Birth outcomes by neighbourhood income and recent immigration in Toronto

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Abstract

Objectives

This article examines differences in birth outcomes by neighbourhood income and recent immigration for singleton live births in Toronto, Ontario.

Data sources

The birth data were extracted from hospital discharge abstracts compiled by the Canadian Institute for Health Information.

Analytical techniques

A population-based cross-sectional study of 143,030 singleton live births to mothers residing in Toronto, Ontario from 1 April 1996 through 31 March 2001 was conducted. Neighbourhood income quintiles of births were constructed after ranking census tracts according to the proportion of their population below Statistics Canada's low-income cutoffs. Logistic regression was used to estimate odds ratios for the effects of neighbourhood income quintile and recent immigration on preterm birth, low birthweight and full-term low birthweight, adjusted for infant sex and maternal age.

Main results

Low neighbourhood income was associated with a moderately higher risk of preterm birth, low birthweight, and full-term low birthweight. The neighbourhood income gradient was less pronounced among recent immigrants compared with longer-term residents. Recent immigration was associated with a lower risk of preterm birth, but a higher risk of low birthweight and full-term low birthweight.

Keywords

preterm, low birthweight, socioeconomic factors, immigration

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Despite improvements over time in indicators such as infant mortality and low birthweight, adverse birth outcomes continue to be a concern in industrialized countries. This is especially true for preterm birth, which is the single most important cause of perinatal mortality and is associated with infant morbidity and other long-term health consequences.[1-3]

Socio-economic disparities in birth outcomes are one of the most persistent findings in perinatal research. Evidence of an association between several measures of low socio-economic status and adverse birth outcomes exists across and within countries,[4,5] even in those with universal access to health care such as Canada.[6-8] Measures reflecting economic deprivation have generally (though not always) detected stronger associations than have other markers of socio-economic status.[9,10]

Unlike socio-economic disadvantage, recent immigration is a dimension of potential health disparities that is poorly understood. One debated phenomenon is the "healthy migrant effect,"[11] according to which first-generation immigrants are often healthier than native-born residents, despite lower standards of living on arrival. Only a few Canadian studies have assessed the relationship between immigration and perinatal outcomes. One study[12] found lower perinatal mortality among the offspring of Chinese compared with White women. Another study[13] did not find significant differences in low birthweight between foreign-born and Canadian-born mothers, and a third suggested that the risk of low birthweight among immigrant women increased as they became more acculturated to Canadian society.[14] From an equity perspective, it is important to know how outcomes for recent immigrants compare with those of longer-term residents, particularly in areas that receive a large influx of immigrants each year, such as Toronto.

In 2001, the newly amalgamated city of Toronto had a population of 2.48 million, and the larger Toronto Census Metropolitan Area (CMA) was the destination of around half of all immigrants to Canada that year (roughly 125,000). In 2001, immigrants made up about 40% of the population of the Toronto CMA. The objective of this study is to examine differences in non-fatal birth outcomes in Toronto by recent immigration and neighbourhood income.

Methods

Data sources

Although vital statistics data are considered the gold standard for studying perinatal outcomes in Canada, several data quality concerns have led to separate reporting of Ontario in recent national statistics on birth outcomes.[15] Ontario's vital statistics data consist of records that compile information from two forms, one completed by the parents, and the second by the attending health practitioner. Both forms must be submitted for a birth to be included in the vital statstics. In 1996, Ontario municipalities were allowed to introduce an administrative fee for birth registrations, which at that time ranged from $10 to $27.50. This had the effect of discouraging some parents from submitting their birth registration documents.[16] Selective under-reporting was detected as early as 1997 (around 4%, with wide variability across municipalities) for those at higher risk for low birthweight, and for births to mothers younger than 25. As well, in Ontario vital statistics data for 1994 to 1997, approximately 4% of records had incomplete or invalid postal codes, and so could not be used to assign neighbourhood income. Other data quality concerns with Ontario vital statistics include the measurement of gestational age, and missing links of live births to corresponding infant deaths.[15]

As an alternative to vital statistics, this study uses hospitalization records from the Discharge Abstract Database of the Canadian Institute for Health Information to identify a population of liveborn singleton births in Toronto for whom information on various non-fatal birth outcomes and on certain infant, birth and maternal characteristics was available. Hospital discharge abstracts cover almost 99% of all live births in Ontario, excluding only home births. The use of hospital discharge abstracts for perinatal research has been evaluated by Wen and colleagues,[17] proving to have excellent coverage and to provide plausible rates for Ontario. The information used in this analysis was obtained subsequent to a comprehensive research agreement between the Institute for Clinical Evaluative Sciences (ICES) and the Ontario Ministry of Health and Long-Term Care.

Until fiscal year 2002/2003, the discharge database maintained separate and unrelated records for the mother and newborn. In order to allow analyses combining newborn and maternal characteristics before that date, an algorithm was developed to link the records of each mother and newborn. Newborns were selected if their admission date coincided with the birth date and the "institution from" number was missing (an indication that the patient had not been transferred from another institution). Potential mothers were selected mainly through case-mix group (CMG) codes.[17] A small number (N=589) of obstetric deliveries missed by the CMG codes were captured by additional criteria such as "main patient service

code 51" and the 16 diagnostic and 10 procedure fields. The linkage of mothers and newborns was based on a combination of institution number, postal codes in the discharge abstract and the provincial health insurance registry (Registered Persons Database), municipal residence codes, and admission and discharge dates from both the mother and the newborn records. This probabilistic linkage resulted in 95% of all newborn records in the Discharge Abstract Database having a valid match to a mother.

Records for all 154,458 infants *live-born* to women residing within the 2001 boundaries of the city of Toronto (including the formerly separate boroughs of Etobicoke, York, East York, North York, and Scarborough) in the five fiscal years from 1996/1997 through 2000/2001 (including births from 1 April, 1996 through 31 March, 2001) were extracted from hospital discharge abstracts. After exclusion of newborns weighing less than 500 grams (N=125) or more than 6,000 grams (N=28) or with missing information on birthweight (N=13), births missing links to mothers (N=6,241), records with missing information on key maternal characteristics such as place of residence (N=692) and new registration with the provincial health insurance program (N=26) and records to which census neighbourhood income information could not be assigned (N=286), records for 147,047 infants remained (95.2% of the original records). After further exclusion of multiple live births (N=4,017 twins, triplets and higher order births), 143,030 newborn-mother pairs remained (44,977 recent registrants and 98,053 longer-term residents). This population was distributed across 474 census tracts. Small-area data from the closest census years (1996 or 2001) were used to determine neighbourhood income, defined as the proportion of the population in the census tract with family income below Statistics Canada's low-income cutoff (which is specific to family size). The date of first registration for health insurance coverage in Ontario was obtained from the Registered Persons Database.

The study was approved by Research Ethics Boards at the University of Toronto, St. Michael's Hospital, and Sunnybrook Health Sciences Centre, all in Toronto.

Analytical techniques

A cross-sectional design aggregating the five fiscal years 1996/1997 through 2000/2001 was used to assess associations of neighbourhood income and recent immigration with preterm birth, low birthweight and full-term low birthweight. These outcomes were modeled by means of multiple logistic regression. When the variability in the outcome across clusters is higher than that assumed by the binomial probability model, the data are said to be overdispersed, and the model may underestimate the true variance. Therefore, standard errors were adjusted for such overdispersion in the data.[18,19] As the assumption of the independence of observations may not hold true in clustered data with a contextual exposure variable, generalized estimating equation methods were used to account for any correlation between observations within the census tracts.[19,20] However, because the results of those analyses were virtually identical, the ordinary estimates are reported. To evaluate whether the neighbourhood income gradient in non-fatal birth outcomes differed by recent immigration status, an interaction term was included in the adjusted models. Stratified analyses by recent immigration status are thus reported. All analyses were carried out using SAS Version 9.1 for UNIX (SAS Institute, Cary, NC) at the Institute for Clinical Evaluative Sciences in Toronto.

Definitions

Outcomes

Gestational age in completed weeks was not recorded on hospital discharge abstracts in Ontario during the study period. Therefore, morbidity codes assigned according to the Ninth Revision of the International Classification of Diseases[21] were used to approximate the missing gestational age categories of interest: very premature birth (ICD-9 765.0: "*Extreme immaturity*. Usually implies a birthweight of less than 1,000 grams and/or a gestational age of less than 28 completed weeks."); moderately premature birth (ICD-9 765.1: "*Other preterm infants*. Prematurity or small size, not classifiable to 765.0 or as 'light-for-dates' in 764.– : Usually implies a

birthweight of 1,000 to 2,499 grams and/or a gestation of 28 to 37 completed weeks"); post-term birth (ICD-9 766.2: *"Post-term infant, not 'heavy-for-date'* with gestation period of 42 or more completed weeks"); and full-term birth (residual category not classified above, so approximately 38 weeks to 41 weeks completed gestation).

Preterm births were defined by the ICD-9 codes 765.0 or 765.1.

Low birthweight was defined as less than 2,500 grams. Infants whose reported birthweight was less than 500 grams or more than 6,000 grams were excluded from the analyses.[21]

Full-term low birthweight was defined as births of low birthweight who were not premature, as a proxy for intrauterine growth retardation when there is no gestational age in weeks available to construct small-for-gestational-age based on percentiles.[22]

Neighbourhood income and recent immigration

Using postal code conversion software (PCCF+ Versions 3G and 4D),[23,24] postal codes of the mother's place of residence at the time of delivery were assigned to the corresponding census tract from the closest census years (1996 census for births in 1996/1997 and 1997/1998; 2001 census for births that occurred from 1998/1999 through 2000/2001). Census tracts are relatively stable urban neighbourhoods, with a population typically from 2,500 to 8,000. The percentage of the population living in private households with family income below Statistics Canada's low-income cutoff was used to rank and group[25] census tracts into approximate quintiles of births. Based on the mother's place of residence at the time of the birth, the neighbourhood income quintile of the census tract was assigned to each birth record. For ratio measures of effect, the highest income quintile was used as the reference category.

When newcomers to Ontario are approved for coverage, their client registration and identification information is entered into the provincial health insurance registry. For this study, first-time registration with the provincial health insurance program within 5 years of the birth was used as a proxy for recent immigration (yes/no).

Birth, infant and maternal characteristics

Relevant birth, infant and maternal characteristics reported in the hospital discharge data included infant sex (male, female), maternal age (less than 20, 20 to 34, 35 or older), mode of delivery (cesarean section or not), and maternal morbidity assessed by ICD-9 codes for any of 14 conditions (yes/no):[21] diabetes mellitus, abnormal glucose tolerance, epilepsy, maternal asthma, pre-existing hypertension, anemia, thyroid dysfunction, renal and liver disorders, genitourinary tract infection, incompetent cervix, preeclampsia, eclampsia, placenta previa, and abruptio placenta.

Results

Socio-economic disadvantage

In both 1996 and 2001, there was a clear gradient across Toronto neighbourhood income quintiles in the percentage of the population with family income below Statistics Canada's low-income cutoff (Table 1). Although the proportion of the population below the cutoff decreased from 1996 to 2001 overall and for each quintile, the ratio of the lowest to the the highest quintiles increased slightly.

Each of the adverse birth outcomes examined in this analysis—preterm birth, low birthweight and full-term low birthweight—was more common as the percentage of the population below the low-income cutoff in the neighbourhood increased (Table 2). Compared with mothers in the highest

Table 1
Percentage of population with family income below Statistics Canada low-income cutoff, by neighbourhood income quintile, Toronto, 1996 and 2001

	Below low-income cutoff	
	1996	2001
	%	%
All quintiles	**27.6**	**16.6**
Q1 (highest)	11.9	9.4
Q2	21.3	17.2
Q3	29.2	24.3
Q4	35.7	28.8
Q5 (lowest)	47.9	41.8
Ratio (Q5/Q1)	4.0	4.4

Source: 1996 and 2001 Census of Population.

neigbourhood income quintile, those from the lowest quintile were more likely to be younger than 20, to have had at least one illness during pregnancy, and to have given birth to a very preterm infant. Older mothers were more heavily concentrated in the highest compared with the lowest income quintile. Mothers in the lowest income quintile were 2.5 times more likely to be recent immigrants than were mothers in the highest income quintile. For cesarean section, significant differences across income quintiles reflect a high power to detect small differences because of the large sample size, rather than substantial differences across the quintiles.

Even when adjustments were made for infant sex, maternal age group and recent immigration (plus gestational age group in the low birthweight model), all adverse birth outcomes remained more common among women in the lowest neighbourhood income quintile (Table 3). While these adjustments somewhat reduced the effect sizes for low birthweight and full-term low birthweight, the effect size became stronger for preterm birth. All the odds ratios remained statistically significant after adjustment. Compared with women in the highest neighbourhood income quintile, those in the lowest had 25% higher odds of preterm birth, 46% higher odds of low birthweight, and 53% higher odds of full-term low birthweight.

Recent immigration

Singleton infants liveborn to recent immigrant mothers accounted for 31.5% of all births in the study population. Births to recent immigrants were less likely than those to longer-term residents to be preterm, but they were more likely to be low birthweight and full-term low birthweight (Table 2). Recent immigrant mothers were more likely to live in lower-income neighbourhoods, and less likely to be younger than age 20, or aged 35 or older. Longer-term residents were more likely than recent immigrant mothers to have had at least one illness during pregnancy and to have delivered by cesarean section.

Table 2
Birth outcomes and infant and maternal characteristics, by neighbourhood income quintile and recent immigrant status, Toronto, 1996/1997 to 2000/2001

	Total	Neighbourhood income quintile					Recent† immigration	
		Q1 (highest)	Q2	Q3	Q4	Q5 (lowest)	Yes	No
Singleton live births (number)	143,030	28,512	28,367	28,789	28,698	28,664	44,977	98,053
Outcomes	%	%	%	%	%	%	%	%
Preterm birth	5.3	4.7	5.3	5.3	5.4	5.6**	4.9	5.4**
Low birthweight	5.0	4.0	4.9	5.1	5.2	5.8**	5.2	4.9*
Full-term low birthweight	1.9	1.4	1.9	1.9	1.9	2.3**	2.2	1.7**
Maternal and infant characteristics								
Recent immigrant	31.5	17.3	27.4	31.9	36.7	43.8**	100.0	0.0
Maternal age								
Less than 20	3.6	1.8	3.4	3.8	4.3	4.7**	2.5	4.1**
20 to 34	74.3	68.2	74.1	74.8	76.5	77.8**	82.9	70.3**
35 or more	22.1	30.0	22.5	21.4	19.2	17.5**	14.5	25.6**
Maternal illness	12.5	11.6	12.3	12.5	12.8	13.5**	11.5	13.0**
Cesarean section	20.2	19.6	20.3	20.3	20.2	20.6*	19.3	20.6**
Gestational age (weeks)								
Less than 28	0.4	0.2	0.4	0.3	0.4	0.5**	0.4	0.4**
28 to 37	4.9	4.5	4.9	5.0	5.0	5.1**	4.5	5.1**
38 to 41	94.2	94.8	94.3	94.2	94.1	93.8	94.6	94.1**
42 or more	0.5	0.4	0.5	0.5	0.5	0.6*	0.6	0.5**
Male infant sex	51.3	51.3	50.8	51.3	50.6	51.5*	51.3	51.3

† within 5 years
* $p < 0.05$
** $p < 0.01$
Note: Chi-square tests were used for differences in proportions and the Cochran-Armitage test for trend in binomial proportions across the five neighbourhood income quintiles.
Source: Discharge Abstract Database, Canadian Institute for Health Information.

Table 3
Crude and adjusted odds ratios comparing neighbourhood income quintiles Q2, Q3, Q4 and Q5 with Q1, and recent immigrants with longer-term residents, Toronto, 1996/1997 to 2000/2001

	Preterm birth				Low birthweight				Full-term low birthweight			
Neighbourhood income quintiles	Crude odds ratio	95% confidence interval	Adjusted odds ratio‡	95% confidence interval	Crude odds ratio	95% confidence interval	Adjusted odds ratio§	95% confidence interval	Crude odds ratio	95% confidence interval	Adjusted odds ratio§	95% confidence interval
Q1 (highest)†	1.00	...	1.00	...	1.00	...	1.00	...	1.00	...	1.00	...
Q2	1.12*	1.03 to 1.20	1.14*	1.05 to 1.25	1.26*	1.16 to 1.37	1.23*	1.11 to 1.36	1.37*	1.20 to 1.56	1.33*	1.15 to 1.52
Q3	1.12*	1.04 to 1.21	1.16*	1.06 to 1.27	1.29*	1.19 to 1.40	1.28*	1.16 to 1.41	1.36*	1.19 to 1.55	1.30*	1.13 to 1.49
Q4	1.15*	1.06 to 1.23	1.19*	1.09 to 1.30	1.33*	1.23 to 1.44	1.28*	1.16 to 1.41	1.38*	1.21 to 1.57	1.29*	1.12 to 1.49
Q5 (lowest)	1.19*	1.11 to 1.28	1.25*	1.15 to 1.37	1.50*	1.39 to 1.62	1.46*	1.32 to 1.61	1.66*	1.46 to 1.88	1.53*	1.34 to 1.76
Recent immigrant												
No†	1.00	...	1.00	...	1.00	...	1.00	...	1.00	...	1.00	...
Yes	0.89*	0.84 to 0.93	0.89*	0.84 to 0.95	1.06*	1.01 to 1.12	1.18*	1.10 to 1.26	1.30*	1.20 to 1.40	1.24*	1.14 to 1.35

† reference category
‡ adjusted for infant sex, maternal age group, neighbourhood income quintile, and recent immigrant status
§ also adjusted for gestational age group
* significantly different from reference category ($p < 0.05$)
Source: Discharge Abstract Database, Canadian Institute for Health Information.

Adjustment for infant sex, maternal age group, and neighbourhood income quintile did not modify the association between recent immigration and preterm birth. The adjusted odds of preterm birth for recent immigrants were only 89% those of longer-term residents (Table 3). However, the adjusted odds of low birthweight and of full-term low birthweight were 18% and 24% higher among recent immigrants than among longer-term residents.

Neighbourhood income and recent immigration

A product term between neighbourhood income quintile and recent immigration status was added to the adjusted models to test for interaction. Because the interaction terms were statistically significant ($p<0.05$) in the adjusted models for all outcomes, stratified analyses of the effects of neighbourhood income on birth outcomes were calculated by recent immigration status (Table 4).

Table 4
Adjusted odds ratios comparing neighbourhood income quintiles Q2, Q3, Q4 and Q5 with Q1, by recent immigration status, Toronto, 1996/1997 to 2000/2001

	Preterm birth‡				Low birthweight§				Full-term low birthweight‡			
	Longer-term residents		Recent immigrants		Longer-term residents		Recent immigrants		Longer-term residents		Recent immigrants	
Neighbourhood income quintiles	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Q1 (highest)†	1.00	...	1.00	...	1.00	...	1.00	...	1.00	...	1.00	...
Q2	1.15*	1.05 to 1.26	1.05	0.88 to 1.27	1.32*	1.18 to 1.48	0.98	0.82 to 1.17	1.49*	1.28 to 1.74	0.94	0.72 to 1.22
Q3	1.19*	1.09 to 1.30	1.01	0.85 to 1.21	1.36*	1.21 to 1.53	1.04	0.88 to 1.23	1.41*	1.21 to 1.65	1.00	0.78 to 1.28
Q4	1.24*	1.13 to 1.35	1.02	0.85 to 1.21	1.30*	1.16 to 1.47	1.15	0.97 to 1.35	1.37*	1.17 to 1.60	1.05	0.82 to 1.33
Q5 (lowest)	1.34*	1.22 to 1.46	1.03	0.87 to 1.22	1.48*	1.31 to 1.67	1.30*	1.11 to 1.53	1.66*	1.42 to 1.94	1.21	0.96 to 1.52
P value††	0.0221				0.0497				0.0419			

† reference category
‡ adjusted for infant sex and maternal age group
§ also adjusted for gestational age group
†† for the interaction between neighbourhood income quintiles and recent immigrant status
* significantly different from reference category ($p < 0.05$)
Source: Discharge Abstract Database, Canadian Institute for Health Information.

When infant sex, maternal age group and gestational age group (in the low birthweight model) were taken into account, the adjusted odds ratios comparing the lowest with the highest neighbourhood income quintiles were consistently higher among longer-term residents than among recent immigrants for all birth outcomes. As well, among recent immigrants, the effect of neighbourhood socio-economic disadvantage disappeared for preterm birth and full-term low birthweight.

Discussion

Conclusion

Despite universal access to most physician and hospital services, and consistent with previous studies of urban areas,[6-8] socio-economic disparities in adverse birth outcomes existed in Toronto during the 1996/1997 to 2000/2001 period. Recent immigrants appeared to be protected from preterm birth, but at higher risk of low birthweight. However, among recent immigrants, there was a virtual absence of disparities in preterm birth and full-term low birthweight rates across neighbourhood income quintiles. Longer-term residents in low-income neighbourhoods were clearly the subgroup experiencing the highest risk of adverse birth outcomes, probably because of the influence of lasting socio-economic disadvantage.[26]

Preterm birth and low birthweight have generally been regarded as less-than-favourable outcomes that often occur together. For example, low birthweight can result from being born early (preterm birth), from being born small for gestational age (which is a proxy for intrauterine growth restriction), or from a combination of the two. Yet paradoxically, while births to recent immigrant mothers in Toronto were less likely to be preterm, they were also more likely to be low birthweight and full-term low birthweight. To some extent, this may be because of a "healthy migrant effect" among recent immigrant women that makes them less susceptible to conditions that can cause preterm birth, and because the distribution of causes of low birthweight differs between recent immigrant women and longer-term residents.

The prevalence of maternal illnesses, such as genito-urinary infection, pregnancy-induced hypertension, incompetent cervix and abruption placenta, which are important predictors of preterm birth, was lower among recent immigrants than among longer-term residents. The lower rates of preterm birth among recent immigrants may also be influenced by another example of the "healthy migrant effect": less exposure to negative health behaviours, notably, cigarette smoking and alcohol consumption, compared with longer-term residents.[11,27] By the same token, it is very unlikely that low birthweight among recent immigrant mothers could be due to higher smoking and alcohol consumption, although these behaviours would be factors in low birthweight among longer-term residents. A more plausible speculation is that the higher rates of low birthweight may reflect differences in the anthropometry and diet of recent immigrant mothers, given that low weight gain during pregnancy, low body mass index, and short stature are important predictors of intrauterine growth restriction.[5,28] The Discharge Abstract Database contains no information about recent immigrant mothers' country of origin, but according to the 2001 census, the top five countries of origin of immigrants to Toronto from 1996 to 2001 were China, India, Pakistan, the Philippines, and Sri Lanka. Women born in southern and eastern Asia tend to be shorter and lighter and to have lower caloric intake than Canadian-born women—factors that contribute to smaller babies, and consequently, to lower birthweight.[28]

Limitations

These findings should be interpreted with certain limitations in mind. The use of recent registration for provincial health insurance as a proxy for recent immigration has not been validated. Even so, according to census data, 81.2% of the people new to the Toronto CMA between 1996 and 2001 who were not from another part of the province came directly from other countries. As well, many of the remainder (that is, interprovincial migrants) might also be recent immigrants to Canada who came to Ontario via other provinces. However, if a

substantial number of new registrants were not recent immigrants, the measures of effect in this analysis would tend to be biased towards the null.

The lack of information about recent immigrants' country of origin implies that the findings apply only to the recent immigrant population in the study period as a whole, but cannot be extrapolated to specific ethnic groups or nationalities. Further research designed to examine ethnic variations in birth outcomes would be needed for that purpose.

Another limitation was the inability to obtain an individual measure of socio-economic disadvantage. Instead, the analysis relied on a neighbourhood-based measure, which usually,[29] but not always,[7,30,31] produces attenuated (and therefore, conservative) effect estimates. Nonetheless, area-based measures can be conceptualized as meaningful socio-economic indicators in their own right, since they provide information on contextual influences that are not reducible to the individual level (that is, physical and social environment).[9] However, without data on individual income, it is not possible to separate the effects of individual and neighbourhood-level income on birth outcomes.

The use of ICD codes to approximate preterm birth and full-term low birthweight may have introduced some measurement error, since the categories are not completely specific to gestational age. Even so, it is unlikely that this produced serious bias in the estimates, since a fifth digit is reserved in the ICD-9 to indicate birthweight categories, and a broad overlap in the distribution of birthweight between gestational age groups in this analysis (not shown) suggests that this categorization was driven primarily by gestational age cutoffs. Imperfect measurement of gestational age also somewhat undermined the efficiency of adjustment for this factor, thus leading to some degree of residual confounding. However, control for gestational age was applied only for the low birthweight model.

Analyses aimed at assessing potential bias due to characteristics of the majority of the excluded births (data not shown) showed that these births were at high risk for the adverse birth outcomes studied, and that the distribution of the excluded births was shifted towards the lower income quintiles. The consequence is that the true effect of neighbourhood income would likely have been somewhat greater had this bias not been present. Yet even with these limitations, the effect sizes were within the range of previously reported in Canada.[6-8,10]

Other limitations included a lack of information on maternal marital status, living arrangements, place of birth, occupation, household income, education, smoking, and Aboriginal identity, as well as a complete lack of information on paternal characteristics. Some of those variables would have been available from vital statistics birth registrations. Also, current place of residence recorded on hospital discharge abstracts may differ from usual place of residence recorded on vital statistics birth registrations. Finally, because live births in this study were not linked to infant deaths, no information was available on fatal outcomes (except for deaths occurring during the initial hospitalization).

Implications

One of the main challenges in perinatal health continues to be the reduction of preterm birth. Further research on maternal and general health status differences between recent immigrants and longer-term residents may inform interventions that could help to reduce preterm birth and socio-economic inequalities in preterm birth.

Lower neighbourhood income was associated with higher rates of preterm delivery, low birthweight and full-term low birthweight among longer-term residents (most of whom were not immigrants). Longer-term residents could be seen as the main target population, not only for fetal growth interventions, but also for the prevention of preterm birth.

In fact, for the study population as a whole, the relatively good outcomes for recent immigrants appeared to partially mask the deleterious effects of low neighbourhood income on preterm birth among longer-term residents. Studies of socioeconomic disparities in birth outcomes should be designed to account for the full extent of such effects.

More research is needed to fully validate the use of the Discharge Abstract Database as an alternative

source of data on pregnancy outcomes, especially since fiscal year 2001/2002. At that time, a major redevelopment of the database took place, including the reporting of gestational age in weeks, obstetric history, and a straightforward linkage between mothers' and infants' records.[32] These innovations have made the database an attractive source of information for further studies of pregnancy outcomes. Linkage of the Discharge Abstract Database to Ontario vital statistics is desirable in order to exploit the strengths of each for a more complete picture of birth outcomes and their determinants at the population level. In addition, a side-by-side comparison of results obtained from the two sources would shed light on their relative strengths and limitations, and probably lead to suggestions on how to address data quality issues.

In the absence of complete registration of births in Ontario vital statistics, hospital discharge abstracts from 1996/1997 to 2000/2001 can serve as an alternate source of data on non-fatal birth outcomes, despite serious limitations in the variables that are available. However, complete birth registration in Ontario vital statistics is needed, as well as routine linkage of all live births to corresponding infant deaths, so that fatal outcomes such as birthweight and gestational-age-specific infant mortality can also be assessed. ●

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