Socioeconomic factors and epinephrine prescription in children with peanut allergy

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BACKGROUND: Epinephrine autoinjectors provide life-saving therapy for individuals with peanut allergies.
OJECTIVE: To evaluate the association between socioeconomic status (SES) and epinephrine prescription among urban Canadian children with peanut allergy.
METHODS: Population-based survey data from school children in grades 1 and 2 participating in the Toronto Child Health Evaluation Questionnaire were used. Children with peanut allergy, their epinephrine autoinjector prescription status and their SES were identified by parental report.
RESULTS: Between January and April 2006, 5619 completed questionnaires from 231 Toronto, Ontario, schools were returned. A total of 153 (2.83%) children were identified as having a peanut allergy, 68.6% of whom reported being prescribed an epinephrine autoinjector. Children from upper-middle and high-income homes (OR 8.35 [95% CI 2.72 to 25.61]) and with asthma (OR 4.74 [95% CI 1.56 to 14.47]) were more likely to report having an epinephrine prescription.
CONCLUSION: A significant health disparity exists in the prescribing pattern of epinephrine autoinjectors for peanut-allergic children from families of differing SES.

Key Words: *Epidemiology; Health disparities; Peanut allergy; Socioeconomic status*

Les facteurs socioéconomiques et la prescription d'adrénaline aux enfants allergiques aux arachides

HISTORIQUE : Les auto-injecteurs d'adrénaline offrent une thérapie salvatrice aux personnes allergiques aux arachides.
OBJECTIF : Évaluer l'association entre le statut socioéconomique (SSÉ) et la prescription d'adrénaline à des enfants canadiens de milieu urbain allergiques aux arachides.
MÉTHODOLOGIE : Les auteurs ont utilisé les données d'une étude en population auprès d'enfants de 1re et 2e année qui avaient participé au *Toronto Child Health Evaluation Questionnaire*. Ils ont dépisté les enfants allergiques aux arachides, leur statut de prescription d'auto-injecteur d'adrénaline et leur SSÉ d'après le compte rendu des parents.
RÉSULTATS : Entre janvier et avril 2006, les auteurs ont reçu 5 619 questionnaires remplis provenant de 231 écoles de Toronto, en Ontario. Au total, il a été établi que 153 (2,83 %) enfants étaient allergiques aux arachides, dont 68,6 % ont déclaré s'être fait prescrire un auto-injecteur d'adrénaline. Les enfants de ménages à revenu moyen-supérieur ou à revenu élevé (RRR 8,35 [95 % IC 2,72 à 25,61]) et les enfants asthmatiques (RRR 4,74 [95 % IC 1,56 à 14,47]) étaient plus susceptibles de déclarer avoir reçu une prescription d'adrénaline.
CONCLUSION : On constate une importante disparité en matière de santé dans le modèle de prescription d'auto-injecteur d'adrénaline aux enfants allergiques aux arachides provenant de familles aux SSÉ différents.

Peanuts and tree nuts account for the majority of fatal reactions to foods (1-3), and delayed epinephrine use for the management of anaphylaxis increases the likelihood of fatality (4-6). All individuals with peanut allergy should be prescribed epinephrine (6), which is most commonly dispensed as EpiPen Jr or EpiPen autoinjectors (King Pharmaceuticals, Canada) and costs approximately $100 in Canada (7).

Although previous studies have established that socioeconomic status (SES) can affect a child's ability to access asthma medications in Canada (8,9), access to life-saving epinephrine autoinjectors has not previously been studied in a population-based sample of Canadian children.

The objective of the present study was to evaluate the association between SES and epinephrine autoinjector prescriptions among children with peanut allergy.

METHODS

The Toronto Child Health Evaluation Questionnaire (T-CHEQ), a cross-sectional parent-completed survey, was designed to collect population-based data regarding atopic diseases among Toronto (Ontario) school children in grades 1 and 2. For details of the study design, questionnaire validation and sampling strategy, please refer to a previous publication (10). From the survey, the subset of children with peanut allergy (defined as an affirmative response to the question, "Has your child ever had a peanut allergy diagnosed by a doctor?") were selected for the present study. The primary outcome – prescription of epinephrine autoinjector – was measured by an affirmative response to the question, "Has your child ever been prescribed an epinephrine autoinjector (EpiPen)?". SES covariates that were examined included income adequacy, parental education level, type of dwelling, household ownership and immigrant status. Income adequacy is a derived variable, defined by Statistics Canada (11), that takes into account the total household income and the number of people living in the household. The income categories are summarized in Table 1.

Other potential covariates that were examined included the presence of other atopic diseases (asthma, eczema and other food

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TABLE 1
Income adequacy categories

Household income level	Number of people in household
Lowest	
<$15,000	1 or 2
<$20,000	3 or 4
<$30,000	≥5
Lower-middle	
$15,000 to $29,999	1 or 2
$20,000 to $39,999	3 or 4
$30,000 to $59,999	≥5
Upper-middle	
$30,000 to $59,999	1 or 2
$40,000 to $79,999	3 or 4
$60,000 to $79,000	≥5
Highest	
≥$60,000	1 or 2
≥$80,000	≥3

Data from reference 11

allergies) and health care provider variables (type of health care provider and number of visits in the previous 12 months). All covariates were defined by questions previously validated in national surveys (10,11).

Using SAS version 9.1 (SAS Institute Inc, USA), bivariate logistic regression was used to determine possible predictors of epinephrine autoinjector prescription. Then, correlations between all variables were examined to ensure that no two highly correlated variables (Pearson r>0.30) were included in the same model. The primary exposure (SES) was selected from any of the following: income adequacy; type of dwelling; or household ownership. If these variables proved to be highly correlated, the single variable with the strongest association with the outcome would be considered as the primary exposure. Statistically significant variables at the bivariate level (P<0.05) were then added to a model containing the primary exposure and outcome. Variables that elicited a greater than 5% change in the risk estimate of the primary exposure were included in the final multivariate model. To account for possible clustering of students according to school attended, regression models used the generalized estimating equations 'repeated' statement.

Study participants gave implied consent by completing and returning the written survey. The Hospital for Sick Children Research Ethics Board (Toronto) approved the research protocol.

RESULTS

Between January and April 2006, 5619 completed questionnaires from 231 schools were returned, identifying 153 (2.83%) children with peanut allergy, 68.6% of whom were ever prescribed epinephrine. Among the bivariate associations with epinephrine autoinjector prescription (Table 2), income adequacy was strongly correlated with type of dwelling and household ownership, and was selected as the most appropriate SES measure for multivariate analysis.

In the multivariate model (Table 3), only income adequacy and current asthma were associated with epinephrine autoinjector prescription.

DISCUSSION

In our study, epinephrine autoinjector prescription was reported for 68.6% of children with peanut allergy (18.2% in the lower or lower-middle income adequacy group), representing a concerning

TABLE 2
Characteristics of Toronto Child Health Evaluation Questionnaire (T-CHEQ) participants with peanut allergy stratified according to parent-reported epinephrine autoinjector prescription*

	Epinephrine† prescribed, n (row %)		
Variable	Yes	No	P
All children with peanut allergy (n=153)‡	105 (68.6)	48 (31.4)	
Sex			0.603
Male (n=87)	61 (70.1)	26 (29.9)	
Female (n=65)	43 (66.2)	22 (33.8)	
Current asthma			0.008
Yes (n=76)	62 (81.6)	14 (18.4)	
No (n=27)	15 (55.6)	12 (44.4)	
Eczema			0.033
Yes (n=103)	77 (74.8)	26 (25.2)	
No (n=47)	27 (57.4)	20 (42.6)	
Concurrent allergy to other food			0.169
Yes (n=92)	67 (72.8)	25 (27.2)	
No (n=61)	38 (62.3)	23 (37.7)	
Concurrent allergy to fish/seafood			0.603
Yes (n=25)	16 (64.0)	9 (36.0)	
No (n=127)	88 (69.3)	39 (30.7)	
Concurrent allergy to tree nuts			0.005
Yes (n=60)	49 (81.7)	11 (18.3)	
No (n=92)	55 (59.8)	37 (40.2)	
Type of dwelling			0.001
Single (n=76)	60 (79.0)	16 (21.0)	
Semidetached or row house (n=34)	25 (73.5)	9 (26.5)	
Duplex or low-rise apartment (n=14)	9 (64.3)	5 (35.7)	
High-rise apartment (≥5 stories) (n=25)	16 (64.0)	9 (36.0)	
Household ownership			<0.0001
Own (n=105)	83 (79.0)	22 (21.0)	
Rent (n=48)	22 (45.8)	26 (54.2)	
Education level of respondent			0.007
Completed high school or less (n=29)	13 (44.8)	16 (55.2)	
Completed postsecondary education or less (n=60)	45 (75.0)	15 (25.0)	
Completed postgraduate education or less (n=63)	47 (74.6)	16 (25.4)	
Income adequacy§			<0.0001
Lower and lower-middle (n=44)	8 (18.2)	36 (81.8)	
Upper-middle and highest (n=102)	82 (80.4)	20 (19.6)	
Immigrant status			0.002
Born in Canada (n=141)	101 (71.6)	40 (28.4)	
Born outside Canada (n=11)	3 (27.3)	8 (72.7)	
Health care provider type			0.288
No physician (n=17)	10 (58.8)	7 (41.2)	
Paediatrician only (n=39)	25 (64.1)	14 (35.9)	
Family doctor only (n=32)	26 (81.2)	6 (18.8)	
Mixed provider (n=58)	42 (72.4)	16 (27.6)	
Health care provider contact (number of visits in previous 12 months)			0.376
0 (n=17)	10 (58.8)	7 (41.2)	
1 to 4 (n=65)	49 (75.4)	16 (24.6)	
≥5 (n=64)	44 (68.8)	20 (31.2)	

**Frequencies for each variable are adjusted for missing values; †Affirmative response to the question "Has your child ever been prescribed an epinephrine autoinjector (EpiPen)?" (EpiPen [King Pharmaceuticals, Canada]); ‡Affirmative response to the question "Has your child ever had a peanut allergy diagnosed by a doctor?"; §Income adequacy is a derived variable defined by Statistics Canada (refer to Table 1 for a summary of the income adequacy categories)*

under-availability given the association between lack of accessible epinephrine and death (2,3,5).

The T-CHEQ sample was previously demonstrated to be representative of the general population of urban Canadian children, with sociodemographic characteristics similar to census-derived data and prevalence of asthma symptoms similar to data from national health surveys (10). In a registry-based study of nut-allergic individuals (12), who were likely a well-informed subset of patients, more than 95% reported receiving epinephrine prescriptions. In a random-digit-dial telephone survey in the United States (13), 46% of children with physician-evaluated nut allergy were prescribed epinephrine. Our study showed a slightly higher proportion of epinephrine prescription (68.6%) in a population-based sample of peanut-allergic Canadian children.

The striking, and somewhat disturbing, finding of the present study was the association between income adequacy and epinephrine autoinjector prescription. Peanut-allergic children in the upper-middle or highest income adequacy group were 8.35 times more likely to have been prescribed self-injectable epinephrine, indicating that children from families of lower SES may be at a disproportionately increased risk of fatality following allergic reactions. This finding is not entirely surprising because previous studies have shown that the working poor are least likely to have insurance that fully covers medications (7,8), that those without drug plans are more likely to delay or not fill a prescription because of cost (9), and that a patient's SES (14-16) or race (17) may influence physician prescribing patterns. Although our findings suggest that physicians may be less likely to prescribe epinephrine to peanut-allergic children of lower SES, these results may also reflect that families of lower SES were less likely to fill and, therefore, less likely to recall and report being prescribed epinephrine.

In the present study, peanut-allergic children with current asthma were also more likely to have been prescribed epinephrine. This is an encouraging pattern given the association between asthma and fatal reactions to peanuts (1).

Our study was limited because we used parental report of health characteristics. Although the prevalence of peanut allergies in the present study (2.83%) was higher than previously published, parental reporting of peanut allergies was validated in a similar multicultural urban setting in Canada (18). To our knowledge, however, parental reporting of epinephrine autoinjector prescriptions has not been validated relative to other sources. A second epinephrine autoinjector (Twinject [Shionogi Pharma Inc, USA]) became available in 2006, between the time of printing and conducting the present survey. We did not specifically mention this trade name in our survey, and it is possible that subjects were only familiar with trade names for epinephrine; this could have resulted in some under-reporting of epinephrine prescriptions. However, this limitation is unlikely to invalidate our main results of the association between SES and epinephrine prescription because the under-reporting effect would be expected to be small and differential misclassification between subjects of different socioeconomic classes is unlikely. Our study was also limited because we did not ask whether epinephrine prescriptions were filled, autoinjectors were current and accessible, or families were trained in their use. However, these limitations would bias our results toward over-reporting epinephrine availability. Hence, the true rate of underavailability of epinephrine autoinjectors for life-threatening peanut anaphylaxis is likely to be much higher.

Self-injectable epinephrine may be life saving for children with peanut allergy, but it imposes a significant financial burden on their families. The suboptimal prescribing pattern suggested by the results of the present study needs to be addressed. Further research is warranted to explain and determine strategies to rectify the disparities in epinephrine prescribing among peanut-allergic children from families of differing SES.

TABLE 3
Predictors of parent-reported epinephrine autoinjector prescription in children with peanut allergy

	OR (95% CI)	
Variable name	Bivariate analysis	Adjusted multivariate analysis
Female sex	0.83 (0.38–1.80)	–
Current asthma	3.54 (1.36–9.23)	4.74 (1.56–14.47)
Eczema	2.19 (1.08–4.44)	–
Concurrent allergy to fish/seafood	0.79 (0.26–2.40)	–
Concurrent allergy to tree nuts	3.00 (1.44–6.22)	–
Type of dwelling		
Single	REF	–
Semidetached or row house	0.74 (0.28–1.99)	–
Duplex or low-rise apartment	0.48 (0.14–1.67)	–
High-rise apartment (≥5 stories)	0.15 (0.05–0.41)	–
Dwelling rented (versus owned)	0.22 (0.11–0.48)	–
Education level of respondent		
Completed high school or less	REF	–
Completed postsecondary education	3.69 (1.49–9.18)	–
Completed graduate or professional degree	3.62 (1.43–9.12)	–
Income adequacy*		
Lowest and lower-middle	REF	REF
Upper-middle and highest	5.92 (2.86–12.24)	8.35 (2.72–25.61)
Immigrant status		
Born outside Canada	REF	–
Born in Canada	6.73 (1.70–26.61)	–
Health care provider type		
No physician	REF	–
Paediatrician only	1.25 (0.42–3.75)	–
Family doctor only	3.03 (0.82–11.19)	–
Mixed provider	1.84 (0.61–5.51)	–
Health care provider contact (number of visits in past 12 months)		
0	REF	–
1 to 4	2.14 (0.70–6.59)	–
≥5	1.54 (0.56–4.26)	–

**Income adequacy is a derived variable defined by Statistics Canada (refer to Table 1 for a summary of the income adequacy categories). REF Reference value*

REFERENCES

1. Sampson HA. Clinical practice. Peanut allergy. N Engl J Med 2002;346:1294-9.
2. Bock SA, Munoz-Furlong A, Sampson HA. Further fatalities caused by anaphylactic reactions to food, 2001-2006. J Allergy Clin Immunol 2007;119:1016-8.
3. Pumphrey RS, Gowland MH. Further fatal allergic reactions to food in the United Kingdom, 1999-2006. J Allergy Clin Immunol 2007;119:1018-9.
4. Simons FE. 9. Anaphylaxis. J Allergy Clin Immunol 2008;121(2 Suppl):S402-7; quiz S20.

5. Bock SA, Munoz-Furlong A, Sampson HA. Fatalities due to anaphylactic reactions to foods. J Allergy Clin Immunol 2001;107:191-3.
6. Al-Muhsen S, Clarke AE, Kagan RS. Peanut allergy: An overview. CMAJ 2003;168:1279-85.
7. Frost DW, Chalin CG. The effect of income on anaphylaxis preparation and management plans in Toronto primary schools. Can J Public Health 2005;96:250-3.
8. Cope SF, Ungar WJ, Glazier RH. Socioeconomic factors and asthma control in children. Pediatr Pulmonol 2008;43:745-52.
9. Ungar WJ, Daniels C, McNeill T, Seyed M. Children in need of Pharmacare: Medication funding requests at the Toronto Hospital for Sick Children. Can J Public Health 2003;94:121-6.
10. Dell SD, Foty RG, Gilbert NL, et al. Asthma and allergic disease prevalence in a diverse sample of Toronto school children: Results from the Toronto Child Health Evaluation Questionnaire (T-CHEQ) Study. Can Respir J 2010;17:e1-6.
11. Statistics Canada. National Longitudinal Survey of Children and Youth (NLSCY/KIDS), Cycle 5 (2002-2003): Self-Administered Questionnaire file. Ottawa: Statistics Canada, Human Resources Development Canada, 2003.
12. Sicherer SH, Furlong TJ, Munoz-Furlong A, Burks AW, Sampson HA. A voluntary registry for peanut and tree nut allergy: Characteristics of the first 5149 registrants. J Allergy Clin Immunol 2001;108:128-32.
13. Sicherer SH, Munoz-Furlong A, Sampson HA. Prevalence of peanut and tree nut allergy in the United States determined by means of a random digit dial telephone survey: A 5-year follow-up study. J Allergy Clin Immunol 2003;112:1203-7.
14. Kozyrskyj AL, Dahl ME, Chateau DG, Mazowita GB, Klassen TP, Law BJ. Evidence-based prescribing of antibiotics for children: Role of socioeconomic status and physician characteristics. CMAJ 2004;171:139-45.
15. Reuveni H, Sheizaf B, Elhayany A, et al. The effect of drug co-payment policy on the purchase of prescription drugs for children with infections in the community. Health Policy 2002;62:1-13.
16. Kozyrskyj AL, Mustard CA, Simons FE. Socioeconomic status, drug insurance benefits, and new prescriptions for inhaled corticosteroids in schoolchildren with asthma. Arch Pediatr Adolesc Med 2001;155:1219-24.
17. Hannaway PJ, Connelly ME, Cobbett RM, Dobrow PJ. Differences in race, ethnicity, and socioeconomic status in schoolchildren dispensed injectable epinephrine in 3 Massachusetts school districts. Ann Allergy Asthma Immunol 2005;95:143-8.
18. Kagan RS, Joseph L, Dufresne C, et al. Prevalence of peanut allergy in primary-school children in Montreal, Canada. J Allergy Clin Immunol 2003;112:1223-8.