Wheezing episodes due to rhinovirus early in life is a major risk factor for diagnosis of asthma at 6, and viral respiratory tract infections especially those by rhinovirus are associated with asthma exacerbations. A national survey in the United States suggested that lower vitamin D levels were associated with recent upper respiratory tract infection, with the association being stronger in subjects with asthma. Intervventional trials in children with vitamin D supplementations also supported the association with reduction in respiratory tract infections. A study in Tokyo suggested that vitamin D supplementation during the winter may reduce the incidence of influenza A and the risk of asthma exacerbations in a subgroup with previous diagnosis of asthma. Majak et al also showed that vitamin D supplement was associated with a decrease in the number of asthma exacerbations triggered by acute respiratory tract infections.

In conclusion, there is growing knowledge in the association between vitamin D and asthma in children. More research is warranted to the further understanding of the relationship. On the other hand, multicenter, randomised controlled trial is required to delineate the relationship between vitamin D supplement and asthma control.

References