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Food consumption and the risk of childhood allergy

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ABSTRACT

Background: The prevalence of allergic conditions is increasing in most countries. One possible explanation may be childhood nutrition.
Objective: The aim of the study was to investigate the relationship between consumption of pre-specified types of food in school-aged children and presence of respiratory and allergic symptoms.
Methods: A total of 191 students aged 9–11 years were recruited from 5 schools to geographically cover all of Malta. Data was collected between October 2011 and February 2012. This was part of a bigger study which included clinical and environmental tests besides standardized health questionnaires. For the purposes of this part of the study only the health questionnaires were used. These standardized health questionnaires based on the International Study of Asthma and Allergies in Childhood (ISAAC) were used to identify the presence of respiratory and allergic symptoms and to identify the types of foods and the frequency of consumption of various types of foods.
Results: We found that milk, meat, butter, olive oil, and yoghurt consumption had a negative association with allergic symptoms in children, whilst fish consumption had a detrimental effect. These relationships remained significant after correction for paternal level of education.
Conclusion: The study highlights the fact that nutrition in early childhood may have a significant effect on the risk of allergic conditions. Our results, taken together with data in the literature, suggest that different types of fish might have had different effects. This is probably related to their different fatty acid constitution thus warranting further studies.

Keywords: Nutrition; Child; Allergies; Food

INTRODUCTION

Most countries are experiencing a higher prevalence of allergic conditions. Could nutrition and the type of food we consume in early childhood play a part?

Current research has shown that nutrition trends in early childhood years may have an impact on human health at a later age particularly on the respiratory, gastrointestinal and immune systems [1-4]. Changes in dietary habits mainly the decreased intake of fresh fruit and vegetables and a higher intake of processed foods have previously been linked to an

increasing prevalence of asthma [5-7]. There is particular interest in the effect of different types of fat on risk of allergic conditions, but studies have often been inconsistent. In this study, we investigated the association between the consumption of different food items in school-aged children and childhood symptoms of allergy in a small Mediterranean island - Malta. Consuming fats was found to improve upper airways symptoms whilst the ingestion of fish seems to have a positive association with allergic symptoms. This may raise a number of questions and highlight the need for further studies. We believe that our results may differ from other foreign data due to some specific features in our diet especially when it comes to the choice of fish. It was also interesting to note the effect parental education had on the significance of these associations.

MATERIALS AND METHODS

The study was carried out in Malta, an island of about 450,000 inhabitants in the Mediterranean Sea. Previous studies, namely The International Study of Asthma and Allergies in Childhood (ISAAC) phases I and III carried out 7 years apart between 1994 and 2001 had shown a high prevalence of wheezing among school-aged children [8]. In our study we wanted to assess whether the prevalence of symptoms of allergy was associated with the consumption and frequency of particular food items.

A total of 191 students aged 9–11 years were chosen from 5 different primary state schools in the Maltese Islands. Three classes from each school where randomly selected to limit potential bias. All schools were coeducational. The schools were chosen so as to geographically cover the whole island from North to South; yet given the small size of Malta, all children were exposed to the same climate and infectious factors. Data was collected between October 2011 and February 2012. This formed part of a larger study where indoor air pollution was also assessed. For the purpose of this study only the questionnaires were assessed.

Standardized health questionnaires based on the ISAAC [8] were answered by the children's parents. They were asked to identify the presence of respiratory and allergic symptoms in their children and to also identify the types of foods and the frequency of consumption of such foods. The foods listed were fish, fruit, meat, vegetables, milk, yogurt, fast food, butter, margarine, olive oil, sunflower oil, lard.

This study was approved by the University of Malta Research Ethics Committee and the Education Department Research Directorate (date: 22/9/2011; ref number: 43/2011). Students and their parents were given written information sheets about the study, and a meeting for all students and parents was held at each school. Parents were asked to sign a consent form.

For statistical significance, a p value cutoff point of 0.05 was adopted. The chi-square and Fisher exact tests were used to assess the relationship of respiratory symptoms with the frequency of ingestion of identified foods (0, never or rarely; 1, often or every day). Bonferroni correction for multiple testing was performed to decrease the probability of identifying any significant results due to chance. Ordinal regression was used to further assess the relationship of respiratory symptoms with the frequency of intake of the various dietary components Participants were assigned a '0' if never or seldom eating a particular food or '1' if sometimes or frequently eating the food being assessed. We then assessed whether this association remained significant after adjustment for parental education by multivariate analyses.

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Table 1. Association of food intake with respiratory/allergic symptoms after Bonferroni correction

Food	Symptom	*p* value	OR (95% CI)
Fish	Nasal symptoms in past 12 months	0.036	3.95 (2.21–7.65)
Meat	Phlegm on most days of week	0.032	2.65 (1.65–4.50)
	Dry throat in past 3 months	0.015	1.98 (1.23–3.78)
	Sore throat in past 3 months	0.024	2.36 (1.81–8.87)
Yogurt	Wheezing during or after exercise in past 12 months	0.037	0.23 (0.12–0.68)
Fast food	Nasal symptoms in past 12 months	0.021	0.33 (0.15–0.89)
Butter	Wheezing influencing sports or physical activities in past	0.047	0.75 (0.24–0.98)
	Sleep disturbed by wheezing in last 12 months	0.049	0.65 (0.35–0.78)
	Nasal obstruction in past 3 months	0.005	0.78 (0.42–0.95)

OR, odds ratio; CI, confidence interval.

Table 2. Association of symptoms with extent of ingestion of a particular food (0, never or rarely; 1, often/every day) using ordinal regression

Food	Symptom	Unadjusted *p* value	OR (95% CI)	*p* value after adjusting for parental education
Butter	Sneezing/runny nose or blocked nose ever	0.027	0.396 (0.17–0.92)	0.013*
	Sneezing/runny nose or blocked nose in past 12 months	0.044	0.41 (0.17–0.97)	0.006*
	Runny nose or phlegm in past 3 months	0.01	0.36 (0.16–0.82)	-
	Nasal obstruction in past 3 months	0.003	0.33 (0.16–0.7)	0.0013*
Fish	Sneezing/runny nose or blocked nose in past 12 months	0.035	4.04 (1.93–14.36)	0.006*
Yoghurt	Sneezing/runny nose or blocked nose in past 12 months	0.023	0.38 (0.16–0.89)	0.003*
Margarine	Dry throat in past 3 months	0.031	0.93 (0.88–0.97)	-
	Sore throat in past 3 months	0.017	0.93 (0.88–0.97)	0.042*
Milk	Itchy rash in past 12 months	0.04	0.34 (0.12–0.98)	0.044*
	Skin rash on arms/hands in past 12 months	0.001	0.123 (0.039–0.386)	0.0001†
Olive oil	Sneezing/runny nose/blocked nose in past 12 months	0.04	0.21 (0.04–0.86)	0.003*
	Ever had allergic rhinitis	0.025	0.39 (0.326–0.467)	0.0001†
	Allergic rhinitis confirmed by physician	0.025	0.39 (0.326–0.467)	-
Sunflower oil	Ever had itchy rash for 6 months	0.016	0.24 (0.07–0.84)	-

OR, odds ratio; CI, confidence interval.
$p<0.05$, significant difference.
*Paternal. †Paternal and maternal.

RESULTS

Table 1 shows the results of the association between ingestion of studied food items and allergic manifestations. The majority of foods including both those high in unsaturated fats such as olive oil and margarine and those high in saturated fats such as butter, yogurt and milk were significantly associated with a decrease in upper airway symptoms (**Tables 1**, **2**). The consumption of fish was identified as an independent risk factor for allergy in the children (odds ratio, 4.04; 95% confidence interval, 1.93–14.36)

All results were adjusted for parental education which was considered to be a surrogate marker of socioeconomic status [9].

DISCUSSION

Nutrition in the early years of life is thought to have an important impact on the child's health at a later age. There is evidence that the choice of food consumed in early infancy may have effects on the respiratory, digestive and immune systems [1-4]. In the literature, there is considerable interest in the association of food intake by children and the development of respiratory symptoms, but results have not always been consistent. Later interventional studies aiming to replace nutrients which were thought to be beneficial have not been very successful [10, 11].

In our study, we found that most foods, both those high in unsaturated fats as well as those high in saturated fats had a protective association especially with regard to nasal and upper airway symptoms. What was striking, however, was the strong positive association between allergic symptoms and consumption of fish.

A literature review assessing the effects of fish intake during infancy and childhood with atopy is inconsistent [12] but some studies (nine out of fourteen) showed a protective effect of fish if consumed during infancy or childhood on allergic outcomes [13, 14]. A study by Saadeh et al. [12] carried out in 6 French cities clearly showed that increased consumption of fish was associated with a lower prevalence of asthma among nonallergic children. Although studies have shown that eating fish during pregnancy protects against symptoms of allergy, these results might suggest that ingestion of fish during the early years of life might trigger inflammatory pathways due to chronic low-grade inflammation thus manifesting itself as allergic rhinitis. Zhang et al. [14] also claim that the timing of introduction of fish in the diet of the infant may have some effect with the maximum benefit achieved if fish is introduced before the first year of life.

We believe that our results are different due to the type of fish consumed locally. In the Maltese islands, fish consumed is mainly farmed seabream and dorado fish (*lampuki*). Although farmed fish has a higher fat content compared to its wild counterpart, their fatty acid composition is different. Farmed fish tends to be higher in monounsaturates (monoenes and n6 n-9 and 18:2n-6 fatty acids), whilst wild fish is higher in n-3 and in saturates. Dolphin fish on the other hand has a lower fat content than most other fish [15]. Fish low in fat may have no protective effect since it is the fat content which decreases the risk of allergy symptoms [16]. More specifically, it is likely that the n-3 fatty acids which may be protective [17, 18]. It is interesting that some authors have reported that maternal consumption of nuts, most of which (with the exception of walnuts) are low in n-3 fatty acids [19] may also predispose to wheezing in the offspring [20]. Furthermore, Okuyama et al. [21] reported adverse effects including increased allergic reactions in humans with increased intake of n-6 fatty acids; similar findings have been reported in animal studies [22]. The high n-6:n-3 ratio in farmed fish may therefore explain its deleterious effect on the risk of allergy. The different fatty acid content in different types of fish may explain the conflicting results reported in the literature. It is therefore important that any future study investigating the effect of fish consumption on allergic diseases clearly defines the type of fish commonly consumed in the study population.

The fact that dietary habits of a particular country can have a role on specific conditions in that country was similarly highlighted in a recent Korean study. Here they studied the relationship of diet and asthma in 2 groups, middle and high school students and young adults. They also highlighted the fact that dietary factors may affect asthma differently in different age groups since high fast food consumption was significantly related to asthma in adolescents but not in adults [23].

The protective effect of milk/dairy consumption on risk of allergic eczema confirms the findings by Suárez-Varela et al [24]. It has also been recently reported that dairy products protect against asthma [25]. Authors have reported conflicting results with regard to the effects of meat consumption [25, 26], butter and margarine [27-29]. There is very little data with regard the effects of olive oil, but it has been reported that maternal consumption of olive oil during pregnancy reduces the risk of wheezing during infancy [30]. Our results

therefore provide novel evidence on the negative association of olive oil consumption in childhood with regard to symptoms of allergy.

Most of the observed associations remained significant after adjustment for paternal, but not maternal, level of education. This makes it unlikely that the diet was acting as a surrogate marker for family income or social class. The most likely explanation is that maternal education level had a greater impact on the diet of the offspring than did paternal education. Our results suggest that the known association of parental socio-economic status with symptoms of allergy can be mediated, at least in part, through its effects on dietary constitution.

The mechanism by which dietary constituents affect the risk of allergy is not fully understood and needs further study. N-3 polyunsaturated fatty acids have been shown to have immunomodulatory effects [31, 32] including inhibition of Th2 response [33, 34]. Dietary olive oil may increase synthesis of n-3 fatty acids [34]. The protective effects of yoghurt may be mediated through the immune-modulatory effects of its microbiota content [35, 36].

We believe that due to the small size of our country, despite the wide distribution of our sample, all the children were exposed to the similar conditions. However, we appreciate that there are a number of limitations including the fact that the diet intake was assessed only at one point in time and we understand that dietary habits may change over time. We also appreciate that there might be some recall bias since we depended mainly on the answers given by parents for this part of our study.

This study highlights the fact that nutrition in early childhood may have a significant effect on our health at a later stage. We found that milk, meat, butter, olive oil and yoghurt consumption had a negative association with allergic symptoms in children, whilst fish consumption had a detrimental effect. Our results highlighted the importance of varying effects of different types of fish, which is probably related to their different fatty acid constitution. It is not yet completely clear why certain foods are thought to have had a negative association with allergic symptoms and we may need to look beyond the fatty-acid component. More studies are surely required to evaluate the effect of fish in our diet but as this study highlights, we also need to look into the different types of fish certain countries might be consuming compared to others.

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