

The Effect of Income on Anaphylaxis Preparation and Management Plans in Toronto Primary Schools

David W. Frost, BSc
Catherine G. Chalin, MDiv, PhD

ABSTRACT

Background: Outcomes of serious allergic reactions are worse at school than at home. Prompt administration of epinephrine is the first-line treatment for anaphylactic reactions, and the EpiPen® device is not subsidized by Ontario public health insurance. This study examines the relationship between the proportion of low-income households in Toronto neighbourhoods and the adequacy of anaphylaxis management plans in primary schools.

Methods: A survey was administered to principals of primary schools. It addressed the areas of: prevalence of food allergy, the presence of EpiPen at school and staff training in its use, and exposure prevention policy. The results were correlated to 2001 Canadian Census data for percentage of low-income households in each school's area.

Results: Children with reported severe food allergy attending schools in areas with greater than 20% low-income households were less likely to have medication at school than those in neighbourhoods with less than 20% (relative risk 2.2, 95% confidence interval 1.1-4.4). Other aspects of the anaphylaxis action plan, including staff EpiPen training and parental provision of information to the school, showed no significant correlation to income. Overall, about 50% of schools have their entire teaching staff trained to administer the EpiPen.

Interpretation: The lack of medication at school for anaphylaxis is a limiting factor in optimal anaphylaxis management in the school setting. Government support in the purchase of EpiPen in low-income households may be indicated.

MeSH terms: Anaphylaxis; income; children; epinephrine

La traduction du résumé se trouve à la fin de l'article.

Department of Public Health Sciences, Faculty of Medicine, University of Toronto
Correspondence and reprint requests: Catherine G. Chalin, Department of Public Health Sciences University of Toronto, Faculty of Medicine, McMurrich Building, Room 103E, 12 Queen's Park Crescent West, Toronto, ON M5S 1A8, Tel: 416-978-7806, Fax: 416-978-2087, E-mail: c.chalin@utoronto.ca

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Between 1986-2000, there were 32 fatal allergic reactions to food in Ontario.¹ With prompt administration of epinephrine via EpiPen® and subsequent management in hospital, these deaths could have been largely preventable. The prevalence of food allergy in children has recently seen an increase, as have severe reactions characterized by anaphylactic shock, laryngeal edema, and severe acute asthma.² Food allergies may affect up to 6% of preschool and school-aged children with varying degrees of severity. In these children, outcomes after exposure to allergen are worse at school than at home; in a study of fatal and near-fatal anaphylactic reactions to food in children, 67% of reactions occurred at school.³

The existence of an anaphylaxis action plan benefits children other than those known to have severe allergic reactions. The US National Peanut and Tree Nut Allergy Registry shows that among children currently known to be allergic, the first reaction to peanut occurred in school 25% of the time.⁴ Thirteen percent of patients with peanut allergy have severe index reactions.⁵ This argues for the presence of action plans in all schools, regardless of whether there is a known allergic student attending or not.

The single most effective treatment for severe allergic reaction is the administration of epinephrine, typically through an autoinjector with 0.3 mg of epinephrine (EpiPen) or 0.15 mg (EpiPen Jr.®). Despite the evidence that early administration of epinephrine saves lives, there is often reluctance on the part of non-health-care professionals to administer it to a child experiencing symptoms of allergic reaction. An Australian study of anaphylaxis in schools showed that in 71% of anaphylactic reactions to food, an EpiPen was not used, yet in 69% of these occasions, an EpiPen was available and had not expired.⁶ Other studies in the US and England showed similar results.

In Ontario, EpiPen is not universally subsidized by the government. Only low-income seniors qualify for a subsidy through the Ontario Drug Benefit Plan. The population most susceptible to anaphylaxis to food – children and adolescents – do not qualify for any support in the purchase of this life-saving medication, regardless of financial means. The cost of the EpiPen is not trivial; it costs approxi-

mately \$100 and expires every 18 months.⁷ The hypothesis of this work is that adequacy of anaphylaxis management plans in Toronto schools is less in lower-income neighbourhoods.

METHODS

This study was conducted through the administration of a questionnaire to school principals. The questionnaire was based on one used in Britain and published in 2002.⁸ Certain questions were added which facilitated an analysis of anaphylaxis preparation and its correlation to income, the specific determinant of health under investigation. The issues addressed in the questionnaire generally included prevalence of reported anaphylactic-type food allergies, presence of medication for anaphylaxis at school, knowledge and training of the staff, and attitudes towards allergy policies (Full questionnaire available from corresponding author upon request).

In addition, we wanted to assess whether peanut restrictions were perceived as unfair by parents of non-allergic children in the school, particularly those in lower-income areas. This may be because food banks often provide peanut butter as a protein source. To detect this effect, the surrogate of complaints to the principal regarding the peanut/nut policy at the school was also measured. The hypothesis was that schools in areas of lower income that have instituted food restrictions (e.g., peanut ban) will have received more complaints from parents regarding these restrictions than schools in more affluent areas.

The Board in this study has 168 elementary schools; 100 of these schools were randomly chosen from a table of random numbers. Principals who did not respond by mail were contacted by telephone, and administered the questionnaire if they agreed to participate.

Municipal electoral wards were used to define the area in which a school is located. This was chosen because of the readily available access to Canadian 2001 Census data for these areas.⁹ The schools where principals agreed to participate were spread throughout the City of Toronto.

To control for the effect of relatively few high-income households skewing the data, the percentage of low-income households in the city ward was employed as a mea-

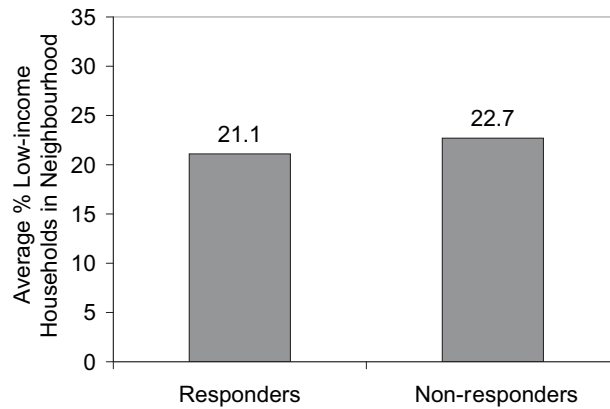


Figure 1. Comparison of schools responding to questionnaire to those not responding
Average percentage of households with a low income does not significantly differ between responders and non-responders.

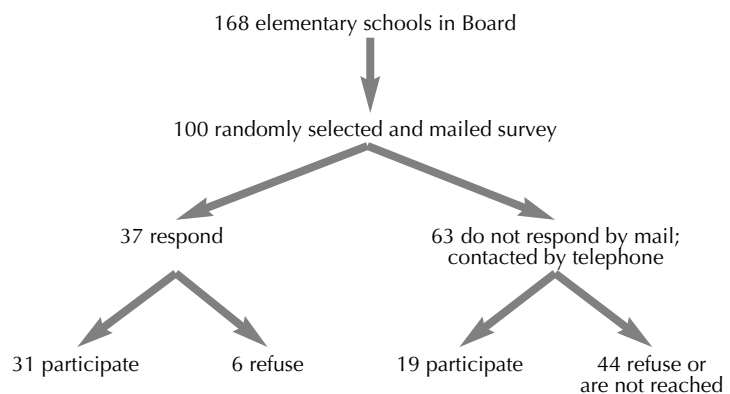


Figure 2. Response to survey
Total response rate was 50%.

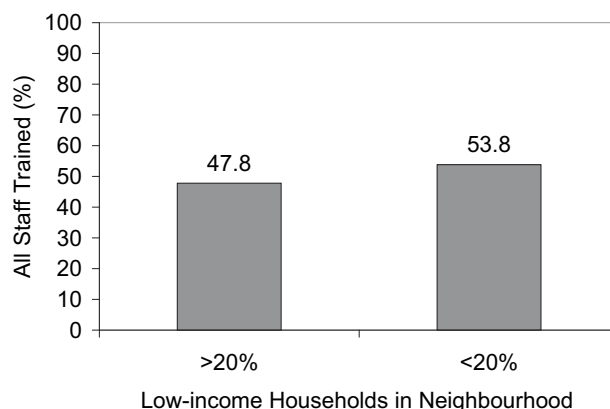


Figure 3. Schools where the entire teaching staff is trained to administer the EpiPen
Relative risk (RR) 1.1 (95% confidence interval (CI) 0.6-2.0)

sure of income. The definition of low income was Statistics Canada's definition used for the 2001 Census which takes into account household size and the population of the area in question. The data were stratified by using 20% low-income households as the border between poorer and

more affluent wards. This almost evenly divided the data, and was close to the Toronto average.

The income parameters described above were compiled for both responding schools and non-responding schools in order to detect a response bias in income. The data

TABLE I
Stratification of Allergy Prevalence and Presence of Medication at School by Income

	Allergic Children	Total Children	Prevalence of Reported Allergy	Allergic Children Without Medication at School	Percentage Without Medication at School
<20% low-income households	134	8116	1.7%	10	7.5%
>20% low-income households	153	10,143	1.5%	25	16.3%
Total	287	18,259	1.6%	35	12.2%

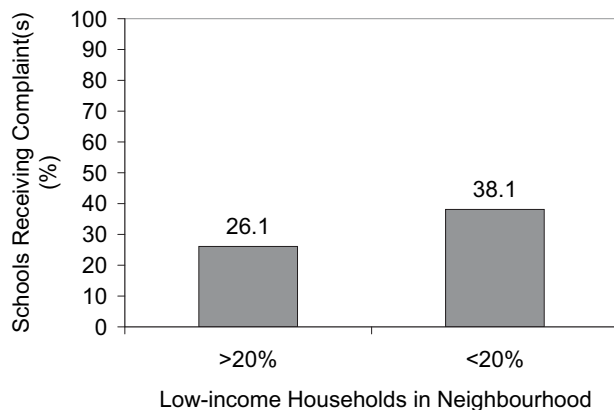


Figure 4. Schools where the principal has received complaint(s) about the peanut or nut restriction policy
 RR 1.5 (95% CI 0.5-3.5)

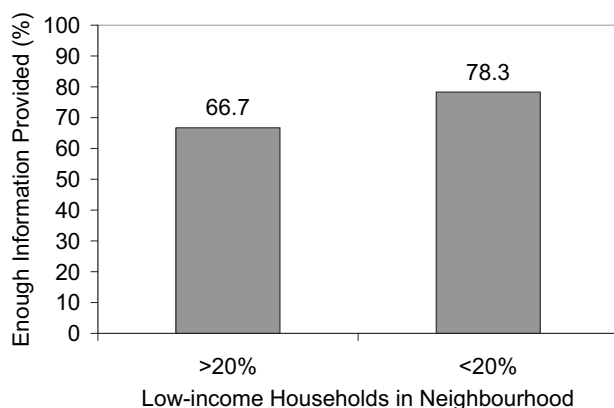


Figure 5. Principals' opinion that adequate information is provided by parents when they have an allergic child at school
 RR 1.2 (95% CI 0.8-1.7)

are shown in Figure 1 and demonstrate no significant income-based difference in responders vs. non-responders.

Data were analyzed using EpiInfo software (version 3.2). The sample size (n=50) did not allow substratification of the income data, and made high- vs. low-income neighbourhoods a more suitable measure for data analysis. Similarly, questions involving a sliding scale of answers ranging from strongly agree to strongly disagree were analyzed as either agree or do not agree. This also facilitated data analysis. This type of data permitted the calculation of relative risk and its associated 95%

confidence interval. When comparing 2 discrete outcomes between 2 discrete groups (e.g., presence or absence of medication in high- vs. low-income neighbourhoods), the χ^2 calculation was also used to determine significance. Differences were considered significant with a p-value of 0.05 or less.

This study was approved by the University of Toronto Research Ethics Board.

RESULTS

The response to the questionnaire is outlined in Figure 2. A total of 50 out of 100

principals contacted agreed to participate in the study (50% response rate).

The 50 principals who participated represented 287 children with serious allergies reported to the school. The stratification of the study population by income is shown in Table I. The total number of students in the schools surveyed was 18,259. The prevalence of reported severe food allergy was therefore 287/18,259 (1.6%). This is consistent with previously published data.¹⁰ Table I also shows the stratification of allergic children by neighbourhood income. The 287 allergic children were stratified into 134 in neighbourhoods with <20% low-income households, and 153 in neighbourhoods with >20% low-income households. When divided into the total number of students in these income groups, the prevalence rates were 1.7% in more affluent areas, and 1.5% in less affluent areas, showing no significant difference in prevalence by income. When asked whether the students with reported severe allergies had medications at school, a total of 252/287, or 87.8%, had an EpiPen at school. Two schools additionally had Benadryl®.

The analysis of presence of medication at school in allergic children showed a correlation to neighbourhood income. Table I shows that 10/134 allergic children in more affluent neighbourhoods did not have medication at school. This contrasts with 25/153 in less affluent areas. This difference was statistically significant; the p-value was <0.05, and the relative risk (RR) was 2.2 (95% confidence interval (CI) of 1.1-4.4).

Figure 3 shows the data obtained regarding the training of staff in the use of the EpiPen. A small income-related difference in the rate of fully trained staff was detected (54% in higher- and 48% in lower-income neighbourhoods). However, this difference was not statistically significant (RR 1.1, 95% CI 0.6-2.0). When asked whether EpiPen training in their school is adequate, 68% of principals reported that it was.

Eighty-six percent of schools had a peanut restriction policy, with no statisti-

cally significant difference between high- and low-income neighbourhoods (data not shown). Figure 4 shows that the analysis by income surprisingly demonstrated that higher-income areas were 1.5 times more likely to have received a complaint than lower-income areas, although this difference did not reach statistical significance (RR 1.5, 95% CI 0.6-3.5).

A possible barrier to the existence of an effective anaphylaxis action plan at school is parental provision of information to the school. Principals were asked whether they considered the amount of information provided by parents of allergic children at school to be adequate. These data are shown in Figure 5. About 78% of principals in higher-income neighbourhoods felt that information was adequate, compared to 67% in lower-income neighbourhoods. This result did not reach statistical significance (RR 1.2, 95% CI 0.8-1.7).

DISCUSSION

The major finding of this study was that the only component of the anaphylaxis management plan significantly correlated to neighbourhood income was the presence of medication at school. Allergic students in lower-income neighbourhoods were 2.2 times more likely to have no medication at school. The results of this study showed that income was a significant determinant of preparation to deal with anaphylaxis in primary schools, because without medication at school, optimal management is impossible. The other components of the anaphylaxis plan that were assessed (i.e., parental information, prevention of exposure, staff training in the use of EpiPen) had no significant correlation with neighbourhood income.

There are some potential weaknesses to this study. The data about allergic children were collected indirectly from the school principal. This allowed a high total number of children to be included, but assumed that school principals accurately reported the prevalence of allergy and medication in school. At 50%, the response rate was low. However, we have shown no significant difference between neighbourhood incomes in responders versus non-responders. Additionally, the low response rate may underestimate differences in allergy preparedness, since princi-

pals of schools with suboptimal plans may have been less likely to answer the questionnaire.

Less than 50% of schools studied had their entire teaching staff trained to use EpiPens. Training in the use of EpiPen is quite simple, and takes only minutes. Several principals expressed frustration with the lack of organized training in the use of the device. In several cases, parents trained the staff. This is not acceptable; parents should not be the sole source of information, as they may not necessarily have the skills, knowledge, or time to train school staff. A more organized training policy, perhaps through a Public Health Department, may improve the situation.

Legal issues related to the administration of prescription medication by a non-healthcare professional to a child who has not been specifically prescribed the medication currently stand in the way of having one EpiPen in every school for any potential reaction. This approach, however, would likely be optimal since it would negate the income-related difference seen in this study. It would be beneficial to clarify the legal issues surrounding administration of EpiPen at school to children without identified allergies (i.e., those suffering their first reaction). If legally acceptable, each classroom should have at least one EpiPen, regardless of whether or not they have an allergic child.

Having an EpiPen in every classroom would optimize management of anaphylaxis in schools. However, allergic children are

at risk everywhere and this approach would not address other locations. Perhaps a better solution is government assistance to low-income families in the purchase of EpiPens. A direction for future study is a cost-benefit analysis of this intervention compared to others currently provided.

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RÉSUMÉ

Contexte : Les conséquences des réactions allergiques graves sont plus néfastes à l'école qu'à domicile. L'administration prompte d'épinéphrine est le traitement principal en cas d'anaphylaxie. Cependant, l'auto-injecteur EpiPen® n'est pas subventionné par le régime d'assurance-maladie de l'Ontario. Nous avons examiné la relation entre la proportion de ménages à faible revenu dans des quartiers de Toronto et la qualité des plans de traitement de l'anaphylaxie dans les écoles primaires.

Méthode : Nous avons administré une enquête aux directeurs d'établissements. L'enquête a inclus des questions sur la prévalence des allergies alimentaires, la présence de l'EpiPen à l'école et la formation du personnel pour l'administrer, ainsi que les consignes pour limiter l'exposition aux allergènes. Les résultats ont été corrélés avec le pourcentage, tiré du recensement canadien de 2001, de ménages à faible revenu dans chaque quartier.

Résultats : Il était moins probable que les enfants avec une allergie grave dans des quartiers ayant plus de 20 % de ménages à faible revenu aient eu d'EpiPen à l'école que ceux vivant dans les quartiers ayant moins de 20 % de tels ménages (risque relatif = 2,2, intervalle de confiance de 95 % = 1,1-4,4). D'autres aspects du plan d'action contre l'anaphylaxie, y compris la formation du personnel et la fourniture d'information par les parents, n'ont montré aucune corrélation significative avec le revenu. En général, tout le personnel a reçu la formation pour administrer l'EpiPen dans 50 % des écoles.

Interprétation : Le manque de médicaments contre l'anaphylaxie est un facteur limitant pour le traitement de l'anaphylaxie à l'école. Il se peut qu'un soutien gouvernemental à l'achat de l'EpiPen soit nécessaire pour les ménages à faible revenu.