There has been increasing interest in the role of nutrition in the development of asthma, and in the modulating effect of nutrition on environmental exposures. The growth of airways during childhood may be vulnerable to oxidative lung stimuli; higher intakes may have beneficial function.1–3 Flavonoids may have an adverse effect on the modulation of antioxidants that cannot easily be quantified. Several epidemiological studies of adults have demonstrated a reduced risk of asthma in relation to a high fruit intake,4–7 but fewer have focused on childhood allergic respiratory diseases and their findings have been inconsistent. The SIDI collection study in Italy showed that intakes of cooked vegetables, tomatoes and fruits rich in vitamin C were protective factors for current wheezing symptoms.8 Higher intakes may have beneficial associations with asthma, wheezing symptoms and ventilatory function.1–3

Fruits and vegetables contain many potentially important antioxidants that cannot easily be quantified. Several epidemiological studies of adults have demonstrated a reduced risk of asthma in relation to a high fruit intake,4,5 but fewer have focused on childhood allergic respiratory diseases and their findings have been inconsistent. The SIDRIA cross-sectional study in Italy showed that intakes of cooked vegetables, tomatoes and fruits rich in vitamin C were protective factors for current wheezing symptoms.4 In another cross-sectional study of 2650 school children in England and Wales, fresh fruit consumption was found to be positively associated with ventilatory function (forced expiratory volume in 1 s (FEV₁)), the association being stronger among children with wheezing, although wheezing itself was not related to fresh fruit consumption.14 The CESAR cross-sectional study of children in six Central European countries showed that fruit intake was negatively associated with cough—particularly winter cough—but not with wheeze.11 Hijazi et al.12 in a case–control study of asthma in 12-year-old children, reported an inverse association of dietary intake of vitamin E with asthma, but little or no association with vitamin C or vegetable intake.

The traditional Mediterranean diet is characterised by an increased intake of plant foods such as fruits and vegetables, bread and cereals (primarily whole grain), legumes and nuts. Olive oil serves as the principal source of fat. All these are important sources of dietary antioxidants. Apart from the widely known antioxidants contained in fruits and vegetables, other compounds such as oleuropein, hydroxytyrosol and other polyphenols present in olive oil possess a marked antioxidant activity and other advantageous biological properties.13–14 There has to date been no study on the association of adherence to a Mediterranean diet and the occurrence of asthma and atopy.

There are reputed to have a prototypic Mediterranean diet, although recent changes in lifestyle have modified dietary habits in the population. In a cross-sectional study of children living in rural settings on the island, we found an “intermediate” prevalence of atopy but a low prevalence of allergic disease.15 To test the hypothesis that dietary intake of fresh fruits and vegetables rich in antioxidants and adherence to the traditional Mediterranean diet prevent the occurrence of respiratory symptoms related to atopy, we examined nutritional information collected in the same cross-sectional survey.

METHODS
The survey was conducted in 2001 in four rural areas of Crete, Greece. All school children aged between 7 and 18 years were invited to participate in the study (n = 857).16 Permission was obtained from the appropriate ethical committees (Venizelion Hospital in Heraklion, Royal Brompton Hospital in London, Ministry of Education in Greece). All parents gave written informed consent.

Abbreviations: BMI, body mass index; FEV₁, forced expiratory volume in 1 s
The parents were invited to complete a questionnaire that included questions on the child’s respiratory and allergic symptoms (modified ISAAC questionnaire translated into Greek), family history of allergic diseases, birth order and sibling numbers, levels of parental education and occupation. The questions were forward translated from English to Greek and vice versa by two independent translators. Discrepancies were decided by consensus of both translators.

Children were considered to have current allergic rhinitis when they were reported to have had, over the last 12 months, a runny or blocked nose apart from a common cold/flu. Current seasonal rhinitis was defined by these symptoms during the months of March to September, and “allergic rhinitis ever” by the same symptoms at some point in the past. Current wheezing was defined by any report of wheeze in the past 12 months.

Each child was invited to undergo skin prick tests, in accordance with the ISAAC protocol, using a series of 10 common aeroallergens: grass pollen (Mediterranean mix), *Parietaria*, olive blossom, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Cladosporium*, cat, goat, cockroach and poultry epithelium, all purchased from ALK Abello (Hungerford, UK). Histamine and saline solutions were used as positive and negative controls, respectively. A positive skin prick test was one where the mean weal diameter was at least 3 mm greater than the response to the negative control. A child was considered atopic if he or she demonstrated a positive reaction to one or more of the 10 allergens.

### Assessment of diet

We measured dietary habits using a detailed food frequency questionnaire. A total of 58 food items were investigated to study nine food categories: vegetables, fruits, nuts, fish, cereal, dairy products, meat, poultry and vegetable fats (margarine). The questionnaire assessed usual weekly food consumption during the previous 12 months with a six-level scale: never, less than once a week, 1–2 times per week, 3–4 times per week, once per day, more than once per day. The degree of adherence to a traditional Mediterranean diet was based on the KIDMED index. We made minor adaptations to the index to adapt it for our study population; thus, we excluded the items on consumption of fast foods, sweets, and legumes since this information was not requested in the diet questionnaire used in the study. Weekly consumption of dietary compounds positively associated with the Mediterranean diet was assigned a value of +1, whereas weekly consumption of compounds with a negative association was assigned a value of −1. Weekly consumption of more red than white meat was considered a detrimental component and assigned a value of −1. The original KIDMED index ranged from 0 to 12 and the sums of the values were classified into three levels: (1) ≥8, optimal Mediterranean diet; (2) 4–7, improvement needed to adjust intake to Mediterranean patterns; (3) ≤3, very low diet quality. In the present study the index ranged from 0 to 10 and was categorised into three levels: (1) ≥6, optimal Mediterranean diet; (2) 4–5, medium quality Mediterranean diet; (3) ≤3, low quality Mediterranean diet. In order to compare the results from the use of the KIDMED index with another index evaluating adherence to a Mediterranean diet, we used a second scale based on the “Mediterranean Diet Score” applied to a large cohort study (EPIC) in adults. Because the index had been developed for adults and our study population involved children, we presumed diary products to be protective and not detrimental dietary compounds and did not include alcohol consumption in the index.

### Statistical analysis

Data analysis was performed using SPSS 13.0 (SPSS Inc, Chicago, Illinois, USA). Univariate analyses of categorical variables were made using Pearson’s χ² test. The outcome variables that were evaluated in relation to diet were: wheezing ever, wheezing ever with atopy, current wheezing, nocturnal dry cough in the last 12 months apart from a common cold/flu, allergic rhinitis ever, allergic rhinitis ever with atopy, current allergic rhinitis, current seasonal allergic rhinitis and atopy. Multivariate logistic regression models were performed to examine the association between fruit and vegetable consumption (in three levels, using “never” as reference) and the outcome variables, after adjusting for the following confounders: age (in years; three categories: 7–12, 13–14, 15–18), sex, body mass index (BMI, age- and sex-adjusted cut off points for normal, overweight, obese children), parental asthma (yes, no) and number of older siblings (0, 1, 2, 3+). Logistic regression was performed to examine the association between the outcome variables and the consumption of specific nutrients included in the Mediterranean diet index and, separately, with the overall adherence to the Mediterranean diet (in three levels, using “low” level as reference). All models were adjusted for the same confounders. ORs and 95% CIs were computed.

### RESULTS

Seven hundred and ninety-seven children (93.0% of those eligible) completed the main questionnaire of the study. Of these, 107 individuals for whom information on 46 or more food items on the food frequency questionnaire (equivalent to 80% of the total items) was missing were excluded. From the remaining children (n = 690, 80.5%), complete information for all the variables included in the Mediterranean diet index was provided by 537 (62.7%).

Table 1 presents a description of the study population according to dietary fruit intake. Age, sex, BMI, parental education, number of older siblings, reported parental asthma and current parental farming showed no association with daily fruit intake.

Table 2 presents the weekly intakes of eight different fruits and vegetables known to be high sources of dietary antioxidants. There were very high consumptions of locally produced fruits and vegetables such as oranges, grapes, tomatoes and apples. Daily vegetable consumptions were moderate to low.

The prevalence rates for any wheezing and rhinitis symptoms in the past were 16.8% and 18.7%, respectively. When these symptoms were combined with atopy, the prevalence rates for wheezing and rhinitis were 5.4% and 6.7%, respectively. The prevalence of atopy was 22.3%. The occurrence rates of current wheezing and nocturnal dry cough (apart from a cold in the last 12 months) were 4.6% and 10.9%, respectively. Prevalence rates for current allergic rhinitis and current seasonal allergic rhinitis were 13.3% and 5.1%, respectively.

Tables 3 and 4 show the associations between wheezing and allergic rhinitis, respectively, and the daily intakes of different fruits and vegetables rich in antioxidants after adjusting for potential confounders. Specifically, daily consumption of grapes (OR 0.19; 95% CI 0.09 to 0.42, p = 0.001), oranges (OR 0.30; 95% CI 0.11 to 0.90, p < 0.05), apples (OR 0.14; 95% CI 0.04 to 0.48, p < 0.01), and fresh tomatoes (OR 0.32; 95% CI 0.15 to 0.67, p < 0.01) was found to have a beneficial effect on wheezing ever symptoms. Atopic sensitisation without wheeze was not significantly related to the intake of either fruits or vegetables. Current wheezing was negatively associated with daily consumption of grapes (OR 0.32; 95% CI 0.10 to 0.97, p < 0.05).

Daily intake of grapes was also inversely associated with allergic rhinitis ever (OR 0.31; 95% CI 0.14 to 0.64, p < 0.01),
current allergic rhinitis (OR 0.36; 95% CI 0.16 to 0.81, p = 0.05) and current seasonal allergic rhinitis (OR 0.18; 95% CI 0.06 to 0.54, p = 0.01) after adjusting for potential confounders. The associations showed a significant decreasing trend when intake was higher. Allergic rhinitis ever was also negatively associated with daily intake of oranges (OR 0.29; 95% CI 0.11 to 0.80, p = 0.05) and kiwi (OR 0.37; 95% CI 0.16 to 0.86, p = 0.05), whereas intake of other fruits and vegetables was not significantly related to allergic rhinitis.

Complete information for all the variables included in the Mediterranean diet index was available for 537 (67.4%) children. Table 5 shows the degree of adherence to the diet among these children. A low index was found for 27.9% of the sample, 43.8% had intermediate values, and 28.3% had a high index. There were no significant associations between the levels of the Mediterranean diet index and sex, parental education status, number of siblings, reported parental asthma and current parental farming. A significant decline was noted with age, the children in the 13–14 year age group having the most favourable values (34.9% with optimal Mediterranean diet) while older children (age group of 15–18 years) had the lowest (18.8%).

Associations between the consumption of different nutrients included in the Mediterranean diet index and wheezing, current allergic rhinitis and atopy are shown in Table 2. No significant associations were found between the consumption of different nutrients and wheezing, current allergic rhinitis and atopy among these children. A low index was found for 27.9% of the sample, 43.8% had intermediate values, and 28.3% had a high index. There were no significant associations between the levels of the Mediterranean diet index and sex, parental education status, number of siblings, reported parental asthma and current parental farming. A significant decline was noted with age, the children in the 13–14 year age group having the most favourable values (34.9% with optimal Mediterranean diet) while older children (age group of 15–18 years) had the lowest (18.8%).

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allergic rhinitis and atopy are shown in table 6. Fruit, vegetable, cereal, and brown bread intakes showed a trend towards negative associations with the outcome variables, although these were not statistically significant. Consumption of nuts more than three times per week was inversely associated with wheezing ever (OR 0.54; 95% CI 0.34 to 0.86, p<0.01) and current wheeze (OR 0.46; 95% CI 0.20 to 0.98, p<0.05). On the other hand, weekly intake of margarine appeared to be harmful to current wheezing (OR 2.19; 95% CI 1.01 to 4.82, p<0.05), allergic rhinitis ever (OR 1.99; 95% CI 1.32 to 3.00, p=0.001) and current allergic rhinitis symptoms (OR 2.10; 95% CI 1.31 to 3.37, p<0.01).

Multivariate logistic regression analysis suggested that a high level of adherence to the Mediterranean diet was inversely related to the occurrence of allergic rhinitis ever (OR 0.34; 95% CI 0.18 to 0.64, p<0.01), allergic rhinitis ever with atopy (OR 0.39: 95% CI 0.13 to 0.97, p<0.05), current allergic rhinitis (OR 0.49; 95% CI 0.24 to 0.99, p<0.05) and nocturnal dry cough apart from a cold in the last 12 months (OR 0.49; 95% CI 0.23 to 0.96, p<0.05). A high level of adherence to the Mediterranean diet was also protective for wheezing symptoms and atopy, although the associations were not statistically significant (table 7).

Results obtained using the KIDMED score were similar to those using an alternative index (Mediterranean diet score) that evaluated adherence to the Mediterranean diet in adults. Specifically, the high level of adherence to the Mediterranean diet according to this scale had an inverse association with nocturnal dry cough, apart from a cold in the last 12 months (OR 0.40; 95% CI 0.18 to 0.91, p<0.05), allergic rhinitis ever (OR 0.45; 95% CI 0.23 to 0.86, p<0.05) and current allergic rhinitis (OR 0.43; 95% CI 0.20 to 0.92, p<0.05) (data not shown).

**DISCUSSION**

Children in Crete consume high quantities of locally produced fruits and vegetables; regular and frequent consumption may have a beneficial role against wheezing and rhinitis symptoms. A high consumption of nuts also had a protective effect, while margarine intake was positively associated with reported symptoms. Most of the children had a moderate to high level of adherence to the dietary pattern of the Mediterranean diet. A high level of adherence to the Mediterranean diet showed a protective effect on allergic rhinitis, asthma-like symptoms and atopy, although it was not statistically significant for the last two outcomes. These findings are consistent with results from previous epidemiological studies on the protective effects of citrus fruits, apples and tomatoes on asthma and rhinitis symptoms.4,5 A protective effect of grapes has not previously been reported. These were the only fruits to show a consistent inverse association with wheezing ever, current wheezing, allergic rhinitis ever, current allergic rhinitis and current seasonal allergic rhinitis after adjustment for potential confounders. Red grape skin extract contains a mix of non-bioflavonoid polyphenols (derivatives of cinnamic and benzoic acid) and bioflavonoid polyphenols (quercetin, catechins, flavonols, and proanthocyanidins). Oligomeric proanthocyanidins are antioxidants with an anti-inflammatory action that is relevant to oxygen-free radical scavenging, antilipid peroxidation and inhibition of the formation of inflammatory cytokines. Moreover, resveratrol (3,4,5-trihydroxystilbene), a polyphenolic stilbene found in the skins of grapes, has the ability to inhibit cytokine-stimulated inducible nitric oxide synthase expression and nitrite production in human primary airway epithelial cells. It is possible that the beneficial effect of grape intake on wheezing and allergic rhinitis symptoms is mediated through the antioxidant effect of grape phenolic content.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Association between frequency of consumption of fruits and vegetables rich in antioxidants, wheezing and atopy</th>
<th>Table 4</th>
<th>Association between frequency of consumption of fruits and vegetables rich in antioxidants and allergic rhinitis (AR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oranges</td>
</tr>
<tr>
<td>Consumption per day</td>
<td>Consumption per day</td>
<td>Consumption per day</td>
<td>Consumption per day</td>
</tr>
<tr>
<td>&lt;1/day</td>
<td>&gt;1/day</td>
<td>p for trend</td>
<td>&lt;1/day</td>
</tr>
<tr>
<td>Oranges</td>
<td>0.28 (0.10 to 0.76)</td>
<td>0.30 (0.11 to 0.90)</td>
<td>0.804</td>
</tr>
<tr>
<td>Kow fruits</td>
<td>0.62 (0.39 to 0.96)</td>
<td>0.54 (0.34 to 1.19)</td>
<td>0.039</td>
</tr>
<tr>
<td>Grapes</td>
<td>0.26 (0.12 to 0.55)</td>
<td>0.19 (0.09 to 0.42)</td>
<td>0.001</td>
</tr>
<tr>
<td>Apples</td>
<td>0.14 (0.04 to 0.47)</td>
<td>0.14 (0.04 to 0.48)</td>
<td>0.225</td>
</tr>
<tr>
<td>Fresh tomatoes</td>
<td>0.40 (0.19 to 0.83)</td>
<td>0.32 (0.15 to 0.67)</td>
<td>0.010</td>
</tr>
<tr>
<td>Green peppers</td>
<td>0.86 (0.54 to 1.36)</td>
<td>0.54 (0.22 to 1.31)</td>
<td>0.368</td>
</tr>
<tr>
<td>Carrots</td>
<td>0.50 (0.22 to 1.57)</td>
<td>0.75 (0.27 to 2.63)</td>
<td>0.823</td>
</tr>
<tr>
<td>Broccoli</td>
<td>0.93 (0.56 to 1.54)</td>
<td>–</td>
<td>0.862</td>
</tr>
</tbody>
</table>

**[ Orchestra with 95% CI derived from logistic regression models after adjusting for age, sex, body mass index, parental asthma and number of older siblings. The reference group for each food item includes those subjects not consuming the specific item.](http://www.thoraxjnl.com)**
The study also showed a protective effect of nut consumption on the prevalence of wheezing symptoms. Nuts are a very rich source of vitamin E, the body’s principal defence against oxidant-induced membrane injury in human tissue via its role in breaking the lipid peroxidation chain reaction. The reported results are consistent with those from NHANES study which showed a lower incidence of asthma among women who had a high vitamin E intake, but the effect in that population was attenuated after excluding nut consumption. Nuts also have a high magnesium content which has been shown to have a protective effect on asthma symptoms and lung function volumes.12 21

Weekly intake of margarine had a harmful effect on asthma and rhinitis symptoms in this population. Margarine is a rich source of omega-6 polyunsaturated fatty acids such as linoleic acid. Prostaglandins such as prostaglandin E2 are formed by the action of cyclo-oxygenase on arachidonic acid. Arachidonic acid, in turn, is formed from linoleic acid. As a result, an increase in linoleic acid in the diet will promote the formation of prostaglandins with a consequent increase in the likelihood of atopic sensitisation, asthma and atopic disease.24

Epidemiological studies in Italy, Germany and Finland have reported a higher consumption of margarine among children with asthma, atopy and allergic rhinitis.8 25 26

We showed a general protective effect of a high level of adherence to the Mediterranean diet on allergic rhinitis, asthma and atopy. Although considerable advances in knowledge have been gained with studies focused on single nutrients or foods, these may fail to account for correlations and interactions between nutrients, and they do not evaluate patterns of dietary intake.27 Thus, interest has shifted to the study of food groups and, more recently, dietary patterns including the evaluation of the potential protective role of the Mediterranean diet.

During the past decades a large body of evidence has related adherence to a Mediterranean diet with reductions in all-cause mortality, the prevalence of metabolic disorders such as obesity and high blood pressure, and the incidence of coronary heart disease and various types of cancer.19 24–31 The ATTICA study suggested that a greater adherence to the Mediterranean diet is associated with increased total antioxidant capacity in healthy adults.31 Analyses of the dietary pattern of the traditional diet of Crete have shown a number of protective substances such as selenium, glutathione, resveratrol, a balanced ratio of (n-6):(n-3) essential fatty acids, high amounts of fibre, polyphenols from olive oil, vitamins E and C.35 The majority of these have marked antioxidant activity. In the present study we showed that a high level adherence to the Mediterranean diet had a protective effect on allergic rhinitis and nocturnal dry cough in the last 12 months. There was a trend for negative associations with wheezing symptoms that did not reach statistical significance, possibly due to the relatively small sample size.

Several indices are available which evaluate adherence to the Mediterranean diet in epidemiological studies.32 The KIDMED index is the only Mediterranean diet quality index constructed to evaluate food habits in a population of children and is based on positive and negative component scoring for protective and detrimental nutrients, respectively.31 This index was slightly modified to adapt it to the questionnaire and the dietary habits of the studied population. A limitation of the present index is the absence of information on the consumption of “fast foods”, sweets and legumes, as these components were not included in the food frequency questionnaire. A higher consumption of red meat than white meat was assigned a negative value as, in the Cretan Mediterranean diet, there is a recommendation for low consumption of red meat (pork, lamb, beef) and its replacement by poultry.34 Olive oil serves as the principal source of fat in all Cretan families.35 This was also found in this study population and, for that reason, we did not include in the index a question on the use of olive oil at home.

The use of an alternative index of adherence to the Mediterranean diet gave similar results to the KIDMED score. Nonetheless, it remains uncertain how far the observed associations would be modified if other potentially detrimental components such as fast foods and sweets were included. Western-type fast food is rarely consumed in rural Crete, and it is likely that the impact of such foods on the diet of school children was minor.

We are aware of some inherent limitations to our survey. First, its cross-sectional methodology is not optimal for the assessment of causal relationships and can only be suggestive of an association between dietary intake and respiratory

### Table 5 Mediterranean diet quality index among children in Crete (n = 690)

<table>
<thead>
<tr>
<th>Mediterranean diet components</th>
<th>Children, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One fruit or fruit juice daily +1</td>
<td>645 (93.5%)</td>
</tr>
<tr>
<td>Two or more fruits daily +1</td>
<td>556 (80.6%)</td>
</tr>
<tr>
<td>One vegetable daily +1</td>
<td>622 (90.1%)</td>
</tr>
<tr>
<td>Two or more vegetables daily +1</td>
<td>472 (68.4%)</td>
</tr>
<tr>
<td>Fish &gt;2 times per week +1</td>
<td>258 (37.4%)</td>
</tr>
<tr>
<td>Cereals for breakfast daily +1</td>
<td>112 (16.2%)</td>
</tr>
<tr>
<td>Brown bread daily +1</td>
<td>120 (17.4%)</td>
</tr>
<tr>
<td>One dairy product daily +1</td>
<td>510 (73.9%)</td>
</tr>
<tr>
<td>Two or more dairy products daily +1</td>
<td>194 (28.1%)</td>
</tr>
<tr>
<td>Nuts (=3 times per week) +1</td>
<td>312 (45.2%)</td>
</tr>
<tr>
<td>Red meat =&gt; white meat consumption per week -1</td>
<td>483 (70.0%)</td>
</tr>
<tr>
<td>Margarine =&gt; once per week -1</td>
<td>331 (48.0%)</td>
</tr>
<tr>
<td>Mediterranean diet score</td>
<td></td>
</tr>
<tr>
<td>Poor (&lt;5)</td>
<td>150 (27.9%)</td>
</tr>
<tr>
<td>Average (4–5)</td>
<td>235 (43.8%)</td>
</tr>
<tr>
<td>Good (6–10)</td>
<td>152 (28.3%)</td>
</tr>
<tr>
<td>Total</td>
<td>537</td>
</tr>
</tbody>
</table>

*Diet score evaluated for subjects without missing values in specific components.

### Table 6 Associations between nutrients included in the Mediterranean diet index and wheezing, allergic rhinitis and atopy

<table>
<thead>
<tr>
<th></th>
<th>Wheezing ever</th>
<th>Current wheezing</th>
<th>Allergic rhinitis ever</th>
<th>Current allergic rhinitis</th>
<th>Atopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>One fruit or fruit juice daily</td>
<td>0.61 (0.27 to 1.39)</td>
<td>0.63 (0.23 to 1.42)</td>
<td>0.77 (0.34 to 1.78)</td>
<td>0.78 (0.36 to 1.81)</td>
<td>0.72 (0.33 to 1.57)</td>
</tr>
<tr>
<td>One vegetable daily</td>
<td>0.65 (0.37 to 1.19)</td>
<td>0.85 (0.37 to 1.93)</td>
<td>0.80 (0.35 to 1.78)</td>
<td>0.85 (0.49 to 1.86)</td>
<td>0.92 (0.60 to 1.42)</td>
</tr>
<tr>
<td>Fish &gt;2 times per week</td>
<td>0.67 (0.42 to 1.07)</td>
<td>0.69 (0.31 to 1.66)</td>
<td>0.88 (0.58 to 1.34)</td>
<td>0.90 (0.56 to 1.72)</td>
<td>0.70 (0.47 to 1.03)</td>
</tr>
<tr>
<td>Cereals for breakfast daily</td>
<td>0.64 (0.24 to 1.71)</td>
<td>0.79 (0.26 to 1.84)</td>
<td>0.71 (0.32 to 1.57)</td>
<td>0.93 (0.45 to 1.93)</td>
<td>0.81 (0.35 to 1.90)</td>
</tr>
<tr>
<td>Brown bread daily</td>
<td>0.79 (0.42 to 1.50)</td>
<td>0.51 (0.14 to 1.72)</td>
<td>0.95 (0.53 to 1.70)</td>
<td>0.89 (0.45 to 1.75)</td>
<td>1.04 (0.63 to 1.71)</td>
</tr>
<tr>
<td>One dairy product daily</td>
<td>1.09 (0.63 to 1.90)</td>
<td>1.14 (0.64 to 2.01)</td>
<td>1.03 (0.62 to 1.70)</td>
<td>1.14 (0.62 to 2.05)</td>
<td>0.77 (0.49 to 1.22)</td>
</tr>
<tr>
<td>Nuts &gt;3 times per week</td>
<td>0.54 (0.34 to 0.86)</td>
<td>0.46 (0.20 to 0.98)</td>
<td>0.77 (0.51 to 1.18)</td>
<td>0.83 (0.53 to 1.46)</td>
<td>0.76 (0.52 to 1.20)</td>
</tr>
<tr>
<td>Red meat =&gt; white meat consumption per week</td>
<td>1.05 (0.62 to 1.78)</td>
<td>1.53 (0.66 to 3.54)</td>
<td>1.04 (0.64 to 1.69)</td>
<td>1.13 (0.65 to 1.98)</td>
<td>1.06 (0.67 to 1.68)</td>
</tr>
</tbody>
</table>

ORs with 95% CI derived from logistic regression models after adjusting for age, sex, body mass index, parental asthma and number of older siblings.
hyper-responsiveness and parental atopy are needed. Studies with measurement of lung function volumes, bronchial early childhood to adolescence. To evaluate further the role of have a protective effect on the inflammatory response from hypothesis that a dietary pattern rich in antioxidants may associations between dietary intake of fruits, vegetables, nuts refers to cross-sectional data, the demonstration of negative also holds for the parents or whether this community has a whether this discrepancy in the prevalence of atopy/wheezing groups, although statistically significant for many of the foods 12 years and

**Table 7** Association between the level of adherence to the Mediterranean diet and wheezing, allergic rhinitis and atopy

<table>
<thead>
<tr>
<th></th>
<th>Average diet score (n = 235)</th>
<th>High diet score (n = 152)</th>
<th>p for trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheezing ever</td>
<td>0.94 (0.64 to 2.02)</td>
<td>0.67 (0.34 to 1.32)</td>
<td>0.229</td>
</tr>
<tr>
<td>Wheezing ever with atopy</td>
<td>0.98 (0.45 to 2.79)</td>
<td>0.53 (0.16 to 1.80)</td>
<td>0.417</td>
</tr>
<tr>
<td>Current wheezing</td>
<td>0.92 (0.41 to 2.83)</td>
<td>0.64 (0.20 to 2.05)</td>
<td>0.564</td>
</tr>
<tr>
<td>Nocturnal cough (last 12 months)</td>
<td>0.68 (0.36 to 1.27)</td>
<td>0.49 (0.23 to 0.96)</td>
<td>0.095</td>
</tr>
<tr>
<td>Allergic rhinitis ever</td>
<td>0.70 (0.42 to 1.16)</td>
<td>0.34 (0.18 to 0.64)</td>
<td>0.004</td>
</tr>
<tr>
<td>Allergic rhinitis ever with atopy</td>
<td>1.14 (0.50 to 2.57)</td>
<td>0.39 (0.13 to 0.97)</td>
<td>0.102</td>
</tr>
<tr>
<td>Current allergic rhinitis</td>
<td>0.77 (0.43 to 1.39)</td>
<td>0.49 (0.24 to 0.99)</td>
<td>0.142</td>
</tr>
<tr>
<td>Current seasonal allergic rhinitis</td>
<td>0.63 (0.24 to 1.65)</td>
<td>0.51 (0.20 to 1.25)</td>
<td>0.321</td>
</tr>
<tr>
<td>Atopy</td>
<td>0.94 (0.51 to 1.72)</td>
<td>0.54 (0.21 to 1.99)</td>
<td>0.384</td>
</tr>
</tbody>
</table>

ORs with 95% CI derived from logistic regression models after adjusting for age, sex, body mass index, parental asthma and number of older siblings. The reference group includes those subjects with a low Mediterranean diet score.

Some analyses, such as those examining the consumption of oranges and apples, were based on a reference group that included few subjects. A sensitivity analysis using alternative groups of exposure gave essentially the same results, indicating that the protective effect of consumption of fruits and vegetables was not dependent on arbitrary categorisations.

In our findings indicate that a high dietary intake of commonly consumed fruits and vegetables and nuts may have a protective role on the prevalence of asthma-like symptoms and allergic rhinitis. A high level of adherence to the Mediterranean diet had a beneficial effect on allergic rhinitis, asthma-like symptoms and atopy, although this was not statistically significant for the last two outcomes. A diet high in antioxidants may prevent the expression of allergic disease in this population.

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Effect of fruits, vegetables and the Mediterranean diet on asthma and allergies in children


LUNG ALERT

Bronchoscopy in haematopoietic stem cell transplant recipients may not be beneficial

Hemopoietic stem cell transplant (HSCT) recipients have a high rate of pulmonary complications, and bronchoscopy is traditionally felt to be beneficial as part of diagnostic examination. This was a retrospective review of HSCT patients in a single institution who had undergone bronchoscopy over a 10-year period; it aimed to assess whether alterations in management based on bronchoscopy results led to a survival advantage.

Of 1651 HSCTs that were performed, two-thirds were autologous; 190 patients were admitted for pneumonia and 101 bronchoscopies were performed, but complete records were only available for 91 episodes in 78 patients. Forty-nine per cent of bronchoscopies gave a probable diagnosis, with the commonest organisms isolated being Aspergillus, cytomegalovirus, Gram-negative bacteria and other viruses. All patients were on prophylactic antibacterial, antifungal, antipneumocystis and antiviral treatment.

The overall median survival after bronchoscopy was 35 days with no statistically significant difference in survival between bronchoscopies, which yielded a diagnosis (infected or otherwise) compared with those that did not (29 vs 46 days, p = 0.165), nor between those in which diagnosis led to a change in treatment or not (31 vs 24 days, p = 0.546). Complications occurred in seven of 91 bronchoscopies, 6 of which involved bleeding after transbronchial biopsy. The additional yield of transbronchial biopsy over bronchoalveolar lavage was only 5%, and the authors therefore do not recommend performing transbronchial biopsy. Overall, the benefit of bronchoscopy in HSCT recipients is questioned.

The study was limited by selection bias, relatively small numbers and the retrospective, single centre design. Further, prospective studies in other centres are needed to better characterise the benefit of bronchoscopy in this patient group.

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Protective effect of fruits, vegetables and the Mediterranean diet on asthma and allergies among children in Crete

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