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Comparison of receipt of routine preventive care among infant daughters and sons of immigrant mothers to Ontario, Canada

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Abbreviations:
RPDB- Registered Persons Database
CIHI-DAD- Discharge Abstract Database of the Canadian Institute for Health Information
IRCC- Immigration, Refugees, and Citizenship Canada Permanent Resident Database
OR- Odds Ratio
aOR- Adjusted Odds Ratio
95%CI- 95% Confidence Interval

What is already known on this topic

- Gender inequities exist in routine primary care between male and female children in early life in several immigrant-sending countries due to son-preference.
- It is unknown whether gender inequities in routine primary care exist within immigrant families in high-income countries.

What this study adds

- Gender equity in routine preventive health care is largely achieved among children of immigrants with the exception of those from India whose daughters receive fewer well-child care visits than sons.

Abstract

Objectives: To explore gender disparities in infant routine preventive care across maternal countries of birth (MCOB), and by mother tongue among infants of Indian-born mothers.

Setting: Retrospective population-based administrative cohort in Ontario, Canada (births between 2002 and 2014).

Participants: 350,366 healthy term singletons with at least one opposite gender sibling, of mothers born in the top 15 countries by number of births in Ontario.

Outcome measures: Fixed effects conditional logistic regression generated adjusted odds ratios for a daughter being under-immunized and having an inadequate number of well-child visits compared to her brother, stratified by MCOB. Modifying effects by maternal mother tongue were assessed among families with Indian-born mothers.

Results: Under-immunization and inadequate well-child visits were common among both boys and girls, ranging from 26% to 45% (under-immunization) and 10% to 47% (inadequate well-child visits) depending on the maternal birthplace. Girls whose mothers were born in India had 1.19 times (95% CI: 1.07, 1.33) the adjusted odds of inadequate well-child visits versus their brothers. The association was only observed among the Punjabi mother tongue subgroup (aOR:1.26, 95%CI: 1.08, 1.47).

Conclusions: Gender equity in routine preventive health care is mostly achieved among children of immigrants. However, daughters of Indian-born mothers whose mother tongue is Punjabi, appear to be at a disadvantage for well-child visits compared to their brothers. This suggests son preference may persist beyond the family planning stage among some Indian immigrants.

Strengths and Limitations of the Study

- This was the first retrospective population-based cohort to examine gender disparities across multiple routine preventive care outcomes among children of diverse immigrant populations and language groups.
- Our approach advanced existing research by considering maternal immigration and nativity, rather than ethnicity, as well within-sibling comparison approach to control for within-family unobservable factors
- Mother tongue is not a perfect representation of geographic origins and is not necessarily her most commonly spoken language around the time of delivery, potentially introducing some heterogeneity.

Introduction

In early childhood, parents are the principal gatekeepers to their child's health care use.[1] Barriers facing immigrants in concert with health beliefs and family dynamics may influence parental healthcare decision-making around immunizations and well-child check-ups.[1-3] Evidence shows that beliefs about gender norms, roles and relations adversely affect the health and wellbeing of girls in top source countries of immigrants to Canada including India, Pakistan, and China, among others.[4-15] In select immigrant-sending countries, differential health investments exist towards sons and daughters, to the disadvantage of girls with respect to breastfeeding, immunization, and seeking health care for illness,[10-14] which some researchers have termed 'health-care neglect'.[8 15] Studies have identified son-preference among immigrant communities in Canada, the United Kingdom, and Australia manifesting through sex-selective pregnancy termination.[5 16-21] In the Indo-Canadian community, this practice is documented at higher birth orders particularly among mothers whose first language is Punjabi.[18]

It is unknown if son preference may affect the routine preventive care of young girls and boys across different immigrant groups. One study British South Asian children could not identify gender differences in immunization rates due to a limited sample size and an analytic approach not suited to examine gender bias within families.[22] Daughters in some immigrant groups may experience 'double jeopardy' concerning health care in early life due to their gender and parental country of birth, and such disparities, if any, must be quantified.[23]

Ontario, Canada provides an ideal setting in which to conduct health research on the children of immigrants. Ontario has one of the most diverse immigrant populations in the world,[24] and children are covered for universal health care in Canada from birth including routine anticipatory

care (i.e., well-child visits and the recommended series of vaccinations) by a publicly-funded health insurance system, without direct cost to the parent.

The primary objective was to identify any existing gender disparities in routine preventive care within families across various maternal countries of birth. Since there is growing evidence of sex-selective pregnancy termination within specific linguistic subgroups in Indian diaspora,[18] the secondary objective was to investigate if gender disparities among this subgroup were dependent on mother tongue.

Methods

Data sources

The data for this study comes from several linked population-based administrative databases at ICES to form a retrospective cohort following children from birth to 24 months of age. A unique coded identity number facilitates record linkage between the databases. The Registered Persons Database (RPDB) is the provincial health care registry. It contains information on birth date, sex, and postal code which was linked to Canadian Census data to obtain neighborhood information at the level of a dissemination area, the smallest census geographic unit.

Hospitalization-related deliveries in Ontario, Canada between April 1st, 2002 and March 31st, 2014 were identified from the Discharge Abstract Database (DAD) of the Canadian Institute for Health Information (capturing 98% of births). Well-child check-ups and vaccinations with family physicians and pediatricians were captured using the Ontario Health Insurance Plan (OHIP) claims database, which contains information on physicians' billings, such as fee codes for visits, diagnostic codes, and date of service. We sourced the Ontario portion of the federally maintained Immigration, Refugees, and Citizenship Canada (IRCC) Permanent Resident Database for information on maternal birthplace, immigrant class, and landing date to Canada. Many earlier

studies have linked the IRCC databases with the other databases used in this study.[16 18 19 25] Overall, the IRCC has an 86% match rate to the RPDB. Non-immigrants are those who remain unmatched to the IRCC database. A small proportion of the non-immigrant group may be immigrants who landed before 1985.[26] These datasets were linked using unique encoded identifiers and analyzed at ICES.

Patient and public involvement (PPI)

No individual patients were directly involved in this study.

Study population

The study population included healthy singleton term siblings born in Ontario, Canada between April 1st, 2002 and March 31st, 2014 eligible for OHIP from a pediatrician or family physician/general practitioner until 24.5 months of age. Included infants were those whose maternal country of birth was among the top 15 in Ontario (representing >90% of all births) and who had at least one eligible sibling of the opposite gender born in the study period.

Infants born at <37 weeks gestation, or weighing <2500 grams at birth, or those diagnosed with a complex chronic condition (e.g., including major congenital malformations,) were excluded,[27] as these may have influenced their experience of routine care.

Infants were removed from the study cohort if they had no documented well-child visits or immunizations, or if they received any primary care from community health centers as these physicians do not bill OHIP for their activities. Infants with no health care billings may see a salaried physician or other health care provider who does not submit billings. Mothers or infants with any missing covariate or outcome data were also excluded, although this is uncommon in the current administrative data. Figure 1 presents a flowchart for the cohort formation.

Variables

Outcomes

Number of vaccinations by a family physician or pediatrician by 24 months of age. An immunization was measured by identifying the codes physicians use to bill the province for the administration of a vaccine and the number of units delivered on a given day. The total number of vaccinations did not include unscheduled vaccinations occurring before six weeks. Infants were categorized as *under-immunized* if they had received less than the expected number of vaccination doses publicly available and recommended in Ontario at their time of birth. Infants born in 2002-2003, 2004-2009, 2010-11, and 2013 should have had 5, 12, 11, and 10 vaccines respectively by 24 months, against the availability in Ontario at the time (e.g., varied iterations and combinations of DPTP/Hib, MMR, pneumococcus, meningococcus and varicella vaccines). We did not examine specific antigens therefore under-immunization here does not represent coverage necessarily.

Number of well-child visits by a family doctor or pediatrician by 24 months of age. These were operationalized by a set of core primary care fee codes and diagnostic codes and excluded immunization-only visits.[28] Infants were determined to have *inadequate well-child check-ups* if they had fewer than five check-ups by a family doctor or pediatrician (recommended at 2, 4, 6, 12, 15 (optional) and 18 months of age) in the first two years of life.

Vaccines or check-ups documented two weeks after 24 months were included as a buffer for appointment scheduling.

Exposures

Maternal country of birth (MCOB) is recorded from notarized documents in the IRCC permanent resident database. If mothers did not have an immigration record, they were classified as Canadian-born. In this study, MCOB represents exposure to the health and gender-related norms of that country which may differentially affect the use of routine anticipatory care for sons and daughters.

Child gender. Gender norms, roles, and relations may differentially affect the receipt of routine, anticipatory health care for boys and girls within the family unit. In this study, biological sex documented at birth was described as gender, as the question under study is gender-based bias.

Covariates

Confounders were selected a priori and included variables that could vary between siblings.[29] They included maternal age at delivery of the index child (≤19, 20-34, ≥35 years of age), infant birth year,[30] birth order (1st, 2nd, 3rd, 4th or more),[31] neighborhood income quintile (1=lowest and 5=highest) and urban/rural residence (urban≤40 on Rurality Index of Ontario; rural ≥40) of the maternal place of residence at the birth of the index child,[32 33] and among immigrant mothers, time in Canada (≤5, 6-9, 10-14, 15+ years). Covariate data originated from the hospital record (maternal age, infant birth year, birth order), Canadian census data (neighborhood income quintile and urban/rural residence), and IRCC documentation (time in Canada since landing date). Statistics Canada's Postal Code Conversion File links the mother's postal code at delivery to generate values for the census-related variables. Deliveries before January 1st, 2004 were linked with the 2001 census, and deliveries afterward were linked to the 2006 census.

We examined maternal *mother tongue* as a potential effect modifier for the relationship between gender and routine preventive care among children of Indian-born mothers. Female disadvantage

appears to vary regionally within countries. For example, states in southern India may not exemplify the same degree of gender bias as seen in northern regions, where Punjabi is the dominant culture and language spoken. Previous research has demonstrated variability in sex-selective pregnancy termination across Indian language groups.[18] Mother tongue was recorded and documented in the IRCC at landing. We chose the three most commonly declared mother tongues to preserve sample size (Punjabi, Gujarati, Hindi, and 'Other').

Analysis

Cross-tabulations and univariate procedures were used to obtain the baseline proportions of under-immunization and inadequate well-child visits for each gender within MCOB. Next, a fixed effects approach with conditional logistic regression stratified by MCOB was used to estimate whether daughters have higher odds of adverse outcomes compared to sons *within families, within the given MCOB stratum*. Fixed effects are useful for studying sibling differences by accounting for unobservable differences in maternal/family level variables.[29 34 35] Within-sibling variation is used to estimate the regression parameter for gender, and all stable characteristics of the family environment are controlled —isolating the effect of child's gender on anticipatory care outcomes within-families. Models were adjusted for maternal age, income quintile, rurality, birth year, birth order, and category of time spent in Canada (immigrant models only). A statistical test for interaction was performed between mother tongue*gender (significant at $p \leq 0.2$) to determine whether gender disparities are dependent on mother tongue for children of Indian-born mothers. Effect modification was also assessed by further stratifying gender disparities by Indian mother tongue.[13 18]

SAS version 9.4 was used to perform all analyses (SAS Institute, Inc, Cary, NC). The study obtained ethics approval from the Research Ethics Board at the University of Toronto (Protocol reference #33799).

Results

Demographic characteristics

Table 1 describes the characteristics of mothers and infants from each included MCOB. The total eligible population was 350,366 healthy, term, singleton infants, of 154,259 mothers from the 15 countries most commonly delivering in Ontario. Countries represented included Canada, India, Pakistan, China, Philippines, Sri Lanka, Jamaica, Afghanistan, Vietnam, Poland, Somalia, Iraq, USA, Guyana, and Iran. Figure 1 shows the flow of the cohort formation and application of exclusion criteria.

Within-family gender disparities in routine preventive care

Under-immunization and inadequate well-child visits were common among both boys and girls, ranging from 26% to 45% (under-immunization) and 10% to 47% (inadequate well-child visits) depending on the maternal birthplace. Table 2 presents the prevalence of the outcomes by MCOB and gender, as well as unadjusted and adjusted within-family odds ratios and 95% Cis for under-immunization and inadequate well-child care for daughters compared to sons across MCOB strata.

No significant within-family gender differences were observed for immunization, although daughters whose mother was born in India had 1.08 times (95% CI 0.99, 1.17) the odds of under-immunization and 1.19 times (95% CI: 1.07, 1.33) the odds of inadequate check-ups compared

with their male sibling. Girls in Afghani families had 27% greater odds of inadequate check-ups compared to their brothers (OR: 1.27, 95%CI: 1.01, 1.60), however the OR was no longer significant after covariate adjustment. We observed no significant within-family gender disparities for any other countries.

Effect modification by mother tongue among infants of Indian-born mothers

The three most common mother tongues among Indian-born mothers were Punjabi (55.4%), Gujarati (15.9%) and Hindi (9.4%). Among Indian-born mothers, statistical tests for interaction between mother tongue*gender were significant at $p \leq 0.2$ for both outcomes (Under-immunization: chisq=4.79 p=0.19; Inadequate well-child checkups: chisq=5.27, p=0.15). Stratified analysis showed the relationship between gender and inadequate routine care was dependent on maternal mother tongue. Figure 2 shows significantly higher odds for sisters compared to brothers for inadequate well-child visits only for siblings in the Punjabi mother-tongue group (aOR:1.26, 95%CI: 1.08, 1.47), but not for Gujarati, Hindi or Other groups. Daughters of mothers in the Hindi group had lower odds of under-immunization compared to their brothers (aOR: 0.73, 95%CI: 0.54, 0.98).

Discussion

In this population-based study, we did not find evidence of gender disparities in under-immunization or inadequate well-child visits for most MCOB, except among Indian families where sisters had significantly higher odds of inadequate well-child visits compared to their brothers. To our knowledge, no studies have examined within-family gender disparities in early childhood routine care outcomes by maternal country of birth, which is essential given documented gender disparities in many source countries of immigrants to high-income countries.

Interpretation

Our study contrasts earlier work that did not find gender disparities in vaccinations among British South Asian children.[22] By using a larger sample size and fixed effects analysis,[29] we were able to estimate family-held gender biases adversely affecting health care for daughters compared to sons within families. We found that gender disparities within Indo-Canadian families were dependent on the Punjabi mother tongue. This finding is consistent with earlier studies of sex-selective pregnancy terminations in the Indo-Canadian community [18] as well as research from the North-West of India where Punjabi is a dominant language.[13 37 38] Research within Punjabi populations describes the economic benefits of sons over daughters, including the provision of old age support, higher-paid employment, patrilineal kinship systems, and avoiding the high cost of dowry or marriage payments.[5 14 38 39] For some families, son preference may manifest primarily through sex selection but also through health-care neglect.[8] It is possible for similar mechanisms related to sex selection to influence gender equity in infant health care. In unconditional models, we found female disadvantage among children of among children of Afghanistan-born mothers for inadequate well-child visits. In adjusted models the effect estimate did not change substantially, but precision suffered. Therefore, it is plausible that the 23% increased odds of inadequate females is relevant to clinical or public health practice, and would be statistically significant with a larger sample size, such as in the case of India.[40] Further research may clarify this issue. We also found a female advantage for immunization among the Hindi language group. It is possible that greater immunization among females relates to a belief that immunizations are harmful, thereby protecting males, although there is little evidence supporting this. In contrast, the observed disparity may be due to chance for the following reasons. First, the Hindi group is small relative to other groups and the observed confidence limits are wide. Second, Hindi is a language spoken all over India and therefore it does not

directly represent a well-defined linguistic, geographic, or cultural group in the same way as Gujarathi or Punjabi.

Strengths

To our knowledge, this was the first retrospective population-based cohort to examine gender disparities across multiple routine preventive care outcomes among children of immigrants. Second, due to the substantial diversity of Ontario mothers, we were able to examine gender disparities across many MCOB. Third, this study is the first to examine the issue of gender bias occurring within families that may be affecting the health of children of immigrants and non-immigrants. Our approach advanced existing research by considering maternal immigration and nativity (as opposed to the effects of ethnicity) as well as a within-sibling comparison. Finally, the use of: 1) official government immigration data to identify immigration factors; and 2) population-based administrative health data help strengthen both the internal and external validity of the study.

Limitations

Immigration data is only available for those arriving in Canada after 1985, so those arriving prior were misclassified as non-immigrants. Therefore, the Canadian-born group may be heterogeneous with health and gender beliefs related to their ancestral immigrant group. However, given an extended duration of residence, beliefs and health practices may be closer to Canadian norms.[41] As well, this population is likely small relative to the Canadian-born population. We were unable to assess paternal country of birth, potentially biasing results towards the null effect. Mother tongue may not necessarily represent a particular geographic region of India nor her most commonly spoken language around the time of the index delivery,[18] introducing possible heterogeneity. We found lower immunization than earlier reports that

ascertained coverage with surveys and immunization records.[42] In the Ontario portion of the Childhood National Immunization Coverage Survey, antigen-specific coverage at two years of age ranged from 75.0% (Hib) to 93.4% (Polio).[43] Therefore combining each antigen for an overall vaccine coverage estimate is conditional on the coverage of each antigen each coverage and therefore would much lower and closer to our observed rates. However, the goal of our study was not to estimate antigen-specific coverage but to approximate a measure of routine health care utilization, using overall vaccine dose counting. One study using physician billing for dose-counting found a similar prevalence (42%) of under-immunization to ours.[44]

Finally, census-derived variables are measured infrequently, and may result in misclassification, contributing to residual confounding. Using a fixed-effects analytic approach helped to control for within-family unobservable factors.[29 34 35] It is also important to note that immigrants are not representative of the source population, which may explain why we did not find significant effects for most MCOB, even among those where gender inequity is high.[38 39] Findings may not be generalizable to children born outside of Ontario, Canada, including children who themselves immigrated, although it is also possible that stronger effects may have been observed.

Conclusion and Implications

Gender equity in routine preventive health care is achieved among children of immigrants, with the notable exception of those from India. In this select case, son preference appears to persist beyond family planning and may adversely affect the wellbeing of daughters whose mothers migrate from India. This work may help health care providers attend to children needing additional preventive care. Future directions include verifying the mechanisms behind son preference in child health care, as well as exploring potential gender-based adversity through other areas of child well-being. Community-led interventions addressing son preference and the

well-being of daughters may be helpful in improving gender equity in health care among those affected.

Table 1 Descriptive characteristics of included mother-infant sibling sets with at least one boy and one girl, among the 15 countries with the greatest share of births in Ontario, Canada April 2002- March 2013, data is complete unless otherwise specified.

	Maternal Country of Birth														
N infants=350,336 154,259 mothers	Canada	India	Pakistan	China	Philippines	Sri Lanka	Jamaica	Afghanistan	Vietnam	Somalia	Poland	Iraq	USA	Guyana	Iran
N (%)	290,009 (82.8)	12,356 (3.5)	9150 (2.6)	7566 (2.2)	5654 (1.6)	6169 (1.8)	3057 (0.9)	2684 (0.8)	2424 (0.7)	2382 (0.7)	2340 (0.7)	2030 (0.6)	1828 (0.5)	1626 (0.5)	1061 (0.3)
Maternal Age %															
≤19	3.80	0.4	0.8	0.2	1.1	0.3	5.3	1.2	0.5	1.1	0.8	1.1	1.0	2.5	0.5
20-34	80.1	90.0	87.5	75.5	69.3	86.4	79.8	85.2	80.9	74.0	83.9	81.8	75.7	82.1	68.9
35+	16.1	9.6	11.7	24.3	29.5	13.2	14.8	13.4	18.6	24.7	15.3	17.1	23.2	15.4	30.6
Female %	49.8	51.0	50.1	50.3	49.8	49.9	49.5	50.5	50.1	50.0	49.5	50.0	50.1	49.9	49.9
Birth Order %															
First	36.8	41.2	35.8	45.0	39.5	39.7	30.6	31.7	39.2	18.5	40.2	32.2	34.3	35.7	46.6
Second	41.1	44.6	39.2	46.3	43.4	42.2	38.5	37.1	43.1	23.7	43.5	37.9	37.6	42.1	48.0
3rd	15.5	11.6	19.1	7.7	13.7	15.4	18.9	20.3	13.6	20.9	13.2	21.0	16.0	15.6	4.6
4th or greater	6.7	2.6	6.0	1.0	3.4	2.7	12.0	10.8	4.2	37.0	3.1	8.9	12.1	6.6	0.9
Time since landing %															
<5 years	-	57.8	64.0	60.4	43.8	55.5	13.8	45.5	40.0	32.7	16.1	53.6	62.5	21.6	42.6
5-9 years	-	28.8	25.9	31.0	25.5	23.2	23.0	30.1	24.1	30.1	13.6	26.1	18.8	26.2	28.0
10-14 years	-	9.2	7.6	6.9	17.9	13.2	29.7	15.3	17.5	25.4	26.0	13.8	8.7	24.8	15.3
15+ years	-	4.3	2.6	1.7	12.7	8.1	33.5	9.2	18.4	11.9	44.2	6.5	10.1	27.4	14.1
Neighborhood Income Quintile															
1: Lowest	17.6	28.6	39.9	26.4	32.3	36.7	44.6	50.4	31.9	70.0	13.0	43.0	13.2	36.1	17.3
2	18.5	27.5	22.8	30.2	24.1	29.0	23.8	17.6	25.0	16.4	20.7	21.4	18.4	23.3	11.8
3	20.6	24.3	18.2	19.5	19.7	20.5	18.7	13.6	22.7	7.0	21.2	16.6	18.7	24.5	20.0
4	23.0	14.0	14.1	15.3	15.4	10.3	8.6	12.3	14.5	4.9	26.5	13.0	23.4	11.6	31.5
5: Highest	19.6	5.7	5.0	8.3	8.5	3.4	4.2	6.0	5.8	1.5	18.6	5.7	26.2	4.6	19.1
Lives in Rural Area	14.7	0.3	0.3	0.3	1.0	0.0	0.2	0.3	0.2	0.0	2.0	0.2	10.7	0.4	0.2
Missing Data on Income or Rurality	0.7	0.4	0.4	0.6	0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.4	0.5	0.1	0.6
No documented preventive care in physician billings	10.1	5.8	7.4	7.9	4.5	9.9	6.6	7.5	5.9	12.9	7.5	6.8	10.1	5.9	5.9

Table 2 Within-family Gender Disparities in Routine Preventive Care Outcomes Stratified by Maternal Country of Birth, among all opposite-gender sibling sets born in Ontario, Canada between April 2002- March 2013

	Under-Immunization				Inadequate Well-child Visits			
	%		F:M OR (95% CI)	F:M aOR (95% CI)	%		F:M OR (95% CI)	F:M aOR (95% CI)
Maternal Country of Birth	F	M			F	M		
Canada	44.6	44.4	0.99 (0.97, 1.01)	0.99 (0.97, 1.00)	16.3	17.0	0.94 (0.91, 0.96) †	0.96 (0.92, 1.00)
India	38.1	36.9	1.05 (0.97, 1.14)	1.08 (0.99, 1.17)	18.8	16.9	1.17 (1.05, 1.30) †	1.19 (1.07, 1.33) †
Pakistan	41.3	42.7	0.95 (0.97, 1.05)	0.96 (0.87, 1.05)	21.9	22.7	0.94 (0.84, 1.05)	0.95 (0.85, 1.07)
China	30.2	28.9	1.09 (0.97, 1.22)	1.07 (0.95, 1.20)	19.9	19.9	1.01 (0.88, 1.16)	1.02 (0.89, 1.17)
Philippines	30.5	31.1	0.95 (0.84, 1.08)	0.98 (0.89, 1.11)	13.4	14.6	0.88 (0.74, 1.05)	0.89 (0.74, 1.07)
Sri Lanka	34.2	34.3	0.99 (0.88, 1.12)	1.00 (0.88, 1.12)	16.5	17.2	0.94 (0.81, 1.10)	0.92 (0.78, 1.08)
Jamaica	45.2	44.6	1.03 (0.88, 1.20)	0.98 (0.83, 1.16)	26.9	25.4	0.93 (0.77, 1.12)	0.9 (0.73, 1.10)
Afghanistan	38.3	40.1	0.89 (0.75, 1.06)	0.90 (0.75, 1.07)	18.8	16.1	1.27 (1.01, 1.60) †	1.23 (0.96, 1.56)
Vietnam	27.9	27.8	1.01 (0.82, 1.24)	1.02 (0.82, 1.26)	10.9	10.5	0.9 (0.66, 1.23)	0.82 (0.58, 1.16)
Somalia	58.2	53.1	0.79 (0.67, 0.95)	0.84 (0.69, 1.03)	44.5	47.8	0.87 (0.72, 1.05)	0.99 (0.76, 1.50)
Poland	45.1	43.5	1.08 (0.90, 1.30)	1.10 (0.91, 1.35)	16.1	15.6	1.07 (0.83, 1.39)	1.02 (0.75, 1.38)
Iraq	37.3	37.0	0.99 (0.81, 1.22)	1.03 (0.83, 1.28)	18.0	17.7	0.97 (0.74, 1.26)	0.99 (0.75, 1.31)
USA	45.5	46.8	0.96 (0.78, 1.18)	0.93 (0.75, 1.15)	20.3	19.2	1.17 (0.91, 1.51)	1.2 (0.87, 1.66)
Guyana	39.1	38.3	1.03 (0.83, 1.29)	1.07 (0.84, 1.35)	17.1	20.2	0.81 (0.61, 1.07)	0.83 (0.61, 1.14)
Iran	26.5	28.0	0.94 (0.67,1.28)	0.95 (0.67, 1.34)	13.7	11.0	0.76 (0.50, 1.16)	0.86 (0.51, 1.45)

Adjustment was for maternal age, income quintile, rurality, birth year, birth order, and category of time spent in Canada (immigrant models only).
OR odds ratio, aOR adjusted odds ratio, 95% CI 95% Confidence Interval
†indicates statistical significance at p<0.05.
Reference group= males

Figure 1 Flow Chart of Cohort Formation

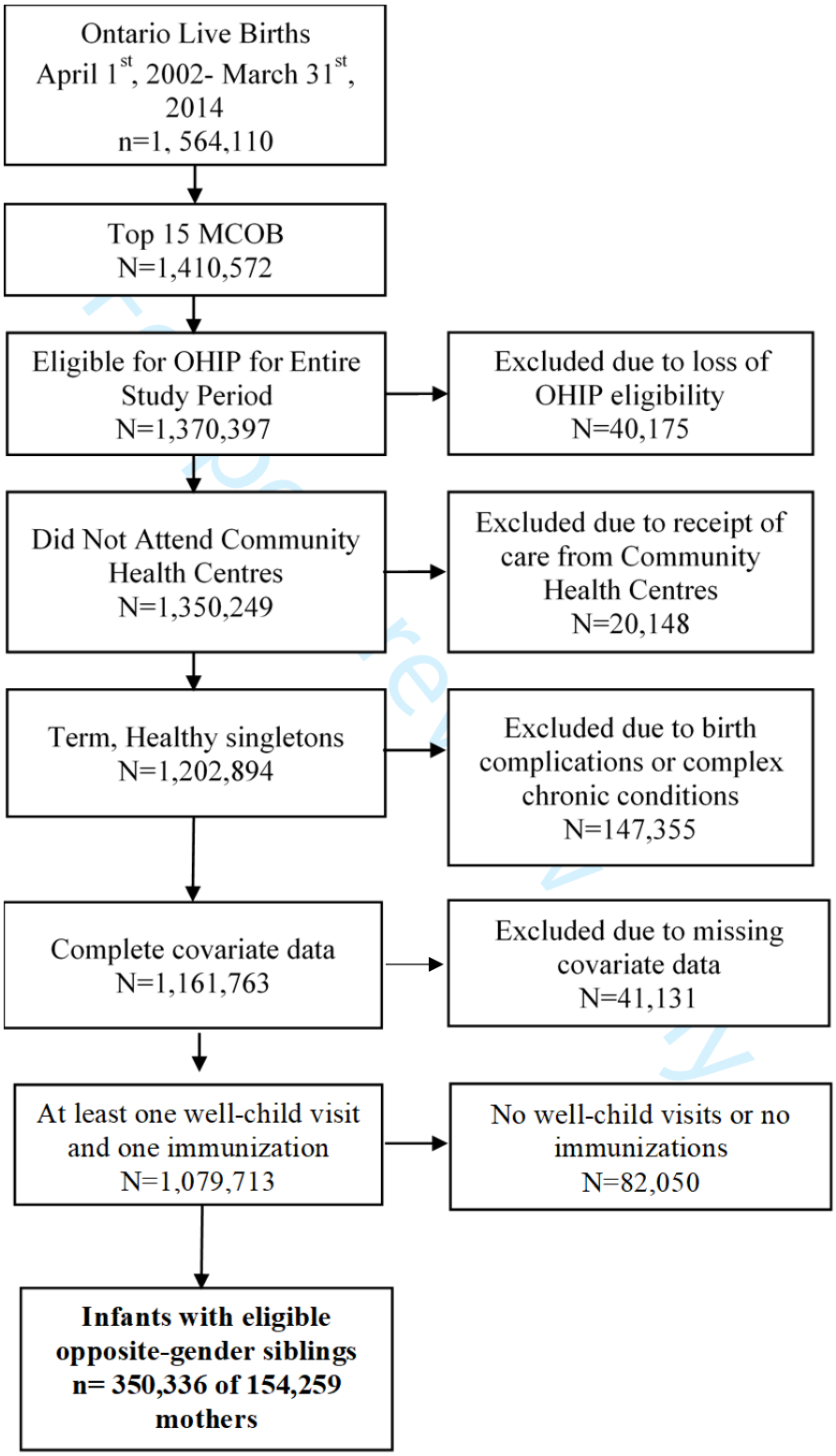
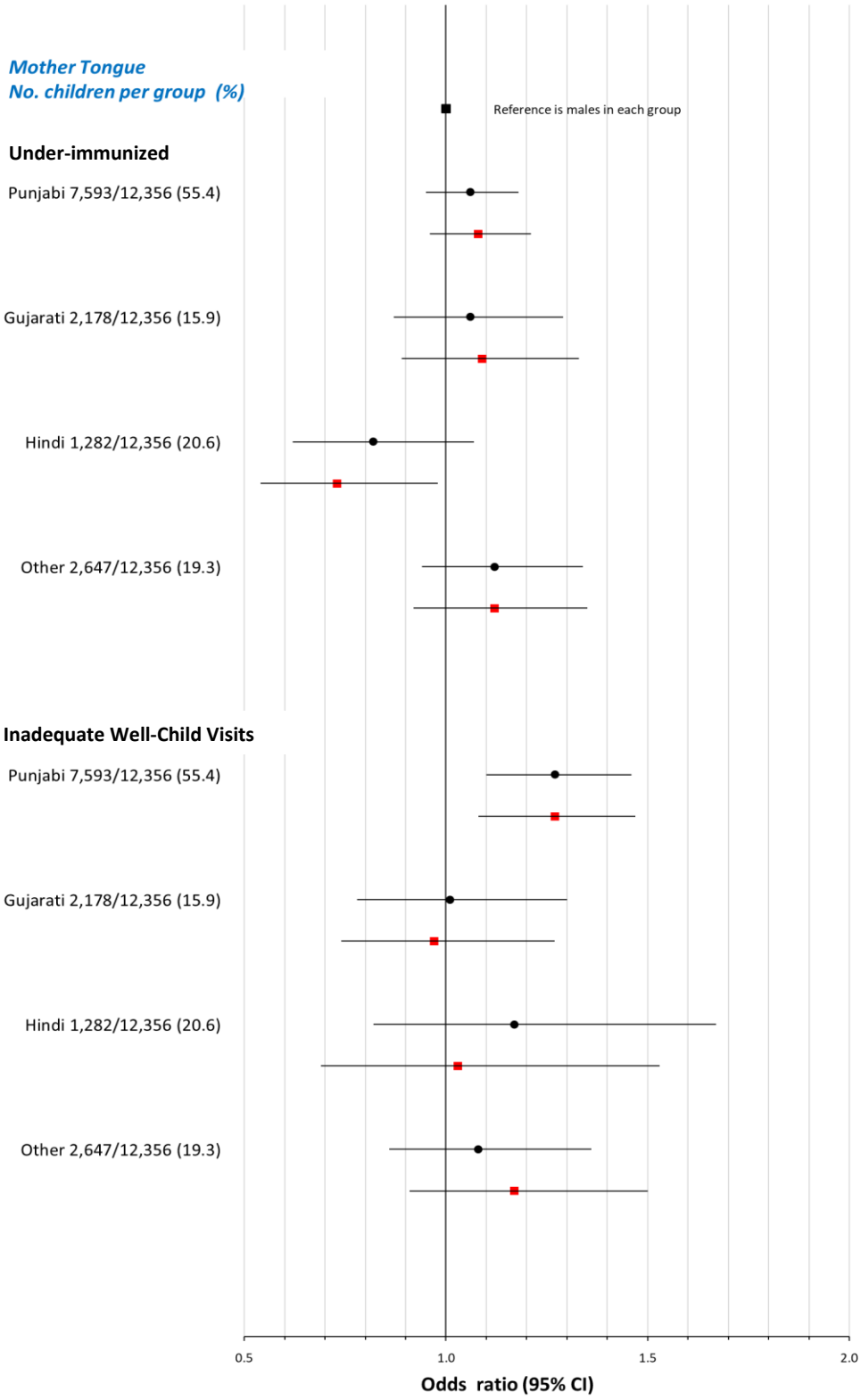


Figure 2 Within-family Gender Disparities (Female:Male Unadjusted ● and Adjusted ■ Odds Ratios) in Under-Immunization and Inadequate Well-Child Visits among Children of Indian-born Mothers, Stratified by Mother Tongue. Adjustment was for maternal age, income quintile, rurality, birth year, birth order, and category of time spent in Canada.



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Receipt of routine preventive care among infant daughters and sons of immigrant mothers to Ontario, Canada: A retrospective cohort study

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Abbreviations:
RPDB- Registered Persons Database
CIHI-DAD- Discharge Abstract Database of the Canadian Institute for Health Information
IRCC- Immigration, Refugees, and Citizenship Canada Permanent Resident Database
OHIP- Ontario Health Insurance Plan
OR- Odds Ratio
aOR- Adjusted Odds Ratio
95%CI- 95% Confidence Interval

Abstract

Objectives: To explore gender disparities in infant routine preventive care across maternal countries of birth (MCOB), and by mother tongue among infants of Indian-born mothers.

Setting: Retrospective population-based administrative cohort in Ontario, Canada (births between 2002 and 2014).

Participants: 350,366 (inclusive) healthy term singletons belonging to families with a minimum of one opposite gender child.

Outcome measures: Fixed effects conditional logistic regression generated adjusted odds ratios for a daughter being under-immunized and having an inadequate number of well-child visits

compared to her brother, stratified by MCOB. Moderation by maternal mother tongue was assessed among children to Indian-born mothers.

Results: Under-immunization and inadequate well-child visits were common among both boys and girls, ranging from 26.5% to 58.2% (under-immunization) and 10.5% to 47.8% (inadequate well-child visits). depending on the maternal birthplace. Girls whose mothers were born in India had 1.19 times (95% CI: 1.07, 1.33) the adjusted odds of inadequate well-child visits versus their brothers. This association was only observed among the Punjabi mother tongue subgroup (aOR:1.26, 95%CI: 1.08, 1.47). In the Hindi mother tongue subgroup, girls had lower odds of under-immunization than their brothers (aOR: 0.73, 95%CI: 0.54, 0.98).

Conclusions: Gender equity in routine preventive health care is mostly achieved among children of immigrants. However, daughters of Indian-born mothers whose mother tongue is Punjabi, appear to be at a disadvantage for well-child visits compared to their brothers. This suggests son preference may persist beyond the family planning stage among some Indian immigrants.

Strengths and Limitations of the Study

- This was the first retrospective population-based cohort to examine gender disparities across multiple routine preventive care outcomes among children of diverse immigrant populations and language groups.
- Our approach advanced existing research by considering maternal immigration and nativity, rather than ethnicity, as well within-sibling comparison approach to control for within-family unobservable factors

- Mother tongue is an imperfect proxy for regional and cultural variation and may not accurately reflect the most commonly spoken language around the time of childbearing.

Introduction

In early childhood, parents are the principal gatekeepers to their child's health care use.[1] Barriers facing immigrants in concert with health beliefs and family dynamics may influence parental healthcare decision-making around immunizations and well-child check-ups.[1-3] Evidence shows that beliefs about gender norms, roles and relations adversely affect the health and wellbeing of girls in top source countries of immigrants to Canada including India, Pakistan, and China, among others.[4-15] In select immigrant-sending countries, differential health investments exist towards sons and daughters, to the disadvantage of girls with respect to breastfeeding, immunization, and seeking health care for illness,[10-14] which some researchers have termed 'health-care neglect'.[8 15] Studies have identified son-preference among immigrant communities in Canada, the United Kingdom, and Australia manifesting through sex-selective pregnancy termination.[5 16-22] In the Indo-Canadian community, this practice is documented at higher birth orders particularly among mothers whose first language is Punjabi.[18]

It is unknown if son preference may affect the routine preventive care of young girls and boys across different immigrant groups. One study British South Asian children could not identify gender differences in immunization rates due to a limited sample size and an analytic approach not suited to examine gender bias within families.[23] Daughters in some immigrant groups may experience 'double jeopardy' concerning health care in early life due to their gender and parental country of birth, and such disparities, if any, must be quantified.[24]

Ontario, Canada provides an ideal setting in which to conduct health research on the children of immigrants. Ontario has one of the most diverse immigrant populations in the world,[25] and children are covered for universal health care in Canada from birth including routine anticipatory

care (i.e., well-child visits and the recommended series of vaccinations) by a publicly-funded health insurance system, without direct cost to the parent.

The primary objective was to identify any existing gender disparities in routine preventive care within families across various maternal countries of birth. Since there is growing evidence of sex-selective pregnancy termination within specific linguistic subgroups in Indian diaspora,[18] the secondary objective was to investigate if gender disparities among this subgroup varied by mother tongue, as a proxy for potential regional and cultural variation.

Methods

Data sources

The data for this study comes from several linked population-based administrative databases at ICES to form a retrospective cohort following children from birth to 24 months of age. A unique coded identity number facilitates record linkage between the databases. The Registered Persons Database (RPDB) is the provincial health care registry. It contains information on birth date, sex, and postal code which was linked to Canadian Census data to obtain neighborhood information at the level of a dissemination area, the smallest census geographic unit.

Hospitalization-related deliveries in Ontario, Canada between April 1st, 2002 and March 31st, 2014 were identified from the Discharge Abstract Database (DAD) of the Canadian Institute for Health Information (capturing 98% of births). Well-child check-ups and vaccinations with family physicians and pediatricians were captured using the Ontario Health Insurance Plan (OHIP) claims database, which contains information on physicians' billings, such as fee codes for visits, diagnostic codes, and date of service. We sourced the Ontario portion of the federally maintained Immigration, Refugees, and Citizenship Canada (IRCC) Permanent Resident Database for information on maternal birthplace, immigrant class, and landing date to Canada. Many earlier

studies have linked the IRCC databases with the other databases used in this study.[16 18 19 26] Overall, the IRCC has an 86% match rate to the RPDB. Non-immigrants are those who remain unmatched to the IRCC database. A small proportion of the non-immigrant group may be immigrants who landed before 1985.[27] These datasets were linked using unique encoded identifiers and analyzed at ICES.

Patient and public involvement (PPI)

No individual patients were directly involved in this study.

Data Availability Statement

Data used for the current study is held securely at ICES in Ontario, Canada. Data sharing agreements prohibit ICES from making the dataset publicly available.

Study population

The study population included healthy singleton term siblings born in Ontario, Canada between April 1st, 2002 and March 31st, 2014 eligible for OHIP from a pediatrician or family physician/general practitioner until 24.5 months of age. Included infants were those whose maternal country of birth was among the top 15 in Ontario (representing >90% of all births) and those whose mothers delivered an opposite gender sibling in the study period (also to be included).

Infants born as multiples, at <37 weeks gestation, or weighing <2500 grams at birth, or those diagnosed with a complex chronic condition (e.g., including major congenital malformations,) were excluded,[28] as these may have influenced their experience of routine care. Moreover, due to the nature of siblings sharing a birthdate, it is likely the early primary health care experience of multiples is shared, and we would expect these children to exhibit minimal differences in their health care experience due to parental volition.

Infants were removed from the study cohort if they had no documented well-child visits or immunizations, or if they received any primary care from community health centers as these physicians do not bill OHIP for their activities. Infants with no health care billings may see a salaried physician or other health care provider who does not submit billings. Mothers or infants with any missing covariate or outcome data were also excluded, although this is uncommon in the current administrative data. Figure 1 presents a flowchart for the cohort formation.

Variables

Outcomes

Number of vaccinations by a family physician or pediatrician by 24 months of age. An immunization was measured by identifying the codes physicians use to bill the province for the administration of a vaccine and the number of units delivered on a given day. The total number of vaccinations did not include unscheduled vaccinations occurring before six weeks. Infants were categorized as *under-immunized* if they had received less than the expected number of vaccination doses publicly available and recommended in Ontario at their time of birth. Infants born in 2002-2003, 2004-2009, 2010-11, and 2013 should have had 5, 12, 11, and 10 vaccines respectively by 24 months, against the availability in Ontario at the time (e.g., varied iterations and combinations of DPTP/Hib, MMR, pneumococcus, meningococcus and varicella vaccines). We did not examine specific antigens therefore under-immunization here does not represent coverage necessarily.

Number of well-child visits by a family doctor or pediatrician by 24 months of age. These were operationalized by a set of core primary care fee codes and diagnostic codes and excluded immunization-only visits.[29] Infants were determined to have *inadequate well-child check-ups* if

they had fewer than five check-ups by a family doctor or pediatrician (recommended at 2, 4, 6, 12, 15 (optional) and 18 months of age) in the first two years of life.

Vaccines or check-ups documented two weeks after 24 months were included as a buffer for appointment scheduling.

Exposures

Maternal country of birth (MCOB) is recorded from notarized documents in the IRCC permanent resident database. If mothers did not have an immigration record, they were classified as Canadian-born. In this study, MCOB represents exposure to the health and gender-related norms of that country which may differentially affect the use of routine anticipatory care for sons and daughters.

Child gender. Gender norms, roles, and relations may differentially affect the receipt of routine, anticipatory health care for boys and girls within the family unit. In this study, biological sex documented at birth was described as gender, as the question under study is gender-based bias.

Covariates

Confounders were selected a priori and included variables that could vary between siblings.[30] They included maternal age at delivery of the index child (≤19, 20-34, ≥35 years of age), infant birth year,[31] birth order (1st, 2nd, 3rd, 4th or more),[32] neighborhood income quintile (1=lowest and 5=highest) and urban/rural residence (urban≤40 on Rurality Index of Ontario; rural ≥40) of the maternal place of residence at the birth of the index child,[33 34] and among immigrant mothers, time in Canada (≤5, 6-9, 10-14, 15+ years). Covariate data originated from the hospital record (maternal age, infant birth year, birth order), Canadian census data (neighborhood income quintile and urban/rural residence), and IRCC documentation (time in Canada since landing

date). Statistics Canada's Postal Code Conversion File links the mother's postal code at delivery to generate values for the census-related variables. Deliveries before January 1st, 2004 were linked with the 2001 census, and deliveries afterward were linked to the 2006 census.

We examined maternal *mother tongue* as a potential effect modifier for the relationship between gender and routine preventive care among children of Indian-born mothers. Female disadvantage appears to vary regionally within countries. For example, states in southern India may not exemplify the same degree of gender bias as seen in northern regions, where Punjabi is the dominant culture and language spoken. Previous research has demonstrated variability in sex-selective pregnancy termination across Indian language groups.[18] Mother tongue was recorded and documented in the IRCC at landing. We chose the three most commonly declared mother tongues to preserve sample size (Punjabi, Gujarati, Hindi, and 'Other').

Analysis

Cross-tabulations and univariate procedures were used to obtain the baseline proportions of under-immunization and inadequate well-child visits for each gender within MCOB. Next, a fixed effects approach with conditional logistic regression stratified by MCOB was used to estimate whether daughters have higher odds of adverse outcomes compared to sons *within families, within the given MCOB stratum*. Fixed effects are useful for studying sibling differences by accounting for unobservable differences in maternal/family level variables.[30 35 36] Within-sibling variation is used to estimate the regression parameter for gender, and all stable characteristics of the family environment are controlled —isolating the effect of child's gender on anticipatory care outcomes within-families. Models were adjusted for maternal age, income quintile, rurality, birth year, birth order, and category of time spent in Canada (immigrant models only). A statistical test for interaction was performed between mother tongue*gender (significant

at p≤0.2) to determine whether gender disparities are dependent on mother tongue for children of Indian-born mothers. Effect modification was also assessed by further stratifying gender disparities by Indian mother tongue.[13 18]

SAS version 9.4 was used to perform all analyses (SAS Institute, Inc, Cary, NC). The study obtained ethics approval from the Research Ethics Board at the University of Toronto (Protocol reference #33799).

Results

Demographic characteristics

Table 1 describes the characteristics of mothers and infants from each included MCOB. The total eligible population was a total of 350,366 healthy, term, singleton infants who were part of a sibling set (2 or more children of the same mother), of 154,259 mothers from the 15 countries most commonly delivering in Ontario. Countries represented included Canada, India, Pakistan, China, Philippines, Sri Lanka, Jamaica, Afghanistan, Vietnam, Poland, Somalia, Iraq, USA, Guyana, and Iran. Figure 1 shows the flow of the cohort formation and application of exclusion criteria.

Within-family gender disparities in routine preventive care

Under-immunization and inadequate well-child visits were common among both boys and girls, ranging from 26.5% to 58.2% (under-immunization) and 10.5% to 47.8% (inadequate well-child visits) depending on the maternal birthplace. Table 2 presents the prevalence of the outcomes by MCOB and gender, as well as unadjusted and adjusted within-family odds ratios and 95% Cis for

under-immunization and inadequate well-child care for daughters compared to sons across MCOB strata.

No significant within-family gender differences were observed for immunization, although daughters whose mother was born in India had 1.19 times (95% CI: 1.07, 1.33) the odds of inadequate check-ups compared with their male sibling, following adjustments for covariates. Girls in Afghani families had 27% greater odds of inadequate check-ups compared to their brothers (OR: 1.27, 95%CI: 1.01, 1.60), however the OR was no longer significant after covariate adjustment. As well, females had a slight advantage over males of Canadian-born mothers 0.94 (0.91, 0.96), however this effect was small and disappeared following co-variate adjustment. We observed no significant within-family gender disparities for any other countries.

Effect modification by mother tongue among infants of Indian-born mothers

The three most common mother tongues among Indian-born mothers were Punjabi (55.4%), Gujarati (15.9%) and Hindi (9.4%). Among Indian-born mothers, statistical tests for interaction between mother tongue*gender were significant at $p \leq 0.2$ for both outcomes (Under-immunization: chisq=4.79 p=0.19; Inadequate well-child checkups: chisq=5.27, p=0.15). Stratified analysis showed the relationship between gender and inadequate routine care was dependent on maternal mother tongue. Figure 2 shows significantly higher odds for sisters compared to brothers for inadequate well-child visits only for siblings in the Punjabi mother-tongue group (aOR:1.26, 95%CI: 1.08, 1.47), but not for Gujarati, Hindi or Other groups. Daughters of mothers in the Hindi group had lower odds of under-immunization compared to their brothers (aOR: 0.73, 95%CI: 0.54, 0.98).

Discussion

In this population-based study, we did not find evidence of gender disparities in under-immunization or inadequate well-child visits for most MCOB, except among Indian families where sisters had significantly higher odds of inadequate well-child visits compared to their brothers. To our knowledge, no studies have examined within-family gender disparities in early childhood routine care outcomes by maternal country of birth, which is essential given documented gender disparities in many source countries of immigrants to high-income countries.

Interpretation

Our study contrasts earlier work that did not find gender disparities in vaccinations among British South Asian children.[23] By using a larger sample size and fixed effects analysis,[30] we were able to estimate family-held gender biases adversely affecting health care for daughters compared to sons within families. We found that gender disparities within Indo-Canadian families variedby the Punjabi mother tongue. This finding is consistent with earlier studies of sex-selective pregnancy terminations in the Indo-Canadian community [18] as well as research from the North-West of India where Punjabi is a dominant language.[13 37 38] Research within Punjabi populations describes the economic benefits of sons over daughters, including the provision of old age support, higher-paid employment, patrilineal kinship systems, and avoiding the high cost of dowry or marriage payments.[5 14 38 39] For some families, son preference may manifest primarily through sex selection but also through health-care neglect.[8] It is possible for similar mechanisms related to sex selection to influence gender equity in infant health care. In unconditional models, we found female disadvantage among children of among children of Afghanistan-born mothers for inadequate well-child visits. In adjusted models the effect estimate did not change substantially, but precision suffered. Therefore, it is plausible that the 23%

increased odds of inadequate females is relevant to clinical or public health practice, and would be statistically significant with a larger sample size, such as in the case of India.[40] Further research may clarify this issue. We also found a female advantage for immunization among the Hindi language group. There is limited evidence suggesting that greater immunization among females relates to a belief that immunizations are harmful for males. There have been reports of lower immunization rates among boys in some African countries, presumably due to fears of male sterilisation.[41] In this case, the female "advantage' may reflect a cultural practice aimed at favouring boys. Despite this possibility, we have not found literature suggesting this may be occurring in India. . Therefore, the observed disparity may be due to chance for the following reasons. First, the Hindi group is small relative to other groups and the observed association is of borderline significance with a wide confidence interval. Second, Hindi is a language spoken all over India and therefore it does not directly represent a well-defined linguistic, geographic, or cultural group in the same way as Gujarati or Punjabi.

We observed stronger gender differences in inadequate well-child visits but not in immunizations. Doctor's visits require explicit parental decision making and planning; what occurs at the doctor's office, such as the delivery of immunizations, is largely influenced by the doctor his or herself combined with public health initiatives. In other words, parents can act as gate-keepers for planning and attending doctor's visits, while doctors act the gate-keepers for immunization delivery.

Strengths

To our knowledge, this was the first retrospective population-based cohort to examine gender disparities across multiple routine preventive care outcomes among children of immigrants. Second, due to the substantial diversity of Ontario mothers, we were able to examine gender disparities across many MCOB. Third, this study is the first to examine the issue of gender bias

occurring within families that may be affecting the health of children of immigrants and non-immigrants. Our approach advanced existing research by considering maternal immigration and nativity (as opposed to the effects of ethnicity) as well as a within-sibling comparison. Finally, the use of official government immigration data to identify immigration factors and population-based administrative health data help strengthen both the internal and external validity of the study.

Limitations

Immigration data is only available for those arriving in Canada after 1985, so those arriving prior were misclassified as non-immigrants. Therefore, the Canadian-born group may be heterogeneous with health and gender beliefs related to their ancestral immigrant group. However, given an extended duration of residence, beliefs and health practices may be closer to Canadian norms.[42] As well, this population is likely small relative to the Canadian-born population. We were unable to assess paternal country of birth, potentially biasing results towards the null effect. Mother tongue may not necessarily represent a particular geographic region of India nor her most commonly spoken language around the time of the index delivery,[18] introducing possible heterogeneity. We found lower immunization than earlier reports that ascertained coverage with surveys and immunization records.[43] In the Ontario portion of the Childhood National Immunization Coverage Survey, antigen-specific coverage at two years of age ranged from 75.0% (Hib) to 93.4% (Polio).[44] Therefore combining each antigen for an overall vaccine coverage estimate is conditional on the coverage of each antigen each coverage and therefore would much lower and closer to our observed rates. However, the goal of our study was not to estimate antigen-specific coverage but to approximate a measure of routine health

care utilization, using overall vaccine dose counting. One study using physician billing for dose-counting found a similar prevalence (42%) of under-immunization to ours.[45]

Finally, census-derived variables are measured infrequently, and may result in misclassification, contributing to residual confounding. Using a fixed-effects analytic approach helped to control for within-family unobservable factors.[30 35 36] It is also important to note that immigrants are not representative of the source population, which may explain why we did not find significant effects for most MCOB, even among those where gender inequity is high.[38 39] Findings may not be generalizable to children born outside of Ontario, Canada, including children who themselves immigrated, although it is also possible that stronger effects may have been observed.

Conclusion and Implications

Gender equity in routine preventive health care is achieved among children of immigrants, with the notable exception of those from India. In this select case, son preference appears to persist beyond family planning and may adversely affect the wellbeing of daughters whose mothers migrate from India. This work may help health care providers attend to children needing additional preventive care. For example, pediatricians can inquire about siblings and the status of their immunizations and well-child visits. The pediatrician is presented with the opportunity to help ensure gender equity within the family with respect to health care in early childhood.

Future directions include verifying the mechanisms behind son preference in child health care, as well as exploring potential gender-based adversity through other areas of child well-being. Community-led interventions addressing son preference and the well-being of daughters may be helpful in improving gender equity in health care among those affected.

Table 1 Descriptive characteristics of included mother-infant sibling sets with at least one boy and one girl, among the 15 countries with the greatest share of births in Ontario, Canada April 2002- March 2013, data is complete unless otherwise specified.

	Maternal Country of Birth														
N infants=350,336 154,259 mothers	Canada	India	Pakistan	China	Philippines	Sri Lanka	Jamaica	Afghanistan	Vietnam	Somalia	Poland	Iraq	USA	Guyana	Iran
N (%)	290,009 (82.8)	12,356 (3.5)	9150 (2.6)	7566 (2.2)	5654 (1.6)	6169 (1.8)	3057 (0.9)	2684 (0.8)	2424 (0.7)	2382 (0.7)	2340 (0.7)	2030 (0.6)	1828 (0.5)	1626 (0.5)	1061 (0.3)
Maternal Age %															
≤19	3.80	0.4	0.8	0.2	1.1	0.3	5.3	1.2	0.5	1.1	0.8	1.1	1.0	2.5	0.5
20-34	80.1	90.0	87.5	75.5	69.3	86.4	79.8	85.2	80.9	74.0	83.9	81.8	75.7	82.1	68.9
35+	16.1	9.6	11.7	24.3	29.5	13.2	14.8	13.4	18.6	24.7	15.3	17.1	23.2	15.4	30.6
Female %	49.8	51.0	50.1	50.3	49.8	49.9	49.5	50.5	50.1	50.0	49.5	50.0	50.1	49.9	49.9
Birth Order %															
First	36.8	41.2	35.8	45.0	39.5	39.7	30.6	31.7	39.2	18.5	40.2	32.2	34.3	35.7	46.6
Second	41.1	44.6	39.2	46.3	43.4	42.2	38.5	37.1	43.1	23.7	43.5	37.9	37.6	42.1	48.0
3rd	15.5	11.6	19.1	7.7	13.7	15.4	18.9	20.3	13.6	20.9	13.2	21.0	16.0	15.6	4.6
4th or greater	6.7	2.6	6.0	1.0	3.4	2.7	12.0	10.8	4.2	37.0	3.1	8.9	12.1	6.6	0.9
Time since landing %															
<5 years	-	57.8	64.0	60.4	43.8	55.5	13.8	45.5	40.0	32.7	16.1	53.6	62.5	21.6	42.6
5-9 years	-	28.8	25.9	31.0	25.5	23.2	23.0	30.1	24.1	30.1	13.6	26.1	18.8	26.2	28.0
10-14 years	-	9.2	7.6	6.9	17.9	13.2	29.7	15.3	17.5	25.4	26.0	13.8	8.7	24.8	15.3
15+ years	-	4.3	2.6	1.7	12.7	8.1	33.5	9.2	18.4	11.9	44.2	6.5	10.1	27.4	14.1
Neighborhood Income Quintile															
1: Lowest	17.6	28.6	39.9	26.4	32.3	36.7	44.6	50.4	31.9	70.0	13.0	43.0	13.2	36.1	17.3
2	18.5	27.5	22.8	30.2	24.1	29.0	23.8	17.6	25.0	16.4	20.7	21.4	18.4	23.3	11.8
3	20.6	24.3	18.2	19.5	19.7	20.5	18.7	13.6	22.7	7.0	21.2	16.6	18.7	24.5	20.0
4	23.0	14.0	14.1	15.3	15.4	10.3	8.6	12.3	14.5	4.9	26.5	13.0	23.4	11.6	31.5
5: Highest	19.6	5.7	5.0	8.3	8.5	3.4	4.2	6.0	5.8	1.5	18.6	5.7	26.2	4.6	19.1
Lives in Rural Area	14.7	0.3	0.3	0.3	1.0	0.0	0.2	0.3	0.2	0.0	2.0	0.2	10.7	0.4	0.2
Missing Data on Income or Rurality	0.7	0.4	0.4	0.6	0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.4	0.5	0.1	0.6
No documented preventive care in physician billings	10.1	5.8	7.4	7.9	4.5	9.9	6.6	7.5	5.9	12.9	7.5	6.8	10.1	5.9	5.9

Table 2 Within-family Gender Disparities in Routine Preventive Care Outcomes Stratified by Maternal Country of Birth, among all opposite-gender sibling sets born in Ontario, Canada between April 2002- March 2013

	Under-Immunization				Inadequate Well-child Visits			
	%		F:M OR (95% CI)	F:M aOR (95% CI)	%		F:M OR (95% CI)	F:M aOR (95% CI)
Maternal Country of Birth	F	M			F	M		
Canada 290,009 (82.8)	44.6	44.4	0.99 (0.97, 1.01)	0.99 (0.97, 1.00)	16.3	17.0	0.94 (0.91, 0.96) †	0.96 (0.92, 1.00)
India 12,356 (3.5)	38.1	36.9	1.05 (0.97, 1.14)	1.08 (0.99, 1.17)	18.8	16.9	1.17 (1.05, 1.30) †	1.19 (1.07, 1.33) †
Pakistan 9150 (2.6)	41.3	42.7	0.95 (0.97, 1.05)	0.96 (0.87, 1.05)	21.9	22.7	0.94 (0.84, 1.05)	0.95 (0.85, 1.07)
China 7566 (2.2)	30.2	28.9	1.09 (0.97, 1.22)	1.07 (0.95, 1.20)	19.9	19.9	1.01 (0.88, 1.16)	1.02 (0.89, 1.17)
Philippines 5654 (1.6)	30.5	31.1	0.95 (0.84, 1.08)	0.98 (0.89, 1.11)	13.4	14.6	0.88 (0.74, 1.05)	0.89 (0.74, 1.07)
Sri Lanka 6169 (1.8)	34.2	34.3	0.99 (0.88, 1.12)	1.00 (0.88, 1.12)	16.5	17.2	0.94 (0.81, 1.10)	0.92 (0.78, 1.08)
Jamaica 3057 (0.9)	45.2	44.6	1.03 (0.88, 1.20)	0.98 (0.83, 1.16)	26.9	25.4	0.93 (0.77, 1.12)	0.9 (0.73, 1.10)
Afghanistan 2684 (0.8)	38.3	40.1	0.89 (0.75, 1.06)	0.90 (0.75, 1.07)	18.8	16.1	1.27 (1.01, 1.60) †	1.23 (0.96, 1.56)
Vietnam 2424 (0.7)	27.9	27.8	1.01 (0.82, 1.24)	1.02 (0.82, 1.26)	10.9	10.5	0.9 (0.66, 1.23)	0.82 (0.58, 1.16)
Somalia 2382 (0.7)	58.2	53.1	0.79 (0.67, 0.95) †	0.84 (0.69, 1.03)	44.5	47.8	0.87 (0.72, 1.05)	0.99 (0.76, 1.50)
Poland 2340 (0.7)	45.1	43.5	1.08 (0.90, 1.30)	1.10 (0.91, 1.35)	16.1	15.6	1.07 (0.83, 1.39)	1.02 (0.75, 1.38)
Iraq 2030 (0.6)	37.3	37.0	0.99 (0.81, 1.22)	1.03 (0.83, 1.28)	18.0	17.7	0.97 (0.74, 1.26)	0.99 (0.75, 1.31)
USA 1828 (0.5)	45.5	46.8	0.96 (0.78, 1.18)	0.93 (0.75, 1.15)	20.3	19.2	1.17 (0.91, 1.51)	1.2 (0.87, 1.66)
Guyana 1626 (0.5)	39.1	38.3	1.03 (0.83, 1.29)	1.07 (0.84, 1.35)	17.1	20.2	0.81 (0.61, 1.07)	0.83 (0.61, 1.14)
Iran 1061 (0.3)	26.5	28.0	0.94 (0.67,1.28)	0.95 (0.67, 1.34)	13.7	11.0	0.76 (0.50, 1.16)	0.86 (0.51, 1.45)

Adjustment was for maternal age, income quintile, rurality, birth year, birth order, and category of time spent in Canada (immigrant models only).
OR odds ratio, aOR adjusted odds ratio, 95% CI 95% Confidence Interval
†indicates statistical significance at p<0.05.
Reference group= males

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Figure legends/captions

Figure 1

1) MCOB- Maternal Countries of Birth; OHIP- Ontario Health Insurance Plan
2) 350,336 represents all included children within sibling sets.

Figure 2

1) Unadjusted ● and Adjusted ■ Odds Ratios
2) Adjustment was for maternal age, income quintile, rurality, birth year, birth order, and category of time spent in Canada.

Figure 1 Flow Chart of Cohort Formation

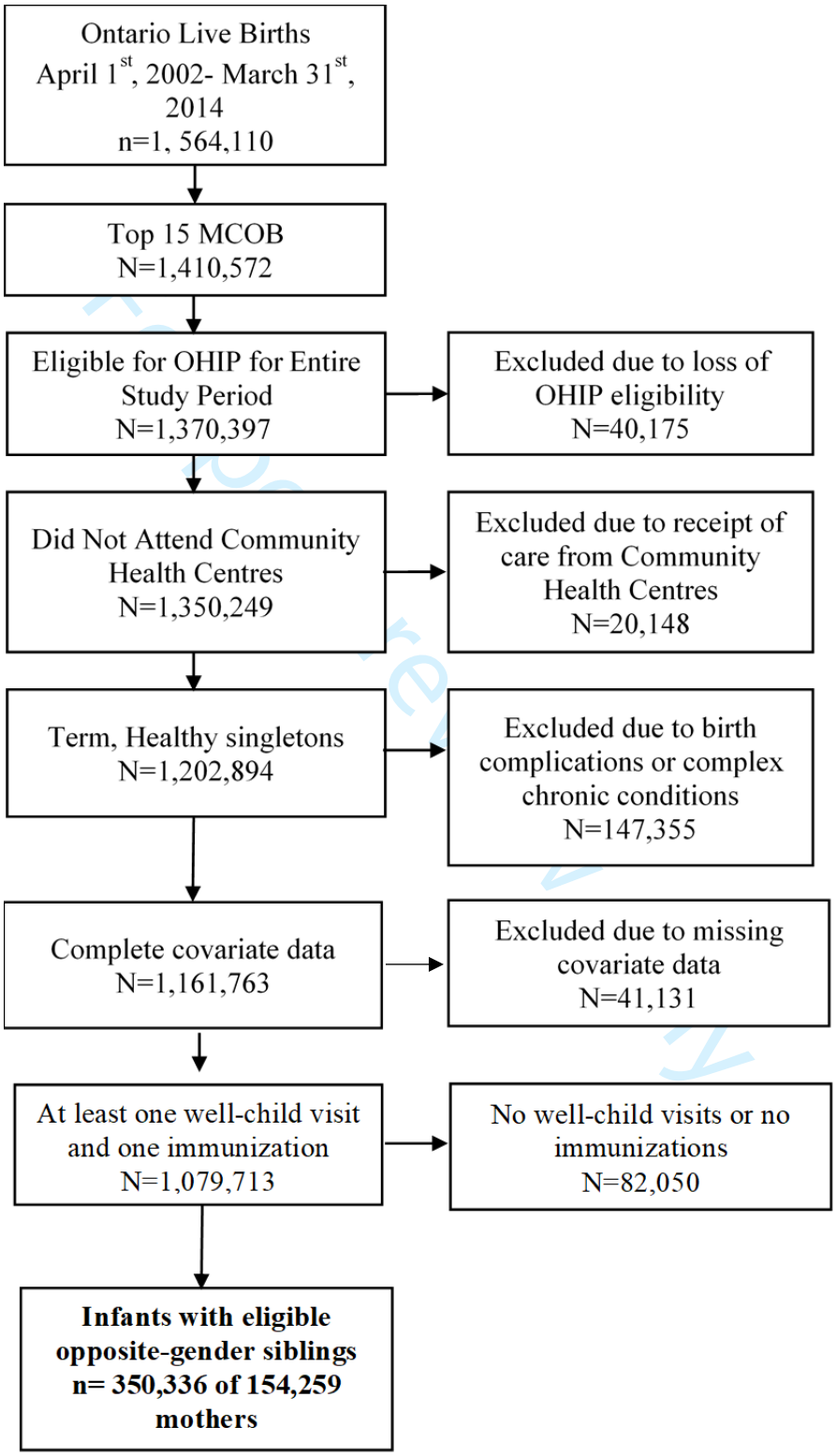
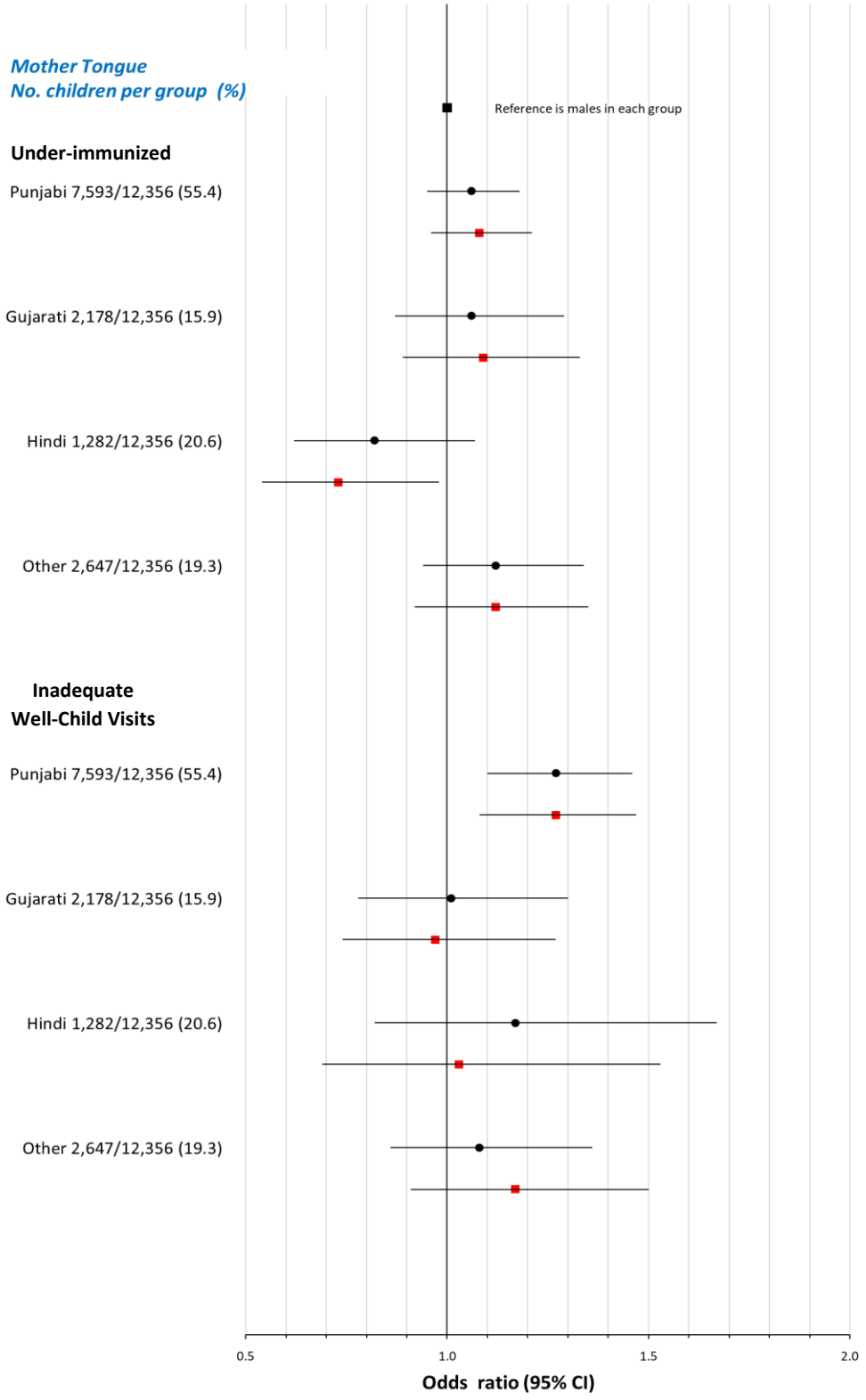


Figure 2 Adjusted odds ratios for under-immunization and inadequate well-child visits among daughters of Indian-born mothers compared to their brothers, stratified by mother tongue.



STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page number location in manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 6
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 7
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	Page 7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 8-9
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6-9
Bias	9	Describe any efforts to address potential sources of bias	Page 10, Page 14
Study size	10	Explain how the study size was arrived at	Page 7, Page 19
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 8-10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 10
		(*b*) Describe any methods used to examine subgroups and interactions	Page 10
		(*c*) Explain how missing data were addressed	Page 8, Page 19
		(*d*) If applicable, explain how loss to follow-up was addressed	Page 7, Page

		(*e*) Describe any sensitivity analyses	Page 10
Results			
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 19
		(b) Give reasons for non-participation at each stage	Page 19
		(c) Consider use of a flow diagram	Page 19
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 11, Page 17
		(b) Indicate number of participants with missing data for each variable of interest	Page 17
		(c) Summarise follow-up time (eg, average and total amount)	Page 6, Page 8, Page 19
Outcome data	15	Report numbers of outcome events or summary measures over time	Page 18
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 18, Page 20
		(*b*) Report category boundaries when continuous variables were categorized	Page 9, Page 17
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 10, Page 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 1