Influence of paternal and maternal ethnicity and ethnic enclaves on newborn weight

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ABSTRACT
Background The association between maternal ethnicity and newborn weight is understudied. Less is known about the additional influence of paternal ethnicity and neighbourhood ethnic composition.

Methods We studied 692 301 singleton live births of parents of Canadian, Bangladeshi, Sri Lankan, Pakistani, Indian, Filipino, Vietnamese, Korean, Hong Kong or Chinese birthplace. We used multivariable regression to calculate mean (95% CI) birthweight differences between infants of two Canadian-origin parents and (1) foreign-born mother and Canadian-born father, (2) Canadian-born mother and foreign-born father or (3) two foreign-born parents from the same country. We also stratified by high versus low same-ethnic concentration of the parent’s residence. We adjusted for gestational age at birth, maternal age, parity, marital status and income quintile.

Results Compared with male and female infants of two Canadian-born parents, those of same-country foreign-born parents weighed 6.2% (−218 g, 95% CI −214 g to −223 g) and 5.6% (−192 g, 95% CI −187 g to −196 g) less, respectively. The largest mean weight difference was among male (8.4% (−297 g, 95% CI −276 g to −319 g)) and female (8.2% (−279 g, 95% CI −262 g to −296 g)) infants of two Bangladeshi parents. Infants of a foreign-born mother and Canadian-born father had weights closest to those of two Canadian-born parents. Residing in an area of high (vs low) same-ethnic concentration was associated with lower birthweight among infants of mixed union couples, but not among those of parents originating from the same country.

Conclusions Paternal and maternal ethnic origin influence newborn weight, which is modified by settlement in a high same-ethnic concentration area only among parents of mixed union.

BACKGROUND
Nearly all babies are weighed at birth. Birthweight serves as an important and robust indicator of newborn health.1 Those who fall below or above the physiological boundaries of normal fetal growth may experience greater morbidity and mortality,2–4 and this influences both clinical care and the expectations of the child’s parents.5,6

In dense multiethnic populations, it is important to consider whether children born to immigrant parents have significantly different birthweights from children born to non-immigrant parents. These differences may ultimately impact whether they are being properly classified as ‘normal’ size. Maternal country of origin has been shown to influence newborn weight.7 This influence can be explained, in part, by demonstrated ethnic differences in birthweight.8,9 However, there appears to be a distinct relation between maternal immigrant status and birthweight; children born to immigrant mothers were shown to have slightly larger birthweights than children born to women in their native country, for example.10 Since both parents contribute to the genetic potential of fetal growth,11 the influence of paternal (and not just maternal) immigrant status and country of origin on birthweight is seemingly important, but poorly understood.

Wells et al.12 recently observed that children born to two parents of Indian origin (n=2892) had lower birthweights than children of two European parents (n=95 578), while those of mixed-ethnic parentage (n=243) had an intermediate birthweight. Previous studies have considered other ethnic groups with similar findings to those of Wells, but simply categorised all individuals as ‘Asian’.13 Given that these studies focused on a small number of parents of Indian or Asian ethnicity, and that marital status and infant sex were not controlled for, findings from previous studies are not convincing.

A full understanding of the influence of immigrant status on birthweight extends beyond the genetic consideration of parental ethnicity to include living conditions,14 such as neighbourhood ethnic composition. Although ethnic minority groups appear to be healthier when they live in areas with a high concentration of people who are ethnically similar—so-called ‘enclaves’,15 studies have generated mixed results about the association between neighbourhood ethnic composition and birthweight.16–21 Unfortunately, none of the studies considered paternal country of origin in addition to maternal, and most were limited to only a few hundred infants per ethnic group.

In the current study, we address whether there is a difference in birthweight in children born to one or two immigrant parents. We additionally examine whether the relation between parental country origin and birthweight is modified by neighbourhood ethnic composition.

METHODS
We completed a population-based study of all singleton male and female livebirths between 24 and 41 gestational weeks in the entire province of Ontario, Canada, between 2002 and 2009. A woman could contribute more than one birth in the period of study. All birth records were provided by Vital Statistics, as previously described,7 and were stripped of all parental and child identifiers.
During the study period, there were 1,078,495 live births in Ontario. Of these, 344,518 (31.9%) were initially excluded because one or both parents were from a country not included in the study list (n=298,940 (27.7%)), paternal country of origin was unknown (n=45,473 (4.2%)) and/or maternal country or origin was unknown (n=850 (0.1%)). We further excluded individuals for the following reasons: birthweight missing (n=692 (0.06%)), birthweight <500 g (n=624 (0.06%)), infant sex missing (n=3 (0.00%)), gestational age missing (n=725 (0.07%)), gestational age <24 or >41 weeks (n=5575 (0.5%)), multiple pregnancy (n=35,222 (3.3%)), maternal age missing (n=675 (0.06%)), parity missing (n=710 (0.07%)), maternal postal code missing (n=9524 (0.9%)), income quintile missing (n=18,564 (1.7%)) and/or area-level language missing (n=21,853 (2.0%)). A total of 692,301 (64.2%) met our inclusion criteria. Among the parents who were eligible for our study based on country of birth, the proportion of births missing gestational age (n=357 (0.05%)) did not differ appreciably between maternal countries of origin.

The study outcome was birthweight, measured as a continuous variable, in grams. The main exposures—maternal and paternal country of origin—were self-reported on the child’s birth record. We limited our dataset to parent(s) born exclusively in Canada and/or one of the nine major immigrant source countries to Ontario: Bangladesh, Sri Lanka, Pakistan, India, Philippines, Vietnam, Korea, Hong Kong and China. If both parents were foreign-born, they had to both originate from the same country in order to be included in the study. For example, if a father was born in India and the mother in China, then they were not included. Hong Kong and China were evaluated separately because of their distinct cultural, linguistic and migration features.22

The main independent variable in the secondary analysis was neighbourhood same-ethnic concentration. Neighbourhood ethnic concentration23 24 was estimated for each of the 16,430 dissemination areas (DAs)—small geographic units comprising 400–700 persons—in Ontario, using the 2006 Canada Census reported proportion of residents who spoke a language at home corresponding to one of the ethnicities in this study (see online supplementary file 1). Specifically, the top 5% (ie, ≥95th centile) of DAs with the highest proportion of residents who spoke a specific ethnic minority language at home were categorised as ‘high same-ethnic concentration’ neighbourhoods for each ethnic group. Conversely, the remaining 95% of DAs were classified as ‘low same-ethnic concentration’ areas (see online supplementary file 1).

Covariates included infant sex, gestational age at birth (in completed weeks), maternal age (years), parity (1, 2, 3+), marital status (single, married/common-law) and neighbourhood income quintile. The latter was derived for maternal DA of residence using Statistics Canada’s Postal Code Conversion File Plus (PCCF+). 23

Data analyses
To investigate the first objective, we used multivariable linear regression methods to calculate adjusted mean birthweight differences and 95% CIs between infants whose parents were both Canadian-born (the referent) minus infants of parents classified as follows: (i) foreign-born mother and Canadian-born father, (ii) Canadian-born mother and foreign-born father, or (iii) both parents from the same foreign country (‘same-country’). Sex-specific analyses were run for each foreign country separately, as well as by aggregating all nine foreign countries. Models were adjusted for gestational age at birth, maternal age, parity, marital status and neighbourhood income quintile. We also ran analyses restricted to term infants born at 37–41 weeks’ gestation to reduce the likelihood of pathological weight differences related to placental disease or a maternal illness that might result in a preterm delivery.4

For the second objective, the above analysis was repeated by stratifying on high-area versus low-area same-ethnic concentration. Specifically, using multivariable generalised estimating equations to correct for clustering of parents within DAs, we calculated the adjusted mean birthweight difference (95% CI) between infants whose parents were both Canadian-born and residing in a low same-ethnic concentration area (the referent) and infants in the following seven groups: (i) both parents Canadian-born residing in a high same-ethnic concentration area; (ii) mother foreign-born and father Canadian-born, residing in a low same-ethnic concentration area (as the foreign-born mother); (iii) mother foreign-born and father Canadian-born, residing in a high same-ethnic concentration area (as the foreign-born mother); (iv) mother Canadian-born and father foreign-born, residing in a low same-ethnic concentration area (as the foreign-born father); (v) mother Canadian-born and father foreign-born, residing in a high same-ethnic concentration area (as the foreign-born father); (vi) both parents foreign-born from the same country, residing in a low same-ethnic concentration area and (vii) both parents foreign-born from the same country, residing in a high same-ethnic concentration area. We adjusted for the same covariates as in the first model. Data were presented in aggregate form for the nine foreign countries to maximise statistical power and to simplify the presentation of results.

Statistical analyses were performed using SAS V9.3 (SAS Institute Inc., Cary, North Carolina, USA).

RESULTS
Around 78% of the newborns in our study sample (n=692,301) were from two Canadian-born parents (table 1). Of the remaining 144,977 infants, there were 134,291 (92.7%) born to parents from the same foreign country, 10,686 (7.4%) from a Canadian-born mother and a foreign-born father, and 6973 (4.8%) from a Canadian-born father and foreign-born mother. About 5.9% of infants were born preterm (table 1).

Compared with the mean birthweights of male (3530 g) and female (3408 g) infants of two Canadian-born parents, those of same-country foreign-born parents weighed 6.2% (−218 g, 95% CI −214 g to −223 g) and 5.6% (−192 g, 95% CI −187 g to −196 g) less, respectively, among all nine foreign countries aggregated, in adjusted analyses (figure 1). Infants of a foreign-born mother and a Canadian-born father had a birthweight closest to that of infants of two Canadian-born parents. Specifically, males weighed, on average, 3.5% (−117 g, 95% CI −105 g to −129 g) and females 3.4% (−111 g, 95% CI −98 g to −123 g) less than newborns of two Canadian parents (figure 1, top). However, among infants of a Canadian-born mother and foreign-born father, males were 5.6% (−198 g, 95% CI −185 g to −212 g) and females 4.7% (−161 g, 95% CI −146 g to −176 g) lower in birthweight than those with two Canadian-born parents (figure 1). Findings were similar when the model was limited to term infants born at 37–41 weeks (data not shown).

In country-specific analyses, the most pronounced adjusted mean weight difference was seen among male (8.4% (−297 g, 95% CI −276 g to −319 g)) and female (8.2% (−279 g, 95% CI −262 g to −296 g)) infants of dual Bangladeshi-born parents, but a comparable pattern was seen across other groups (figure 1). The significant stepwise pattern of increasing birthweight differences
that was observed in the aggregate immigrant data was, however, not evident in all country-specific analyses. For infants born to parents from Bangladesh or Sri Lanka, the CIs were wide, and for newborns of one or two Chinese-born parents, there was a significant reverse-J shaped relation (figure 1, bottom).

In analyses stratified by area ethnic concentration, 50% of same-country foreign-born parents resided within the top 5% (ie, ≥95th centile) most concentrated areas for their ethnicity, compared with 18–23% of mixed-ethnicity couples when all immigrant countries were aggregated (table 2). In country-specific analyses, the prevalence of preterm birth was significantly higher among births to parents from Bangladesh or Sri Lanka, but not from Canada or China. The elevated prevalence of preterm birth among children born to parents from Bangladesh or Sri Lanka was also accompanied by increased low birthweight (LBW) prevalence, but not among children born to parents from China or Canada. These findings are also consistent with an inverse-J shaped relation in the prevalence of LBW in the aggregate immigrant group. Future studies are needed to understand the underlying risk factors for preterm birth in these high-risk immigrant populations.
specific analyses, same-country parents from Hong Kong, India, Sri Lanka and Bangladesh were more likely, and Korean, Vietnamese, Filipino and Pakistani parents were less likely to reside within the top 5% most concentrated areas for their ethnicity.

For parents both originating from Canada or from the same foreign country, there was no difference in newborn weights for those residing in high versus low same-ethnic concentration areas (figure 2). However, among infants of one Canadian-born and one foreign-born parent, residing in high same-ethnic
concentration area was associated with a lower birthweight than residing in a low same-ethnic concentration area, especially among males newborns (figure 2).

**DISCUSSION**

Infants of one or two foreign-born parents had lower birthweights than infants of two Canadian-born parents. When all nine immigrant countries were aggregated together, the adjusted birthweight difference was greatest for infants of two same-country foreign-born parents compared with those of two Canadian-born parents. Smaller weight differences were seen for mixed-origin couples, with infants born to foreign-born mothers and Canadian-born fathers having the most similar birthweights to those of Canadian-born parents. Previous
Table 2 Distribution of births by parents’ nativity and neighbourhood same-ethnic concentration, for nine immigrant source countries, Ontario, 2002–2009

<table>
<thead>
<tr>
<th>Country of origin</th>
<th>Neighbourhood same-ethnic concentration*</th>
<th>Parent’s nativity (number (%))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mom and dad Canadian-born</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mom foreign born, dad</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Canadian born, dad foreign</td>
</tr>
<tr>
<td></td>
<td></td>
<td>born in same country</td>
</tr>
<tr>
<td>All immigrant</td>
<td>High concentration</td>
<td>79 290 (14.7)</td>
</tr>
<tr>
<td>countries</td>
<td>Low concentration</td>
<td>1964 (18.4)</td>
</tr>
<tr>
<td>China</td>
<td>High concentration</td>
<td>568 (8.0)</td>
</tr>
<tr>
<td></td>
<td>Low concentration</td>
<td>1193 (78.9)</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>High concentration</td>
<td>1193 (78.9)</td>
</tr>
<tr>
<td></td>
<td>Low concentration</td>
<td>8215 (1.5)</td>
</tr>
<tr>
<td>Korea</td>
<td>High concentration</td>
<td>131 (15.0)</td>
</tr>
<tr>
<td></td>
<td>Low concentration</td>
<td>15 201 (2.8)</td>
</tr>
<tr>
<td>Vietnam</td>
<td>High concentration</td>
<td>18 031 (3.3)</td>
</tr>
<tr>
<td></td>
<td>Low concentration</td>
<td>1011 (88.1)</td>
</tr>
<tr>
<td>Philippines</td>
<td>High concentration</td>
<td>13 044 (2.4)</td>
</tr>
<tr>
<td></td>
<td>Low concentration</td>
<td>499 (13.7)</td>
</tr>
<tr>
<td>India</td>
<td>High concentration</td>
<td>11 918 (2.2)</td>
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<tr>
<td></td>
<td>Low concentration</td>
<td>424 (25.3)</td>
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<tr>
<td>Pakistan</td>
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<td>15 711 (2.9)</td>
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<tr>
<td></td>
<td>Low concentration</td>
<td>153 (22.5)</td>
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<tr>
<td>Sri Lanka</td>
<td>High concentration</td>
<td>11 263 (2.1)</td>
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<tr>
<td></td>
<td>Low concentration</td>
<td>35 (15.4)</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>High concentration</td>
<td>16 586 (3.1)</td>
</tr>
<tr>
<td></td>
<td>Low concentration</td>
<td>12 (14.8)</td>
</tr>
</tbody>
</table>

*Specifically, the top 5% of neighbourhoods (ie, dissemination areas (DAs)) with the highest proportion of residents who spoke a specific ethnic minority language at home (ie, ≥ 95% centile) were categorised as ‘high same-ethnic concentration’ neighbourhoods for each ethnic group. The remaining 95% of DAs were classified as ‘low same-ethnic concentration’ areas.

Figure 2 Absolute difference in birthweight of infants of immigrant mothers and/or fathers from various world regions compared with infants whose parents are both of Canadian origin, further stratified by those living in a residential area with a low (squares ▪) or high (diamonds ♦) same-ethnic concentration. A high same-ethnic concentration area comprises the top 5% of dissemination areas with the highest proportion of residents who speak the same-ethnic minority language at home. Values in parentheses represent the absolute mean newborn weight for each maternal–paternal combination and ethnic concentration stratum, and are compared with male (birthweight 3531 g) and female infants (birthweight 3409 g) whose parents are both of Canadian origin and living in an area with low same-ethnic concentration (red squares ▪).
studies similarly found that infants born to ethnic non-European parents had lower birthweights than children of two parents of European ancestry. Wells et al. and Migone et al. found that children of mixed parentage had an intermediate birthweight. Other studies that focused on mixed parentage found that, among fathers of African origin and mothers of European descent, infants tended to weigh more. Because our study focused predominantly on East Asian and South Asian populations, other patterns might be seen among immigrant populations from other world regions, including Africa or Latin America.

Previous studies only considered birthweight and residential ethnic concentration based on maternal ethnicity, and with varied results. Our results highlight the influence of paternal ethnicity, in addition to maternal ethnicity, on infant birthweight. In our secondary analysis, there was a contrast in newborn weight among those residing in high versus low same-country concentration areas only among mixed couples, and which was most pronounced when the father was foreign born (figure 2). It is postulated that parents living in high same-ethnic-concentration neighbourhoods have lower birthweight infants because they experience blocked social and spatial mobility, or their neighbourhoods have different characteristics, like higher crimes rates. For two same-country foreign-born parents, the negative effects of these neighbourhoods on birthweight may be mitigated by the benefits of these communities. For example, living in a neighbourhood of high ethnic density may promote aspects of shared culture and increased availability of traditional foods and social cohesion. Lower levels of acculturation and adoption of the lifestyle and dietary habits of the host country have been hypothesized as one reason why low birthweight is less prevalent among Hispanic-American, Arab-American and South Asian infants whose parents reside in areas of high same-ethnic concentration. In the case of mixed unions, however, especially where the father is foreign born, settlement in areas of high same-ethnic concentration may reflect retention of traditional values and practices without, necessarily, the gains described above. Mixed minority enclaves—those in which there is a high proportion of visible minorities, but without a dominant group—also tend to have higher rates of low income and unemployment, for example. Future work should determine whether mixed couples comprising a foreign-born father are more likely to settle in mixed minority enclaves than those comprising a foreign-born mother.

Our study was strengthened by its robust sample size, the large number of prevalent immigrant groups within an ethnically diverse province, a universal healthcare system that ensures the capture of nearly all live births in administrative databases and our ability to control for some important covariates such as marital status and small area income. As a limitation, we could not account for the ethnic background of the parents born in Canada. The presence of mixed-ethnicity couples in our Canadian–Canadian parent reference group would likely have reduced the observed birthweight differences between infants of this group and those of the foreign-born parent groups. We also could not account for immigrant length of residency in Canada, a potential marker of acculturation and an influence on birthweight. As infants born to mothers still living in their native country are smaller than their counterparts who emigrate, it is possible that with longer duration of residence in Canada after migration, birthweight increases. There are a number of other potential confounders that we could not measure, such as smoking and maternal body mass index (BMI). Smoking is known to reduce birthweight, and immigrants generally smoke less than non-immigrant populations. Hence, had we controlled for smoking, then we might have observed even larger birthweight differences between the newborns of foreign-born and Canadian-born parents. While maternal BMI may influence newborn weight, recent data suggest that maternal ethnic origin has an even greater influence. With respect to the secondary analysis, we could not control for the time that the mother had been living in a high or low same-ethnic concentration neighbourhood.

In conclusion, both paternal and maternal country of origin appear to influence newborn weight. This effect is only modified by the same-ethnic concentration of the neighbourhoods where mixed couples live at the time of delivery. In regions where immigration is common, and mixed unions may be the way of the future, it may be necessary to reconsider definitions of ‘normal’ birthweight. Birthweight curves tailored to maternal ethnicity might be further informed by paternal ethnicity or country of origin. To evaluate whether observed differences in birthweight are clinically important requires an analysis of short- and long-term infant outcomes.

### Policy Implication

These study findings suggest that birthweight curves should be customized to not only maternal, but also paternal country of origin. Among mixed couples, residing in a high vs. low same-ethnic concentration area further influences newborn weight.

### What this study adds

- The adjusted birthweight differences were greatest for infants of two same-country foreign-born parents compared with those of two Canadian-born parents.
- Smaller weight differences were seen for mixed-origin couples, and especially when the child was of a foreign-born mother and a Canadian-born father.
- Among dual foreign-born or dual Canadian-born parents, there was no difference in birthweights between those who resided in a high same-ethnic concentration neighbourhood and those who resided in a low same-ethnic concentration neighbourhood.
- Among mixed-origin couples (one Canadian-born and one foreign-born parent), residing in a high same-ethnic concentration area was associated with lower birthweight than residing in a low same-ethnic concentration area.
Provenance and peer review

The study was approved by the Research Ethics Board of St. Michael’s Hospital.

Provenance and peer review

Not commissioned; externally peer reviewed.

REFERENCES


