Preventive Health Care Among Children of Women With Schizophrenia:
A Population-Based Cohort Study

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ABSTRACT

Objective: To compare well-baby visit and vaccination schedule adherence up to age 24 months in children of mothers with versus without schizophrenia.

Methods: Using administrative health data on births in Ontario, Canada (2012–2016), children of mothers with schizophrenia (*ICD-9*: 295; *ICD-10*: F20/F25; *DSM-IV* schizophrenia or schizoaffective disorder) (n = 1,275) were compared to children without maternal schizophrenia (n = 520,831) on (1) well-baby visit attendance, including an enhanced well-baby visit at age 18-months, and (2) vaccine schedule adherence for diphtheria, tetanus, pertussis, polio, *Haemophilus influenzae* type B (DTaP-IPV-Hib), and measles, mumps, rubella (MMR). Cox proportional hazard regression models were adjusted for each of maternal sociodemographics, maternal health, and child health characteristics in blocks and all together in a fully adjusted model.

Results: About 50.3% of children with maternal schizophrenia had an enhanced 18-month well-baby visit versus 58.6% of those without, corresponding to 29.0 versus 33.9 visits/100 person-years (PY), a hazard ratio (HR) of 0.82 (95% CI, 0.76–0.89). The association was dampened after adjustment for maternal sociodemographics, maternal health, and child health factors in blocks and overall, with a fully adjusted HR of 0.91 (95% CI, 0.84–0.98). Full vaccine schedule adherence occurred in 40.0% of children with maternal schizophrenia versus 46.0% of those without (22.6 vs 25.9/100 PY), yielding a HR of 0.86 (95% CI, 0.78–0.94). The association was dampened when adjusted for maternal sociodemographics and child health characteristics and became nonsignificant when adjusted for maternal health characteristics. The fully adjusted HR was 0.95 (95% CI, 0.87–1.04).

Conclusions: Increased efforts to ensure that children with maternal schizophrenia receive key early preventive health care services are warranted.

J Clin Psychiatry 2023;84(2):22m14497

To cite: Taylor CL, Brown HK, Saunders NR, et al. Preventive health care among children of women with schizophrenia: a population-based cohort study. *J Clin Psychiatry.* 2023;84(2):22m14497.

To share: https://doi.org/10.4088/JCP.22m14497

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Early childhood establishes the foundation for health across the life course.[1] Well-baby visits determine if a child is meeting developmental milestones, promote early identification of health problems, and deliver life-saving vaccinations.[2,3] Barriers to preventive care in young children include factors linked to social marginalization (young maternal age, low family income, migrant status),[4-9] while greater uptake has been observed in children with known or suspected developmental disorders and in those receiving primary care from a pediatrician compared with a family physician.[7,10]

Schizophrenia affects about 1% of the population, and pregnancy is increasingly common in individuals with schizophrenia due to prolactin-sparing medications that do not inhibit fertility and community-based psychiatric care allowing more chances for relationships than institutionalized care.[11,12] Children of pregnant people with schizophrenia are at increased risk for delayed development, medical conditions, and mental illness, highlighting the importance of preventive care.[13–17] Childbearing people with schizophrenia are disproportionately young and often experience aspects of social marginalization including single parenthood and poverty compared to those without schizophrenia.[18] These are also risk factors for reduced uptake of preventive care in children.[7,9]

While reduced preventive care uptake for reproductive issues (mammography, cervical cancer screening, prenatal care) has been observed among people with schizophrenia[19] little is known about uptake in their children. One matched cohort study[20] among children of women with psychotic disorders (n = 199) in the UK found children aged 3–9 months were slightly less likely to have had any vaccination (risk ratio [RR] = 0.94; 95% CI, 0.88–0.99) than children of women without psychosis.

Clinical Points

- There are few data on vaccination uptake and no data on uptake of well-baby visits in children of women with schizophrenia. Given risk of poorer neurocognitive functioning and health and social outcomes, early preventive care is of particular importance to identify developmental needs, avoid preventable illness, and promote long-term health.
- It is important to ensure uptake of primary preventive care for children of women or child-bearing people with schizophrenia, which may include strategies such as focus on the mother-infant dyad and integrated models of care.

A subsequent study[21] of 1,120 children of women with psychotic disorders also found reduction in childhood up-to-date vaccinations at age 2 (odds ratio [OR] = 0.85; 95% CI, 0.70–1.02). No research has investigated uptake of well-baby visits in this population.

In this population-based study in Ontario, Canada, we compared children of individuals (female based on their health record) with and without schizophrenia on preventive health care uptake in their children up to child age 24 months before and after adjusting for sociodemographic, maternal mental and physical health, and child health covariates. We specifically focused on attendance at Ontario's enhanced visit due at 18 months designed to promote early identification of developmental concerns rolled out in 2010[22] as well as other well-baby care physician visits and adherence to the basic Ontario vaccine schedule of DTaP-IPV-Hib (diphtheria, tetanus, acellular pertussis, inactivated polio, and *Haemophilus influenzae* type b) and the MMR (measles, mumps, and rubella) vaccines.

METHODS

Study Setting

This population-based cohort study used linked administrative data from Ontario, Canada, where health care is provided through a public health insurance plan to ≈ 14.6 million residents. Multiple sources of deidentified data are housed at ICES (https://www.ices.on.ca/DAS), including the Ontario Mother-Baby linked dataset (MOMBABY), which links child-bearing people to babies for in-hospital births (> 98% of births),[23] and the Ontario Health Insurance Plan (OHIP), which gives physician billing data with well-baby visit and vaccine-specific fee codes.[24,25] Datasets including sociodemographics and health care utilization were also used (Appendix 1). ICES data are accurate and complete for demographic data, inpatient diagnoses, and physician billing claims.[24] These datasets were linked using unique encoded identifiers and analyzed at ICES.

Study Cohort

All children live-born in Ontario hospitals from April 1, 2012, to March 31, 2016, were considered. This allowed 1 year for physician uptake of vaccine-specific OHIP billing codes introduced in March 2011.[25] Figure 1 shows numbers and reasons for exclusion. Each child was followed from birth to age 24 months, with final follow-up to March 31, 2018.

Children were considered to have a mother with schizophrenia if the childbearing parent had ≥ 1 hospitalization and/or ≥ 3 outpatient contacts within 3 years of each other for which the most responsible diagnosis was schizophrenia or schizoaffective disorder, prior to the child's birth (*International Classification of Diseases*, 9th Revision [*ICD-9*]: 295 in the outpatient dataset; *ICD-10*: F20, F25 or *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition [*DSM-IV*], schizophrenia or schizoaffective disorder in the hospitalization datasets). Validated against clinical charts, this definition has a sensitivity of 90.1%, a specificity of 68.0%, a positive predictive value (PPV) of 77.1%, and a negative predictive value (NPV) of 88.7% for detection of a chronic psychotic disorder.[26] Children of mothers with contacts for any psychotic disorder from 2 years before pregnancy until the child's birth who did not meet the algorithm criteria were not analyzed, and all other children were classified as unexposed to maternal schizophrenia.

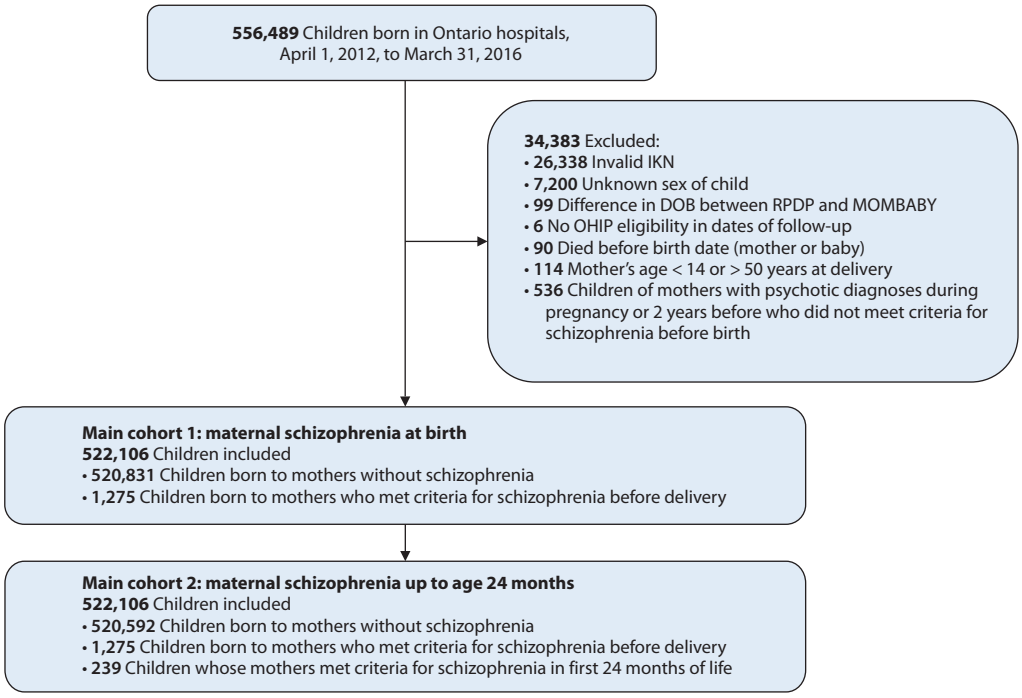
For an additional analysis, we identified children whose mothers met criteria for schizophrenia between birth and age 24 months and re-classified them into the maternal schizophrenia group at the time of the maternal diagnosis.

Outcomes

In Ontario, well-baby visits for infants under age 2 years are scheduled to occur at ages 2 months, 4 months, and 6 months and then at ages 9 months, 15 months, and 18 months.[2] The primary well-baby visit outcome was the 18-month "enhanced" well-baby visit (the recommended standard of care).[22] Aligned with prior studies that provided flexibility in the window of assessment for visits scheduled to occur at specific ages,[7,27] we allowed for this visit to occur anytime from 17 to 24 months of age. Secondary outcomes were (1) any 18-month well-baby visit occurring between 17 and 24 months (ie, a general well-baby visit or the enhanced visit), (2) well-baby visits prior to the enhanced visit (2, 4, 6, 9, 12 months), and (3) ≥ 6 versus < 6 well-baby visits over 24 months (Supplementary Table 1).[27,28]

Coverage with vaccinations against diphtheria, pertussis, and tetanus and the first dose of measles vaccine prior to age 2 years are global indicators of immunization program performance.[29] The corresponding Ontario vaccination schedule stipulates (1) 4 doses of DTaP-IPV-Hib delivered at ages 2, 4, 6, and 18 months and (2) MMR at age 12 months.[30] Therefore, the primary vaccination outcome for this study was 4 DTaP-IPV-Hib injections and 1 MMR injection by child age 24 months. Secondary outcomes were each individual vaccination, allowing for flexibility in timing of administration, as in previous studies.[25] In Ontario, for DTaP-IPV-Hib at 2 months, measured from age 7–15 weeks, the data have a sensitivity of 71.6%, a specificity of 88.9%, a PPV of 99.3%, and an NPV of 12.9% compared to electronic chart review. MMR at 12 months, measured from age 11–15 months, has a sensitivity of 70.1%, a specificity of 88.5%, a

Figure 1. Study Flowchart



Abbreviations: DOB = date of birth, ICES = Institute for Clinical Evaluative Services, IKN = ICES Key Number, MOMBABY = Ontario Mother-Baby linked dataset, OHIP = Ontario Health Insurance Plan, RPDP = Registered Persons Database.

PPV of 96.9%, and an NPV of 36.6%. Supplementary Table 2 shows detailed descriptions of outcomes and timings of measurement.

Covariates

Variables that may explain the relation between maternal schizophrenia status and child preventive care uptake were (1) sociodemographic characteristics at birth (maternal age, parity, rural residence, neighborhood income quintile, and immigrant status [non-migrant/long-term resident, non-refugee migrant, refugee]), (2) maternal health characteristics (from 2 years prior to conception to birth: non-psychosis psychiatric diagnosis [mood/anxiety, alcohol or substance use, other (including personality disorders)], psychiatric severity [hospitalization], maternal medical morbidity [collapsed ambulatory diagnostic group (CADG category 5) from the John Hopkins Adjusted Clinical Groups system (ACG) version 10,[31] which identifies unstable chronic medical conditions from outpatient billing claims], and severe pregnancy complications [eg, eclampsia]), and (3) child characteristics at birth (child sex, gestational age, neonatal intensive care unit [NICU] admission, and whether the child was discharged to social services). See Supplementary Table 2 for details.

For the additional analysis in which children whose mothers did not have a diagnosis of schizophrenia at the time of their birth were re-classified into the maternal schizophrenia group when the maternal diagnosis occurred postnatally, we defined several postnatal health service use characteristics, including child's usual provider of primary care from birth to 24 months (pediatrician or family physician), the continuity of care (high: ≥ 76% of visits to the same provider, low: ≤ 75% of visits to the same provider,[32] infrequent users: < 4 visits),[33–35] and maternal non-psychosis psychiatric diagnoses and psychiatric admissions between birth and age 24 months; pregnancy/child characteristics (child complex chronic conditions [defined as conditions "involving several organ systems or 1 organ system severely enough to require specialty paediatric care and/or hospitalisation in a tertiary care centre"[36]]); and mother-child cohabitating at same postal code at child age 24 months as a proxy for child not living with mother.[37]

Analysis

Baseline characteristics were described by maternal schizophrenia status at the time of the child's birth. Cox proportional hazards models were generated to compare outcomes between children with and without maternal schizophrenia. Hazard ratios (with 95% confidence intervals) were adjusted for each of the following prespecified explanatory variables in blocks and then all together: sociodemographic (maternal age, primiparity, rurality, income quintile, immigration status), maternal health/pregnancy (non-psychosis psychiatric diagnoses and hospitalizations in pregnancy or 2 years prior to conception, unstable chronic medical conditions before pregnancy,

Table 1. Characteristics of the Children and Their Mothers Included in the Study Cohort[a]

Characteristic	Maternal Schizophrenia (n = 1,275)	No Maternal Schizophrenia (n = 520,831)
Sociodemographic		
Maternal age at delivery, mean (SD), y	30.9 (6.1)	30.5 (5.3)
Primiparous	565 (44.3)	228,405 (43.9)
Neighborhood income in lowest quintile (Q1)	483 (37.9)	116,216 (22.3)
Rural residence (< 10,000 population)	107 (8.4)	51,261 (9.8)
Immigrant status		
Non-migrant/long-term resident	1,049 (82.3)	372,246 (71.5)
Non-refugee immigrant	180 (14.1)	130,118 (25.0)
Refugee	46 (3.6)	18,467 (3.5)
Maternal Health to End of Pregnancy		
Unstable chronic medical condition from 2 years pre-conception	163 (12.8)	46,665 (9.0)
Any non-psychosis psychiatric diagnosis from 2 years pre-conception	870 (68.2)	75,555 (14.5)
Type of non-psychosis psychiatric diagnosis from 2 years pre-conception		
Mood/anxiety disorder	826 (64.8)	71,645 (13.8)
Alcohol or substance use disorder	136 (10.7)	5,286 (1.0)
Other (including personality disorders)	146 (11.5)	2,854 (0.5)
Psychiatric admission 2 years pre-conception or during pregnancy	312 (24.5)	2,154 (0.4)
Severe pregnancy complications[b]	208 (16.3)	70,159 (13.5)
Cesarean section	398 (31.2)	150,124 (28.8)
Child		
Baby's sex male	651 (51.1)	267,263 (51.3)
Preterm birth < 37 weeks' gestation	136 (10.7)	41,158 (7.9)
Admitted to NICU in the index birth hospitalization	308 (24.2)	66,486 (12.8)
Child discharged to social services at birth	59 (4.6)	1,015 (0.2)

[a]All data are presented as n (%) unless otherwise specified.
[b]Severe pregnancy complications comprise pre-eclampsia, eclampsia, venous thromboembolism, severe obstetric morbidity (placental abruption, placental infarction, obstetric embolism, septic shock, uterine rupture), or systemic maternal complications in pregnancy or postpartum (cardiomyopathy, complications of anesthesia, acute renal failure, myocardial infarction/pulmonary edema, cerebrovascular disease, acute respiratory distress syndrome, disseminated intravascular coagulation, status epilepticus, hysterectomy).
Abbreviation: NICU = neonatal intensive care unit.

severe pregnancy complications, cesarean section), and pregnancy/child characteristics (sex of baby, preterm birth, NICU admission, and child discharged to social services at birth).[6,10,27] In this initial analysis, children were censored when they died or lost OHIP coverage or if the mother was diagnosed with schizophrenia after birth. Robust standard errors accounted for clustering of children born to the same mother during the study period, including non-singleton births.

We conducted 3 additional analyses. First, as it was possible that some children's outcomes were not captured because they were receiving care in community health centers where providers do not bill OHIP for services or because they moved out of province without deactivating their health cards, we repeated the primary analysis excluding children with no primary care visits recorded during the outcome window. Second, we conducted additional analyses for DTaP-IPV-Hib vaccination outcomes using two more inclusive definitions (Supplementary Table 2). Third, we repeated the primary analysis reclassifying children whose mothers were diagnosed with schizophrenia postnatally into the schizophrenia group by considering maternal schizophrenia status as a time-dependent variable. In this analysis, we used the same blocks of explanatory variables as in the primary analysis and additionally introduced the block of postnatal covariates.[38]

Use of data was authorized under section 45 of Ontario's Personal Health Information Protection Act, which does not require review by a Research Ethics Board. This study was approved by the ICES privacy office (ICES logged study: 2020 0990 113 001). Due to privacy regulations, cells with fewer than 6 participants were suppressed. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement.

RESULTS

From 556,489 children born in Ontario (2012–2016), 34,383 (6.2%) were excluded, resulting in 522,106 births to 441,368 unique mothers (Figure 1), of whom 1,275 (0.2%) were diagnosed with schizophrenia prior to their child's birth. Mothers with schizophrenia were similar in age, parity, and rural versus urban residence to those without (Table 1). However, they were less likely to be immigrants (14.1% vs 25.0%), more frequently living in the lowest income quintile neighborhoods (37.9% vs 22.3%), and more likely to have chronic unstable medical conditions (12.8% vs 9.0%). Their children were more likely to be born preterm (10.7% vs 7.9%), to require NICU admission (24.2% vs 12.8%), and

Table 2. 18-Month Enhanced Well-Baby Visit up to 24 Months of Age in Children Born to Women With (n = 1,275) Versus Without (n = 520,831) Schizophrenia, Adjusted for Sociodemographic, Maternal Health, and Child Health Covariate Blocks, Individually and Together

Variable	Value[a]	Rate/100 PY	Unadjusted HR (95% CI)	Adjusted HR 1 (95% CI) (Sociodemographics Only)[b]	Adjusted HR 2 (95% CI) (Maternal Health Characteristics Only)[b]	Adjusted HR 3 (95% CI) (Child Characteristics Only)[b]	Fully Adjusted HR (95% CI)[b]
18-Month Enhanced Well-Baby Visit							
No maternal schizophrenia	305,231 (58.6)	33.9	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	641 (50.3)	29.0	0.82 (0.76–0.89)	0.84 (0.78–0.92)	0.90 (0.83–0.98)	0.84 (0.77–0.91)	0.91 (0.84–0.98)
Sociodemographic Characteristics							
Maternal age at delivery, mean (SD), y	30.5 (5.3)		1.02 (1.02–1.02)	1.03 (1.02–1.03)			1.03 (1.02–1.03)
Parity							
Multiparous	161,239 (55.0)	31.4	1.00 (referent)	1.00 (referent)			1.00 (referent)
Primiparous	144,633 (63.2)	37.2	1.32 (1.31–1.33)	1.40 (1.39–1.41)			1.41 (1.40–1.42)
Income							
Q1 (lowest)	58,849 (50.4)	28.7	1.00 (referent)	1.00 (referent)			1.00 (referent)
Q2	58,988 (56.5)	32.6	1.18 (1.17–1.20)	1.14 (1.12–1.15)			1.13 (1.12–1.14)
Q3	63,178 (59.5)	34.5	1.27 (1.26–1.29)	1.21 (1.20–1.22)			1.20 (1.19–1.22)
Q4	69,437 (63.7)	37.3	1.42 (1.41–1.44)	1.33 (1.32–1.35)			1.32 (1.31–1.34)
Q5	55,420 (64.5)	37.8	1.45 (1.43–1.47)	1.34 (1.32–1.36)			1.33 (1.31–1.34)
Region of residence							
Urban	283,191 (60.2)	35.0	1.00 (referent)	1.00 (referent)			1.00 (referent)
Rural	22,681 (44.2)	24.6	0.62 (0.61–0.63)	0.66 (0.65–0.67)			0.66 (0.65–0.67)
Immigrant status							
Non-migrant/long-term resident	219,224 (58.7)	34.0	1.00 (referent)	1.00 (referent)			1.00 (referent)
Non-refugee immigrant	76,785 (58.9)	34.3	1.03 (1.03–1.04)	1.00 (0.99–1.00)			0.99 (0.98–1.00)
Refugee	9,863 (53.3)	30.5	0.87 (0.85–0.89)	0.88 (0.86–0.90)			0.88 (0.86–0.89)
Maternal Health							
Unstable chronic medical condition							
No	277,589 (58.4)	33.8	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	28,283 (60.4)	35.2	1.06 (1.04–1.07)		1.05 (1.04–1.07)		1.04 (1.02–1.05)
Mood/anxiety disorder							
No	264,025 (58.7)	34.0	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	41,847 (57.7)	33.3	0.97 (0.96–0.98)		0.98 (0.97–0.99)		0.98 (0.97–0.99)
Alcohol or substance use disorder							
No	303,820 (58.8)	34.1	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	2,052 (37.8)	21.0	0.54 (0.52–0.57)		0.56 (0.53–0.58)		0.68 (0.65–0.71)
Other non-psychotic mental disorder							
No	304,363 (58.6)	33.9	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	1,509 (50.3)	28.7	0.79 (0.75–0.83)		0.91 (0.86–0.96)		0.97 (0.92–1.03)
Psychiatric admission 2 y pre-pregnancy							
No	304,743 (58.6)	34.0	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	1,129 (45.8)	25.9	0.70 (0.66–0.74)		0.84 (0.79–0.89)		0.92 (0.86–0.98)
Severe pregnancy complications[c]							
No	264,441 (58.5)	33.9	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	41,431 (58.9)	34.3	1.02 (1.01–1.03)		1.02 (1.01–1.03)		1.00 (0.99–1.01)
Cesarean section							
No	216,624 (58.3)	33.7	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	89,248 (59.3)	34.4	1.03 (1.02–1.04)		1.03 (1.02–1.03)		0.98 (0.98–0.99)

(continued)

Table 2 (continued).

Variable	Value[a]	Rate/100 PY	Unadjusted HR (95% CI)	Adjusted HR 1 (95% CI) (Sociodemographics Only)[b]	Adjusted HR 2 (95% CI) (Maternal Health Characteristics Only)[b]	Adjusted HR 3 (95% CI) (Child Characteristics Only)[b]	Fully Adjusted HR (95% CI)[b]
Child Characteristics							
Baby's sex							
Male	156,893 (58.6)	33.9	1.00 (referent)			1.00 (referent)	1.00 (referent)
Female	148,979 (58.6)	33.9	1.00 (0.99–1.01)			1.00 (0.99–1.01)	1.00 (0.99–1.01)
Preterm birth							
37 weeks' gestation or later	282,934 (58.8)	34.0	1.00 (referent)			1.00 (referent)	1.00 (referent)
< 37 weeks' gestation	22,938 (55.5)	32.8	0.96 (0.94–0.97)			0.98 (0.96–1.00)	0.96 (0.94–0.98)
NICU in the index birth hospitalization							
No	268,346 (58.9)	34.1	1.00 (referent)			1.00 (referent)	1.00 (referent)
Yes	37,526 (56.2)	32.8	0.95 (0.94–0.96)			0.96 (0.95–0.97)	0.94 (0.93–0.95)
Discharged to social services at birth							
No	305,527 (58.6)	33.9	1.00 (referent)			1.00 (referent)	1.00 (referent)
Yes	345 (32.1)	19.4	0.55 (0.49–0.61)			0.56 (0.50–0.62)	0.80 (0.71–0.89)

[a]Unless otherwise noted, values are shown as n (%) with the outcome in question; for example, for the outcome Multiparous, 161,239 represents 55.0% of the 293,136 children of multiparous mothers (710 with maternal schizophrenia and 292,426 with no maternal schizophrenia).
[b]Including maternal schizophrenia in the model.
[c]Severe pregnancy complications comprise pre-eclampsia, eclampsia, venous thromboembolism, severe obstetric morbidity (placental abruption, placental infarction, obstetric embolism, septic shock, uterine rupture), or systemic maternal complications in pregnancy or postpartum (cardiomyopathy, complications of anesthesia, acute renal failure, myocardial infarction/pulmonary edema, cerebrovascular disease, acute respiratory distress syndrome, disseminated intravascular coagulation, status epilepticus, hysterectomy).
Abbreviations: HR = hazard ratio, NICU = neonatal intensive care unit, PY = person-years, Q = quintile.

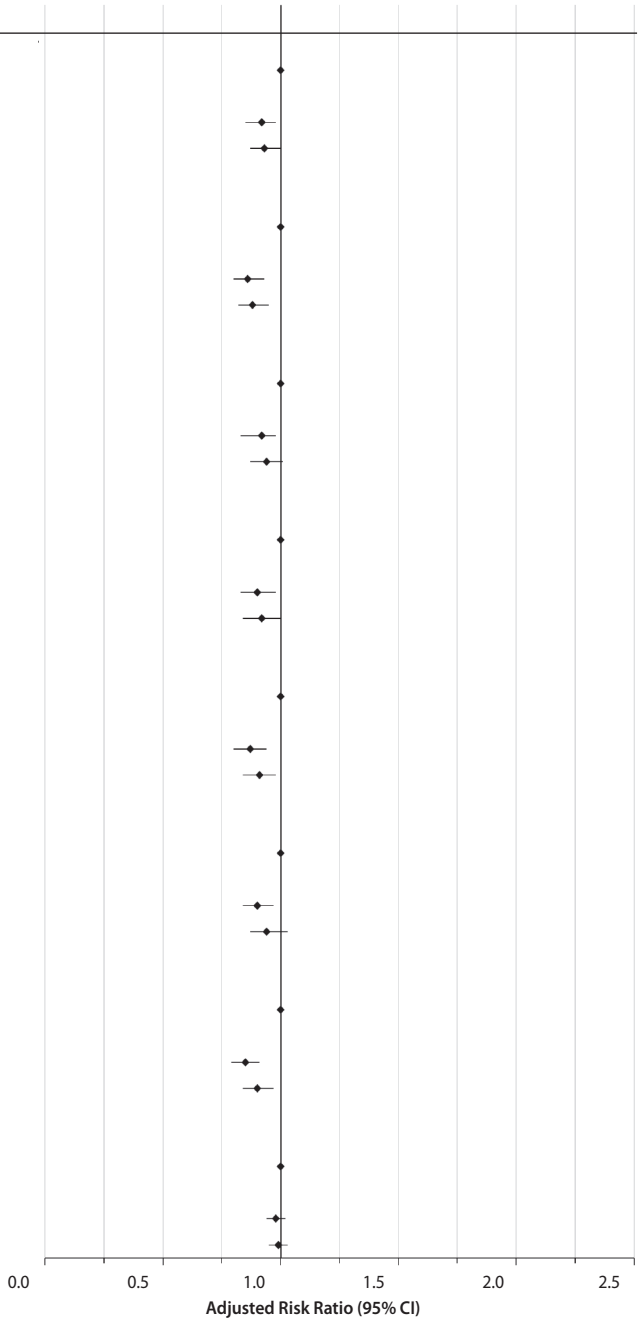
to be discharged to social services from maternity care (4.6% vs 0.2%).

About 50.3% of children whose mothers had schizophrenia had an enhanced 18-month well-baby visit versus 58.6% of the unexposed, with incidence rate 29.0 vs 33.9 visits/100 person-years (PY) (HR = 0.82; 95% CI, 0.76–0.89). The maternal health block of explanatory variables dampened the association most substantially, with comorbid mental disorders, substance use disorders and a history of psychiatric admission all decreasing the likelihood of the 18-month enhanced well-baby visit (Table 2). A child discharged to social services at the time of the birth was also associated with a lower likelihood of the enhanced 18-month visit. The fully adjusted HR was 0.91 (95% CI, 0.84–0.98; see Table 2). Children of mothers with schizophrenia were also less likely to have attended any 18-month well-baby visit (ie, general or enhanced), and attendance at earlier well-baby visit time points followed a similar pattern (Figure 2). About 40.0% of children whose mothers had schizophrenia had full DTaP-IPV-Hib/MMR vaccine schedule adherence by age 2 years versus 46.0% of those without maternal schizophrenia. This corresponded to incidence rates of 22.6 vs 25.9/100 PY (HR = 0.86; 95% CI, 0.78–0.94). While adjustment for the sociodemographics and child health variable blocks dampened the association, maternal health covariate adjustment rendered the association nonsignificant. Therein, comorbid maternal alcohol or substance use disorder, other psychiatric conditions, and a history of psychiatric hospitalization in the 2 years prior to pregnancy were major factors (Table 3). The fully adjusted HR was 0.95 (95% CI, 0.87–1.04). Results were similar for specific vaccine doses (Figure 3). In additional analyses of the well-baby visits and vaccine uptake, when removing children with no primary care visits in the first 24 months, uptake of all preventive health care services was very slightly higher, but the comparative difference between the two groups was consistently similar to that in the primary analysis (Supplementary Table 3). Additional analyses with the more inclusive definitions of DTaP-IPV-Hib were also similar (Supplementary Table 4).

An additional 239 children had mothers who newly met criteria for schizophrenia over their first 24 months of life for a total of 1,514 children with maternal schizophrenia and 520,592 children without maternal schizophrenia. The distribution of characteristics across groups was similar to that in the original cohort (Supplementary Table 5). Unadjusted, maternal schizophrenia was associated with a lower likelihood of both the enhanced 18-month visit and up-to-date vaccinations by age 2 years (Supplementary Tables 6 and 7). Similar to in the primary analysis, accounting for maternal mental health before birth—especially alcohol or substance use disorders—dampened the effect. However, the block of postnatal covariates also played a strong role, explaining the association completely. Maternal substance use disorders and maternal psychiatric hospitalizations after birth reduced preventive care uptake, and having a pediatrician or high continuity of primary care for the child were protective factors.

Figure 2. Well-Baby Visit and Vaccination Outcomes up to 24 Months of Age in Children Born to Women With (n = 1,275) Versus Without (n = 520,831) Schizophrenia

Visit	n (%) With Outcome	Rate/100 PY	HR (95% CI)
2-month visit			
No maternal schizophrenia	384,637 (73.9)	431.1	1.00 (referent)
Maternal schizophrenia			
Unadjusted	881 (69.1)	398.1	0.92 (0.85–0.98)
Fully adjusted[a]			0.93 (0.87–1.00)
4-month visit			
No maternal schizophrenia	358,555 (68.8)	191.1	1.00 (referent)
Maternal schizophrenia			
Unadjusted	787 (61.7)	170.4	0.86 (0.80–0.93)
Fully adjusted[a]			0.88 (0.82–0.95)
6-month visit			
No maternal schizophrenia	366,809 (70.4)	126.3	1.00 (referent)
Maternal schizophrenia			
Unadjusted	834 (65.4)	116.9	0.92 (0.85–0.98)
Fully adjusted[a]			0.94 (0.87–1.01)
9-month visit			
No maternal schizophrenia	256,645 (49.3)	58.7	1.00 (referent)
Maternal schizophrenia			
Unadjusted	568 (44.6)	53.2	0.90 (0.83–0.98)
Fully adjusted[a]			0.92 (0.84–1.00)
12-month visit			
No maternal schizophrenia	315,406 (60.6)	56.2	1.00 (referent)
Maternal schizophrenia			
Unadjusted	693 (54.4)	50.6	0.87 (0.80–0.94)
Fully adjusted[a]			0.91 (0.84–0.98)
15-month visit			
No maternal schizophrenia	252,075 (48.4)	36.0	1.00 (referent)
Maternal schizophrenia			
Unadjusted	557 (43.7)	32.8	0.90 (0.83–0.98)
Fully adjusted[a]			0.94 (0.87–1.03)
Any 18-month visit			
No maternal schizophrenia	367,805 (70.6)	42.2	1.00 (referent)
Maternal schizophrenia			
Unadjusted	802 (62.9)	37.5	0.85 (0.79–0.91)
Fully adjusted[a]			0.90 (0.84–0.97)
≥ 6 visits at 24 months			
No maternal schizophrenia	323,778 (62.2)	44.0	1.00 (referent)
Maternal schizophrenia			
Unadjusted	727 (57.0)	42.8	0.94 (0.89–1.00)
Fully adjusted[a]			0.97 (0.91–1.02)



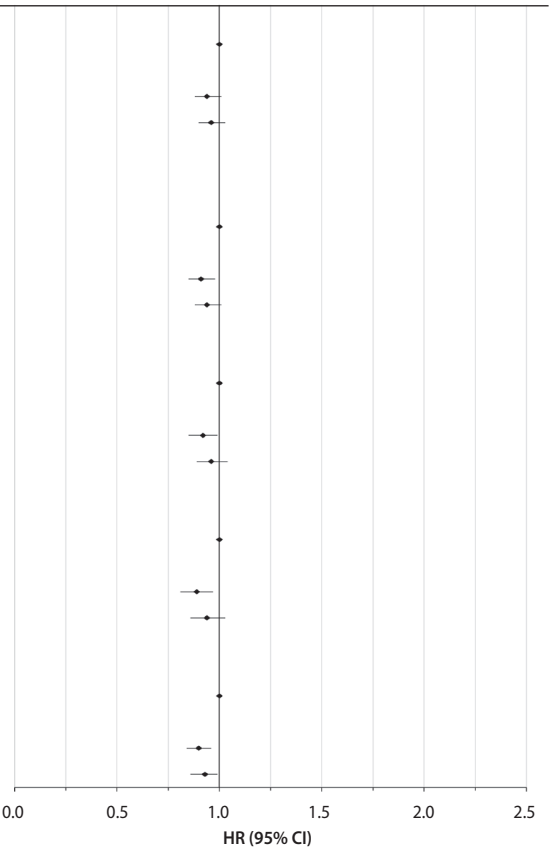
[a]Adjusted for sociodemographic (maternal age, primiparity, rurality, income quintile, immigration status), maternal health (any non-psychiatric diagnosis and/or hospitalizations in pregnancy or 2 years prior to conception, unstable chronic medical conditions before pregnancy), and pregnancy/child characteristics (severe pregnancy complications, sex of baby, preterm birth, NICU admission, and child discharged to social services at birth).
Abbreviation: HR = hazard ratio, NICU = neonatal intensive care unit, PY = person-years.

DISCUSSION

In Ontario, Canada, children born to mothers with schizophrenia prior to their birth were slightly less likely to receive well-baby visits and vaccinations than children whose mothers did not have schizophrenia. Maternal comorbid psychiatric illness (including comorbid substance use disorders) as well as psychiatric illness severity before and after the child's birth appeared to contribute quite substantially to this disparity, as did several other social factors, including low-income status. Having a consistent primary care provider postnatally for the child was also an important protective factor for preventive care uptake, and fewer children of women with schizophrenia had high continuity of primary care. Taken together, these results suggest that uptake of primary preventive care for

Figure 3. Forest Plot of Adjusted Hazard Ratios (95% CI) for Secondary Vaccination Outcomes up to 24 Months of Age in Children Born to Women With (n = 1,275) Versus Without (n = 520,831) Schizophrenia

Outcome	n (%) With Outcome	Rate/100 PY	HR (95% CI)
DTaP-IPV-Hib 2 months			
No maternal schizophrenia	371,245 (71.3)	338.2	1.00 (referent)
Maternal schizophrenia			
Unadjusted	874 (68.5)	321.6	0.94 (0.88–1.01)
Fully adjusted[a]			0.96 (0.90–1.03)
DTaP-IPV-Hib 4 months			
No maternal schizophrenia	328,280 (63.0)	161.7	1.00 (referent)
Maternal schizophrenia			
Unadjusted	761 (59.7)	151.8	0.91 (0.85–0.98)
Fully adjusted[a]			0.94 (0.88–1.01)
DTaP-IPV-Hib 6 months			
No maternal schizophrenia	311,321 (59.8)	85.0	1.00 (referent)
Maternal schizophrenia			
Unadjusted	720 (56.5)	79.3	0.92 (0.85–0.99)
Fully adjusted[a]			0.96 (0.89–1.04)
4 DTaP-IPV-Hib by 24 months			
No maternal schizophrenia	255,984 (49.1)	28.0	1.00 (referent)
Maternal schizophrenia			
Unadjusted	557 (43.7)	25.0	0.89 (0.81–0.97)
Fully adjusted[a]			0.94 (0.86–1.03)
MMR			
No maternal schizophrenia	377,244 (72.4)	55.4	1.00 (referent)
Maternal schizophrenia			
Unadjusted	853 (66.9)	50.2	0.90 (0.84–0.96)
Fully adjusted[a]			0.93 (0.86–0.99)



[a]Fully adjusted hazard ratios were adjusted for sociodemographic (maternal age, primiparity, rurality, income quintile, immigration status), maternal health (any non-psychiatric diagnosis and/or hospitalizations in pregnancy or 2 years prior to conception, unstable chronic medical conditions before pregnancy), and pregnancy/child characteristics (severe pregnancy complications, sex of baby, preterm birth, NICU admission, and child discharged to social services at birth).

Abbreviations: DTaP-IPV-Hib = diphtheria, tetanus, acellular pertussis, inactivated polio, and *Haemophilus influenzae* type b; HR = hazard ratio; MMR = measles, mumps, rubella; NICU = neonatal intensive care unit; PY = person-years.

children of mothers with schizophrenia is a key target for improvement.

The study results are consistent with those of two prior UK studies[20,21] that found small associations with lower vaccine adherence in the maternal population with severe mental illness, suggesting generalizability to high-income settings with universal health coverage. Our study assessment of well-baby care uptake in relation to maternal schizophrenia is novel. Our results also differ slightly from some evidence examining uptake of well-baby visits in relation to maternal mental disorders such as depression and anxiety, for which there appears to be more inconsistency. Similar to our study, the Healthy Steps for Young Children study,[27] from 15 sites across the United States (n = 867), found reduced attendance at well-baby visits by 18 months (OR = 0.81, 95% CI, 0.68–0.95) and reduced vaccination schedule adherence at 24 months (OR = 0.79, 95% CI, 0.60–0.93) among women with depressive symptoms at 2 to 4 months postpartum. A study using Danish health administrative data[39] found relative risks of 1.15 (95% CI, 1.13–1.17) for recent maternal depression and 1.09 (95% CI, 1.07–1.11) for maternal depression 5 years prior to the child's birth in relation to non-attendance at well-baby visits. Other research shows that mothers with mental illness are less likely to engage in infant health–promoting behaviors, for example, breastfeeding and cognitive stimulation such as reading to their children.[40–42] However, one study from the US (Medicare, Medicaid and private health insurance plans)[28] found no difference in uptake of well-baby visits or vaccinations in the first year of life between mothers with and without perinatal depression or anxiety.

In examining risk and protective factors for the outcomes, our findings were consistent with previous research focused in general populations in which parity, income, and prenatal care attendance have been associated with preventive care uptake in children.[7,43] Maternal substance use between birth and 24 months has also previously been a key risk factor for reduced uptake in vaccinations at child age 2 years in the UK.[21] In addition, symptoms of the illness such as paranoia and suspiciousness, disorganization, or impaired

Table 3. Up-To-Date Vaccinations at 24 Months of Age in Children Born to Women With (n = 1,275) Versus Without (n = 520,831) Schizophrenia, Adjusted for Sociodemographic, Maternal Health, and Child Health Covariate Blocks, Individually and Together

Variable	Value[a]	Rate/100 PY	Unadjusted HR (95% CI)	Adjusted HR 1 (95% CI) (Sociodemographics Only)[b]	Adjusted HR 2 (95% CI) (Maternal Health Characteristics Only)[b]	Adjusted HR 3 (95% CI) (Child Characteristics Only)[b]	Fully Adjusted HR (95% CI)[b]
Up-to-Date Vaccinations at 24 Months							
No maternal schizophrenia	239,531 (46.0)	25.9	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	510 (40.0)	22.6	0.86 (0.78–0.94)	0.89 (0.81–0.98)	0.94 (0.86–1.03)	0.88 (0.80–0.96)	0.95 (0.87–1.04)
Sociodemographic Characteristics							
Maternal age at delivery, mean (SD), y	35.0 (5.3)		1.02 (1.02–1.02)	1.02 (1.02–1.02)			1.02 (1.02–1.02)
Parity							
Multiparous	128,976 (44.0)	24.5	1.00 (referent)	1.00 (referent)			1.00 (referent)
Primiparous	111,065 (48.5)	27.6	1.19 (1.18–1.20)	1.26 (1.25–1.27)			1.27 (1.25–1.28)
Income							
Q1 (lowest)	46,858 (40.2)	22.3	1.00 (referent)	1.00 (referent)			1.00 (referent)
Q2	47,198 (45.2)	25.4	1.17 (1.15–1.18)	1.14 (1.12–1.15)			1.13 (1.12–1.15)
Q3	49,528 (46.7)	26.3	1.21 (1.20–1.23)	1.17 (1.16–1.19)			1.17 (1.15–1.18)
Q4	53,826 (49.4)	28.0	1.31 (1.30–1.33)	1.26 (1.24–1.28)			1.25 (1.24–1.27)
Q5	42,631 (49.6)	28.1	1.32 (1.30–1.34)	1.26 (1.25–1.28)			1.25 (1.24–1.27)
Region of residence							
Urban	223,830 (47.5)	26.9	1.00 (referent)	1.00 (referent)			1.00 (referent)
Rural	16,211 (31.6)	17.1	0.58 (0.57–0.59)	0.63 (0.62–0.65)			0.64 (0.63–0.65)
Immigrant status							
Non-migrant/long-term resident	167,020 (44.7)	25.1	1.00 (referent)	1.00 (referent)			1.00 (referent)
Non-refugee immigrant	64,777 (49.7)	28.3	1.18 (1.17–1.19)	1.13 (1.12–1.14)			1.12 (1.11–1.13)
Refugee	8,244 (44.5)	25.0	1.00 (0.97–1.02)	0.99 (0.97–1.02)			0.99 (0.97–1.01)
Maternal Health							
Unstable chronic medical condition							
No	217,895 (45.8)	25.8	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	22,146 (47.3)	26.7	1.05 (1.03–1.06)		1.05 (1.03–1.06)		1.03 (1.01–1.04)
Mood/anxiety disorder							
No	206,973 (46.0)	25.9	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	33,068 (45.6)	25.6	0.98 (0.97–0.99)		1.00 (0.99–1.01)		1.01 (0.99–1.02)
Alcohol or substance use disorder							
No	238,527 (46.2)	26.0	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	1,514 (27.9)	15.2	0.54 (0.51–0.56)		0.55 (0.53–0.58)		0.68 (0.64–0.71)
Other non-psychotic mental disorder							
No	238,927 (46.0)	25.9	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	1,114 (37.1)	20.6	0.76 (0.72–0.81)		0.86 (0.81–0.92)		0.94 (0.88–1.00)
Admission 2 y pre-pregnancy							
No	239,192 (46.0)	25.9	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	849 (34.4)	19.1	0.69 (0.65–0.74)		0.84 (0.78–0.90)		0.92 (0.85–0.99)
Severe pregnancy complications[c]							
No	207,969 (46.0)	25.9	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	32,072 (45.6)	25.7	1.00 (0.99–1.01)		1.00 (0.98–1.01)		0.99 (0.98–1.01)
Cesarean section							
No	169,502 (45.6)	25.6	1.00 (referent)		1.00 (referent)		1.00 (referent)
Yes	70,539 (46.9)	26.4	1.04 (1.03–1.05)		1.04 (1.03–1.05)		1.00 (0.99–1.01)
Child Characteristics							
Baby's sex							
Male	123,245 (46.0)	25.9	1.00 (referent)			1.00 (referent)	1.00 (referent)
Female	116,796 (45.9)	25.8	1.00 (0.99–1.01)			1.00 (1.00–1.01)	1.00 (1.00–1.01)

(continued)

Table 3 (continued).

Variable	Value[a]	Rate/100 PY	Unadjusted HR (95% CI)	Adjusted HR 1 (95% CI) (Sociodemographics Only)[b]	Adjusted HR 2 (95% CI) (Maternal Health Characteristics Only)[b]	Adjusted HR 3 (95% CI) (Child Characteristics Only)[b]	Fully Adjusted HR (95% CI)[b]
Preterm birth							
37 weeks' gestation or later	222,127 (46.2)	25.9	1.00 (referent)			1.00 (referent)	1.00 (referent)
< 37 weeks' gestation	17,914 (43.4)	24.9	0.96 (0.94–0.97)			0.98 (0.96–1.00)	0.96 (0.94–0.98)
NICU							
No	210,743 (46.3)	26.0	1.00 (referent)			1.00 (referent)	1.00 (referent)
Yes	29,298 (43.9)	24.9	0.95 (0.94–0.96)			0.96 (0.95–0.98)	0.95 (0.94–0.96)
Discharged to social services at birth							
No	239,791 (46.0)	25.9	1.00 (referent)			1.00 (referent)	1.00 (referent)
Yes	250 (23.3)	13.8	0.53 (0.46–0.60)			0.54 (0.47–0.61)	0.75 (0.66–0.86)

[a]Unless otherwise noted, values are shown as n (%) with the outcome in question; for example, for the outcome Multiparous, 128,976 represents 44.0% of the 293,136 children of multiparous mothers (710 with maternal schizophrenia and 292,426 with no maternal schizophrenia).
[b]Including maternal schizophrenia in the model.
[c]Severe pregnancy complications comprise pre-eclampsia, eclampsia, venous thromboembolism, severe obstetric morbidity (placental abruption, placental infarction, obstetric embolism, septic shock, uterine rupture), or systemic maternal complications in pregnancy or postpartum (cardiomyopathy, complications of anesthesia, acute renal failure, myocardial infarction/pulmonary edema, cerebrovascular disease, acute respiratory distress syndrome, disseminated intravascular coagulation, status epilepticus, hysterectomy).
Abbreviations: HR = hazard ratio, NICU = neonatal intensive care unit, PY = person-years, Q = quintile.

cognition might limit consistent preventive care visits.[44] Negative past experiences or fear of losing custody might lead women to be reluctant about accessing health care.[45] For mothers with custody of their children, barriers to preventive care uptake related to these variables might include issues with access to transport or unmet childcare needs for other children.[9]

Similar to previous Ontario research,[10,46] preventive care uptake was greater among those who had good continuity of primary care and who were receiving pediatrician care. It is true that among women with schizophrenia, mothers who engage with health care services may have more stable mental health or greater trust in health care and therefore greater adherence to preventive care guidelines. It may also be that children with more complex medical needs access health care more frequently, thus providing more opportunities for preventive care.[32] Leveraging factors already demonstrated to increase preventive care uptake may be important for maximizing uptake in this group.[47] Due to some unique and complex needs of mothers with schizophrenia, specifically targeted interventions may be required, so research examining increasing uptake of preventive care or parenting support for mothers with schizophrenia is warranted.[48,49] Future qualitative research might help to further elucidate some of these barriers and facilitators as well as finding out from women what types of support would help them.

Limitations

While strengths of this study were its population-level coverage and validated method of identifying schizophrenia and vaccinations,[25,26] rates of vaccine coverage appeared low. Research has indicated potential underestimation of vaccine coverage in administrative data,[25,50] but if underestimation was non-differential, this would not impact the hazard ratios. In our sensitivity analysis including only children with evidence of primary care visits (ie, excluding children who may have received vaccines either out of province or in community health centers that do not submit vaccine codes to the province), vaccine coverage rates were higher, and the results comparing children with and without maternal schizophrenia were similar to those of the main analysis, suggesting that the hazard ratios are likely to be internally valid. Coding of primary care as well-baby visits might be another source of misclassification in these data. Classification of maternal schizophrenia relied on an algorithm rather than a clinical assessment, with an excellent NPV of 88.1% but a PPV of 77.1%, which means that a reasonable number of cases could be misclassified as maternal schizophrenia when really the mother did not have schizophrenia. This misclassification would most likely bias findings toward the null hypothesis, suggesting that the effect could be slightly greater than what we observed. We also did not analyze women with psychotic disorder who did not meet the criteria for the algorithm of schizophrenia. Including these would have reduced specificity and PPV, and classifying them in the unexposed group could have biased findings toward the null.[26] We did not have demographic details on race or ethnicity, single parenthood, or fathers or data on treatment status, as not all individuals with schizophrenia are covered by the provincial drug plans. We did include hospitalization status as a covariate that can be considered a proxy for stability. Furthermore, history of psychiatric or medical trauma was not measured. These factors may have additionally explained part of the relation between maternal schizophrenia and uptake of preventive care. Neighborhood income quintile and maternal-child cohabitation were determined using

postal-code data at area level, not individual level. While we determined a proxy for maternal-child cohabitation, we could not ascertain further information regarding child living situation or the timing of maternal-child cohabitation in relation with preventive care uptake.

CONCLUSION

Children whose mothers had schizophrenia were slightly less likely to receive preventive care than children whose mothers did not have schizophrenia up to age 24 months, with associated factors similar to those observed in other populations. The small effect size is somewhat reassuring given these children are disproportionately exposed to risk factors for reduced uptake of preventive care. However, children born to women with schizophrenia are at risk for neonatal complications, poorer neurocognitive functioning in the first 2 years of life,[14,16] and poorer longer-term health outcomes,[15] so early preventive health care is of particular importance. Future efforts to improve preventive care uptake in this population will help to identify developmental needs, avoid preventable illness, and support maternal and family needs to promote long-term well-being.[22] These goals might be achieved by focusing on the mother-infant dyad as well as on models of integrated care.[51] Dyadic care is considered crucial for improving maternal and neonatal outcomes, including mortality and morbidity, leading to longer-term improvements in health and well-being as well as breaking the intergenerational transmission of health and social disadvantages.[52] Among mothers with schizophrenia, psychological treatments emphasizing the mother-child dyad such as toddler-parent psychotherapy have been efficacious for improving maternal sensitivity and child attachment.[53] Integrated care, including addressing mental health in obstetric settings, has been effective for bipolar disorder and depression in the perinatal period[54,55] and so may also be applicable to the care of patients with schizophrenia and, combined with a dyadic approach, could help to improve preventive care uptake and related outcomes in their children.

Submitted: April 18, 2022; accepted October 11, 2022.

Published online: March 1, 2023.

Relevant financial relationships: **Drs Taylor, Brown, Saunders, Barker, Chen, Dennis, Cohen,** and **Ray** have no conflict of interest. **Dr Vigod** reports royalties from authorship of materials related to depression and pregnancy from UpToDate, Inc.

Funding/support: This research was funded by the Canadian Institute of Health Research (CIHR PJT-156021). This study was supported by ICES, which is funded by an annual grant from the Ontario Ministry of Health (MOH) and the Ministry of Long-Term Care (MLTC). Parts of this material are based on data and/or information compiled and provided by the MOH, the Canadian Institute for Health Information (CIHI) and Immigration, Refugees and Citizenship Canada's Permanent Resident Database (IRCC) current to May 31, 2017.

Role of the sponsor: The analyses, conclusions, opinions, and statements expressed herein are solely those of the authors and are independent from the funding sources.

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Additional information: The dataset from this study is held securely in coded form at ICES. While legal data sharing agreements between ICES and data providers (eg, health care organizations and government) prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at https://www.ices.on.ca/DAS (e-mail: das@ices.on.ca). The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and therefore either are inaccessible or may require modification.

Supplementary material: Available at Psychiatrist.com.

REFERENCES

1. WHO CoSDoHWHO. *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health: Commission on Social Determinants of Health Final Report*. World Health Organization; 2008.
2. Record RB. Ottawa: Canadian Paediatric Society. CPS website. www.cps.ca/en/tools-outils/rourke-baby-record. Updated November 17, 2017. Accessed August 31, 2020.
3. Williams R, Clinton J. Canadian Paediatric Society, Early Years Task Force. Getting it right at 18 months: in support of an enhanced well-baby visit. *Paediatr Child Health*. 2011;16(10):647–654.
4. Bocquier A, Ward J, Raude J, et al. Socioeconomic differences in childhood vaccination in developed countries: a systematic review of quantitative studies. *Expert Rev Vaccines*. 2017;16(11):1107–1118.
5. Gidding HF, Flack LK, Sheridan S, et al; ACIR linkage Investigator Team. Infant, maternal and demographic predictors of delayed vaccination: a population-based cohort study. *Vaccine*. 2020;38(38):6057–6064.
6. Gilbert NL, Gilmour H, Wilson SE, et al. Determinants of non-vaccination and incomplete vaccination in Canadian toddlers. *Hum Vaccin Immunother*. 2017;13(6):1–7.
7. Guttmann A, Saunders NR, Kumar M, et al. Implementation of a physician incentive program for 18-month developmental screening in Ontario, Canada. *J Pediatr*. 2020;226:213–220.e1.
8. Périnet S, Kiely M, De Serres G, et al. Delayed measles vaccination of toddlers in Canada: associated socio-demographic factors and parental knowledge, attitudes and beliefs. *Hum Vaccin Immunother*. 2018;14(4):868–874.
9. Van Berckelaer AC, Mitra N, Pati S. Predictors of well child care adherence over time in a cohort of urban Medicaid-eligible infants. *BMC Pediatr*. 2011;11(1):36.
10. Guttmann A. *Uptake of Ontario's Enhanced 18-Month Well-Baby Visit: An AHRQReport*. Institute for Clinical Evaluative Sciences; 2016.
11. Goldner EM, Hsu L, Waraich P, et al. Prevalence and incidence studies of schizophrenic disorders: a systematic review of the literature. *Can J Psychiatry*. 2002;47(9):833–843.
12. Vigod SN, Seeman MV, Ray JG, et al. Temporal trends in general and age-specific fertility rates among women with schizophrenia (1996–2009): a population-based study in Ontario, Canada. *Schizophr Res*. 2012;139(1–3):169–175.
13. Howard LM, Kumar R, Thornicroft G. Psychosocial characteristics and needs of mothers with psychotic disorders. *Br J Psychiatry*. 2001;178(5):427–432.
14. Hameed MA, Lewis AJ. Offspring of parents with schizophrenia: a systematic review of developmental features across childhood. *Harv Rev Psychiatry*. 2016;24(2):104–117.
15. Vigod SN, Kurdyak PA, Dennis CL, et al. Maternal and newborn outcomes among women with schizophrenia: a retrospective population-based cohort study. *BJOG*. 2014;121(5):566–574.
16. Henriksson KM, McNeil TF. Health and development in the first 4 years of life in offspring of women with schizophrenia and affective psychoses: Well-Baby Clinic information. *Schizophr Res*. 2004;70(1):39–48.
17. Sanchez-Gistau V, Romero S, Moreno D, et al. Psychiatric disorders in child and adolescent offspring of patients with schizophrenia and bipolar disorder: a controlled study. *Schizophr Res*. 2015;168(1-2):197–203.
18. Taylor CL, Stewart R, Ogden J, et al. The characteristics and health needs of pregnant women with schizophrenia compared with bipolar disorder and affective psychoses. *BMC Psychiatry*. 2015;15(1):88.
19. Howard LM, Thornicroft G, Salmon M, et al. Predictors of parenting outcome in women with psychotic disorders discharged from mother and baby units. *Acta Psychiatr Scand*. 2004;110(5):347–355.
20. Howard LM, Goss C, Leese M, et al. Medical outcome of pregnancy in women with psychotic disorders and their infants in the first year after birth. *Br J Psychiatry*. 2003;182(1):63–67.
21. Osam CS, Pierce M, Hope H, et al. The influence of maternal mental illness on vaccination uptake in children: a UK population-based

cohort study. *Eur J Epidemiol*. 2020;35(9):879–889.
22. Williams R, Clinton J, Price D, et al. Ontario's enhanced 18-month well-baby visit: program overview, implications for physicians. *Ont Med Rev*. 2010;2:23–27.
23. Maaten S, Guttman A, Kopp A, et al. Care of women during pregnancy and childbirth. *Primary Care in Ontario ICES Atlas Toronto: Institute for Clinical Evaluative*. Toronto: Institute for Clinical Ecaluative Sciences; 2006.
24. Williams J, Young W. A summary of studies on the quality of health care administrative databases in Canada. *Patterns of Health Care in Ontario: the ICES Practice Atlas*. 2nd ed. Ottawa: Canadian Medical Association; 1996;339:45.
25. Schwartz KL, Tu K, Wing L, et al. Validation of infant immunization billing codes in administrative data. *Hum Vaccin Immunother*. 2015;11(7):1840–1847.
26. Kurdyak P, Lin E, Green D, et al. Validation of a population-based algorithm to detect chronic psychotic illness. *Can J Psychiatry*. 2015;60(8):362–368.
27. Minkovitz CS, Strobino D, Scharfstein D, et al. Maternal depressive symptoms and children's receipt of health care in the first 3 years of life. *Pediatrics*. 2005;115(2):306–314.
28. Farr SL, Dietz PM, Rizzo JH, et al. Health care utilisation in the first year of life among infants of mothers with perinatal depression or anxiety. *Paediatr Perinat Epidemiol*. 2013;27(1):81–88.
29. Bland J, Clements J. Protecting the world's children: the story of WHO's immunization programme. *World Health Forum*. 1998;19(2):162–173.
30. Ontario PH. Publicly Funded Immunization Schedules for Ontairo. Health.gov website. https://www.health.gov.on.ca/en/pro/programs/immunization/docs/Publicly_Funded_ImmunizationSchedule.pdf. Accessed December 27, 2021.
31. Johns Hopkins University. The Johns Hopkins ACG System. Q-corp.org website. https://q-corp.org/sites/qcorp/files/Johns%20Hopkins%20ACG%20System.pdf. 2012. Accessed August 31, 2020.
32. Saunders NR, Ray JG, Diong C, et al. Primary care of mothers and infants by the same or different physicians: a population-based cohort study. *CMAJ*. 2020;192(36):E1026–E1036.
33. Arat A, Burström B, Östberg V, et al. Social inequities in vaccination coverage among infants and pre-school children in Europe and Australia: a systematic review. *BMC Public Health*. 2019;19(1):290.
34. Arat A, Norredam M, Baum U, et al. Organisation of preventive child health services: key to socio-economic equity in vaccine uptake? *Scand J Public Health*. 2020;48(5):491–494.
35. McLeod L, Buckley G, Sweetman A. Ontario primary care models: a descriptive study. *CMAJ Open*. 2016;4(4):E679–E688.
36. Feudtner C, Feinstein JA, Zhong W, et al. Pediatric complex chronic conditions classification system version 2: updated for ICD-10 and complex medical technology dependence and transplantation. *BMC Pediatr*. 2014;14(1):199.
37. Liu N, Farrugia MM, Vigod SN, et al. Intergenerational abortion tendency between mothers and teenage daughters: a population-based cohort study. *CMAJ*. 2018;190(4):E95–E102.
38. Bursac Z, Gauss CH, Williams DK, et al. Purposeful selection of variables in logistic regression. *Source Code Biol Med*. 2008;3(1):17.
39. Lyngsøe BK, Vestergaard CH, Rytter D, et al. Attendance of routine childcare visits in primary care for children of mothers with depression: a nationwide population-based cohort study. *Br J Gen Pract*. 2018;68(667):e97–e104.
40. Dias CC, Figueiredo B. Breastfeeding and depression: a systematic review of the literature. *J Affect Disord*. 2015;171:142–154.
41. Kavanaugh M, Halterman JS, Montes G, et al. Maternal depressive symptoms are adversely associated with prevention practices and parenting behaviors for preschool children. *Ambul Pediatr*. 2006;6(1):32–37.
42. Zajicek-Farber ML. The contributions of parenting and postnatal depression on emergent language of children in low-income families. *J Child Fam Stud*. 2010;19(3):257–269.
43. Jones MN, Brown CM, Widener MJ, et al. Area-level socioeconomic factors are associated with noncompletion of pediatric preventive services. *J Prim Care Community Health*. 2016;7(3):143–148.
44. Kaufman EA, McDonell MG, Cristofalo MA, et al. Exploring barriers to primary care for patients with severe mental illness: frontline patient and provider accounts. *Issues Ment Health Nurs*. 2012;33(3):172–180.
45. Dolman C, Jones I, Howard LM. Pre-conception to parenting: a systematic review and meta-synthesis of the qualitative literature on motherhood for women with severe mental illness. *Arch Women Ment Health*. 2013;16(3):173–196.
46. Guttmann A, Manuel D, Dick PT, et al. Volume matters: physician practice characteristics and immunization coverage among young children insured through a universal health plan. *Pediatrics*. 2006;117(3):595–602.
47. Guttmann A, Shipman SA, Lam K, et al. Primary care physician supply and children's health care use, access, and outcomes: findings from Canada. *Pediatrics*. 2010;125(6):1119–1126.
48. Gearing RE, Alonzo D, Marinelli C. Maternal schizophrenia: psychosocial treatment for mothers and their children. *Clin Schizophr Relat Psychoses*. 2012;6(1):27–33.
49. Radley J, Grant C, Barlow J, et al. Parenting interventions for people with schizophrenia or related serious mental illness. *Cochrane Database Syst Rev*. 2021 Oct 19;10(10):CD013536.
50. Holt N, Mygind A, Bro F. Danish MMR vaccination coverage is considerably higher than reported. *Dan Med J*. 2017;64(2):A5345.
51. Mayer-Amberg N, Woltmann R, Walther S. An integrated care initiative to improve patient outcome in schizophrenia. *Front Psychiatry*. 2016;6:184.
52. Glazer KB, Zeitlin J, Howell EA. *Intertwined Disparities: Applying the Maternal-Infant Dyad Lens to Advance Perinatal Health Equity*. Elsevier; 2021:151410.
53. Wan MW, Moulton S, Abel KM. A review of mother-child relational interventions and their usefulness for mothers with schizophrenia. *Arch Women Ment Health*. 2008;11(3):171–179.
54. Moore Simas TA, Flynn MP, Kroll-Desrosiers AR, et al. A systematic review of integrated care interventions addressing perinatal depression care in ambulatory obstetric care settings. *Clin Obstet Gynecol*. 2018;61(3):573–590.
55. Wendt AC, Stamper G, Howland M, et al. Indirect psychiatric consultation for perinatal bipolar disorder: a scoping review. *Gen Hosp Psychiatry*. 2021;68:19–24.

Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Women's Mental Health section. Please contact Marlene P. Freeman, MD, at mfreeman@psychiatrist.com.

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THE JOURNAL OF
CLINICAL PSYCHIATRY
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Supplementary Material

Article Title: Preventive Health Care Among Children of Women With Schizophrenia: A Population-Based Cohort Study

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DOI Number: https://doi.org/10.4088/JCP.22m14497

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Disclaimer

This Supplementary Material has been provided by the author(s) as an enhancement to the published article. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.

Supplementary tables and appendices

Supplementary Table 1: Definitions for preventive service use

Type of service	Definition and timing of measurement	OHIP codes
Age-appropriate well-baby visits		
18 months enhanced visit	**(-1 month, +6 months)**	A002, A268, Q742
Secondary outcomes		
2 months	(+/- 1 month)	A007 or A262 + Dx Code 916 OR Q180 or Q613
4 months	(+/- 1 month)	A007 or A262 + Dx Code 916 OR Q180 or Q613
6 months	(-1 month/ +2 months)	A007 or A262 + Dx Code 916 OR Q180 or Q613
9 months	(-1 month/ +2 months)	A007 or A262 + Dx Code 916 OR Q180 or Q613
12 months	(-1 month/ +2 months)	A007 or A262 + Dx Code 916 OR Q180 or Q613
15 months	(-1 month/ +2 months)	A007 or A262 + Dx Code 916 OR Q180 or Q613
18 months (general/ enhanced)	(-1 month, +6 months)	A002, A268, A007 or A262 + Dx Code 916, Q742, Q180, Q613
Age appropriate Vaccinations according to the vaccine schedule*		
Up to date vaccinations at 24 months	**24 months**	**4 DTaP-IPV-Hib and 1 MMR using codes below**
Secondary outcomes		
DTaP-IPV-Hib - 2 months	1 dose by 3.5 months	G841 (broader definition 1: G841 or G840) (definition 2: G841, G840 or G538)
DTaP-IPV-Hib - 4 months	2 doses by 5.5 months	G841 (broader definition 1: G841 or G840) (definition 2: G841, G840 or G538)
DTaP-IPV-Hib - 6 months	3 doses by 11.5 months	G841 (broader definition 1: G841 or G840) (definition 2: G841, G840 or G538)
DTaP-IPV-Hib - 18 months	4 doses by 24 months	G841 (broader definition 1: G841 or G840) (definition 2: G841, G840 or G538)
MMR 12 months	1 dose by 18 months	G845
MMR 12 months	1 dose by 24 months	G845

DTaP-IPV-Hib = diphtheria, tetanus, acellular pertussis, inactivated polio, and Haemophilus influenzae type b vaccine – given at 2, 4, 6 and 18 months
MMR = measles, mumps, rubella vaccine

*http://www.health.gov.on.ca/en/pro/programs/immunization/docs/immunization_schedule.pdf

Supplementary Table 2: Description of covariates

Variable	Source
Sociodemographic characteristics	
Maternal age	RPDB: age at date of delivery
Parity	CIHI-DAD: number of previous live births from the birth hospitalization
Region of residence (rural/ urban	RPDB: derived from postal codes using linkage to Statistics Canada's postcode conversion file recorded at date of delivery
Neighbourhood income quintile	RPDB: derived from postal codes using linkage to Statistics Canada's postcode conversion file, recorded at date of delivery
Immigrant status	the Ontario segment of the Immigration, Refugees and Citizenship Canada (IRCC) database, recorded at date of delivery
Maternal health (psychiatric and medical) characteristics	
Maternal medical morbidity	Unstable chronic medical conditions: collapsed ambulatory diagnostic groups (CADGs) from the John Hopkins Adjusted Clinical Groups system (ACG®) version 10 where CADG category 5 identifies unstable chronic conditions, identified from outpatient billing claims, recorded in the 2 years pre-conception
Comorbid psychiatric diagnoses	Recorded (1) in the 2 years pre-conception or during pregnancy (2) from birth to 24 months
Mood/ anxiety disorder	CIHI-DAD (ICD-10) prior to 2006, OMHRS from 2006 onward (DSM IV), OHIP
Alcohol or Substance use	CIHI-DAD (ICD-10) prior to 2006, OMHRS from 2006 onward (DSM IV), OHIP
Other (including personality disorders)	CIHI-DAD (ICD-10) prior to 2006, OMHRS from 2006 onward (DSM IV), OHIP
Psychiatric admission	CIHI-DAD (for admissions prior to 2006) OMHRS (from 2006 onward) Recorded (1) in the 2 years pre-conception to the end of pregnancy (2) from birth to 24 months
Severe pregnancy complications	CIHI-DAD OHIP, ICD-10 codes and OHIP codes for pre-eclampsia, eclampsia, venous thromboembolism, severe obstetric morbidity (placental abruption, placental infarction, obstetric embolism, septic shock, uterine rupture) or systemic maternal complications in pregnancy or postpartum (cardiomyopathy, complications of anaesthesia, acute renal failure, MI/pulmonary enema, cerebrovascular disease, acute respiratory distress syndrome, DIC (disseminated intravascular coagulation), status epilepticus, hysterectomy from date of conception to live-birth
Caesarean section	CIHI-DAD
Child characteristics	
Child sex	RPDB recorded during the birth hospitalisation
Preterm birth	gestational age from MOMBABY, preterm birth defined as <37 weeks' gestation, recorded during the birth hospitalisation
Admitted to NICU in the index birth hospitalization	MOMBABY, recorded during the birth hospitalisation
Child discharged to social care at birth	CIHI-DAD, recorded during the birth hospitalization
Child complex chronic condition	defined according Feudtner[1], as conditions "involving several organ systems or 1 organ system severely enough to require specialty paediatric care and/or hospitalisation in a tertiary care centre, derived from ICD-9 and ICD-10 codes recorded during the period to 24 months following the index date of birth

Variable	Source
Mother-child discordant residence at 24 months	RPDB: derived from postal codes using Statistics Canada's postcode conversion file, recorded at 24 months from the index date of birth
Health service-use characteristics	
Ultrasound before 20 weeks gestation	OHIP
Type of antenatal care provider	OHIP: family physician (GP/FP), obstetrician, shared care between GP/FP and obstetrician, other/fewer than 4 visits
Child usual provider of care	OHIP: In Ontario children may receive primary care from a paediatrician, or a family doctor whereby physicians are remunerated by fee-for-service or are in enrolment models. Enrolment models comprise practices wherein providers receive set funds per patient or are funded through fee-for-services and in addition receive bonuses based on patient enrolment or out-of-hours services[2]. All visits to General Practitioners, Family Doctors, or Paediatricians in Ontario recorded during the period 42 days to 24 months following the index date of birth The usual provider of primary care (UPC) was determined by identifying the physician with the greatest number of days of visits for a child. For any ties arising, the provider who most recently saw the child was assigned. Groups were: enrolled (reference group), fee-for-service, paediatrician and no primary care visits.
Continuity of care	from the child usual provider of care: high: ≥76% of visits to the same provider, referent; low: ≤75% of visits to the same provider, infrequent users: < 4 recorded during the period 42 days to 24 months following the index date of birth

Supplementary Table 3: Sensitivity analysis, well-baby visit and vaccination outcomes up to 24 months of age in children born to women with (N=1231) versus without (N=507,907) schizophrenia, presenting hazard ratios (HR) and 95% confidence intervals (CI), excluding children with no primary care records

	N (%) with outcome	Rate/ 100 person-year	HR (95% CI)	Adjusted HR (95% CI)*
18-month enhanced well-baby visit				
No maternal schizophrenia	NR	34.8	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	29.9	0.82 (0.76-0.89)	0.88 (0.82-0.96)
Secondary well-baby visit outcomes				
2-month visit				
No maternal schizophrenia	NR	445.2	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	414.6	0.92 (0.86-0.99)	0.95 (0.88-1.01)
4-month visit				
No maternal schizophrenia	NR	196.0	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	175.8	0.86 (0.80-0.93)	0.89 (0.82-0.95)
6-month visit				
No maternal schizophrenia	NR	129.7	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	120.6	0.92 (0.85-0.99)	0.94 (0.88-1.01)
9-month visit				
No maternal schizophrenia	NR	60.1	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	54.7	0.90 (0.83-0.98)	0.92 (0.84-1.00)
12-month visit				
No maternal schizophrenia	NR	57.5	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	52.0	0.87 (0.80-0.94)	0.91 (0.84-0.98)
15-month visit				
No maternal schizophrenia	NR	36.9	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	33.7	0.90 (0.83-0.98)	0.95 (0.87-1.03)
Any 18-month visit				
No maternal schizophrenia	NR	43.3	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	38.7	0.85 (0.79-0.91)	0.91 (0.85-0.97)
≥6 visits at 24 months				
No maternal schizophrenia	NR	32.1	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	NR	30.0	0.98 (0.95-1.02)	0.99 (0.96-1.03)
Up to date vaccinations at 24-months				
No maternal Schizophrenia	239,420 (47.1)	26.5	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	510 (41.4)	23.3	0.86 (0.79-0.95)	0.92 (0.84-1.01)
Secondary vaccination outcomes				
DTaP-IPV-Hib 2 months				
No maternal schizophrenia	370,874 (73.0)	348.4	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	874 (71.0)	334.6	0.95 (0.89-1.02)	0.97 (0.91-1.04)
DTaP-IPV-Hib 4 months				
No maternal schizophrenia	328,038 (64.6)	165.8	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	761 (61.8)	156.8	0.91 (0.85-0.98)	0.95 (0.88-1.02)
DTaP-IPV-Hib 6 months				
No maternal schizophrenia	311,123 (61.3)	87.6	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	720 (58.5)	82.3	0.92 (0.86-0.99)	0.97 (0.90-1.04)
4 DTaP-IPV-Hib by 24 months				
No maternal schizophrenia	255,852 (50.4)	28.6	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	557 (45.3)	25.8	0.89 (0.82-0.97)	0.95 (0.87-1.03)
Measles, Mumps, Rubella (MMR)				
No maternal schizophrenia	376,901 (74.2)	57.2	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	853 (69.3)	52.3	0.90 (0.84-0.97)	0.93 (0.87-1.00)

*adjusted for sociodemographic (maternal age, primiparity, rurality, income quintile, immigration status), maternal health (non-psychosis psychiatric diagnosis and/ or hospitalizations in pregnancy or 2 years prior to conception), unstable chronic medical conditions before pregnancy), and pregnancy/ child characteristics (severe pregnancy complications, sex of baby, preterm birth, NICU admission, and child discharged to social services at birth).**NR = Not reportable, as would lead to identifiable cell numbers of < 6 when compared with figure 2.**

Supplementary Table 4: Sensitivity analysis, vaccination outcomes with broader definitions up to 24 months of age in children born to women with (N=1275) versus without (N=520,831) schizophrenia, presenting hazard ratios (HR) and 95% confidence intervals (CI)

	N (%) with outcome	Rate/ 100 person-year	HR (95% CI)	Adjusted HR (95% CI)*
Broader DTaP-IPV-Hib vaccine definition 1 - G841 or G840				
Up to date vaccinations at 24-months				
No maternal schizophrenia	250,015 (48.0)	27.1	1.00 (referent)	1.00 (referent)
Maternal Schizophrenia	531 (41.6)	23.6	0.85 (0.78-0.93)	0.91 (0.83-0.99)
Secondary vaccination outcomes				
DTaP-IPV-Hib 2 months				
No maternal schizophrenia	378,598 (72.7)	347.4	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	885 (69.4)	327.2	0.93 (0.87-0.99)	0.95 (0.89-1.02)
DTaP-IPV-Hib 4 months				
No maternal schizophrenia	336,717 (64.6)	166.6	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	776 (60.9)	155.3	0.90 (0.84-0.97)	0.93 (0.86-1.00)
DTaP-IPV-Hib 6 months				
No maternal schizophrenia	321,357 (61.7)	88.8	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	740 (58.0)	82.3	0.91 (0.85-0.98)	0.95 (0.88-1.02)
4 DTaP-IPV-Hib by 24 months				
No maternal schizophrenia	267,638 (51.4)	29.4	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	580 (45.5)	26.2	0.87 (0.80-0.95)	0.93 (0.85-1.01)
Broader DTaP-IPV-Hib vaccine definition 2 - G841 or G840 or G538				
Up to date vaccinations at 24-months				
No maternal schizophrenia	269,254 (51.7)	29.9	1.00 (referent)	1.00 (referent)
Maternal Schizophrenia	579 (45.4)	26.3	0.86 (0.79-0.93)	0.91 (0.84-0.99)
Secondary vaccination outcomes				
DTaP-IPV-Hib 2 months				
No maternal schizophrenia	406,516 (78.1)	384.9	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	950 (74.5)	362.1	0.92 (0.87-0.99)	0.95 (0.89-1.01)
DTaP-IPV-Hib 4 months				
No maternal schizophrenia	365,076 (70.1)	184.6	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	839 (65.8)	171.2	0.88 (0.82-0.94)	0.91 (0.85-0.98)
DTaP-IPV-Hib 6 months				
No maternal schizophrenia	352,557 (67.7)	101.7	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	809 (63.5)	93.4	0.90 (0.84-0.97)	0.93 (0.87-1.00)
4 DTaP-IPV-Hib by 24 months				
No maternal schizophrenia	310,403 (59.6)	36.3	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	674 (52.9)	32.1	0.86 (0.79-0.93)	0.91 (0.84-0.98)

*adjusted for sociodemographic (maternal age, primiparity, rurality, income quintile, immigration status), maternal health (non-psychosis psychiatric diagnosis and/ or hospitalizations in pregnancy or 2 years prior to conception), unstable chronic medical conditions before pregnancy), and pregnancy/ child characteristics (severe pregnancy complications, sex of baby, preterm birth, NICU admission, and child discharged to social services at birth).

Supplementary Table 5: Characteristics of N=1514 children at age 2 whose mothers had been diagnosed with schizophrenia up to child age 24-months, and 520,592 children without. Characteristics presented in N (%) unless otherwise specified.

Factor	With maternal schizophrenia (n=1,514)	With no maternal schizophrenia (n= 520,592)
Maternal socio-demographic characteristics		
Maternal age at delivery in years, Mean ± SD	30.5 ± 6.2	30.52 ± 5.3
Primiparous	622 (43.0)	228,314 (43.9)
Neighbourhood income quintile (Q1, lowest)	576 (38.0)	116,123 (22.3)
Rural residence	134 (8.9)	51,234 (9.8)
Immigrant status		
Non-migrant	1,224 (80.8)	372,071 (71.5)
Immigrant	233 (15.4)	130,065 (25.0)
Refugee	57 (3.8)	18,456 (3.5)
Maternal medical history		
Unstable chronic conditions 2 years pre-conception to birth	185 (12.8)	46,637 (9.0)
Non-psychosis psychiatric diagnosis, 2 years pre-conception to birth		
Mood/ anxiety disorder	932 (61.6)	71,539 (13.7)
Substance or alcohol	165 (10.9)	5,257 (1.0)
Other (inc personality)	160 (10.6)	2,840 (0.5)
Psychiatric admission from 2 years pre-conception to birth	332 (21.9)	2,134 (0.4)
Severe pregnancy complications	237 (15.7)	70,130 (13.5)
Caesarean section	464 (30.6)	150,058 (28.8)
Child characteristics		
Baby's sex (Male)	772 (51.0)	267,142 (51.3)
Preterm birth < 37 weeks' gestation	161 (10.6)	41,133 (7.9)
Admitted to NICU in the index birth hospitalization	360 (23.8)	66,434 (12.8)
Child discharged to social services at birth	69 (4.6)	1,005 (0.2)
Postnatal Characteristics		
Non-psychosis psychiatric diagnosis between birth and child 24 months		
Mood/ anxiety disorder	937 (61.9)	80,598 (15.5)
Substance or alcohol	150 (9.9)	4,610 (0.9)
Other (incl. personality)	116 (7.7)	2,525 (0.5)
Psychiatric admission from birth to 24 months postpartum	419 (27.7)	2,111 (0.4)
Child complex chronic condition	59 (3.9)	15,940 (3.1)
Mother-child discordant residence at 24 months	470 (31.0)	70,913 (13.6)
Child usual provider of care†		
Enrolled	1,010 (66.7)	348,632 (67.0)
Fee-for-service/ no care	108 (7.1)	32,748 (6.3)
Paediatrician	396 (26.2)	139,212 (26.7)
Continuity of Care*		
Low (≤75%)	834 (55.1)	243,501 (46.8)
High (≥76%)	680 (44.9)	277,091 (53.2)

§ one or more hospitalizations, and/or ≥3 outpatient contacts within 3 years of each other with a diagnosis of schizophrenia or schizoaffective disorder (ICD-9 or OHIP: 295; ICD-10: F20, 25.

† We determined the usual provider of primary care (UPC) by identifying the physician with the greatest number of days of visits for a child. For any ties arising, the provider who most recently saw the child was assigned. Groups were: enrolled (reference group), fee-for-service, paediatrician and no primary care visits. No primary care visits were combined with fee-for-service due to small cell sizes.

* For continuity of care, infrequent care (<4 visits) and low (≤75%) were combined to stabilize the models and account for small cells **NR = Not reportable, as would lead to identifiable cell numbers of < 6 when compared with main paper Table 1.**

Supplementary Table 6: Sensitivity analysis 18 month enhanced Well-baby visit up to 24 months of age in children born to women with (N=1514) versus without (N=520,592) schizophrenia at child age 24 months, adjusted for sociodemographic, maternal health, child health and postnatal covariates, presenting hazard ratios (HR) and 95% confidence intervals (CI)

	N (%) with outcome	Rate/ 100 person-year	Unadjusted HR (95% CI)	Adjusted HR 1 (Socio-demographics only) §	Adjusted HR 2 (maternal health characteristics only) §	Adjusted HR 3 (child characteristics only) §	Adjusted HR 4 (postnatal characteristics only) §	Fully-Adjusted HR (95% CI) §
18-month enhanced well-baby visit								
No maternal schizophrenia	305,132 (58.6)	33.9	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	740 (49.4)	28.4	0.82 (0.76-0.89)	0.86 (0.80-0.92)	0.90 (0.84-0.97)	0.84 (0.78-0.90)	0.92 (0.85-0.99)	0.95 (0.88-1.03)
Sociodemographic characteristics								
Maternal age at delivery, mean (SD)	30.5 (5.3)		1.02 (1.02-1.02)	1.03 (1.02-1.03)				1.02 (1.02-1.02)
Parity								
Multiparous	161,239 (55.0)	31.4	1.00 (referent)	1.00 (referent)				1.00 (referent)
Primiparous	144,633 (63.2)	37.2	1.32 (1.31-1.33)	1.40 (1.39-1.41)				1.37 (1.36-1.38)
Income								
Q1 (Lowest)	58,849 (50.4)	28.7	1.00 (referent)	1.00 (referent)				1.00 (referent)
Q2	58,988 (56.5)	32.6	1.18 (1.17-1.20)	1.14 (1.12-1.15)				1.10 (1.09-1.11)
Q3	63,178 (59.5)	34.5	1.27 (1.26-1.29)	1.21 (1.20-1.22)				1.17 (1.16-1.19)
Q4	69,437 (63.7)	37.3	1.42 (1.41-1.44)	1.33 (1.32-1.35)				1.26 (1.24-1.27)
Q5 (check where missing is)	55,420 (64.5)	37.8	1.45 (1.43-1.47)	1.34 (1.32-1.36)				1.25 (1.23-1.27)
Region of residence								
Urban	283,191 (60.2)	35.0	1.00 (referent)	1.00 (referent)				1.00 (referent)
Rural	22,681 (44.2)	24.6	0.62 (0.61-0.63)	0.66 (0.65-0.67)				0.76 (0.75-0.77)
Immigrant status								
Non-migrant/long-term resident	219,224 (58.7)	34.0	1.00 (referent)	1.00 (referent)				1.00 (referent)
Non-refugee immigrant	76,785 (58.9)	34.3	1.03 (1.03-1.04)	1.00 (0.99-1.00)				0.95 (0.94-0.96)
Refugee	9,863 (53.3)	30.5	0.87 (0.85-0.89)	0.88 (0.86-0.90)				0.85 (0.83-0.87)
Maternal health								
Unstable chronic medical condition								
No unstable condition	277,589 (58.4)	33.8	1.00 (referent)		1.00 (referent)			1.00 (referent)
Unstable chronic medical condition	28,283 (60.4)	35.2	1.06 (1.04-1.07)		1.05 (1.04-1.07)			1.03 (1.01-1.04)
Mood/anxiety disorder								
No mood/anxiety disorder	264,025 (58.7)	34.0	1.00 (referent)		1.00 (referent)			1.00 (referent)
Mood/anxiety disorder	41,847 (57.7)	33.3	0.97 (0.96-0.98)		0.98 (0.97-0.99)			0.97 (0.96-0.98)
Alcohol or substance use disorder								
No disorder	303,820 (58.8)	34.1	1.00 (referent)		1.00 (referent)			1.00 (referent)

Alcohol or substance use disorder	2,052 (37.8)	21.0	0.54 (0.52-0.57)	0.56 (0.53-0.58)		0.80 (0.77-0.84)
Other non-psychotic mental disorder						
No other non-psychotic disorder	304,363 (58.6)	33.9	1.00 (referent)	1.00 (referent)		1.00 (referent)
Other non-psychotic disorder	1,509 (50.3)	28.7	0.79 (0.75-0.83)	0.91 (0.86-0.96)		1.00 (0.95-1.05)
Psychiatric admission 2 y pre-pregnancy						
No psychiatric admission	304,743 (58.6)	34.0	1.00 (referent)	1.00 (referent)		1.00 (referent)
Psychiatric admission	1,129 (45.8)	25.9	0.70 (0.66-0.74)	0.84 (0.79-0.89)		0.96 (0.90-1.02)
Severe pregnancy complications*						
No severe pregnancy complications*	264,441 (58.5)	33.9	1.00 (referent)	1.00 (referent)		1.00 (referent)
Severe pregnancy complications*	41,431 (58.9)	34.3	1.02 (1.01-1.03)	1.02 (1.01-1.03)		1.01 (1.00-1.02)
Caesarean section						
No caesarean section	216,624 (58.3)	33.7	1.00 (referent)	1.00 (referent)		1.00 (referent)
Caesarean section	89,248 (59.3)	34.4	1.03 (1.02-1.04)	1.03 (1.02-1.03)		0.98 (0.98-0.99)
Child characteristics						
Baby's sex						
Male	156,893 (58.6)	33.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Female	148,979 (58.6)	33.9	1.00 (0.99-1.01)		1.00 (0.99-1.01)	1.00 (0.99-1.01)
Preterm birth						
37 weeks gestation or later	282,934 (58.8)	34.0	1.00 (referent)		1.00 (referent)	1.00 (referent)
<37 weeks' gestation	22,938 (55.5)	32.8	0.96 (0.94-0.97)		0.98 (0.96-1.00)	0.92 (0.91-0.94)
NICU in the index birth						
No NICU	268,346 (58.9)	34.1	1.00 (referent)		1.00 (referent)	1.00 (referent)
NICU	37,526 (56.2)	32.8	0.95 (0.94-0.96)		0.96 (0.95-0.97)	0.95 (0.94-0.96)
Discharged to social services at birth						
Not discharged to social services	305,527 (58.6)	33.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Discharged to social services	345 (32.1)	19.4	0.55 (0.49-0.61)		0.56 (0.50-0.62)	0.87 (0.78-0.97)
Postnatal characteristics						
Maternal mood/anxiety disorder						
No mood/anxiety disorder	257,509 (58.4)	33.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Mood/anxiety disorder	48,363 (59.3)	34.0	0.99 (0.98-1.00)		1.02 (1.01-1.03)	1.03 (1.02-1.04)
Maternal substance use disorder						
No disorder	304,200 (58.8)	34.1	1.00 (referent)		1.00 (referent)	1.00 (referent)
Alcohol or substance use disorder	1,672 (35.1)	19.0	0.48 (0.46-0.50)		0.59 (0.57-0.62)	0.75 (0.71-0.79)
Maternal other non-psychotic disorder						
No other non-psychotic disorder	304,554 (58.6)	33.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Other non-psychotic disorder	1,318 (49.9)	28.0	0.76 (0.72-0.80)		0.92 (0.87-0.98)	0.97 (0.92-1.03)
Maternal psychiatric admission						
None from 0-24 months postpartum	304,708 (58.6)	34.0	1.00 (referent)		1.00 (referent)	1.00 (referent)
From 0- 24 months postpartum	1,164 (46.0)	25.6	0.68 (0.65-0.72)		0.88 (0.82-0.93)	0.92 (0.87-0.98)
Child complex chronic condition						

No	297,562 (58.8)	34.0	1.00 (referent)	1.00 (referent)	1.00 (referent)
Yes	8,310 (51.9)	30.7	0.88 (0.86-0.90)	0.82 (0.80-0.83)	0.84 (0.82-0.86)
Mother-child residence at 24 months					
Concordant	267,552 (59.4)	34.5	1.00 (referent)	1.00 (referent)	1.00 (referent)
Discordant	38,320 (53.7)	30.3	0.83 (0.82-0.84)	0.85 (0.84-0.86)	0.89 (0.88-0.90)
Child usual provider of care†					
Enrolled	201,877 (57.7)	33.2	1.00 (referent)	1.00 (referent)	1.00 (referent)
Fee-for-service/ no care	5,570 (17.0)	9.4	0.23 (0.23-0.24)	0.26 (0.25-0.27)	0.28 (0.27-0.29)
Paediatrician	98,425 (70.5)	42.1	1.49 (1.47-1.50)	1.49 (1.48-1.51)	1.45 (1.43-1.46)
Continuity of Care*					
Low (≤75%)	125,931 (51.5)	29.5	1.00 (referent)	1.00 (referent)	1.00 (referent)
High (≥76%)	179,941 (64.8)	37.9	1.41 (1.40-1.42)	1.29 (1.28-1.30)	1.27 (1.26-1.28)

severe pregnancy complications comprise pre-eclampsia, eclampsia, venous thromboembolism, severe obstetric morbidity (placental abruption, placental infarction, obstetric embolism, septic shock, uterine rupture) or systemic maternal complications in pregnancy or postpartum (cardiomyopathy, complications of anaesthesia, acute renal failure, MI/pulmonary enema, cerebrovascular disease, acute respiratory distress syndrome, DIC (disseminated intravascular coagulation), status epilepticus, hysterectomy. .† We determined the usual provider of primary care (UPC) by identifying the physician with the greatest number of days of visits for a child. For any ties arising, the provider who most recently saw the child was assigned. Groups were: enrolled (reference group), fee-for-service, paediatrician and no primary care visits. No primary care visits were combined with fee-for-service due to small cell sizes For continuity of care, infrequent care (<4 visits) and low (≤75%) were combined to stabilize the models and account for small cells.

[§]Including maternal schizophrenia in the model

Supplementary Table 7: Sensitivity analysis Up-to-date vaccinations at 24 months of age in children born to women with (N=1514) versus without (N=520,592) schizophrenia up to child age 24-months, adjusted for sociodemographic, maternal health, child health and postnatal covariates, presenting hazard ratios (HR) and 95% confidence intervals (CI)

	N (%) with outcome	Rate/ 100 person-year	Unadjusted HR (95% CI)	Adjusted HR 1 (Socio-demographics only) §	Adjusted HR 2 (maternal health characteristics only) §	Adjusted HR 3 (child characteristics only) §	Adjusted HR 4 (postnatal characteristics only) §	Fully-Adjusted HR (95% CI) §
Up to date vaccinations 24 months								
No maternal schizophrenia	239,464 (46.0)	25.9	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)	1.00 (referent)
Maternal schizophrenia	577 (38.5)	21.6	0.84 (0.77-0.92)	0.88 (0.81-0.96)	0.92 (0.84-1.00)	0.86 (0.79-0.94)	0.94 (0.86-1.03)	0.97 (0.89-1.06)
Sociodemographic characteristics								
Maternal age at delivery, mean (SD)	30.5 (5.3)		1.02 (1.02-1.02)	1.02 (1.02-1.02)				1.01 (1.01-1.01)
Parity								
Multiparous	128,976 (44.0)	24.5	1.00 (referent)	1.00 (referent)				1.00 (referent)
Primiparous	111,065 (48.5)	27.6	1.19 (1.18-1.20)	1.26 (1.25-1.27)				1.23 (1.22-1.24)
Income								
Q1 (Lowest)	46,858 (40.2)	22.3	1.00 (referent)	1.00 (referent)				1.00 (referent)
Q2	47,198 (45.2)	25.4	1.17 (1.15-1.18)	1.14 (1.12-1.15)				1.10 (1.09-1.12)
Q3	49,528 (46.7)	26.3	1.21 (1.20-1.23)	1.17 (1.16-1.19)				1.15 (1.13-1.16)
Q4	53,826 (49.4)	28.0	1.31 (1.30-1.33)	1.26 (1.24-1.28)				1.19 (1.18-1.21)
Q5 (check where missing is)	42,631 (49.6)	28.1	1.32 (1.30-1.34)	1.26 (1.25-1.28)				1.18 (1.16-1.19)
Region of residence								
Urban	223,830 (47.5)	26.9	1.00 (referent)	1.00 (referent)				1.00 (referent)
Rural	16,211 (31.6)	17.1	0.58 (0.57-0.59)	0.63 (0.62-0.65)				0.73 (0.72-0.74)
Immigrant status								
Non-migrant/long-term resident	167,020 (44.7)	25.1	1.00 (referent)	1.00 (referent)				1.00 (referent)
Non-refugee immigrant	64,777 (49.7)	28.3	1.18 (1.17-1.19)	1.13 (1.12-1.14)				1.05 (1.04-1.06)
Refugee	8,244 (44.5)	25.0	1.00 (0.97-1.02)	0.99 (0.97-1.02)				0.95 (0.92-0.97)
Maternal health								
Unstable chronic medical condition								
No unstable condition	217,895 (45.8)	25.8	1.00 (referent)		1.00 (referent)			1.00 (referent)
Unstable chronic medical condition	22,146 (47.3)	26.7	1.05 (1.03-1.06)		1.05 (1.03-1.06)			1.02 (1.00-1.03)
Mood/anxiety disorder								
No mood/anxiety disorder	206,973 (46.0)	25.9	1.00 (referent)		1.00 (referent)			1.00 (referent)
Mood/anxiety disorder	33,068 (45.6)	25.6	0.98 (0.97-0.99)		1.00 (0.99-1.01)			1.00 (0.98-1.01)
Alcohol or substance use disorder								

No disorder	238,527 (46.2)	26.0	1.00 (referent)	1.00 (referent)		1.00 (referent)
Alcohol or substance use disorder	1,514 (27.9)	15.2	0.54 (0.51-0.56)	0.55 (0.53-0.58)		0.81 (0.77-0.85)
Other non-psychotic mental disorder						
No other non-psychotic disorder	238,927 (46.0)	25.9	1.00 (referent)	1.00 (referent)		1.00 (referent)
Other non-psychotic disorder	1,114 (37.1)	20.6	0.76 (0.72-0.81)	0.86 (0.81-0.92)		0.97 (0.91-1.03)
Psychiatric admission 2 y pre-pregnancy						
No psychiatric admission	239,192 (46.0)	25.9	1.00 (referent)	1.00 (referent)		1.00 (referent)
Psychiatric admission	849 (34.4)	19.1	0.69 (0.65-0.74)	0.84 (0.78-0.90)		0.96 (0.89-1.03)
Severe pregnancy complications*						
No severe pregnancy complications*	207,969 (46.0)	25.9	1.00 (referent)	1.00 (referent)		1.00 (referent)
Severe pregnancy complications*	32,072 (45.6)	25.7	1.00 (0.99-1.01)	1.00 (0.98-1.01)		1.01 (0.99-1.02)
Caesarean section						
No caesarean section	169,502 (45.6)	25.6	1.00 (referent)	1.00 (referent)		1.00 (referent)
Caesarean section	70,539 (46.9)	26.4	1.04 (1.03-1.05)	1.04 (1.03-1.05)		1.00 (0.99-1.01)
Child characteristics						
Baby's sex						
Male	123,245 (46.0)	25.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Female	116,796 (45.9)	25.8	1.00 (0.99-1.01)		1.00 (1.00-1.01)	1.01 (1.00-1.02)
Preterm birth						
37 weeks gestation or later	222,127 (46.2)	25.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
<37 weeks' gestation	17,914 (43.4)	24.9	0.96 (0.94-0.97)		0.98 (0.96-1.00)	0.92 (0.90-0.94)
NICU in the index birth						
No NICU	210,743 (46.3)	26.0	1.00 (referent)		1.00 (referent)	1.00 (referent)
NICU	29,298 (43.9)	24.9	0.95 (0.94-0.96)		0.96 (0.95-0.98)	0.97 (0.96-0.98)
Discharged to social services at birth						
Not discharged to social services	239,791 (46.0)	25.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Discharged to social services	250 (23.3)	13.8	0.53 (0.46-0.60)		0.54 (0.47-0.61)	0.83 (0.73-0.94)
Postnatal characteristics						
Maternal mood/anxiety disorder						
No mood/anxiety disorder	202,117 (45.9)	25.8	1.00 (referent)		1.00 (referent)	1.00 (referent)
Mood/anxiety disorder	37,924 (46.5)	25.9	0.99 (0.98-1.00)		1.03 (1.02-1.05)	1.04 (1.03-1.06)
Maternal substance use disorder						
No disorder	238,838 (46.2)	26.0	1.00 (referent)		1.00 (referent)	1.00 (referent)
Alcohol or substance use disorder	1,203 (25.3)	13.4	0.46 (0.44-0.49)		0.58 (0.55-0.62)	0.73 (0.69-0.77)
Maternal other non-psychotic disorder						
No other non-psychotic disorder	239,091 (46.0)	25.9	1.00 (referent)		1.00 (referent)	1.00 (referent)
Other non-psychotic disorder	950 (36.0)	19.6	0.71 (0.67-0.76)		0.87 (0.82-0.93)	0.92 (0.86-0.98)

Maternal psychiatric admission					
None from 0-24 months postpartum	239,170 (46.0)	25.9	1.00 (referent)	1.00 (referent)	1.00 (referent)
From 0- 24 months postpartum	871 (34.4)	18.7	0.68 (0.64-0.73)	0.89 (0.83-0.95)	0.93 (0.86-0.99)
Child complex chronic condition					
No	233,992 (46.2)	26.0	1.00 (referent)	1.00 (referent)	1.00 (referent)
Yes	6,049 (37.8)	21.6	0.81 (0.79-0.83)	0.74 (0.72-0.76)	0.76 (0.74-0.78)
Mother-child residence at 24 months					
Concordant	210,299 (46.7)	26.3	1.00 (referent)	1.00 (referent)	1.00 (referent)
Discordant	29,742 (41.7)	22.9	0.84 (0.82-0.85)	0.87 (0.86-0.88)	0.89 (0.88-0.91)
Child usual provider of care†					
Enrolled	150,332 (43.0)	23.9	1.00 (referent)	1.00 (referent)	1.00 (referent)
Fee-for-service/ no care	5,084 (15.5)	8.5	0.32 (0.31-0.33)	0.38 (0.36-0.39)	0.40 (0.39-0.41)
Paediatrician	84,625 (60.6)	35.4	1.71 (1.70-1.73)	1.72 (1.70-1.73)	1.64 (1.62-1.65)
Continuity of Care*					
Low (≤75%)	90,683 (37.1)	20.5	1.00 (referent)	1.00 (referent)	1.00 (referent)
High (≥76%)	149,358 (53.8)	30.7	1.63 (1.61-1.64)	1.51 (1.49-1.52)	1.49 (1.48-1.51)

severe pregnancy complications comprise pre-eclampsia, eclampsia, venous thromboembolism, severe obstetric morbidity (placental abruption, placental infarction, obstetric embolism, septic shock, uterine rupture) or systemic maternal complications in pregnancy or postpartum (cardiomyopathy, complications of anaesthesia, acute renal failure, MI/pulmonary enema, cerebrovascular disease, acute respiratory distress syndrome, DIC (disseminated intravascular coagulation), status epilepticus, hysterectomy. .† We determined the usual provider of primary care (UPC) by identifying the physician with the greatest number of days of visits for a child. For any ties arising, the provider who most recently saw the child was assigned. Groups were: enrolled (reference group), fee-for-service, paediatrician and no primary care visits. No primary care visits were combined with fee-for-service due to small cell sizes For continuity of care, infrequent care (<4 visits) and low (≤75%) were combined to stabilize the models and account for small cells.

[§]Including maternal schizophrenia in the model

Appendix 1: Additional ICES datasets

Additional ICES linked datasets were the: (1) Ontario Registered Persons Database (RPDB) that comprises individual-level dates of birth, death, and postal codes of residence for all Ontario residents and allows for estimation of socioeconomic status; (2) the Ontario segment of the Immigration, Refugees and Citizenship Canada (IRCC) database, that contains data on all immigrants to Ontario since 1985;[3] (3) the Ontario Health Insurance Plan (OHIP) dataset with physician billing data dating from 1992 including diagnostic data to provide information on ambulatory visits for maternal schizophrenia, well-baby visits and vaccine-specific codes (the latter since March 2011);[4,5] (4) the National Ambulatory Care Reporting System (NACRS) that includes all emergency department data from 2002 onward; (5) the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) that contains demographic and clinical information about hospital admissions and discharges, including psychiatric hospitalizations prior to 2006;[6] (6) the Ontario Mental Health Reporting System (OMHRS) that contains inpatient psychiatric hospitalization data from 2006 onward.[7-9]

References

1. Feudtner C, Feinstein JA, Zhong W, Hall M, Dai D. Pediatric complex chronic conditions classification system version 2: updated for ICD-10 and complex medical technology dependence and transplantation. *BMC pediatrics*. Aug 8 2014;14:199. doi:10.1186/1471-2431-14-199
2. McLeod L, Buckley G, Sweetman A. Ontario primary care models: a descriptive study. *CMAJ open*. 2016;4(4):E679.
3. Chiu M, Lebenbaum M, Lam K, et al. Describing the linkages of the immigration, refugees and citizenship Canada permanent resident data and vital statistics death registry to Ontario's administrative health database. *BMC Med Inform Decis Mak*. 2016;16(1):135-135. doi:10.1186/s12911-016-0375-3
4. Williams J, Young W. A summary of studies on the quality of health care administrative databases in Canada. *Patterns of health care in Ontario: the ICES practice atlas 2nd ed Ottawa: Canadian Medical Association*. 1996;339:45.
5. Schwartz KL, Tu K, Wing L, et al. Validation of infant immunization billing codes in administrative data. *Human vaccines & immunotherapeutics*. 2015;11(7):1840-1847.
6. Juurlink D, Preyra C, Croxford R, et al. Canadian institute for health information discharge abstract database: a validation study. *ICES investigative report Institute for Clinical Evaluative Sciences, Toronto*. 2006;
7. Hirdes JP, Marhaba M, Smith TF, et al. Development of the resident assessment instrument–mental health (RAI-MH). *Hosp Q*. 2000;4(2):44-51.
8. Hirdes JP, Smith TF, Rabinowitz T, et al. The resident assessment instrument-mental health (RAI-MH): Inter-rater reliability and convergent validity. *The journal of behavioral health services & research*. 2002;29(4):419-432.
9. Martin L, Hirdes J, Morris J, Montague P, Rabinowitz T, Fries B. Validating the Mental Health Assessment Protocols (MHAPs) in the Resident Assessment Instrument Mental Health (RAI-MH). *Journal of Psychiatric and Mental Health Nursing*. 2009;16(7):646-653.