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Prenatal opioid exposure and well-child care in the first 2 years of life: population-based cohort study

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ABSTRACT

Objectives To quantify well-child visits by age 2 years and developmental screening at the 18-month enhanced well-child visit among children with prenatal opioid exposure (POE) and to identify factors associated with study outcomes.

Design Population-based cohort study.

Setting Ontario, Canada.

Participants 22 276 children with POE born 2014–2018 were classified as (1) 1–29 days of prescribed opioid analgesia, (2) 30+ days of prescribed opioid analgesia, (3) medication for opioid use disorder (MOUD), (4) MOUD and opioid analgesia, or (5) unregulated opioids.

Main outcome measures Attending ≥5 well-child visits by age 2 years and the 18-month enhanced well-child visit. Modified Poisson regression was used to examine factors associated with outcomes.

Results Children with POE to 1–29 days of analgesics were most likely to attend ≥5 well-child visits (61.2%). Compared with these children, adjusted relative risks (aRRs) for ≥5 well-child visits were lower among those exposed to 30+ days of opioid analgesics (0.95, 95% CI 0.91 to 0.99), MOUD (0.83, 95% CI 0.79 to 0.88), MOUD and opioid analgesics (0.78 95% CI 0.68 to 0.90) and unregulated opioids (0.89, 95% CI 0.83 to 0.95). Relative to children with POE to 1–29 days of analgesics (58.5%), respective aRRs for the 18-month enhanced well-child visit were 0.92 (95% CI 0.88 to 0.96), 0.76 (95% CI 0.72 to 0.81), 0.76 (95% CI 0.66 to 0.87) and 0.82 (95% CI 0.76 to 0.88). Having a regular primary care provider was positively associated with study outcomes; socioeconomic disadvantage, rurality and maternal mental health were negatively associated.

Conclusion Well-child visits are low in children following POE, especially among offspring of mothers receiving MOUD or unregulated opioids. Strategies to improve attendance will be important for child outcomes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Developmental concerns have been raised among infants following prenatal opioid exposure (POE). Routine care visits in early life offer key time points for assessing early developmental milestones.

WHAT THIS STUDY ADDS

⇒ This is the first study to explore well-child care by type of POE in a universal insurance healthcare system. In this population-based cohort study of 22 276 children with POE, significant disparities in well-child visits and developmental screening were identified by type of opioid exposure and measurable socioenvironmental factors.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Findings suggest the need for effective strategies to strengthen access to primary care for maternal–child dyads and clinical practice guidelines to ensure all children with POE receive preventive care and developmental screening.

Opioid use in pregnancy is increasingly common in North America,[1 2] with opioids dispensed in 14%–22% of pregnancies in the USA and 4%–7% in Canada.[3–7] Accumulating evidence suggests prenatal opioid exposure (POE) is associated with adverse developmental health, with impairment varying by type of POE, and biological and socioenvironmental factors.[8 9] These factors are compounded by barriers to healthcare, including discrimination, fear of child welfare involvement and lack of a regular primary care provider, which may result in limited interaction with the healthcare system and lower rates of preventive care for children.[10 11]

Well-child care is an important part of paediatric preventive healthcare. Well-child visits provide opportunities to assess development, physical health, administer immunisations, provide anticipatory guidance and connect families to specialised services.[12] While well-child care is important for all children, it may be especially important for children with higher risk of poor health and development, such as those with POE.

Recent studies from the USA show children with POE, compared with unexposed children, are 23%-46% less likely to receive recommended well-child visits in the first 2 years of life.[13–15] However, no studies have explored this association by type of POE. Medication for opioid use disorder (MOUD), compared with untreated opioid use disorder (OUD), is associated with improved maternal and infant health and child welfare outcomes[11 16]; however, the impact of MOUD on paediatric preventive care is unknown. Understanding disparities in well-child care among children with POE is important to identify ways to optimise long-term child health and development. The objectives of this study are to (1) quantify physician well-child visits by age 2 years

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and developmental screening at 18 months by type of POE; (2) identify important social determinants of health associated with receiving study outcomes among children with POE; and (3) among a subgroup of children whose mothers were receiving MOUD in pregnancy, examine the association between postpartum MOUD use and recommended well-child visits.

METHODS

Study design and setting

This population-based cohort study included all live births with POE (defined further) born at 23–42 weeks' gestation in Ontario, Canada, between 1 January 2014 and 28 February 2018. Ontario has a universal publicly funded healthcare system. Included were births to people with provincial health insurance 2 years before conception and during pregnancy. We excluded children born to people aged <12 or >50 years, discharged to social services at birth, with missing information for sex, who received primary care through a community health centre or nurse practitioner, moved out of Ontario or died at <24 months of age. We followed Strengthening the Reporting of Observational Studies in Epidemiology and Reporting of Studies Conducted Using Observational Routinely Collected Health Data reporting guidelines.[17 18]

Table 1 Child and maternal characteristics by type of POE

	Type of POE					
Characteristic, N (%)	Total N=22 276	Analgesic 1–29 days N=15 920	Analgesic 30+ days N=2208	MOUD N=2539	MOUD+analgesic N=334	Unregulated opioid use N=1275
Child						
Female sex	10 800 (48.5)	7779 (48.9)	1066 (48.3)	1243 (49.0)	154 (46.1)	558 (43.8)
Preterm birth <37 weeks' gestation	2520 (11.3)	1551 (9.7)	310 (14.0)‡	367 (14.5)‡	56 (16.8)‡	236 (18.5)‡
Low birth weight <2500 g	1964 (8.8)	1087 (6.8)	251 (11.4)‡	344 (13.6)‡	59 (17.7)‡	223 (17.5)‡
Admission to neonatal intensive care unit	5210 (23.4)	2499 (15.7)	594 (26.9)‡	1281 (50.5)‡	211 (63.2)‡	625 (49.0)‡
Multiple birth	456 (2.0)	349 (2.2)	53 (2.4)	Suppressed	Suppressed	26 (2.0)
Complex medical condition	1287 (5.8)	716 (4.5)	158 (7.2)‡	200 (7.9)‡	47 (14.1)‡	166 (13.0)‡
Neonatal abstinence syndrome	3329 (14.9)	168 (1.1)	263 (11.9)‡	1640 (64.6)‡	240 (71.9)‡	1018 (79.8)‡
Rural residence	3177 (14.3)	1756 (11.0)	271 (12.3)	669 (26.3)‡	59 (17.7)‡	422 (33.1)‡
Neighbourhood-level deprivation						
Q1	3478 (15.6)	2920 (18.3)	267 (12.1)‡	154 (6.1)‡	23 (6.9)‡	114 (8.9)‡
Q2	3677 (16.5)	2968 (18.6)	330 (14.9)	210 (8.3)‡	25 (7.5)‡	144 (11.3)‡
Q3	3769 (16.9)	2947 (18.5)	372 (16.8)	251 (9.9)‡	44 (13.2)‡	155 (12.2)‡
Q4	4134 (18.6)	2941 (18.5)	464 (21.0)	453 (17.8)	72 (21.6)	204 (16.0)
Q5 (most deprived)	6274 (28.2)	3988 (25.1)	739 (33.5)‡	1027 (40.4)‡	150 (44.9)‡	370 (29.0)
Missing	944 (4.2)	156 (1.0)	36 (1.6)	444 (17.5)‡	20 (6.0)‡\	288 (22.6)‡
Median number of well-child visits in the first 2 years of life (IQR)	5 (2–7)	5 (3–7)	5 (3–6)‡	3 (0–5)‡	3 (1–5)‡	3 (0–6)‡
Zero well-child visits in the first 2 years of life	2619 (11.8)	1242 (7.8)	201 (9.1)	718 (28.3)‡\	61 (18.3)‡	397 (31.1)‡
Regular primary care provider, specialty						
No regular primary care provider	722 (3.2)	323 (2.0)	34 (1.5)	237 (9.3)‡	22 (6.6)‡	106 (8.3)‡
General practitioner, primary care model	12 220 (54.9)	9358 (58.8)	1265 (57.3)	989 (39.0)‡	138 (41.3)‡	470 (36.9)‡
General practitioner, no model	6842 (30.7)	4324 (27.2)	697 (31.6)	1097 (43.2)‡	137 (41.0)‡	587 (46.0)‡
Paediatrician	2492 (11.2)	1915 (12.0)	212 (9.6)	216 (8.5)‡	37 (11.1)	112 (8.8)‡
Maternal						
Age at delivery (years), mean±SD	29.9±5.6	30.2±5.6	32.0±5.2‡	28.0±4.7‡	29.4±4.8‡	27.0±6.0‡
<19 years at first birth	2652 (11.9)	1382 (8.7)	263 (11.9)‡	625 (24.6)‡	65 (19.5)‡	317 (24.9)‡
First live birth	8135 (36.5)	6193 (38.9)	662 (30.0)‡	691 (27.2)‡	82 (24.6)‡	507 (39.8)
Immigrant	3058 (13.7)	2736 (17.2)	247 (11.2)‡	Suppressed	Suppressed	46 (3.6)‡
Social disadvantage*†	1281 (5.8)	584 (3.7)	113 (5.1)	345 (13.6)‡	53 (15.9)‡	186 (14.6)‡
Mental health-related hospital care†	1702 (7.6)	908 (5.7)	172 (7.8)	298 (11.7)‡	64 (19.2)‡	260 (20.4)‡
Non-opioid drug-related hospital care†	1172 (5.3)	240 (1.5)	90 (4.1)‡	474 (18.7)‡	98 (29.3)‡	270 (21.2)‡
Regular primary care provider	12 311 (55.3)	9936 (62.4)	1292 (58.5)	584 (23.0)‡	72 (21.6)‡	427 (33.5)‡
Maternal–child concordant regular primary care provider	12 622 (56.7)	10 018 (62.9)	1278 (57.9)	742 (29.2)‡	80 (24.0)‡	504 (39.5)‡

Sample sizes<6 were suppressed.
*Social disadvantage is a composite of violence-related healthcare, homelessness and criminal justice system involvement, as noted within healthcare records, which may not be comprehensive. Criminal justice system involvement includes all billing data related to medical care received while incarcerated or other circumstances resulting in medical referral from police or legal counsel, which will only capture incarceration in the event of concurrent medical care.
†Measured in the 2 years before conception and pregnancy.
‡Indicates a meaningful difference compared with the analgesic 1–29 days group according to standardised differences of >0.10.
MOUD, medication for opioid use disorder; POE, prenatal opioid exposure.

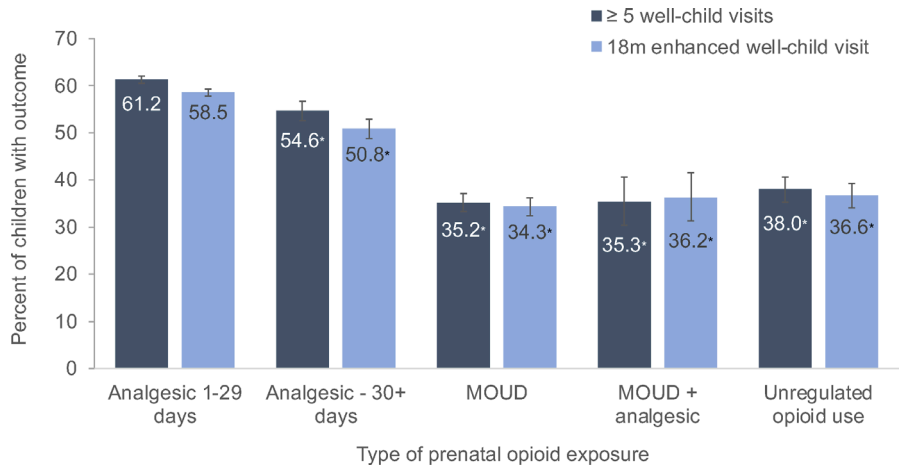

Figure 1 Per cent of children with ≥5 physician visits for well-child care and developmental screening at the 18-month enhanced well-child visit by type of prenatal opioid exposure. *Indicates a meaningful difference compared with the analgesic 1–29 days group according to standardised differences of >0.10. Bars represent 95% CIs. MOUD, medication for opioid use disorder.

Data sources

We used linked administrative databases at ICES, an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyse health and demographic data for health system improvement. We identified maternal–child dyads from a database of newborn records and obtained data on prescription opioids, hospital care, outpatient physician visits and demographics using unique encoded identifiers. Datasets are detailed in online supplemental table 1 and described elsewhere.[19–22]

Exposure

The primary exposure was type of POE categorised as (1) 1–29 days of analgesic use; (2) 30+ days of analgesic use; (3) MOUD (buprenorphine, methadone or unspecified opioid agonist therapy); (4) both MOUD and opioid analgesic use; and (5) unregulated opioid use. POE was identified during pregnancy through (1) prescription opioid analgesics or MOUD; (2) maternal outpatient visits for opioid agonist therapy; (3) maternal opioid-related hospital records (emergency department and hospitalisations) using International Classification of Diseases, 10th Revision, diagnostic codes for OUD, toxicity or adverse drug reactions; or (4) newborn hospital records for neonatal abstinence syndrome (NAS).[23] Opioid-related hospital care in pregnancy or children with NAS and no record of opioid prescriptions or opioid agonist therapy were categorised as unregulated opioid use (ie, heroin and fentanyl). A secondary exposure, postpartum MOUD (prescription methadone or buprenorphine), was measured at 6 weeks post partum among a subset of the cohort whose mothers received MOUD during pregnancy and were followed up into the postpartum period.

Outcomes

Outcomes were based on Canadian Paediatric Society recommendations for well-child visits at 2, 4, 6, 9 (optional), 12, 15 (optional) and 18 months. The 18-month visit is a universal enhanced well-child visit which includes developmental screening using standardised parent and physician tools.[24 25] Outcomes included ≥5 well-child visits by a family physician or paediatrician from 6 weeks up to 24 months of age, and 18-month enhanced well-child visit from a family physician or paediatrician from 17 months up to 24 months of age. Outcomes were ascertained using primary care fee codes specific to well-child visits and the 18-month enhanced well-child visit (online supplemental table 1).

Covariates

Covariates were identified from existing literature.[13 26] Child covariates included year of birth, sex, multiple birth, gestational age, neonatal intensive care unit (NICU) admission, complex medical conditions[27] at birth, neighbourhood-level material deprivation quintile,[28 29] rurality and regular primary care provider specialty.[26] Maternal covariates included age at first delivery, previous live birth, immigrant status,[22] social disadvantage (violence-related hospital care, homelessness recorded in healthcare records or receiving medical care while involved with the criminal justice system), hospital care for mental illness and substance use[30] during pregnancy and 2 years before conception and regular primary care provider (online supplemental table 1).

Statistical analysis

We compared characteristics and study outcomes between each type of POE to the 1–29 days of analgesic use group using standardised differences; differences >0.10 were considered meaningful.[31]

To identify factors associated with each outcome, modified Poisson regression was used to estimate unadjusted and adjusted relative risks (aRRs), with robust variance estimators to account for clustering of multiple births to the same mother.[32] Children's regular primary care provider specialty was not included in 18-month enhanced well-child visit models as some children had no identifiable primary care provider and no 18-month enhanced well-child visit, and we did not want to exclude these children. We adjusted for all other covariates.

We conducted a subgroup analysis among children born to people receiving MOUD in pregnancy. Modified Poisson regression was used to compare the risk of each outcome among children whose mothers were receiving MOUD, relative to no MOUD, at 6 weeks post partum.

Sensitivity analyses included (1) classifying the outcome as a developmental screening composite of physician visits for 18-month enhanced well-child visits, neurodevelopmental assessment or paediatric developmental assessment (to assess additional developmental screening); (2) classifying the exposure as NAS (to assess different follow-up care); (3) classifying the exposure according to five distinct subgroups of people who

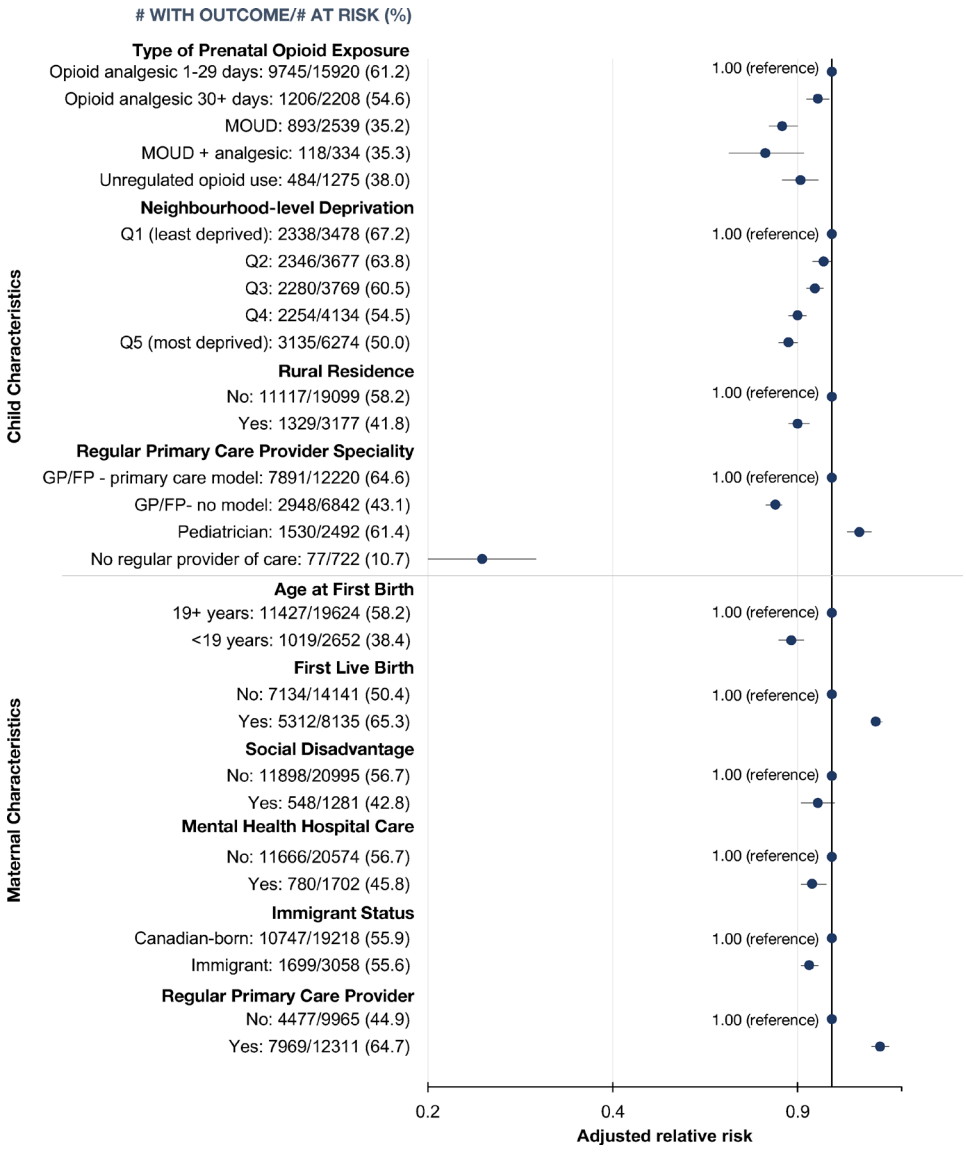

Figure 2 Factors associated with ≥5 physician visits for well-child care in the first 2 years of life among infants with prenatal opioid exposure. Adjusted for year of birth, infant sex, gestational age, multiple births, admission to neonatal intensive care unit and complex chronic medical conditions at birth hospitalisation and maternal non-opioid drug-related hospital care in the 2 years before conception. Missing deprivation quintile: 93/944 (9.9%), aRR 0.28, 95% CI 0.23 to 0.34. Modified Poisson regression was used to generate aRRs and 95% CIs. aRR, adjusted relative risk; FP, family physician; GP, general practitioner; MOUD, medication for opioid use disorder.

used opioids in pregnancy, using a previously generated latent class analysis[33] (LCA) of 20 social, clinical and pharmacological factors (online supplemental table 4), including short-term analgesia with low comorbidity (group 1), analgesia in young people (group 2), MOUD or unregulated opioid use (group 3), pain management with comorbidity (group 4) and mixed opioid use+high social and medical needs (group 5); (4) excluding children residing in rural areas (to assess receiving well-child care from a nursing station in remote areas not captured in our data); (5) excluding children with zero well-child visits (to assess primary care not captured by our data); and (6) excluding children with birth hospitalisations of >56 days (to evaluate different care received while hospitalised).

Model fit and overdispersion of Poisson regression models were assessed using Pearson and deviance statistics. Where gestational age was not available in infant records, maternal records were used. Missing neighbourhood-level deprivation was included in the analyses as a separate category. Analyses were performed using SAS Enterprise Guide V.7.15.

RESULTS

There were 22 276 children with POE (online supplemental figure 1) to 1–29 days of analgesics (n=15 920, 71.5%), 30+ days of analgesics (n=2208, 9.9%), MOUD (n=2539, 11.4%), both MOUD and analgesics (n=334, 1.5%) and unregulated opioids (n=1275, 5.7%). Child and maternal characteristics varied by type of POE (table 1). Children with prenatal exposure to MOUD or unregulated opioids, compared with children with 1–29 days of opioid analgesics, were more likely to experience adverse neonatal outcomes, live in rural areas, have mothers with social disadvantage, mental health and substance use hospital care and no regular primary care provider.

Overall, 55.9% of children attended ≥5 well-child visits in the first 2 years of life, and 53.4% attended the 18-month enhanced

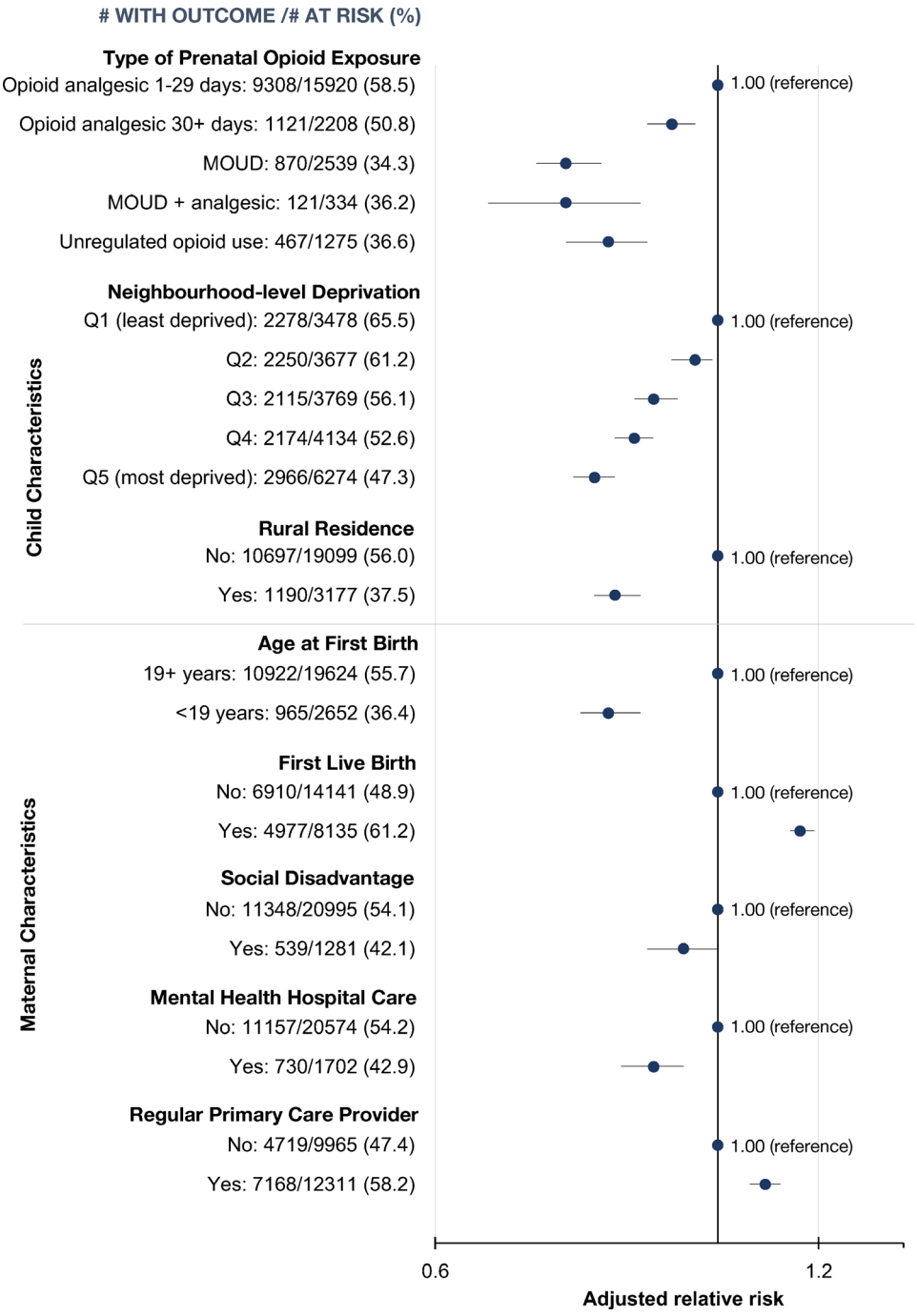

Figure 3 Factors associated with developmental screening at the 18-month enhanced well-child visit among infants with prenatal opioid exposure. Adjusted for year of birth, infant sex, gestational age, multiple births, admission to neonatal intensive care unit and complex chronic medical conditions at birth hospitalisation and maternal non-opioid drug-related hospital care in the 2 years before conception and immigrant status. Missing deprivation quintile: 104/944 (11.0%), aRR 0.28, 95% CI 0.23 to 0.34. Modified Poisson regression was used to generate aRRs and 95% CIs. aRR, adjusted relative risk; MOUD, medication for opioid use disorder.

well-child visit. Children with prenatal exposure to 1–29 days of opioid analgesics were most likely to attend ≥5 well-child visits (61.2%) (figure 1). Compared with these children, there was a lower likelihood of attending ≥5 well-child visits among children with prenatal exposure to 30+ days of opioid analgesics (54.6%; aRR 0.95, 95% CI 0.91 to 0.99), MOUD (35.2%; aRR 0.83, 95% CI 0.79 to 0.88), MOUD and opioid analgesics (35.3%; aRR 0.78, 95% CI 0.68 to 0.90), and unregulated opioids (38.0%; aRR 0.89, 95% CI 0.83 to 0.95) (figure 2).

Children with prenatal exposure to 1–29 days of opioid analgesics were also most likely to attend the 18-month enhanced well-child visit (58.5%), with a lower likelihood of attendance among children with prenatal exposure to 30+ days of opioid analgesics (50.8%; aRR 0.92, 95% CI 0.88 to 0.96), MOUD (34.3%; aRR 0.76, 95% CI 0.72 to 0.81), MOUD and opioid analgesics (36.2%; aRR 0.76, 95% CI 0.66 to 0.87), and unregulated opioids (36.6%; aRR 0.82 95% CI 0.76 to 0.88) (figure 3).

Factors negatively associated with study outcomes included neighbourhood-level material deprivation, rurality, maternal mental health-related hospital care, social disadvantage and young age at first birth. First-born children and with mothers with a regular primary care provider were more likely to receive study outcomes. Children with paediatricians as regular primary care providers were more likely to attend ≥5 well-child visits (figures 2 and 3).

There were 2659 children with prenatal exposure to MOUD in the subgroup analysis, of which 2032 (76.4%) had mothers receiving MOUD at 6 weeks post partum. Children with mothers receiving MOUD at 6 weeks post partum, compared with those not receiving MOUD, had slightly higher rates of ≥5 well-child visits (37.1% vs 33.3%) and 18-month enhanced well-child visit (36.1% vs 32.7%). These differences were attenuated in adjusted analyses (≥5 well-child visits: aRR 0.96, 95% CI 0.86 to 1.08; 18-month enhanced well-child visit: aRR 0.95, 95% CI 0.84 to 1.08) (table 2).

Sensitivity analyses

Children with NAS at birth, compared with without, were less likely to attend ≥5 well-child visits and receive developmental screening. When the exposure was classified as latent subgroups of people with opioid use in pregnancy, children born to mothers with prenatal MOUD and unregulated opioid use were least likely to receive ≥5 well-child visits (aRR 0.64, 95% CI 0.60 to 0.68) and 18-month enhanced well-child visit (aRR 0.56, 95% CI 0.52 to 0.59). There were no other appreciable changes (online supplemental tables 2–7).

DISCUSSION

In this large, population-based cohort study, we reported lower rates of attendance at the 18-month enhanced well-child visit among children with POE than previously reported for children in Ontario (53% vs 61%).[26] Children with prenatal exposure to MOUD and both MOUD and opioid analgesics were least likely to receive recommended well-child care. Though attenuated from the crude analysis, differences in attendance of ≥5 well-child visits and 18-month enhanced well-child visit by type of POE persisted after adjustment. First-born children, followed by a paediatrician for regular primary care, and whose mothers had a regular primary care provider were more likely to attend ≥5 well-child visits and the 18-month enhanced well-child visit. Factors negatively associated with study outcomes were rural residence, social disadvantage and maternal mental health hospital care. We did not identify evidence of an association between postpartum MOUD and well-child visits among children born to mothers receiving MOUD in pregnancy, though most mothers continued MOUD use at 6 weeks post partum (76.4%).

Our findings are consistent with a large US study showing children with POE were less likely to receive recommended well-child care in the first (aRR 0.54) and second (aRR 0.77) years of life.[13] Similarly, Medicaid-enrolled children born to women with OUD were less likely than unexposed children to receive recommended well-child care by 15 months of age (42.1% vs 55.7%), and Medicaid-enrolled infants with POE and NAS were less likely to attend ≥5 well-child visits in the first year of life compared with unexposed infants (31.4% vs 44.8%).[14 15] This is the first study to explore well-child care by type of POE in a universal insurance healthcare system.

Type of POE identified vulnerable groups of children with exposure to MOUD, both MOUD and opioid analgesics, and unregulated opioids. The LCA groups, which contribute an understanding of social circumstances in relation to POE, identified children born to people with MOUD and unregulated opioid use in pregnancy as least likely to receive well-child care, demonstrating the utility of LCA to identify higher-risk children who could benefit from integrated support. Consistent with previous research, maternal mental health and social disadvantage were negatively associated with well-child care[13 34 35] in a universal healthcare context.[26] People with OUD, outside of pregnancy, are less likely to have a regular primary care provider.[10] In our study, 62% of people with short-term prenatal opioid analgesic use had a regular primary care provider compared with 23% of people with prenatal MOUD. Having a regular primary care provider was a strong predictor of well-child care.

Inequities in well-child care likely reflect discrimination, systemic barriers to care and lack of parental agency. Findings support the need for programmes and policies to ensure continuity of care and equitable access to primary healthcare for families affected by POE (eg, non-judgemental treatment, home visits and healthcare navigator).

In Ontario, high-risk infants cared for in level 2/3 NICU are followed by developmental paediatric teams through neonatal follow-up clinics. Maternal drug use or NAS requiring pharmacological treatment meets the criteria for programme referral; however, not all infants with NAS are cared for with these programmes. Sensitivity analyses demonstrated children with NAS, compared with without, were less likely to receive developmental screening by age 2 years (41.6% vs 57.9%). Given the growing evidence of adverse neurodevelopment associated with POE, this criterion could be broadened to POE irrespective of pharmacological treatment. Opportunities to strengthen existing practice guidelines[36 37] to include a standardised approach to developmental screening and guidance for tailored care could mitigate adverse effects of POE.

Our study has limitations. Outcomes were limited to physician billing data, meaning we could not measure primary care through nursing stations in remote locations in Ontario (ie, First Nations

Table 2 Association of MOUD at 6 weeks post partum with well-child care outcomes among children born to people with any use of MOUD in pregnancy

	N	Individuals with outcome, n (%)	Relative risk (95% CI)	
			Unadjusted	Adjusted*
≥5 physician visits for well-child care				
MOUD at 6 weeks post partum				
Yes	2032	754 (37.1)	1.11 (0.98 to 1.25)	0.96 (0.86 to 1.08)
No	627	209 (33.3)	1.00 (ref)	1.00 (ref)
18-month enhanced well-child visit				
MOUD at 6 weeks post partum				
Yes	2032	734 (36.1)	1.10 (0.97 to 1.25)	0.95 (0.84 to 1.08)
No	627	205 (32.7)	1.00 (ref)	1.00 (ref)

Modified Poisson regression was used to generate relative risks (aRR) and 95% confidence intervals (CI).
*Adjusted for year of birth, neighbourhood-level deprivation quintile, rural residence, <19 years of age at birth, first liveborn child, maternal history of social disadvantage, hospital care related to mental illness or non-opioid drug use 2 years before conception and during pregnancy, and maternal regular primary care provider. Social disadvantage is a composite of violence-related healthcare, homelessness and criminal justice system involvement, as noted within healthcare records, which may not be comprehensive.
MOUD, medication for opioid use disorder ; ref, reference.

communities). However, sensitivity analyses excluding children in rural areas did not change primary findings. We assumed people took opioids as prescribed, which may result in exposure overestimation. NAS is typically caused by opioids but is associated with benzodiazepines and alcohol, which may result in misclassification. Evidence from a recent study in Massachusetts suggests almost all newborns with NAS (98%) were exposed to opioids.[38] Health administrative data are subject to coding accuracy, reflect users of the healthcare system and underestimate certain constructs (ie, unregulated opioids and social risk). We used validated and previously used definitions when possible. Nevertheless, findings are highly generalisable and reflect people with access to universal healthcare.

CONCLUSION

We identified significant gaps in preventive care for children with POE in a universal healthcare system. Findings suggest the need for effective strategies to strengthen access to primary care for maternal–child dyads and clinical practice guidelines to ensure all children with POE receive preventive care and developmental screening.

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Contributors AC conceptualised and designed the study, carried out the analyses, drafted the manuscript, and reviewed and revised the manuscript. AG, JR, LB, TG and TT conceptualised and designed the study, provided supervision, and reviewed and revised the manuscript. AC is guarantor.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants but was exempted from ethical approval. ICES is a prescribed entity under Ontario's Personal Health Information Protection Act (PHIPA). Section 45 of PHIPA authorises ICES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the management of, evaluation or monitoring of, the allocation of resources to or planning for all or part of the health system. Projects that use data collected by ICES under section 45 of PHIPA and use no other data are exempt from REB review. Use of data is authorised under section 45 of Ontario's PHIPA and does not require research ethics board review.

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Data availability statement The dataset from this study is held securely in coded form at ICES. While legal data sharing agreements between ICES and data providers (e.g., healthcare 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 www.ices.on.ca/DAS (email: 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 are therefore either inaccessible or may require modification.

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