

Testing the Healthy Immigrant Hypothesis:

Obesity in four-year-olds

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The results in this report are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand. The opinions, findings, recommendations, and conclusions expressed are those of the author, not Statistics NZ. Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this report have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further details can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz.

Author's Note

I was initially hesitant to accept this scholarship because like most students, I'd rather spend my summer exploring the world, catching up with old friends, or participating in the debaucheries of Rhythm and Vines, but I knew life doesn't present too many golden opportunities and I'd forever regret passing this by. Under the excellent tutelage of Nichola and the COMPASS team, I've learned more over one summer break than in my entire university life before. Perhaps that's more telling of myself than the university as an institution, but even so I'd earnestly encourage any and all future students to undertake a summer scholarship. The practical experience of working with real data sets, performing advanced regression techniques, and uncovering the story behind your research is challenging, rewarding, and enlightening. I feel much more prepared for life after university and have gained a mentor, friend, and also honours supervisor, in Nichola.

Background

The healthy immigrant hypothesis (a.k.a. healthy immigrant effect) describes the epidemiological paradox whereby recent immigrants are generally healthier, both physically and mentally, than their native-born counterparts.^{1, 2} This is despite often coming from countries with lower socioeconomic status, poorer healthcare, and greater pollution.^{1, 3} The four main explanations are thought to be: immigrant self-selection (only the healthiest and wealthiest individuals are able to migrate); the salmon effect (ill/unhealthy immigrants return to their home countries); favourable habits and behaviours developed in the home country; and health screening by the host country.^{1, 2, 3}

The protective effects associated with recent immigrants have been well advanced in North American literature, but as New Zealand has a very different immigrant profile, our study aims to establish the existence of such an effect by comparing obesity rates in native-born children with those in foreign-born children. There has been a single study done in New Zealand to date, via Statistics New Zealand's Integrated Data Infrastructure (IDI), in regards to mortality rates – immigrants were found to have slight protective effects.⁴

Our study has found a healthy immigrant effect with regards to childhood obesity, after adjusting for a number of socioeconomic factors such as deprivation, ethnicity, region, and income.

Abstract

Background: Understanding the healthy immigrant effect in New Zealand allows legislature to better implement social programmes, prevent potential regression to New Zealand standards, and maintain residual benefits for future generations, thereby reducing the overall health burden on society.

Methods: Data from the Before School Check (B4SC) were used to classify obesity in four-year-old children, in conjunction with the New Zealand Birth Registry, allowing us to distinguish natives from immigrants. This data set was linked to the 2013 New Zealand Census, giving us additional socioeconomic variables with which to model our data and perform descriptive analysis. Logistic regression was used to investigate the relationship between childhood obesity and: native/foreign birth status, sex, ethnicity, deprivation, age, and region. Further regressions were performed with associated parental factors such as birth status, qualification, and family income.

Results: Native-born children have an obesity₉₅ (at or above the 95th percentile for age and sex adjusted BMI) prevalence of 11.8% compared to 15.0% of immigrant children. Odds of being obese are 1.31 (1.06–1.62) times greater for native-born children than for foreign-born children. Stratified by ethnicity, immigrant European, Māori, and Pacific children experienced obesity rates 2.6%, 4.4%, and 3.0% lower respectively than their New Zealand born counterparts. Greater length of residence immigrant parents was found to increase the odds of their child being obese, but the child's length of residence did not have a significant effect.

Conclusion: Our study suggests that there is indeed a healthy immigrant effect occurring in New Zealand's immigrant population, but the strength of this effect differs by ethnicity, deprivation, parental birth and length of residency, and several other variables.

Aims

- 1) To investigate if immigrant children have lower obesity prevalence than non-immigrant children, and how this varies by ethnicity, country of origin, and length of residence in New Zealand.
- 2) To investigate if the immigration status, socioeconomic position, and length of residence of a child's parents affects their obesity prevalence.
- 3) To construct models to predict a child's obesity status.

Methods

Participants and data

Data were drawn from children who took part in the Before School Check (B4SC) between 2010/11 and 2015/16, and had a calculable BMI (N = 319,098). This data set was then linked to the 2013 New Zealand Census (N = 271,989), with some loss due to emigration or failure to complete the census. We then removed children with no assigned family/household ID (i.e. living in institutions) and those with invalid BMI values (outside 5 standard deviations from the mean), resulting in a final sample size of 266,676.

Child Measures

Obesity₈₅ (overweight) and **Obesity₉₅** (obese) correspond to children at or above the 85th and 95th percentile respectively for age and sex adjusted BMI, as defined by the World Health Organization's Anthro software (v3.2.2). The anthropometric measures used to calculate BMI were all undertaken by registered nurses or nurse practitioners.

Birth_registry was obtained from the department of internal affairs, and used to classify native-born children and foreign-born children.

Ethnicity was based on parental reports from the census (the best quality ethnicity information available in New Zealand administrative data sets). Using the Ministry of Health's ethnicity data protocols, children were assigned into an ethnic group using the following hierarchy of prioritisation: 1) Māori; 2) Pacific; 3) Asian; 4) Middle Eastern, Latin American, and African (MELAA); 5) European and Other. European and Other were combined as there were virtually identical patterns of age, education, income, and socioeconomic status for both, and <1.5% of the children were classified as Other.

Sex in the 2013 census consisted of only two responses, "male" and "female". In theory this should be the biologically/genetically defined category a child is born into, but this is self-reported by the parents so there may be inconsistencies due to gender identity issues. However, the population affected would be so small that the effect is considered negligible.

Country of origin and **region of residence** rely on parental-reports from the census. The former is the specified birth country of the child, grouped logically into larger geographically and culturally similar regions to accommodate low numbers in some areas which would otherwise have been suppressed. The latter is classified by the statistically defined (in complete area units) 16 regional council boundaries.

NZdep is the current standard for measuring deprivation by grouping scores into deciles, where 1 represents the least deprived areas and 10 the most deprived. We reduced this to quintiles, so a value of 5 indicates that a meshblock is in the most deprived 20% of areas in New Zealand. However, it is important to note that NZdep estimates the relative socioeconomic deprivation of an area, and does not directly relate to individuals.

Months in NZ is measured as the number of months between arrival and the time of the census for immigrant families. For domestic families, this measure is simply the child's age at the time of the census.

Parent measures

Parent birth status is collected from self-reported census data and split into two-parent households and one-parent households, then further into groups corresponding to the number of parents born in New Zealand. We end up with five categories: "Both parents NZ-born (2-parent)", "1 parent NZ-born (2-parent)", "No parents NZ born (2-parent)", "Parent NZ-born (1-parent)", and "Parent not NZ-born (1-parent)". Parent 1 is the maternal caregiver in 99% of the cases, so parent 2 would be the paternal caregiver.

Parent's years in NZ is also derived from the census. It is the number of years a person born overseas has lived in New Zealand as a permanent or long-term resident at the time of census. We grouped this into chunks of years (0–1, 2–5, 6–10, etc.) enabling us to better determine whether residence will impact the healthy immigrant effect.

Parent's highest qualification is self-reported in the census for parents aged 15 years or over. If an individual's highest attained qualification is a certificate gained at school (including an overseas secondary school) or post-school, they are grouped as "secondary school qualification". If an individual's highest gained qualification is a bachelor's degree, level 7 qualification, or diploma, then they are grouped under "Bachelor's degree or diploma". Anything higher than an honours degree is grouped under "Postgraduate degree". All others will fall under either "No qualification" or "Not stated / Response unidentifiable".

Family income is the estimated combined parental income for couples or single parents with children. This does not include extended family but takes into account various income sources ranging from wages to dividends.

Parental employment status combines census variables for employment status and labour force status. This way we can distinguish individuals not in the workforce rather than just classifying them as “unemployed”, and we can separate out groups like “unpaid family worker”.

Statistical analysis

Common characteristics among obese children were identified using logistic regression, allowing us to investigate the true nature of the “healthy immigrant effect” after controlling for socioeconomic, parental, regional, and temporal factors. We started off with a model consisting solely of child measures and one consisting solely of adult measures, and finally created an overall model of both combined.

Overall model:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \text{Birth_reg} + \beta_2 \text{Sex} + \beta_3 \text{Ethnicity} + \beta_4 \text{Dep} + \beta_5 \text{Region} + \beta_6 \text{Age}^2 + \beta_7 \text{Country} + \beta_8 \text{ParentalStatus} + \beta_9 \text{Parent1Years} + \beta_{10} \text{Parent2years} + \beta_{11} \text{Qualification} + \beta_{12} \text{Income} + \beta_{13} \text{Parent1Employment} + \beta_{14} \text{Parent2Employment} + \varepsilon$$

where β_0 is the intercept, β_1 – β_{14} are the coefficients, and ε is an independent residual term.

To test the healthy immigrant effect (birth_reg) on obesity95, each outcome was modelled on the categorical variable obesity95 whilst controlling for sex, ethnicity, deprivation, region of residence, and age. Logistic regression was used for dichotomous outcomes, multinomial for categorical outcomes, and linear for continuous outcomes.

A multitude of variables (birth_reg, NZdep, Parental birth status, Age, and months in NZ) exhibited a significant interaction with ethnicity, so we decided it would be better to stratify all future logistic regression models by the different ethnic groups rather than having five interactions in one model.

Results

Descriptive

Obesity95 & Obesity85: Prevalence of being overweight and/or obese was consistently lower in foreign-born children: 33.3% of native-born children in our sample were overweight compared to just 27.3% of foreign-born. As for obesity, 15% of native-born children were obese compared to just 11.8% of immigrant children. The relative risk, however, remained approximately the same: native-born children had a 20% greater risk of being overweight or obese relative to foreign-born children.

Ethnicity: Ethnic groups experienced the healthy immigrant effect to different extents. Native-born European/Other, Māori, and Pacific children had obesity rates of 11.4%, 20.4%, and 33.1% respectively, contrasting with rates of 8.8%, 16.0%, and 30.1% for their foreign-born counterparts. Children of Asian ethnicity exhibited negligible differences between native- and foreign-born (8.7% vs. 9.0%), whilst children of MELAA ethnicity experienced the opposite of the healthy immigrant effect: the native-born had lower rates of obesity than the foreign-born (13.6% vs 16.2%). However, we should note that MELAA is an extremely diverse group, and that it accounted for just 1.4% of the sample population.

Deprivation: The healthy immigrant effect is more prominent among more deprived people. In quintile 1, the least deprived, we observed a difference of only 2% (10.0% for the native-born vs. 8.0% for the foreign-born) in obesity prevalence. However, in quintile 5, the most deprived, we saw a difference of 4.6% (23.2% in native-born vs. 18.6% in foreign born).

Time: A child's length of residence did not significantly impact their obesity prevalence.

Parents: The number of foreign-born parents did not appear to affect obesity⁹⁵ in our descriptive analysis, likely due to the conflicting effects we observed once further stratified by ethnicity. Having at least one native-born parent was linked with lower obesity prevalence in the Māori and Pacific groups, whereas having at least one foreign-born parent led to lower obesity rates in European/Other group. Children in single-parent households had about 5% higher obesity prevalences than those in two-parent households.

Analytic

Healthy immigrant effect: Despite adjusting for socioeconomic, parental, regional, and temporal factors, we observed a distinct protective effect for immigrant children in regard to both obesity⁸⁵ and obesity⁹⁵. The odds of being overweight and obese were 1.42 (1.20–1.68) and 1.31 (1.06–1.62) times greater respectively for native-born children than for foreign-born children.

Child measures: The odds of being obese for males were 1.47 (1.45–1.52) times those for females.

Compared to European/Other ethnicities, odds of being obese for:

- Māori were 1.57 (1.52–1.62) times as high;
- Pacific were 2.91 (2.79–3.03) times as high;
- Asian were 0.71 (0.67–0.75) as high;
- MELAA were 1.12 (1.01–1.25) times as high.

Compared to deprivation quintile 1 (the lowest), odds of being obese for:

- quintile 2 were 1.10 (1.05–1.14) times as high;
- quintile 3 were 1.15 (1.10–1.20) times as high;
- for quintile 4 were 1.29 (1.24–1.34) times as high;
- for quintile 5 were 1.46 (1.40–1.52) times as high.

The odds of being obese decreased by 0.87 (0.78–0.98) for every month of age. By region, the odds were highest among children in Southland and lowest in Nelson. For foreign-born children, the odds were highest among those born in Central/South America and lowest among those from Mainland Europe.

Parent measures: Compared to those with 2 native-born parents (2-parent household), odds of being obese for:

- those with just 1 native-born parent (2-parent household) were 1.22 (0.42–3.51) times as high;
- those with 2 foreign-born parents were 1.57 (0.19–12.99) times as high;
- those with a native-born single parent were 1.51 (0.18–12.50) times as high;
- those with a foreign-born single parent were 1.08 (1.03–1.13) times as high.

Compared to those with at least one native-born parent, the odds of being obese for:

- those with a foreign-born mother who had been living in New Zealand for less than one year were 0.67 (0.23–1.95) times as high;
- those with a foreign-born mother who had been living in New Zealand for 20+ years were 0.81 (0.28–2.34) times as high;
- those with a foreign-born father who had been living in New Zealand for less than one year were 0.82 (0.28–2.40) times as high;
- those with a foreign-born father who had been living in New Zealand for 20+ years were 0.88 (0.31–2.54) times as high.

Compared to those with at least one parent with no formal qualification, the odds of a child's being obese for:

- those with at least one parent with a secondary school qualification were 0.91 (0.88–0.95) times as high;
- those with at least one parent with a bachelor degree or diploma were 0.76 (0.73–0.79) times as high;
- those with at least one parent with a postgraduate degree were 0.65 (0.62–0.69) times as high.

Compared to those in a family earning \$20,000 or less, the odds of a child's being obese for:

- those in a family earning between \$50,001 and \$70,000 were 0.95 (0.90–1.00) times as high;
- those in a family earning more than \$100,000 were 0.87 (0.82–0.92) times as high.

Discussion

The analysis found a consistent pattern of lower obesity prevalence in almost all groups of foreign-born children compared to native-born children, supporting the healthy immigrant hypothesis in New Zealand. MELAA ethnic groups were the only exception to this, and we suspect that this was due to a combination of factors, including diverse ethnic grouping, low sample size (1.5%), and cultural considerations.

Unsurprisingly, obesity prevalence can be affected by a great number of factors, and obvious socioeconomic characteristics like high deprivation, low family income, and low parental qualification tend to increase a child's odds of obesity, which is also supported by the literature.^{1,3} However, what we found unusual and perplexing was that a higher number of foreign-born parents increased a child's odds of obesity; but we did detect a significant interaction between parental birth status and ethnicity, so more research would be required to investigate this result.

Correlation was found between the years of a foreign-born parent's residency and the odds of a child's being obese. Longer residency increased the child's odds of obesity, although the mother's length of residency was more impactful than the father's. Most literature agrees that longer residency reduces the healthy immigrant effect due to host acculturation and assimilation.^{3,5} This would be another interesting area worth investigating, as recent North American literature suggests that the healthy immigrant effect is only marginally detected in second generation immigrants, and almost non-existent in third generation immigrants.^{5,6}

The census almost always relies on self-reported information, but we do not expect this to have impacted our results too much, due to the extremely high sample size. The New Zealand census is among the best in the world in terms of response rate, data accuracy, and comparability. Because we are accessing privileged information, all observations were rounded to base 3 in accordance with the Statistics Act 1975.

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Appendix

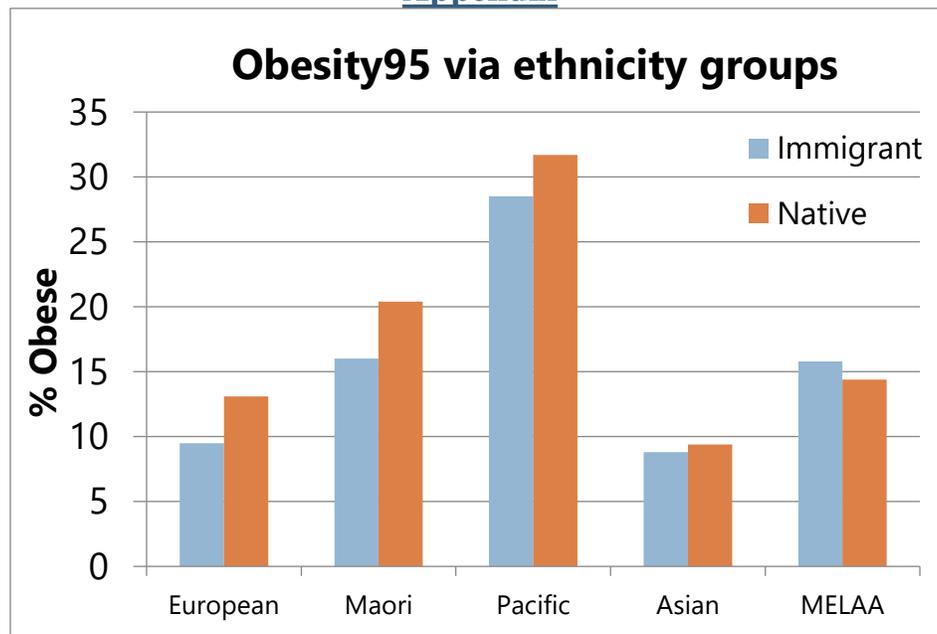


Figure 1: A healthy immigrant effect is observed in all ethnic groups except MELAA. Obesity prevalence is consistently lower in the immigrant population but to varying degrees.

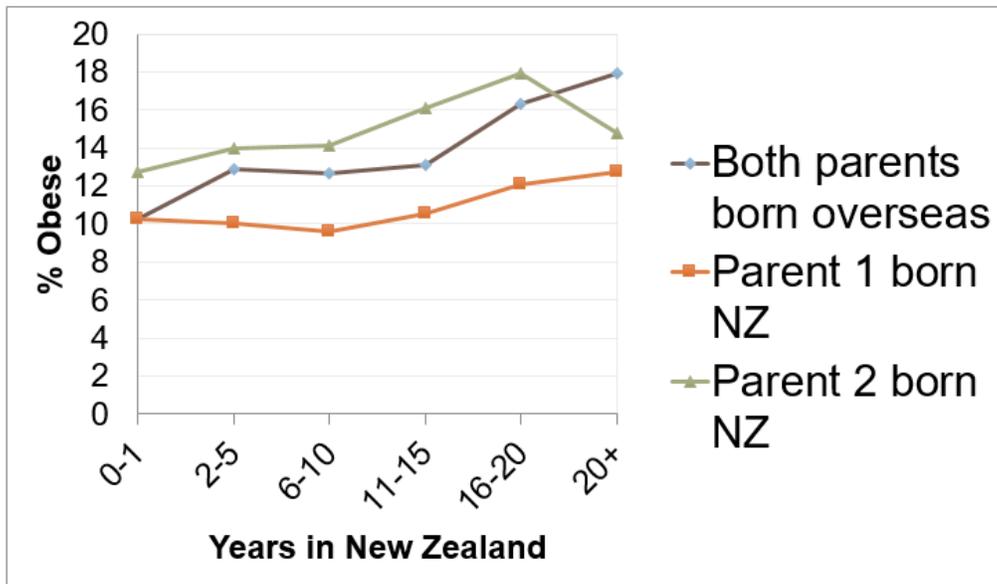


Figure 2: Correlation between length of residency and obesity prevalence.

The longer an immigrant parent resides in New Zealand, the higher the prevalence of obesity. Parent 1 (maternal) tends to have a more substantial protective effect than parent 2 (paternal), but they are all regressing towards and/or above New Zealand obesity levels (15%).