



Effect of diet and maternal education on allergies among preschool children: A case-control study



Sandra Andrusaityte*, Regina Grazuleviciene, Inga Petraviciene

Department of Environmental Sciences, Vytauto Didziojo Universitetas, K. Donelaičio str. 58, Kaunas 44248, Lithuania

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ABSTRACT

Introduction: The prevalence of asthma and allergy has increased among children. This increase in prevalence might be related to dietary patterns.

Aims: The present epidemiological study investigated the relationship between the consumption of fruit, vegetables, nuts, meat and fish, and the prevalence of wheeze, asthma, and eczema among preschool children.

Methods: This nested case-control study included 1489 children aged 4–6 years and residing in Kaunas city, Lithuania. The subjects were recruited to the KANC newborn cohort study during 2007–2009. Parents' responses to questionnaires were used to collect information on allergic diseases, diet, and other variables. The association between dietary patterns and children's allergic diseases were tested by using logistic regressions, after adjustment for maternal education level, smoking during pregnancy, parental asthma, children's sex, parity, and antibiotic usage during the first year of life.

Results: In this study, 83.3% of all children consumed fresh fruit and/or vegetables at least three times per week. A significantly lower adjusted odds ratio (aOR) of wheeze was found among children who ate fruit than among those who did not (aOR: 0.48; 95% CI: 0.22–0.96). The consumption of nuts was also associated with a lower 61% risk of eczema among 4–6 years old children.

Conclusion: The results indicated a beneficial effect of a frequent consumption of fresh fruit and nuts on the prevalence of allergies among children. These results might have important implications for children's health.

1. Introduction

Childhood asthma causes a large public health burden because of its high prevalence and increasing morbidity. Over the past few decades, the prevalence of asthma has markedly increased worldwide, and this increase is largely caused by environmental factors, changes of lifestyle behaviors, and dietary patterns (Lv et al., 2014). Previous studies suggested that the avoidable environmental hazards, such as tobacco smoke, poor housing conditions, and diets with a high caloric content and a low content of antioxidants may be considered to be potential risk factors for childhood asthma (Burke et al., 2012; Eder et al., 2006). Nutrition could contribute to the development of asthma and allergic diseases, although the epidemiological evidence to date is still unclear (Devereux and Seaton, 2005; Romieu and Trenga, 2001; Tricon et al., 2006).

A growing body of evidence suggests that environmental factors, particularly adverse nutritional family habits in the prenatal and early life, significantly contribute to the development of chronic childhood diseases such as obesity and asthma (Julia et al., 2015; Symonds et al.,

2009). The children's dietary patterns often depend on their parents' socioeconomic status, family status, or health behavior. Exposures that confer risk for incident childhood asthma and allergy include early-life stressors and infections, allergens, outdoor pollutants, and tobacco smoke (Chan-Yeung et al., 2008). Pre-natal exposure to tobacco smoke adversely affects postnatal lung function and increases the risk of developing asthma and asthma symptoms later in life (Cook et al., 1998; Gilliland et al., 2000). The mechanisms of the development asthma and allergies are unclear but there is growing evidence indicating that early-life environmental and socioeconomic disadvantage may be associated with higher pro-inflammatory cytokine levels later in life, whereas associations with markers of lipid and glucose metabolism are less consistent (Danese et al., 2009; Entringer et al., 2008; Slopen et al., 2015).

Several epidemiological studies on children have demonstrated a reduced risk of allergic diseases in relation to a high fruit intake. Epidemiological studies have shown a beneficial effect of increased fruit and vegetable consumption on asthma and allergy in children (Farchi et al., 2003; Forastiere et al., 2000). This effect is associated with increased intake antioxidants, which play a positive role in decreasing the

* Corresponding author.

E-mail address: sandra.andrusaityte@vdu.lt (S. Andrusaityte).

risk of allergic diseases throughout childhood and adulthood (Chatzi et al., 2007; Maynard et al., 2003). A higher intake of fruit and vegetables has also been associated with lower blood pressure and a lower risk of stroke in adulthood (Moore et al., 2005; Ness et al., 2005). Previous studies have reported that the quality of the diet is socially oriented, and is associated with parental occupation, education, and income levels (Groth et al., 2001; Krieger et al., 1997; Petrauskienė et al., 2015; Turrell et al., 2003). Less healthy diets are more prevalent among people of lower social classes (Galobardes et al., 2001). Most of the studies on the associations between children's dietary patterns and asthma were cross-sectional and reported inconsistent findings and different levels of associations, while few studies were cohort studies (Romieu et al., 2009; Tromp et al., 2012). A recently published systematic review based on a meta-analysis concluded that the Mediterranean diet in children might prevent current wheeze and asthma during any period of life (Garcia-Marcos et al., 2013).

Meanwhile, a study conducted in Japan found a beneficial effect of maternal “Western” dietary pattern (also called the Standard American Diet, or the meat-sweet diet), characterized by a high intake of sea food and fish and a high intake of processed meat, eggs, and animal fats (Hu, 2002) on wheeze (OR: 0.59; 95% CI: 0.35–0.98; $p = 0.02$) in infants aged 16–24 months (Miyake et al., 2011). In Japan, the “Western” dietary pattern was improved by ingredients associated with a high intake of α -linolenic acid, vitamin E, and β -carotene, which have a beneficial effect on asthma and wheezing (Allan and Devereux, 2011; Nurmatov et al., 2011; Varraso, 2012). Therefore, we can expect that dietary patterns are region-specific and population-specific, and that socio-environmental factors should be taken into account when studying the effects of dietary patterns on children's allergies in diverse populations.

This study seeks to analyze the associations between children's dietary habits (the data were obtained from standardized food frequency questionnaires (FFQ)) and health outcomes, at the individual level controlling for the impact of the covariates associated with asthma. The aim of the present study was to investigate the relationship between the consumption of fruit, vegetables, nuts, meat and fish and the prevalence of wheezing, physician-diagnosed asthma, and eczema among preschool children.

2. Materials and methods

2.1. Study population and data collection

In this study, we used primary data of women residing in Kaunas city who were recruited to the pregnant women's cohort study during 2007–2009. In 2012–2013, we invited 3294 mothers and their 4–6 year-old children to participate in the asthma study. A detailed description of the study has been provided previously (Andrusaityte et al., 2016; Grazuleviciene et al., 2014). Responses to postal questionnaires were received from 1489 mothers. The participants of this research were children whose parents or guardians filled out the questionnaires and agreed to participate in the study. The study was approved by the Lithuanian Bioethics Committee, and parental informed consent was obtained from all participants. Questionnaire responses by parents or guardians were used to categorize children's basic information, medical history, family history, medical history of asthma and allergic rhinitis in the family, personal habits, and housing and environmental conditions, tobacco exposure, and including diet.

Outcome variables were defined as providing positive answers to the following questions of the standardized International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire: for physician-diagnosed asthma - ‘Has your child ever had physician-diagnosed asthma?’; for wheeze - ‘Has your child ever had wheezing or whistling in the chest?’; and for atopic eczema - ‘Has your child ever had eczema?’. Dietary information was collected using a food frequency questionnaire (FFQ), asking about the diet and nutrition of the children.

Information was also collected about the weekly frequency of the consumption of each food group – vegetables (broccoli or cauliflower, carrot, tomato, potatoes, courgettes, lettuce, avocado, cladodes, green beans, and chili or chili sauce) and fruit and nuts (orange, grape, apple, banana, peach, watermelon, pineapple, papaya, pear, kiwi, mango, strawberry, prickly pears, plums, orange juice, grapefruit juice, almonds, walnuts, hazelnuts, and peanuts); meat and fish. In the present study, we considered “fruit and vegetables” to be any fresh, frozen, dried, or canned fruit and vegetables. Questions about the intake frequency of fruit, vegetables, nuts, meat and fish were asked separately. The answer alternatives were: ‘never’; ‘1–2 times per week’; and ‘3 and more times per week’. In analysis to compare the results with previous studies, foods intake were dichotomized into a ‘yes intake category’ if a child eating at least one and more times per week of foods and a ‘no intake category’ if a child do not eat of fruit, vegetables, nuts, meat or fish.

The evaluation of sedentary behavior (physical inactivity) was based on answers to questions on the duration of television watching and computer use. The following questions were asked “How many hours per day does your child watch television on weekdays?” and “How many hours per day does your child spend at the computer on weekdays?” The responses were recorded as the mean number of hours of sedentary behavior per day. According to the recommendation of the American Academy of Pediatrics, the average preschool children screen time should be limited to 3 h per day (American Academy of Pediatrics, 2001).

2.2. Statistical analysis

We used the chi-squared univariate logistic regression analysis to compare the values and the frequencies of baseline characteristics to the allergy status of the children, and to evaluate the associations among the covariates that are known to be related to an increased risk of allergies. Predictor variables whose univariate test showed a statistically significant association ($p < 0.05$) to the outcome or that changed the adjusted odds ratios (aOR) by 10% or more were retained for inclusion in the multivariate logistic regression analysis.

Multivariate logistic regressions were used to assess the relationship between weekly consumption of vegetables, fruit, nuts, meat and fish, and asthma, wheeze, and eczema among children, adjusting for maternal education, active and passive smoking, parental history of asthma, the child's sex, and antibiotic use during the first year of life. Additionally we also adjusted for consumed foods. The group of children who did not consume vegetables, fruit, nuts, meat or fish was used as the reference group. The association between diet and children's allergic diseases was estimated as unadjusted (crude) and adjusted odds ratios with 95% confidence intervals (CI). All statistical analyses were performed using SPSS version 18.0.

3. Results

The demographic variables of those women who did not respond to the questionnaire (non-participants) were not statistically significantly different from the participants with regard to the age, education level, other characteristics, and birth outcomes (see [Supplementary materials Table S1](#)). The characteristics of the children who participated in the study are shown in [Table 1](#). The prevalence of wheeze, atopic eczema, and physician-diagnosed asthma were 11.3%, 6.8%, and 7.5%, respectively. The women who participated in the study were highly educated – 60.8% of them had university degree. The majority of the studied children (83.3% of all participants) ate fresh fruit/vegetables; among them 62.7% consumed vegetables, and 6.2% - nuts at least three times per week. Even 73.3% of children three and more times per week consumed processed meat, while 47.4% of them did not ate fish.

[Table 2](#) shows the distribution of the variables according to the maternal educational level. In general, some characteristics were

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