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The ability of adults and children to visually identify peanuts and tree nuts

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ABSTRACT

Background: Peanuts and tree nuts are common food allergens and are the leading cause of fatalities from food-induced anaphylaxis. Dietary avoidance is the primary management of these allergies and requires the ability to identify peanuts or tree nuts.

Objectives: To investigate the ability of adults and children to visually identify peanuts and tree nuts.

Methods: A nut display was assembled that held peanuts and 9 tree nuts in a total of 19 different forms. Persons 6 years or older completed a worksheet to name the items.

Results: One-thousand one-hundred five subjects completed the study. The mean number of peanuts and tree nuts identified by all subjects was 8.4 (44.2%) out of a possible 19. The mean for children ages 6 to 18 was 4.6 (24.2%), compared with 11.1 (58.4%) for adults older than 18 ($P < .001$). The most commonly identified items were peanut in the shell and without the shell. The least identified was hazelnut (filbert) in the shell and without the shell. No difference was seen in the performance of peanut- or tree nut-allergic subjects compared with nonallergic subjects. Fifty percent of subjects with a peanut or tree nut allergy correctly identified all forms of peanuts or tree nuts to which they are allergic. Parents of peanut- or tree nut-allergic children did no better than parents of children without such allergy.

Conclusions: Overall, both children and adults are unreliable at visually identifying most nuts. Treatment of nut allergies with dietary avoidance should include education for both adults and children on identification of peanuts and tree nuts.

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Introduction

Peanuts and tree nuts are common food allergens among adults and children.¹ Data suggest the prevalence of these allergies is increasing.^{1,2} Allergic reactions to peanuts and tree nuts can be particularly severe, as they are the leading cause of death from food-induced anaphylaxis.^{3,4} Current management for food-induced anaphylaxis includes use of self-injectable epinephrine and supportive care. The only proven preventive treatment is dietary avoidance of the food allergen and all cross-reacting allergens.^{5,6} However, complete avoidance can be difficult. One study showed that 55% of people with peanut allergy suffered an allergic reaction caused by accidental ingestion in a 5-year period.⁷ Reading food labels is helpful but inadequate alone. The ability to visually recognize and identify peanuts and tree nuts is essential for successful avoidance of the allergens and prevention of the severe allergic reactions they can cause.

One previous study has investigated the ability of children to visually identify peanuts and tree nuts. Ferdman et al⁸ surveyed 100 children and demonstrated their inability to correctly identify

peanuts and tree nuts. More than half of them identified 2 or fewer nuts, and nut-allergic children were no better at identifying nuts than nonallergic children.⁸ Generalizing these findings to a larger population is difficult, because this was a small study with only 100 participants, and all were children. Most commonly, parents, teachers, and childcare workers are typically given responsibility to visually identify the nuts. However, no previous study has evaluated how well adults identify peanuts and tree nuts. The goal of our study was to describe the ability of children and adults to visually identify and differentiate peanuts and tree nuts by displaying the nuts in commonly purchased and used forms.

Methods

Approval was obtained from the Behavioral/Social Sciences institutional review board and oral informed consent obtained from all research subjects. A nut display with 19 numbered compartments displayed peanuts and 9 different tree nuts in commonly purchased and used forms (Fig 1). Each form of nut was randomized to a compartment in the nut display. The following forms of nuts were used: almonds whole without the shell and slivered; Brazil nuts whole with and without the shell; cashews whole without the shell; walnuts whole with and without the shell, and chopped; hazelnuts (filberts) whole with and without the shell; macadamia nuts whole without the shell; pecans whole with and without the paper shell, and chopped; pine nuts (pignolias) whole without the

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Fig. 1. 1, Cashew, without shell; 2, Hazelnut (filbert), in shell; 3, Pistachio, without shell; 4, Brazil nut, without shell; 5, Almond, slivered; 6, Pecan, in shell; 7, Walnut, crushed; 8, Peanut, without shell; 9, Pecan, crushed; 10, Pine nut (Pignolia), without shell; 11, Almond, without shell; 12, Peanut, in shell; 13, Macadamia nut, without shell; 14, Pistachio, in shell; 15, Brazil nut, in shell; 16, Pecan, without shell; 17, Walnut, in shell; 18, Hazelnut (filbert), without shell; 19, Walnut, without shell.

shell; pistachios whole with and without the shell; peanuts whole with and without the shell.

Participants were recruited to the nut display at COSI (Center of Science and Industry), an interactive children's science center in Columbus, Ohio. Any English-speaking person 6 years of age or older without known neuropsychiatric condition or developmental delay who visited COSI from March 19 through 25, 2010 and on April 3, 2010, was eligible to voluntarily participate. By written questionnaire, the following demographic information was obtained from children 6 to 15 years of age: age; sex; and history of personal allergy to peanuts or tree nuts, and if so, to which nuts specifically. Subjects 15 years or older were additionally asked number of children in their family; history of peanut or tree nut allergy in their children, and if so, to which nuts specifically; and any current or previous jobs or responsibilities in childcare or teaching, food preparation or serving, or in a patient-care setting in the healthcare field. After gathering demographic data, all participants were asked to visually identify each nut in the display by writing the name in the corresponding area on the answer sheet, which mirrored the nut display so as to help eliminate recording errors (Fig 1). Participants had the option of writing their answers themselves or having study personnel transcribe their answers for them. Credit was given as long as study personnel could decipher the name of the nut that was written, even if it was not spelled correctly. Participants were not required to specify in which form the nut was being displayed.

Data analysis

The primary analysis used in this study used either the Wilcoxon rank-sum or Kruskal-Wallis, both nonparametric analyses. The outcome total number of nuts correctly identified was compared across either 2 groups (Wilcoxon rank-sum) or more than 2 groups (Kruskal-Wallis). Pearson's method was used to establish the linear correlation between age and number of nuts correctly identified. The results are presented as means, standard deviations, median,

minimum, or maximum number of nuts identified correctly by group or by the percent correctly identified within a particular group. All analyses were run using Stata 10.1 (Stata Corporation, College Station, Texas).

Results

A total of 1,105 subjects ranging from 6 to 87 years old completed the study, including 649 adults (>18 years) and 456 children (6–18 years). The mean number answered correctly for all subjects was 8.4 out of a possible 19 (44.2% correct). Adults performed better than children (11.1 out of a possible 19 [58.4% correct] vs 4.6 [24.2%], $P < .001$), and all females did better than all males (9.2 [48.4%] vs 7.2 [37.9%], $P < .001$) (Table 1). Peanuts were the most commonly identified item. Of the participants, 94.7% correctly identified the peanut with the shell, and 80.5% identified it without the shell. Cashew without the shell was the most common form of tree nut correctly identified (76.7%). Hazelnut (filbert), both in and without the shell (16.1% and 16.7%, respectively), were least often identified correctly (Fig 2).

A wide distribution of total number of correct responses occurred. The mode was 3 of 19. Twenty-one subjects (1.9% of the study population) correctly identified all 19 forms of nuts (Fig 3).

A direct correlation ($\rho = 0.637$, $P < .001$) occurred between age and mean number answered correctly. Those aged 6 to 9 years had a mean number correct of 3.2 (16.9%), and those 51 years of age or older did the best, with a mean number correct of 13 (68.4%) (Table 2).

Twenty-seven (2.4%) subjects self-reported peanut or tree nut allergies. No statistical difference was seen between their mean number correct and those who were nonallergic (9.4 [49.5%] vs 8.4 [44.2%], $P = .465$). Neither adults nor children with a peanut or tree nut allergy did better than their nonallergic counterparts (13 [68.4%] vs 11 [57.9%], $P = .104$ for adults and 6.5 [34.2%] vs 4.6 [24.2%], $P = .229$ for children). Peanut- or tree nut-allergic adults

Table 1
Performance comparison between adults and children and sex

Group	Number of subjects	Mean number correct [±] (%)	Standard deviation	Min	Max [±]	p50	P value
Adults (>18 years)	649	11.1 (58.4)	4.4	0	19	11	< .001
Children (6–18 years)	456	4.6 (24.2)	3.3	0	19	4	
All females	664	9.2 (48.4)	5.2	0	19	9	< .001
All males	441	7.2 (37.9)	4.7	0	19	7	
All subjects (6–87 years)	1,105	8.4 (44.2)	5.1	0	19	8	

[±] 19 possible correct answers.

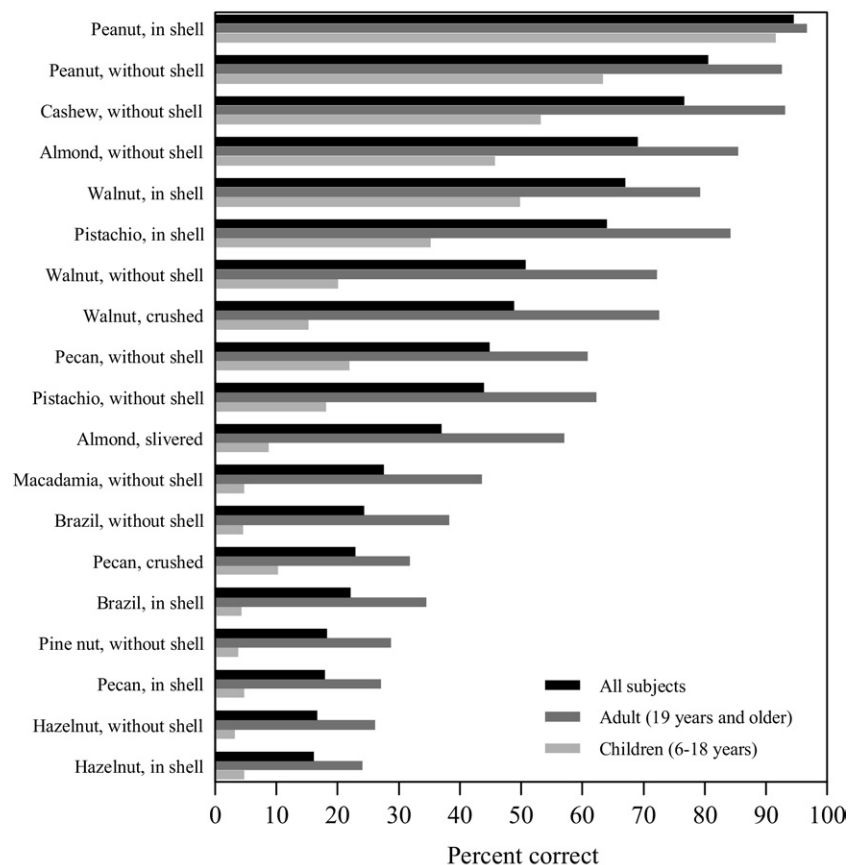


Fig. 2. Percentage of peanuts and nuts correctly identified by item, form, and age group.

did better than peanut- or tree nut-allergic children (13 [68.4%] vs 6.5 [34.2%]; $P = .008$) (Table 3). Twenty of the 27 peanut- or tree nut-allergic subjects listed the specific nuts to which they are allergic, and only 50% of them correctly identified all forms of those nuts.

Twenty subjects reported that they were parents of peanut- or tree nut-allergic children. Their mean number correct was not statistically different from those of parents of nonallergic children (14 [73.7%] vs 12 [63.2%]; $P = .081$). Adults who had children did better than adults without children (12 [63.2%] vs 9 [47.4%]; $P < .001$) (Table 4). Fifteen of the 20 parents of peanut- or tree nut-allergic children specifically listed the nuts to which their children are allergic, and 73.3% of them correctly identify all forms of those nuts.

Three-hundred sixty-nine subjects reported having current or previous jobs or responsibilities in childcare (included responses were childcare, babysitter, teacher, teacher's aide, preschool teacher, Sunday school teacher, camp counselor, coach, and scout leader). These subjects' mean number correct was 11 (57.9%) vs 10 (52.6%) for subjects who had never worked in childcare ($P < .001$). Two-hundred ninety-four subjects reported having current or previous jobs or responsibilities in food service (included responses were chef, server, food preparation, catering, and worked in a restaurant). Their mean number correct was identical to those who had never worked in food service (11 [57.9%]). Finally, 146 subjects reported having current or previous jobs in the healthcare field directly caring for patients (included responses were physician, nurse, dietician, and nutritionist). These subjects' mean number correct was 12 (63.2%) vs 11 (57.9%) for subjects who had never worked in the healthcare field directly caring for patients ($P = .005$) (Table 5).

Discussion

Peanut and tree nut allergies are common food allergens and can cause serious reactions, including death from food-induced anaphylaxis. Complete avoidance of these allergens is the only preventive treatment, but it can be difficult. One study showed that 55% of people with peanut allergy suffered an allergic reaction attributable to accidental ingestion in a 5-year period.⁷ Reading food labels is helpful but inadequate alone. The ability to visually recognize and identify peanuts and tree nuts is essential for successful avoidance of the allergens and prevention of the severe allergic reactions

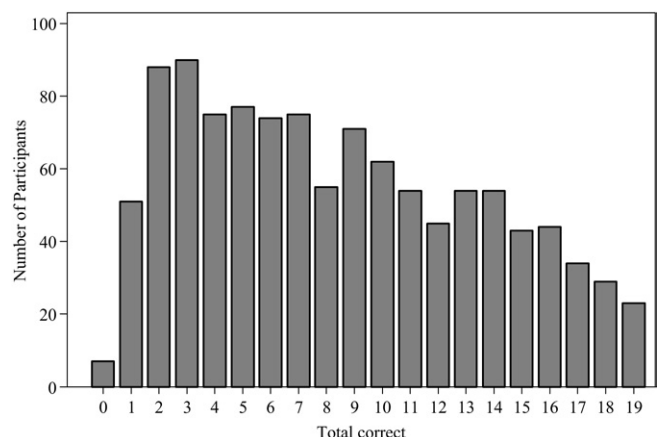


Fig. 3. Distribution of the total number of correct responses.

Table 2
Performance according to age

Age group (years)	Number of subjects	Mean number correct [±] (%)	Standard deviation	Min	Max [±]	p50
6–9	148	3.2 (16.8)	2.2	0	13	3
10–14	258	5.2 (27.4)	3.3	0	19	4
15–18	50	6.4 (33.7)	3.9	1	16	6
19–30	188	8.8 (46.3)	4	0	19	9
31–50	364	12 (63.2)	4.1	2	19	12
≥51	97	13 (68.4)	4.6	0	19	13

[±]19 possible correct answers.

they can cause. This study found that both adults and children are not reliable at visually identifying most nuts. This finding held true when analyzed by age of participant, most individual nuts, history of nut allergy, and personal work history.

By age group, this study showed that both adults and children are unreliable at visually identifying most nuts. Although adults performed better than children, they still only answered an average of 58% correct. Children younger than 18 years old correctly identified only 24% of nuts. Of 1,105 participants, only 1.9% were able to correctly identify all forms of nuts. The form in which the nut was displayed had a significant effect on its ability to be identified. Peanut in the shell was correctly identified by 92% of children, but when it was displayed without the shell, only 63% of children were able to identify it. Among tree nuts, 69% of participants identified the whole almond without the shell, compared with only 37% who correctly identified slivered almonds. Another example is the pecan, in which 45% of participants identified the pecan whole without the shell vs 18% of subjects when it was in the shell. Thus, both increasing age and the form of nut in which it was displayed had an effect on rates of correct identification.

We did not find a difference in the performance of peanut- or tree nut-allergic subjects compared with nonallergic subjects. Participants with a peanut or tree nut allergy correctly identified an average of 9.4 nuts out of 19 nuts compared with 8.4 nuts in participants who did not report an allergy. Furthermore, only half of participants correctly identified all forms of the nuts to which they are allergic. Parents of allergic children did only slightly better, as 73.3% of them correctly identified all forms of nuts to which their children were allergic. Either group could be predicted to perform better than the other. One may anticipate that nonallergic subjects would do better because they have more potential to be exposed to and eat peanuts and tree nuts. Conversely, one may suspect that allergic subjects would do better because their dietary avoidance would make them more educated as they look for and identify nuts in the food they are about to eat. However, our results showed no significant difference in these populations.

Finally, we attempted to analyze subgroups of people who are often caring for children when their primary caretakers are not

present. One subgroup was those who had participated in some form of childcare. We defined “childcare” with the following responses: childcare (including babysitter), teacher, teacher's aide, preschool teacher, Sunday school teacher, camp counselor, coach, and scout leader. Although those subjects had a statistically better performance than those who have not worked in childcare (mean number correct, 11 of 19 vs 10 [$P < .001$] for those who had not worked in childcare), that difference is not clinically relevant. Another subgroup was those who had worked in food preparation or service. We defined this subgroup with the following responses: chef, server, food preparation, catering, and worked in a restaurant. This subgroup performed no better than those who had never worked in food service. The last subgroup was subjects who work in the medical field, and we limited this group to physicians, nurses, dieticians, and nutritionists. As was the same for the childcare subgroup, this group had a statistically better performance than those who had not worked in the medical field (12 vs 11 correct, respectively [$P = .005$]), but this difference is not clinically relevant.

The strength of this study is the large number of participants, consistency in displaying nuts, and ability to display nuts in multiple common forms. However, several limitations arise in generalizing the results of this study. First, the study was performed in one city at one physical location, so whether these findings can be generalized to a broader population is unknown. Second, an element of selection bias may have been inadvertently introduced to deselect people who would perform poorly during the study: during data collection, multiple individuals were invited to participate who refused because they stated they did not know what any nuts looked like and did not want to give wrong answers. Third, the nuts were displayed in plain sight in their typical forms. In real life, it may be more difficult for participants to identify the nuts when mixed into food or topping desserts. Fourth, this study did not display every possible form of nut a patient may encounter. Finally, 2.4% of our study population reported an allergy to peanuts or tree nuts, which is higher than the 1.2 to 1.4% estimated overall prevalence of peanut or tree nut allergy in the United States.⁹ Overall, we believe that these limitations may have resulted in this study re-

Table 3
Peanut- or tree nut-allergic and nonallergic subjects

Group	Number of subjects	Mean number correct [±] (%)	Standard deviation	Min	Max [±]	p50
Allergic adults (>18 years)	12	13 ^{a,c} (68.4)	5.1	3	18	14
Nonallergic adults (>18 years)	637	11 ^a (57.9)	4.4	0	19	11
Allergic children (≤18 years)	15	6.5 ^{b,c} (34.2)	5.3	0	19	6
Nonallergic children (≤18 years)	441	4.6 ^b (24.2)	3.1	0	17	4
All allergic subjects	27	9.4 ^d (49.5)	6.1	0	19	9
All nonallergic subjects	1,078	8.4 ^d (44.2)	5.1	0	19	8

[±]19 possible correct answers.^a $P = .104$.^b $P = .229$.^c $P = .008$.^d $P = .465$.

Table 4
Parents of peanut- or tree nut-allergic and nonallergic children

Group	Number of subjects	Mean number correct [±] (%)	Standard deviation	Min	Max [±]	p50	P value
Parents of allergic children	20	14 (73.7)	3.5	7	19	14	= .081
Parents of nonallergic children	456	12 (63.2)	4.3	0	19	12	
All adult (>18 years) parents	475	12 (63.2)	4.3	0	19	12	< .001
All adults (>18 years) without children	174	9 (47.4)	4	0	19	9	

[±]19 possible correct answers.**Table 5**
Performance of subjects ≥ 15 years old based on occupational history

Group	Number of subjects	Mean number correct [±] (%)	Standard deviation	Min	Max [±]	p50	P value
Subjects who have worked in childcare ^a	369	11 (57.9)	4.4	0	19	11	< .001
Subjects who have not worked in childcare ^a	330	10 (52.6)	4.6	0	19	10	
Subjects who have worked in food service ^b	294	11 (57.9)	4.4	0	19	11	= .274
Subjects who have not worked in food service ^b	405	11 (57.9)	4.6	0	19	11	
Subjects who have worked in medical field ^c	146	12 (63.2)	4.3	2	19	12	P = .005
Subjects who have not worked in medical field ^c	553	11 (57.9)	4.6	0	19	10	

[±]19 possible correct answers.^a"Childcare" includes the following responses: childcare (includes babysitter), teacher, teacher's aide, preschool teacher, Sunday school teacher, camp counselor, coach, scout leader.^b"Food service" includes the following responses: chef, server, food preparation, catering, worked in restaurant.^c"Medical field" includes the following responses: physician, nurse, dietician, nutritionist.

porting higher rates of correct nut identification than is actually the case. Despite these limitations, this is the largest study to date to describe the ability of children to visually identify peanuts and tree nuts. This is also the first study to our knowledge to describe the ability of adults to visually identify peanuts and tree nuts.

Overall, both adults and children are unreliable at visually identifying most nuts. This is independent of age, form of nut, work history, or peanut or tree nut allergy status. Peanut- or tree nut-allergic subjects do poorly at visually identifying all forms of nuts to which they are allergic. The results of this study suggest that treatment of peanut and tree nut allergies with dietary avoidance should include education for both adults and children on identification of peanuts and tree nuts.

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