Prevalence of non-food allergies among non-immigrants, long-time immigrants and recent immigrants in Canada

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ABSTRACT

OBJECTIVES: The prevalence of allergic conditions has been increasing worldwide, with the highest rates seen in Western countries like Canada. The development of allergies is known to be related to both genetic and environmental factors, but the causal pathways remain unclear. Studies on immigrants provide a unique opportunity to disentangle these two factors and provide a better understanding of the disease aetiology. The aim of this study was to investigate the relationship between immigration status and prevalence of non-food allergies in a population-based study of Canadians.

METHODS: Data of 116,232 respondents from the Canadian Community Health Survey (Cycle 3.1, 2005) were used in a multivariable logistic regression to assess the association between immigration status (non-immigrant, long-time immigrant [>10 years] and recent immigrant [≤ 10 years]) and self-reported doctor-diagnosed non-food allergies, adjusting for potential confounders.

RESULTS: The highest prevalence of non-food allergies was found among non-immigrants (29.6%), followed by long-time immigrants (23.9%) and then recent immigrants (14.3%). The odds of non-food allergies were reduced by 60% (OR = 0.40, 95% CI: 0.35, 0.45) among recent immigrants and 25% (OR = 0.75, 95% CI: 0.70, 0.80) among long-time immigrants, compared with non-immigrants, after adjusting for sex, age, socio-economic status and rurality.

CONCLUSION: This study finds a distinctly lower prevalence of non-food allergies among immigrants compared with non-immigrants, with the difference diminishing with longer duration of residence in Canada. The findings highlight the potential of environmental determinants of allergy development that warrant further investigation, and demonstrate the need for multicultural strategies to manage the public health burden of allergic conditions.

KEY WORDS: Allergy and immunology; respiratory hypersensitivity; emigrants and immigrants; socio-economic factors

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

Can J Public Health 2016;107(4-5):e461–e466
doi: 10.17269/CJPH.107.5614

Allergen sensitization is the fundamental step that leads to allergic diseases. In particular, non-food allergies are mainly caused by exposure to allergens via the inhalation route.¹ They are an increasing public health concern worldwide, among which respiratory allergies such as allergic rhinitis are the most common. Globally, approximately 10%–30% of the population are affected by allergic rhinitis,² and Canada, where approximately 20% of the population are affected, has one of the highest prevalence rates in the world.^{3,4} Although respiratory allergies seldom lead to anaphylaxis, their symptoms can have an adverse impact on the quality of life of individuals as well as their families over a long duration, and they are risk factors for other co-morbidities of physical and mental health.^{2,5} They also create a substantial burden on the health care system⁶ that is estimated to increase with climate change and associated production of more aero-allergens.⁷ It has been widely accepted that the development of allergies is determined by both genetic and environmental factors, but the rapid increase of prevalence in the past few decades and a higher prevalence in some countries compared to others over time is more likely to be explained by new and/or changing environmental risk factors.⁸

Migrant populations provide a unique opportunity to investigate the role of environmental factors, as they are going through a natural experiment with exposure to new allergens and pollutants, as well as changes to lifestyles, such as housing conditions and diets.⁹ Previous studies have found that the risk of developing

allergic diseases increases in those immigrating from low-income countries to Western countries,⁹ and the prevalence increases with longer residence in the host country.¹⁰ These results support the “healthy immigrant effect” found in various fields of health research, where recent immigrants tend to be healthier than the native population, but the differences vanish over time with exposures in the host country or the adoption of adverse health behaviours. The mechanism behind differences in allergic conditions by immigration status is still unclear, but the “biodiversity hypothesis” provides a possible explanation. It suggests that adapting to the Western urban environment, where one is exposed to much less diverse microbial species, may cause immune dysfunction and impaired tolerance mechanisms, thus increasing the risk of allergic diseases.¹¹

Most of the studies on respiratory allergies among immigrants have focused on children, whose immune systems are still developing,¹² but these results may not be generalizable to adult

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Acknowledgements: We thank Dr. Mieke Koehoorn for her valuable guidance and feedback from conception to completion of this work. Dr. Hind Sbihi is an AllerGen trainee.

Conflict of Interest: None to declare.

populations with more mature immune systems. Only a few studies have looked at allergies among adolescent or adult immigrants, and results from these studies have been imprecise and inconclusive.¹⁰ Thus, it remains unclear whether the effect of immigration status on allergy development applies to the general population. To address this knowledge gap, data gathered from the Canadian Community Health Survey (CCHS) were used to conduct a population-based study on the relationship between immigration status (non-immigrant, recent immigrant and long-time immigrant) and the prevalence of non-food allergies, which should be dominated by respiratory allergies given their considerably higher prevalence compared with atopic dermatitis.¹ The results will not only add to our knowledge of immigrant health in Canada, but also provide additional evidence of the potential mechanisms of allergic disease development, specifically a largely unexplored morbidity: non-food allergies.

METHODS

Study design

The Canadian Community Health Survey (CCHS Cycle 3.1) is a cross-sectional survey conducted in 2005. It collected health-related information from individuals aged 12 or older in

122 health regions across all provinces and territories in Canada. With a few exclusions, the survey represents approximately 98% of the Canadian population. A multi-stage sampling strategy was used to select respondents using a combination of an area sampling frame (49%), a list frame of telephone numbers (50%) and Random Digit Dialling (1%). Half of the 132,947 valid interviews were conducted in person while the other half were over the telephone, representing a national response rate of 79%. Although CCHS has been conducted every two years, this study used results from Cycle 3.1 because it was the most recent one where all respondents were asked about their allergic conditions.

Analytic sample

To investigate the association between immigration status and non-food allergies, this analysis included all individuals in the survey with valid responses to questions on immigration status and allergies, as well as the potential confounders of age, sex and highest level of education in the household (Figure 1). Individuals with invalid responses (i.e., Don't know, Refusal and Not stated) were excluded. Respondents with food allergies but not the outcome of interest were also excluded to create a reference group without any type of allergies.

Figure 1. Flowchart showing the process of exclusion and inclusion from the Canadian Community Health Survey (Cycle 3.1, 2005) sample to the final analytic sample for the study

Study variables

The binary outcome variable for non-food allergies (yes/no) was derived from responses to two consecutive questions in the survey. The respondents were asked “Do you have food allergies?” followed by the question “Any other allergies?” Respondents who answered yes to the second question were assigned a yes for the study outcome, and respondents who answered no to both the food and other allergy question were assigned a no. Although these were self-reported conditions, a note was given in the interviews stating that the conditions of interest should be expected to last or have already lasted six months or more, and have been diagnosed by a health professional.

The explanatory variable for immigration status was a variable derived based on whether the respondents were born in Canada, and if not, the year that respondents first came to live in Canada and the year of the interview. Statistics Canada categorized responses into three categories: non-immigrant, immigrant with less than 10 years since immigration, and immigrant with 10 years or more since immigration.

Potential confounders included sex (female versus male), age (10-year categories), highest level of education in the household (less than secondary school, secondary school completion or some/completed post-secondary education) as an indicator of household socio-economic status, and population density of health region (very low, medium, and high) as a proxy for rurality. Some studies have shown higher prevalence of allergies in urban areas compared with rural areas,¹³ and immigrants tend to settle in urban centres.¹⁴ The population density indicator was derived from the health region variable in the survey. Statistics Canada first categorized all the health regions into nine peer groups based on seven demographic factors, including population density.¹⁵ For the purpose of this study, these peer groups were further divided into three categories based only on the population density factor.

Analysis plan

Data analyses were conducted using SAS 9.4 (University Edition, SAS Institute Inc., Cary, NC). The probability weights, derived from the survey frequency weights provided by Statistics Canada for each individual, were applied in all analyses to account for the uneven probability of sample selection and to calculate appropriate estimates of variance. The CCHS Public Use Microdata File (PUMF) used in this study is a suppressed version with minimal disclosure or privacy risks.

Descriptive statistics were generated to examine the characteristics of the study sample. Bivariate logistic regression was conducted between the explanatory variable and the outcome variable to generate crude estimates of the association. A multivariable logistic regression was conducted to investigate the association between immigration status and non-food allergies, adjusting for the confounding effects of sex, age, household education level, and population density of health region.

RESULTS

The final study sample included 116,232 individuals (Figure 1), representing approximately 23 million Canadians. Females and males, as well as age groups were evenly distributed in the sample,

Table 1. Descriptive statistics for the study sample investigating immigration status and non-food allergies, Canadian Community Health Survey Cycle 3.1 (2005)

Variable	N (%)	With non-food allergies	Without any allergies
Study sample	116,232	32,922	83,310
Immigration status			
Non-immigrant	100,583 (79.2)	29,308 (84.1)	71,275 (77.4)
Immigrant ≥10 years	12,400 (15.1)	3114 (13.0)	9286 (15.9)
Immigrant <10 years	3249 (5.7)	500 (2.9)	2749 (6.7)
Sex			
Male	52,711 (48.8)	11,904 (41.2)	40,807 (51.7)
Female	63,521 (51.2)	21,018 (58.8)	42,503 (48.3)
Age category, years			
12–19	12,763 (11.3)	3681 (11.1)	9082 (11.3)
20–29	14,576 (15.2)	4493 (17.2)	10,083 (14.5)
30–39	18,276 (16.5)	5485 (17.1)	12,791 (16.3)
40–49	18,235 (20.3)	5271 (20.2)	12,964 (20.3)
50–59	18,981 (16.1)	5494 (16.3)	13,487 (16.1)
60–69	15,435 (10.5)	4165 (9.9)	11,270 (10.7)
70–79	11,729 (6.8)	2949 (5.9)	8780 (7.3)
≥80 years	6237 (3.2)	1384 (2.3)	4853 (3.5)
Highest level of education in household			
Less than secondary	16,665 (8.2)	3875 (6.6)	12,790 (8.8)
Secondary	14,227 (10.5)	3550 (9.1)	10,677 (11.0)
Post-secondary	85,340 (81.3)	25,497 (84.3)	59,843 (80.2)
Health region population density			
Very low	40,006 (18.0)	10,728 (17.3)	29,278 (18.2)
Medium	47,395 (38.7)	13,804 (39.0)	33,591 (38.6)
High	28,831 (43.3)	8390 (43.7)	20,441 (43.2)

except that the proportions of people in the youngest (12–19 years) and oldest (70–79 years and over 80 years) age groups were slightly smaller (Table 1). There was a high level of education in the sample, with the majority of the respondents living in a household where at least one member had post-secondary education (81.3%). Almost half (43.3%) of the sample lived in health regions with high population density.

Among all respondents, 28.3% reported having non-food allergies. For the main explanatory variable, 20.8% of respondents were immigrants, of whom 5.7% were recent immigrants who had immigrated less than 10 years previously (Table 1). Non-food allergies respondents were more likely to be female and young adults, and to live in households with post-secondary education and in health regions with medium or high population density (Table 1).

The highest prevalence of non-food allergies was found among non-immigrants (29.6%), followed by long-time immigrants (23.9%) and then recent immigrants (14.3%). Correspondingly in the unadjusted logistic model, the odds of non-food allergies were associated with immigration status in accordance with the hypotheses. The odds were reduced by 60% (OR = 0.40, 95% CI: 0.35, 0.45) among recent immigrants and 25% (OR = 0.75, 95% CI: 0.70, 0.80) among long-time immigrants, compared with odds among non-immigrants (Table 2). Further, the point estimates and confidence intervals of the odds ratios remained the same without the exclusion of the 8,957 participants with missing information on confounder variables. In the multivariable logistic regression adjusting for sex, age groups, education and health region population density, the odds ratios only changed slightly. Compared with the non-immigrants, the adjusted odds ratio for

Table 2. Logistic regression models for the relationship between immigration status and non-food allergies in the Canadian Community Health Survey Sample Cycle 3.1 (2005)

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Immigration status		
Non-immigrant	1.00	1.00
Immigrant ≥10 years	0.75 (0.70, 0.80)	0.73 (0.68, 0.78)
Immigrant <10 years	0.40 (0.35, 0.45)	0.35 (0.30, 0.40)
Sex		
Male	1.00	1.00
Female	1.52 (1.46, 1.59)	1.55 (1.49, 1.61)
Age category, years		
12–19	1.00	1.00
20–29	1.21 (1.12, 1.30)	1.21 (1.12, 1.30)
30–39	1.07 (0.99, 1.14)	1.11 (1.03, 1.19)
40–49	1.01 (0.94, 1.09)	1.03 (0.96, 1.11)
50–59	1.03 (0.96, 1.11)	1.05 (0.97, 1.13)
60–69	0.94 (0.87, 1.01)	0.99 (0.91, 1.07)
70–79	0.82 (0.76, 0.89)	0.87 (0.80, 0.95)
≥80 years	0.68 (0.61, 0.75)	0.70 (0.63, 0.78)
Highest level of education in household		
Less than secondary	1.00	1.00
Secondary	1.11 (1.02, 1.20)	1.05 (0.96, 1.14)
Post-secondary	1.41 (1.33, 1.49)	1.32 (1.23, 1.41)
Health region population density		
Very low	1.00	1.00
Medium	1.07 (1.02, 1.12)	1.09 (1.04, 1.14)
High	1.07 (1.02, 1.12)	1.20 (1.14, 1.26)

non-food allergies was 0.73 (95% CI: 0.68, 0.78) for long-term immigrants and 0.35 (95% CI: 0.30, 0.40) for recent immigrants. The difference in odds across immigration statuses was distinct and none of the 95% confidence intervals included 1 or overlapped.

All potential confounders included in the final multivariable model were associated with the odds of non-food allergies as expected, where females, young adults, higher education level and living in regions with high population density were associated with increased odds of non-food allergies. The addition of confounders had limited influence on the effect estimate for immigration status. The strongest confounding effect was observed with health region population density, which independently strengthened the main effect (i.e., reduced the odds ratio for immigrants) by approximately 7%. Household highest education level was included as an indicator of socio-economic status. A sensitivity analysis using household income as an alternate measure of socio-economic status yielded almost identical effect estimates for the relationship between non-food allergies and immigration status when education was replaced with household income, or when both variables were included in the model (results not shown). We further examined the effect of sex via stratified analyses, with results suggesting potential interaction with immigration status. Subsequently, a model with sex by immigration interaction confirmed the absence of a statistically significant effect modification by sex.

DISCUSSION

This study demonstrates a clear relationship between immigration status and the prevalence of non-food allergies, with data from a nationwide survey on a large and representative sample of Canadians. The results agree with the hypothesis derived from

the “healthy immigrant effect”, that is, immigrants have a lower prevalence of allergies than non-immigrants, but this difference in prevalence decreases with longer time in the destination country. This finding persists after adjusting for age, sex, socio-economic status and rurality.

Findings from this study are in line with most previous evidence, with a few exceptions. The overall prevalence of non-food allergies found in this study is consistent with the prevalence of respiratory allergies previously reported in Canada and other high-income countries.^{4,5} The prevalence among recent immigrants is at the same scale as those reported for China and India,^{3,16,17} major source countries of immigrants to Canada in recent decades.¹⁸ Previous studies in other countries have also found a lower prevalence of allergies in immigrants compared with non-immigrants,^{19–21} and that longer duration of residence in the host country was associated with a higher prevalence of allergies among immigrants.^{21,22} However, other studies have also reported null associations^{23,24} or a higher prevalence of allergies among immigrants than non-immigrants.²⁵

Several factors may contribute to the inconsistency in research. First, the approaches to define the outcome variable for allergies vary across the studies, including the use of serum IgE level,²⁴ skin prick test results,²⁶ and self-reported symptoms or diagnoses.^{19,20} The different sensitivity and specificity across these approaches may contribute to the inconsistency, yet objective measures and doctor-diagnosed conditions have higher specificity. Second, the definitions of the exposure variable for immigration status also vary. Studies defined immigrant populations with first-generation immigrants (i.e., those born outside of the host country) only,^{19,23,24} a mix of first- and second-generation (i.e., those born in the host country to immigrant parents) immigrants,^{20,26} or second-generation immigrants only.²⁵ Second-generation immigrants have been found consistently to have higher rates of allergies than first-generation immigrants.¹⁰ Third, some studies had very small sample sizes, resulting in imprecise estimates from which it was difficult to draw conclusions.^{23,25} In general, results from this study are consistent with previous studies with similar study design, that is, studies using self-reported allergies as the outcome, looking at first-generation immigrants only and having a relatively large sample size. It is important to note that strengths of this work include a case definition based on doctor-diagnosed conditions, and immigration status is further split as a function of duration of immigration.

The lower prevalence of allergies among recent immigrants compared with non-immigrants may be attributed to the difference in health care access and disease diagnosis, but it can also be the result of differences in genetic and environmental risk factors for allergies, between their countries of origin and Canada. In contrast, the increased prevalence in long-time immigrants compared with recent immigrants should reflect primarily the impact of environmental risk factors, such as urban living, lifestyle factors and diets. This finding may indicate that the immune system that immigrants developed during their early life in the countries of origin, which were protective against allergies, could be reprogrammed to develop allergies later in life when adapting to the new environment.²⁷ However, other factors may also contribute to this finding. First, the prevalence of allergies may be different for recent and long-time immigrants upon entry to

Canada. A higher proportion of long-time immigrants originated from regions of high allergy prevalence, such as Western Europe.¹⁸ The influence of this factor may be offset by the fact that the prevalence of allergies in those regions was much lower a few decades ago when long-time immigrants first came to Canada.²⁸ Second, as immigrants settle in Canada, their access to health care and allergy diagnosis may improve over time. This can also increase the prevalence in long-time immigrants, although a sensitivity analysis controlling for the variable “having a regular medical doctor” as an indicator for health care access had little impact on the study results (results not shown). Further, the effect of access to health care may be diluted due to the relatively large time window considered to classify recent and long-term immigrants.

Limitations

While this study has unique strengths with a large and representative study sample, it has some limitations that may affect the interpretation of its results. First, because of the heterogeneity among immigrants, especially immigrants across different periods of time, the lack of information about country of origin limited the external validity of the study and the ability to hypothesize the potential mechanism behind the findings. However, this limitation should not affect the finding itself or its implication on public health burden in Canada. This study mimics a “natural” experiment where the healthy immigrant effect is reproduced, especially since Canadian immigration legislation requires an immigration medical examination, and adds to the knowledge base by showing that similar effect is true for non-food allergies and that it declines over time. Second, the validity of a self-reported allergy diagnosis is uncertain, although a previous study has shown moderate agreement between self-reported and clinically assessed allergic status, but high accuracy of recalling allergic status once clinically assessed.²⁹ The influence of misclassification may be differential due to language barriers or cultural differences for immigrants.³⁰ Nonetheless, the large sample of immigrants presumably with various levels of language abilities, at different stages of cultural assimilation, is likely to reduce the bias from this limitation.

CONCLUSION

Our findings support further investigations to improve the understanding of the aetiology of non-food allergies, using studies among immigrants. Longitudinal studies with information on country of origin will be needed to confirm the effect of time since immigration on incidence of allergies among immigrants. In addition, time since immigration is essentially a proxy measure for increased exposure to certain environmental risk factors in the host country. Further studies on exposure to potential environmental risk factors among immigrants before, during and after migration will provide vital evidence for the causal mechanism of allergy development. Studies on immigrants will be especially useful when looking at risk factors that have more variability between countries than within countries. A better understanding of the causal mechanism will be fundamental for preventing allergy development in both immigrants and non-immigrants.

Regardless of the reasons, this study clearly shows a high prevalence of non-food allergies among non-immigrants and

increasing prevalence among immigrants in Canada with duration of residence, a population-based finding worthy of further exploration. More research on disease aetiology, prevention and treatment is needed to control and eventually reduce this public health burden. Meanwhile, public health strategies and practical tools for health professionals such as the guidelines established by the Canadian Collaboration for Immigrant and Refugee Health (CCIRH) should be developed.³⁰ At this time CCIRH guidelines focus on infectious, mental health, non-communicable diseases and women’s health, leaving gaps for allergic diseases. Knowledge translation tools to help individuals manage allergies, targeting populations with diverse cultural backgrounds, would also enable lifestyle interventions that can be effective for disease prevention as well as early treatments that can support effective disease management.

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Received: March 31, 2016

Accepted: July 29, 2016

RÉSUMÉ

OBJECTIFS : La prévalence des allergies a connu un accroissement global, en particulier dans les pays industrialisés tels que le Canada. Bien qu'il soit établi que les allergies soient liées à des facteurs génétiques et environnementaux, les liens de causalité entre ces facteurs et le développement des allergies restent controversés. Les études portant sur les immigrants présentent une opportunité de discerner ces deux types de facteur et de mieux comprendre l'étiologie de ces maladies. L'objectif de cette étude, fondée sur la population canadienne, était d'explorer la relation entre le statut d'immigration et la prévalence des allergies non-alimentaires.

MÉTHODES : À l'aide des données de l'Enquête sur la santé dans les collectivités canadiennes (ESCC, Cycle 3.1, 2005), nous avons effectué une analyse de régression logistique multivariée auprès de 116 232 participants pour déterminer les effets indépendants du statut d'immigration (non-immigrant, immigrant de long terme [>10 ans] et immigrant récent [≤ 10 ans]) sur les mesures auto-déclarées de diagnostic d'allergie non-alimentaire par un professionnel de la santé, tout en corrigeant les données de l'effet de variables confusionnelles possibles.

RÉSULTATS : La plus haute prévalence d'allergies non-alimentaires était auprès des non-immigrants (29,6 %), suivie des immigrants de long terme (23,9 %) et enfin des immigrants récents (14,3 %). Les cotes corrigées de l'âge, sexe, statut socio-économique et ruralité ont démontré une diminution du risque de 60 % chez les immigrants récents (CC = 0,40, IC 95% : 0,35, 0,45) et de 25 % chez les immigrants de long terme (CC = 0,75, IC 95% : 0,70, 0,80) comparativement aux non-immigrants.

DISCUSSION : Cette étude démontre clairement et de manière significative une plus faible prévalence d'allergies non-alimentaires chez les immigrants comparativement aux non-immigrants, avec une différence qui diminue parallèlement à la durée de résidence au Canada. Dans l'ensemble, ces résultats mettent l'accent sur la contribution des facteurs environnementaux dans le développement des maladies allergiques et indiquent la nécessité de développer des stratégies multiculturelles pour une meilleure gestion du fardeau de ces maladies sur la santé publique.

MOTS CLÉS : allergie et immunologie; hypersensibilité respiratoire; émigrants et immigrants; facteurs socio-économiques