ORIGINAL RESEARCH

Prenatal Care Coordination and Well-Child Visit Receipt in Early Childhood

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Introduction: **This study evaluates participation in Wisconsin Medicaid's Prenatal Care Coordination (PNCC) program and its association with children's well-child visit (WCV) receipt.**

Study Design: **Data came from linked Wisconsin birth records (2011 to 2015) and Medicaid claims and enrollment data (2010 to 2019). The sample comprised 113,347 children with Medicaid-paid births and continuous Medicaid enrollment ranging from 12 to 48 months post-birth. A sibling subsample comprised of 35,373 children. PNCC receipt in pregnancy was measured dichotomously (none; any) and categorically (none; assessment/care plan only; service uptake). Any WCV receipt and recommended WCV receipt (which varied by age) were measured during each year from age 0 up to 4 years old. Conventional logistic regressions and sibling fixed effects (FE) regressions estimated associations between PNCC receipt and WCV receipt.**

Results: **Demographic-adjusted sibling FE regressions—which best control for unobserved confounding—indicated that any PNCC was positively associated with children receiving any WCVs at age 0 to <1 year-old (OR 1.48; 95% CI 1.05–2.08) and at age 1 to <2 years old (OR 1.24; 95% CI 1.03–1.50). In addition, adjusted sibling FE regressions found that PNCC service uptake was associated with children receiving the recommended number of WCVs at age 0 to <1 year-old (OR 1.35; 95% CI 1.18–1.55).**

Conclusions: **PNCC may improve children's WCV attendance in the first 2 years of life. Findings underscore the potential for obstetric care coordination programs to enhance the continuity of preventive care for participating families. (J Am Board Fam Med 2025;38:513–538.)**

Keywords: **Care Coordination, Child Health, Logistic Models, Medicaid, Pediatrics, Pregnancy, Prenatal Care, Well-Child Visits, Wisconsin**

Introduction

Federal Medicaid expansion in the mid-1980s broadened eligibility, coverage, and benefits for maternal health services among low-income Americans.[1] Subsequently, many states developed obstetric care coordination programs,[2,3] including Prenatal Care Coordination (PNCC) in Wisconsin. PNCC is a Medicaid-funded, nonpharmacologic intervention that supplements standard prenatal care with tailored social and educational services to improve maternal and infant health.[4] Covered services—which include drug and alcohol cessation, psychosocial therapy, nutrition counseling, housing support, and food-purchasing assistance—intervene on behavioral and structural risk factors of adverse pregnancy outcomes. Research suggests that PNCC reduces the risks of preterm birth and low birth weight,[5,6] with similar benefits observed in adjacent programs.[7–12]

PNCC's effectiveness relies on beneficiary-clinician relationships. Through periodic contact, clinicians meet directly with enrolled beneficiaries to

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identify and provide services that align with their needs, desires, and values.[4] Clinicians and beneficiaries then develop a tailored care plan, and clinicians render services directly or assist beneficiaries in receiving those services by organizing at-home visits or nonemergency transportation. This connects PNCC participants to health care that they otherwise might not receive,[13] thereby promoting health care continuity during and following pregnancy.[14] Indeed, studies of adjacent programs found that participation increased maternal receipt of prenatal, postpartum, and family planning care.[15,16] Even PNCC assessment alone may help beneficiaries, as clinicians can connect assessed nonparticipants to services that better meet their health care needs.[14]

If PNCC clinicians help pregnant Medicaid beneficiaries receive additional health care, then PNCC clinicians may also help beneficiaries attain health care for their infants—in particular, well-child visits (WCVs).[17] PNCC and adjacent programs have increasingly promoted their services as holistic strategies that transition families from prenatal care to preventive care following pregnancy.[18–20] Since PNCC clinicians help participating beneficiaries plan for their infant's health care,[13] clinicians may educate beneficiaries on the utility of WCVs, recommended WCV scheduling, and support systems for attending WCVs. Assisting beneficiaries with WCV attendance is particularly relevant, as WCVs and prenatal care share many barriers to access: inadequate transportation, work, childcare, and low income.[13,14,21–24]

Presently, few studies investigate whether obstetric care coordination impacts children's WCV receipt. Analyses of Michigan's Maternal Infant Health Program (MIHP) during 2009 to 2012 found that assessment for services increases an infant's WCV receipt in the first year of life[15]—with dose-response effects among assessed families[25]—but impact beyond infancy is unknown. An evaluation of PNCC during 2008 to 2015 indicated that service receipt in pregnancy increases WCV receipt for older children in the family,[26] although impact on WCVs for the infant of that pregnancy was unexamined. With little attention to this topic, there is an opportunity to investigate obstetric care coordination's effect on WCV receipt after the first year of life and with more recent data to better understand how these programs impact health care continuity.

This study investigates the relationship between maternal PNCC receipt in pregnancy and children's WCV receipt in a Wisconsin birth cohort with data spanning 2010 to 2019. We track WCVs from 0 to 4 years old to examine whether care coordination has enduring benefits on WCV receipt throughout early childhood. We hypothesize that PNCC uptake is positively associated with WCV receipt during and beyond infancy.

Methods

Data

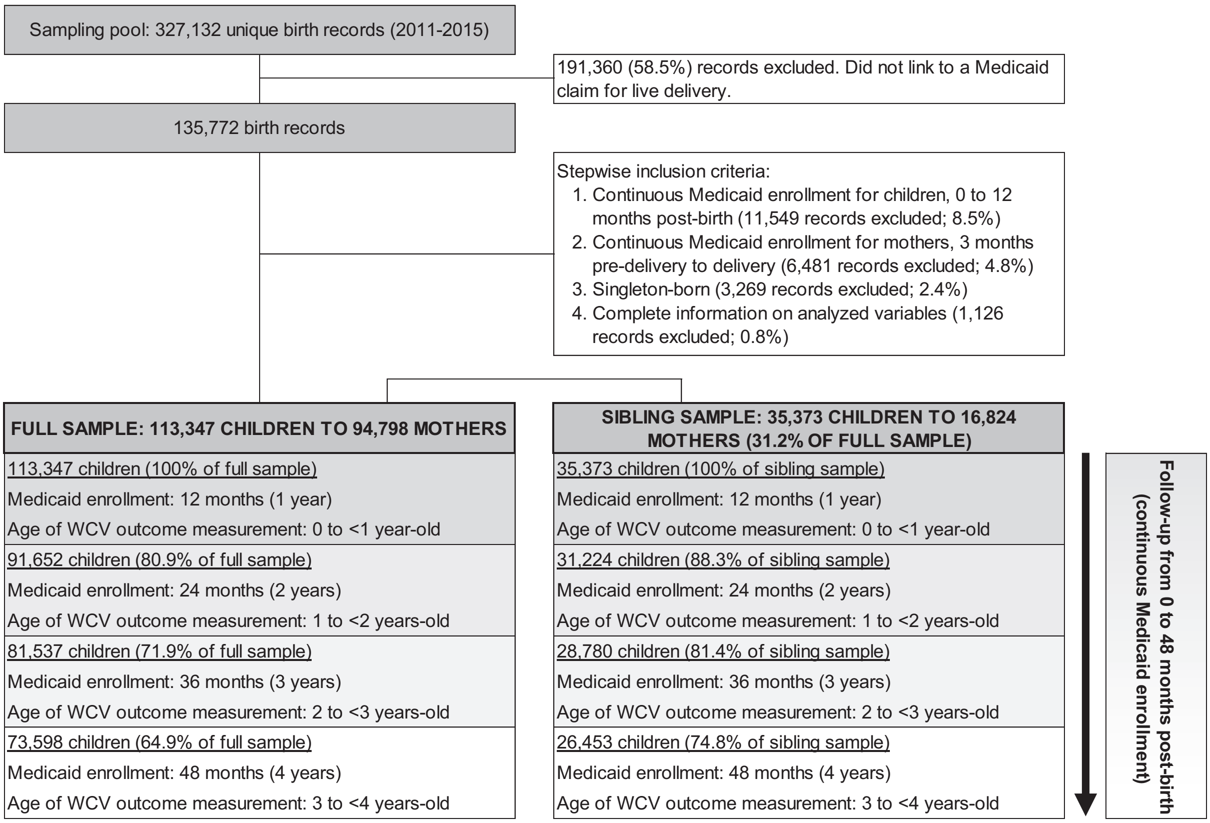
We analyzed Big Data for Little Kids, a longitudinal cohort that links Wisconsin birth records for live, in-state, resident deliveries to Medicaid claims and Medicaid enrollment files from the Wisconsin Administrative Data Core. The Appendix includes codes for identifying Medicaid claims for live delivery, PNCC, and WCVs. Records include unique maternal and child identifiers to create family clusters. Cohort linkage has been described previously.[27]

We sampled Medicaid-paid births (2011 to 2015) with linked Medicaid claims (2010 to 2019) and applied 4 inclusion criteria (Figure 1): continuous Medicaid coverage for children for at least 12 months post-birth to measure WCV receipt within the first year of life; continuous Medicaid coverage for mothers for at least 3 months leading up to delivery to measure PNCC receipt during pregnancy; singleton-born; and complete information on analyzed variables (listed later). From 327,132 birth records, we identified 135,772 Medicaid-paid births (41.5% of all birth records). Applying inclusion criteria yielded a full sample of 113,347 children (83.5% of Medicaid-paid births). We then generated a sibling sample of 35,373 children (31.2% of the full sample) for sibling fixed effects (FE) analyses. Within full and sibling samples, we created 3 subsamples on children's continuous Medicaid enrollment: 24 months post-birth (full: 91,652 children; sibling: 31,224 children); 36 months post-birth (full: 81,537 children; sibling: 28,780 children); and 48 months post-birth (full: 73,598 children; sibling: 26,453 children). These samples captured WCVs in the second, third, and fourth years post-birth while maximizing sample sizes.

Prenatal Care Coordination

PNCC is a Wisconsin state-managed Medicaid program that administers social and behavioral services to pregnant beneficiaries to improve maternal and

Figure 1. Sampling procedure.



Abbreviations: WCV, well-child visit.

infant health.[4] Clinicians can render PNCC assessments, care plans, and services if they meet 2 criteria: they are a Wisconsin Medicaid-enrolled health care professional; and they are employed at a PNCC-certified clinical or community-based service agency (eg, hospital, local public health department).[28] Examples of PNCC clinicians include nurses, physicians, dieticians, and social workers. PNCC clinicians may differ from a beneficiary's primary prenatal care clinician. The PNCC program does not directly mandate communication between PNCC clinicians and prenatal care clinicians. Providing institutions earn PNCC certification by submitting management plans to the Wisconsin Department of Health Services to demonstrate the capacity for administering PNCC.

To enroll, pregnant Medicaid beneficiaries complete an assessment at a PNCC-certified agency with or without referral.[28] Beneficiaries qualify for services if they are <18 years old or report at least 4 of 31 risk factors on a questionnaire (listed in the Appendix).[29] Risk factors relate to demographic background (eg, no college education), pregnancy history (eg, prior preterm birth), living conditions (eg, homelessness), and health behavior (eg, tobacco use). Questionnaires are available in the English, Hmong, and Spanish languages.[30] Eligibility is intentionally wide to broaden program outreach. Participating beneficiaries and care coordinators develop care plans and meet as needed (however, care coordinators can only bill for services once per 30 days).[28] Services last from initiation to 60 days postpartum.

We measured PNCC receipt during pregnancy dichotomously (none; any) and categorically (none; assessment/care plan only; service uptake). "PNCC service uptake" indicates PNCC service receipt beyond the care planning stage. We chose a categorical measure of PNCC over a continuous measure (eg, number of claims) as PNCC clinicians can only bill for services once per 30 days but often meet with participating beneficiaries more frequently.[14,28] We defined pregnancy as the period between conception (estimated with gestational age) and the birthdate.

Well-Child Visits

WCVs are routine preventive health care visits from birth to early adulthood that encompass developmental assessments, immunizations, and screenings for oral, visual, and hearing health.[17] WCVs promote early-life wellbeing, reduce the risk of emergency visits and hospitalization, and increase preventive dental care among infants and young children.[31–33] The first outcome was any WCV receipt (no; yes) at 4 points in a child's life: age 0 to <1 year old; age 1 to <2 years old; age 2 to <3 years old; and age 3 to <4 years old. The second outcome was recommended WCV receipt (no; yes) at 3 time points in a child's life: 6+ visits at age 0 to <1 year old; 3+ visits at age 1 to <2 years old; and 2+ visits at age 2 to <3 years old. These benchmarks match the American Academy of Pediatrics WCV schedule.[34] We measured WCV receipt at 0 to <1 year old for all sampled children. However, we only measured WCV receipt at later ages for children with sufficient continuous Medicaid enrollment. In addition, we did not measure recommended WCV receipt at 3 to <4 years old because 1 annual visit is recommended for this age.

Birth Record Variables

Maternal characteristics included age (years), race/ethnicity (American Indian/Alaska Native non-Hispanic [NH]; Asian/Pacific Islander NH; Black NH; Hispanic; White NH; multiple NH; other NH), nativity (native-born [United States]; foreign-born), education (no high school diploma; high school diploma/equivalent only; some college; undergraduate degree; more than undergraduate degree), marital status (unmarried; married), chronic hypertension (not reported; reported), chronic diabetes (not reported; reported), and resident county urbanicity using the National Center for Health Statistics urban-rural classification scheme (large central metro; large fringe metro; medium metro; small metro; micropolitan; noncore).[35] Selected maternal characteristics are likely confounders, as these factors impact PNCC eligibility,[28] the likelihood of accessing and receiving PNCC services,[27] and the ease of attending of WCVs.[21–23]

Delivery characteristics included parity (first birth; second birth; third birth; fourth or later birth), any congenital anomalies of the newborn (not reported; reported), and neonatal intensive care unit (NICU) admission (not reported; reported). All 3 delivery characteristics influence infant health,[36] which in turn may affect WCV receipt.

Analysis

We tabulated WCV outcomes and baseline characteristics by PNCC receipt for both samples (full and sibling). To estimate the impact of maternal PNCC participation on children's WCV receipt, we executed unadjusted and adjusted regressions for each combination of PNCC exposure (dichotomous or categorical) and WCV outcome (any or recommended) at each time point. Conventional logistic regressions estimated associations with odds ratios (OR) and corresponding 95% confidence intervals (CI) with our full sample. Adjusted regressions controlled for maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; resident county urbanicity; chronic hypertension; chronic diabetes) and parity. All conventional regressions clustered standard errors at the mother level.

We also ran unadjusted and adjusted sibling FE logistic regressions in our sibling sample. Unlike conventional regressions, sibling FE regressions control for unobserved family-level and sibling-invariant factors that confound siblings' outcomes.[37] For example, a family's health-seeking behavior—which is unmeasured in our data—likely affects whether children receive WCVs. If it equally affects siblings' WCV attendance within families, then the FE estimator differences out this confounding. Consequently, the treatment estimate is unbiased from familial health-seeking behavior. Other potential unobserved confounders include family health history, health literacy, and housing stability, all which impact the receipt of—and the barriers to accessing—PNCC and WCVs.[13,14,20–23] This reduces unobserved confounding bias at the expense of precision, as FE regressions only generate estimates from in-sample siblings with differential PNCC exposure. Adjusted FE regressions included the same covariates except for maternal race/ethnicity and nativity, since sibling-invariant covariates are unnecessary in FE models.[37]

We also conducted several sensitivity analyses. First, we repeated adjusted conventional logistic regressions with siblings only to determine whether sample composition explained diverging estimates between conventional and sibling FE regressions. Second, we repeated all adjusted regressions after excluding children with any newborn congenital anomalies or after excluding children with a NICU admission following birth. Infants with congenital anomalies or NICU admission typically receive more intensive health care compared with unaffected infants.[38,39] Given that PNCC prevents adverse birth outcomes, these tests can signal whether congenital anomalies or NICU admissions mediate the PNCC-WCV pathway. Third, we repeated adjusted conventional and sibling FE regressions after restricting the sample to children with 4 years of continuous Medicaid coverage post-birth to determine Medicaid disenrollment over time explains any changing associations between PNCC and WCV receipt at older ages. Fourth, we repeated adjusted conventional and sibling FE regressions with additional controls for gestational hypertension and gestational diabetes. We initially considered only prepregnancy (ie, chronic) hypertension or diabetes to avoid bias from post-treatment covariate adjustment.[40] However, beneficiaries may have gestational hypertension or gestational diabetes diagnoses before PNCC assessment. Therefore, these conditions may confound PNCC-WCV associations. Lastly, we stratified sibling FE regressions on the order of PNCC receipt. Inability to organize childcare is an oft-cited reason among families for missing WCVs.[21] PNCC might have a stronger impact on WCV receipt in families with fewer children and, thus, easier access to WCVs[21–23]—that is, a stronger effect among older children compared with their younger siblings. In our sibling sample, we kept the first 2 children, yielding 33,648 children of 16,824 sibling pairs (ie, families). Among these, 4,024 pairs had differential PNCC exposure: 2,668 had PNCC in the first pregnancy only; and 1,356 had PNCC in the second pregnancy only. We then repeated adjusted sibling FE regressions in 2 subsamples: (a) sibling pairs with constant exposure to any PNCC or with any PNCC in the first pregnancy only (30,936 children [15,468 pairs]); and (b) sibling pairs with constant exposure to any PNCC or with any PNCC in the second pregnancy only (28,312 children [14,156 pairs]).

We conducted analyses in Stata Statistical Software: Release 18.[41] The University of Wisconsin-Madison minimal risk institutional review board approved this project.

Results

Approximately 26% of the sample had any PNCC (assessment/care plan only or service uptake), of which roughly 66% had PNCC uptake beyond care planning (Table 1). Among PNCC-assessed deliveries, 35% and 65% had intakes in the first and second trimesters, respectively, with none having intakes in the third trimester (Appendix Table A1). In the PNCC service uptake group, 60% linked to 5+ billed PNCC service claims. This is consistent with prior estimates of PNCC assessment and uptake rates.[5,6,26,27] Descriptively, greater PNCC exposure was associated with the mother being nonwhite, having incomplete high school education, living in an urban county, or having a first birth. Overall, WCV receipt decreased as children aged, from 97.0% in the first year of life to just over 70% in the fourth year of life (Figure 2). Recommended WCV receipt had a parabolic pattern as children aged: 29.1% in the first year of life, then to 42.5% in the second year of life, and back down to 21.0% in the third year of life. Generally, WCV receipt gradually increased with greater levels of PNCC exposure across age groups. For example, we focus on the 0 to <1 year-old age-group. From no PNCC to service uptake, any WCV receipt increased from 96.4% to 98.7%, and recommended WCV receipt increased from 28.5% to 31.5%. Descriptive patterns were consistent in the sibling sample (Appendix Table A2).

In conventional adjusted regressions, any PNCC receipt was associated with a higher odds of any WCV receipt, and estimates waned with age: from two-fold increase at age 0 to <1 year-old (OR 1.92; 95% CI 1.73-2.13) to an 8% increase at age 3 to <4 years old (OR 1.08; 95% CI 1.04-1.12) (Figure 3; full results in Appendix Table A3). Estimates increased with greater levels of PNCC receipt. For example, the association between PNCC service uptake and any WCV receipt ranged from OR 2.23 (95% CI 1.95-2.55) at age 0 to <1 year-old to OR 1.15 (95% CI 1.10-1.20) at age 3 to <4 years old. However, estimates were consistently lower for PNCC assessment/care plan only with null estimates in the older 2 age groups. Unadjusted regressions yielded similar patterns. Post hoc analyses indicate that the association between PNCC exposure and any WCV receipt at 3 to <4 years old varies by WCV receipt continuity during ages 0 to <3 years old (Appendix).

Adjusted sibling FE regressions attenuated estimates between PNCC and any WCV receipt. In the youngest age-group, any PNCC (OR 1.48; 95% CI 1.05-2.08) and PNCC assessment/care plan only (OR 1.75; 95% CI 1.08-2.82) were associated with any WCV receipt. In addition, any PNCC (OR 1.24; 95% CI 1.03-1.50) and PNCC assessment/care plan only (OR 1.40; 95% CI 1.05-

Table 1. Sample Characteristics, Medicaid-Paid Births in Wisconsin During 2011–2015 (n = 113,347 Children)

Variables	Overall	Maternal PNCC Receipt: None	Assessment/ Care Plan Only	Service Uptake
Sample size, N (row %)	113,347 (100)	83,903 (74.0)	10,099 (8.9)	19,345 (17.1)
Maternal characteristics				
Age (years), mean (SD)	26.1 (5.5)	26.5 (5.4)	25.7 (5.4)	24.4 (5.6)
Race/ethnicity, N (%)				
American Indian/Alaska Native (NH)	2,183 (1.9)	1,591 (1.9)	285 (2.8)	307 (1.6)
Asian/Pacific Islander (NH)	5,538 (4.9)	4,582 (5.5)	452 (4.5)	504 (2.6)
Black (NH)	20,838 (18.4)	13,592 (16.2)	1,421 (14.1)	5,825 (30.1)
Hispanic	18,437 (16.3)	12,340 (14.7)	1,999 (19.8)	4,098 (21.2)
White (NH)	62,673 (55.3)	49,119 (58.5)	5,597 (55.4)	7,957 (41.1)
Multiple (NH)	3,145 (2.8)	2,228 (2.7)	322 (3.2)	595 (3.1)
Other (NH)	533 (0.5)	451 (0.5)	23 (0.2)	59 (0.3)
Nativity, N (%)				
Native-born (United States)	97,725 (86.2)	72,594 (86.5)	8,694 (86.1)	16,437 (85.0)
Foreign-born	15,622 (13.8)	11,309 (13.5)	1,405 (13.9)	2,908 (15.0)
Maternal education, N (%)				
No HS diploma	22,912 (20.2)	14,913 (17.8)	2,307 (22.8)	5,692 (29.4)
HS diploma/equiv. only	45,974 (40.6)	33,508 (39.9)	4,195 (41.5)	8,271 (42.8)
Some college	36,778 (32.4)	28,776 (34.3)	3,133 (31.0)	4,869 (25.2)
Undergraduate degree	6,580 (5.8)	5,739 (6.8)	413 (4.1)	428 (2.2)
More than undergraduate degree	1,103 (1.0)	967 (1.2)	51 (0.5)	85 (0.4)
Marital status, N (%)				
Unmarried	75,784 (66.9)	53,205 (63.4)	7,108 (70.4)	15,471 (80.0)
Married	37,563 (33.1)	30,698 (36.6)	2,991 (29.6)	3,874 (20.0)
Residence county urbanicity, N (%)*				
Large central metro	32,922 (29.1)	22,265 (26.5)	2,595 (25.7)	8,062 (41.7)
Large fringe metro	9,599 (8.5)	6,057 (7.2)	2,123 (21.0)	1,419 (7.3)
Medium metro	14,829 (13.1)	12,866 (15.3)	534 (5.3)	1,429 (7.4)
Small metro	27,119 (23.9)	20,169 (24.0)	2,815 (27.9)	4,135 (21.4)
Micropolitan	13,958 (12.3)	11,057 (13.2)	1,058 (10.5)	1,843 (9.5)
Non-core	14,920 (13.2)	11,489 (13.7)	975 (9.6)	2,457 (12.7)
Chronic hypertension, N (%)				
Not reported	110,835 (97.8)	82,114 (97.9)	9,901 (98.0)	18,820 (97.3)
Reported	2,512 (2.2)	1,789 (2.1)	198 (2.0)	525 (2.7)
Chronic diabetes, N (%)				
Not reported	112,181 (99.0)	83,070 (99.0)	9,999 (99.0)	19,112 (98.8)
Reported	1,166 (1.0)	833 (1.0)	100 (1.0)	233 (1.2)
Delivery characteristics				
Parity, N (%)				
First birth	36,495 (32.2)	23,913 (28.5)	3,246 (32.1)	9,336 (48.3)
Second birth	34,353 (30.3)	26,540 (31.6)	3,200 (31.7)	4,613 (23.9)
Third birth	22,040 (19.4)	17,314 (20.6)	1,981 (19.6)	2,745 (14.2)
Fourth or later birth	20,459 (18.1)	16,136 (19.2)	1,672 (16.6)	2,651 (13.7)
Any congenital anomalies of newborn, N (%)†				
Not reported	112,827 (99.5)	83,536 (99.6)	10,044 (99.5)	19,247 (99.5)
Reported	520 (0.5)	367 (0.4)	55 (0.5)	98 (0.5)

Continued

Table 1. Continued

Variables	Overall	Maternal PNCC Receipt: None	Assessment/ Care Plan Only	Service Uptake
Newborn NICU admission, N (%)				
Not reported	105,121 (92.7)	77,862 (92.8)	9,438 (93.4)	17,821 (92.1)
Reported	8,226 (7.3)	6,041 (7.2)	661 (6.6)	1,524 (7.9)

Notes: All percents are column percents unless otherwise specified. Maternal PNCC receipt is measured during pregnancy.
*Maternal residence county urbanicity is determined with the National Center for Health Statistics 2013 Urban-Rural Classification Scheme, which we linked to the maternal county of residence on the birth record using the county's name. The only "large central metro" county in Wisconsin is Milwaukee County.
†Congenital anomalies as reported on the birth record include anencephaly, meningomyelocele/spina bifida, cyanotic congenital heart disease, congenital diaphragmatic hernia, omphalocele, gastroschisis, limb reduction defect, cleft lip, cleft palate, down syndrome, suspected chromosomal disorder, and hypospadias.
Bold data defines the types of variable.
Abbreviations: HS, high school; NH, non-Hispanic; NICU, neonatal intensive care unit; PNCC, Prenatal Care Coordination; SD, standard deviation.

1.85) were associated with any WCV receipt at age 1 to <2 years old. All other estimates were null, and unadjusted sibling FE regressions yielded similar patterns.

Regarding recommended WCV receipt, estimates in adjusted conventional regressions were generally stable (OR ~1.10) and statistically significant regardless of PNCC exposure measurement (dichotomous or categorical) or age-group (Figure 4; full results in Appendix Table A4). However, estimates did not reach conventional levels of statistical significance in adjusted sibling FE regressions with the following exceptions: any PNCC (OR 1.22; 95% CI 1.08-1.37) and PNCC service uptake (OR 1.35; 95% CI 1.18-1.55) were positively associated with children's recommended WCV receipt at age 0 to <1 year-old. Unadjusted estimates were mostly similar.

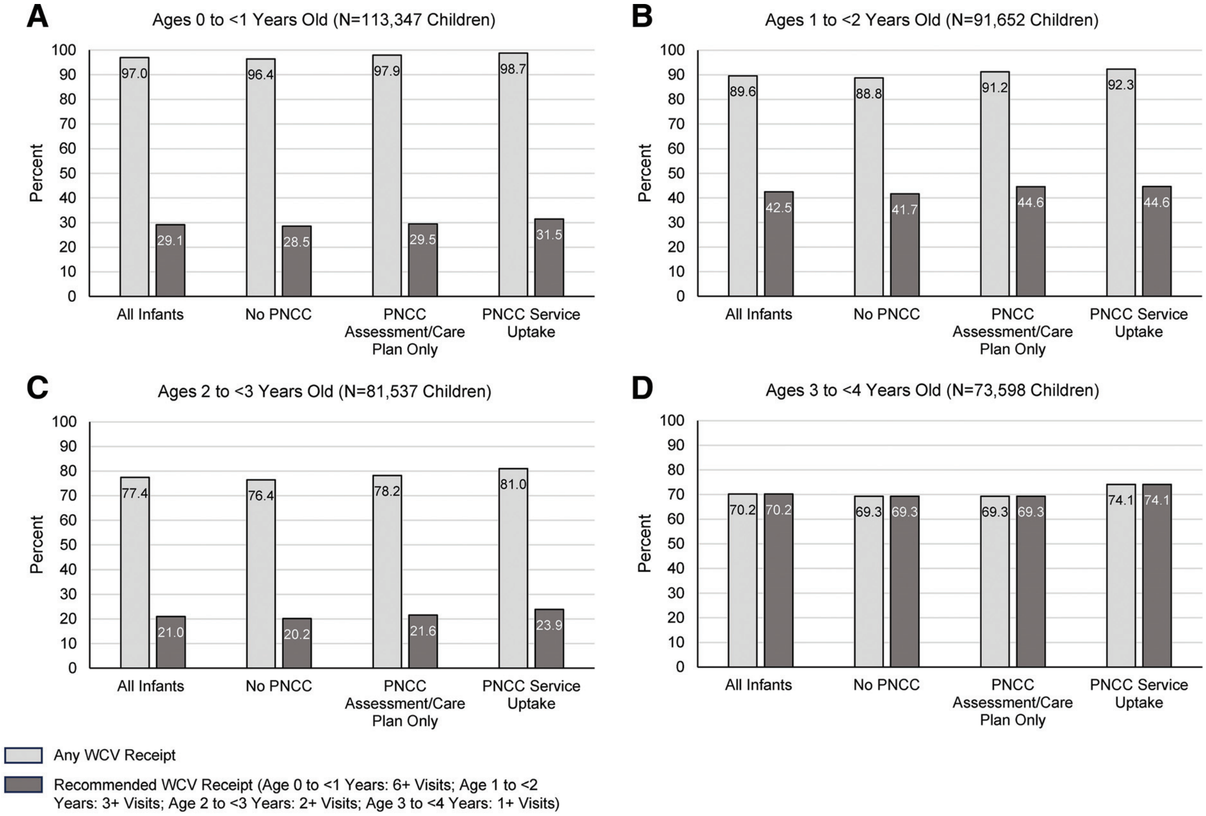
Sensitivity analyses aligned with the main results (Appendix Table A5). Differential sample composition only minimally explained contrasting estimates between conventional and FE regressions, increased health care receipt following a congenital anomaly diagnosis or NICU admission to did not explain PNCC-WCV associations, Medicaid disenrollment did not explain weaker PNCC-WCV associations as children aged, and gestational hypertension nor gestational diabetes did not confound PNCC-WCV associations. However, results from sibling FE regression that stratified on timing of PNCC delivery (first pregnancy only vs second pregnancy only) suggest that PNCC-WCV associations are stronger in prior pregnancies (ie, among older children) (Appendix Table A6).

Discussion

This study investigated PNCC's relationship with children's WCV receipt in early childhood. Our most optimistic findings from demographic-adjusted conventional regressions support our hypothesis: any maternal PNCC receipt during pregnancy is significantly associated with any WCV receipt or recommended WCV receipt in the first 4 years of life. However, from ages 2 to <4 years old, this benefit depends on PNCC service uptake beyond care planning. Sibling FE estimates are more conservative. In these models, PNCC's influence on any WCV receipt only persists from birth to <2 years old, and its impact on children receiving the recommended number of WCVs is limited to the first year of life and to families with PNCC service uptake. Nonetheless, even these findings are important. On average, WCV attendance drops after the first year of life,[42] and roughly one-third of children under 2 years old have inadequate WCV receipt.[24] PNCC may connect families and their young children to WCVs when they otherwise miss these services. More broadly, our results suggest that patient-centered care management programs bridge low-income families to preventive health care and, thus, are an effective public health strategy to improve family health.

Sibling FE regressions likely present the most accurate estimates of PNCC's potential effect on WCV receipt because they control for unobserved family-level confounders. Employment, housing instability, access to health care, and health-seeking behavior impact PNCC and WCV receipt.[13,14,21–23] Without

Figure 2. Incidence of any well-child visit or recommended well-child visit receipt by maternal Prenatal Care Coordination receipt, full sample.

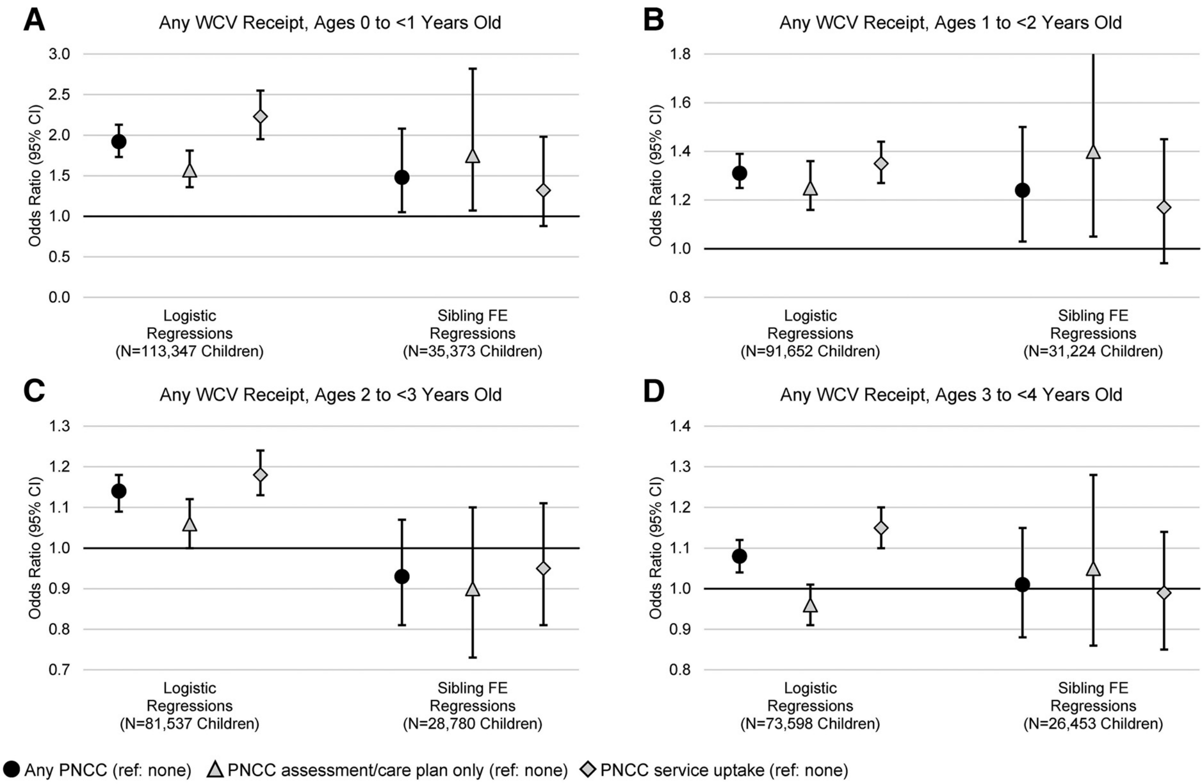


Notes: Maternal PNCC receipt is measured during pregnancy. The American Academy of Pediatrics provides the recommended number of annual well-child visits: 6 visits at age 0 to <1 years; 3 visits at age 1 to <2 years; 2 visits at age 2 to <3 years; and 1 visit annually from age 3 to 21 years. Thus, the threshold for meeting the recommended WCV receipt decreases with age, and having any WCV receipt at age 3 to <4 years is equivalent to having the recommended receipt of WCVs. Additionally, measuring WCVs at later ages requires longer continuous Medicaid enrollment post-birth, so sample sizes decrease when measuring WCVs later in life.
Abbreviations: PNCC, prenatal care coordination; WCV, well-child visit.

such measures in our data, FE regressions mitigate unobserved confounding that otherwise bias estimates in conventional logistic regressions. Therefore, we can better attribute FE estimates to PNCC's actual impact on WCVs.

Our results align with research on Michigan's MIHP program during 2009 to 2012, which found that any program exposure—including assessment only—increased the likelihood that infants had any WCV receipt or recommended WCV receipt within a year post-birth.[15] Further, this study also contributes 3 additional insights. First, the benefit of obstetric care coordination on any WCV in the first year of life did not depend on the mother receiving services beyond assessment. The initial beneficiary-clinician contact could sufficiently route families toward preventive health care. Even without a full care plan, PNCC clinicians can still connect assessed beneficiaries to additional services.[14] This increased contact with other sources of care may in turn promote WCV attendance following pregnancy. Second, obstetric care coordination's impact on infants getting recommended WCV receipt before turning 1 year-old likely depends on mothers receiving services beyond assessment. Low-income families encounter several obstacles to preventive care, including inadequate transportation and childcare, which are difficult to surmount without robust social support.[21–23] Coordinators provide resources and connections to social services that help families attend health care appointments.[13,14,18–20] Third, care coordination may also

Figure 3. Results from adjusted logistic regressions of any well-child visit on maternal Prenatal Care Coordination receipt.

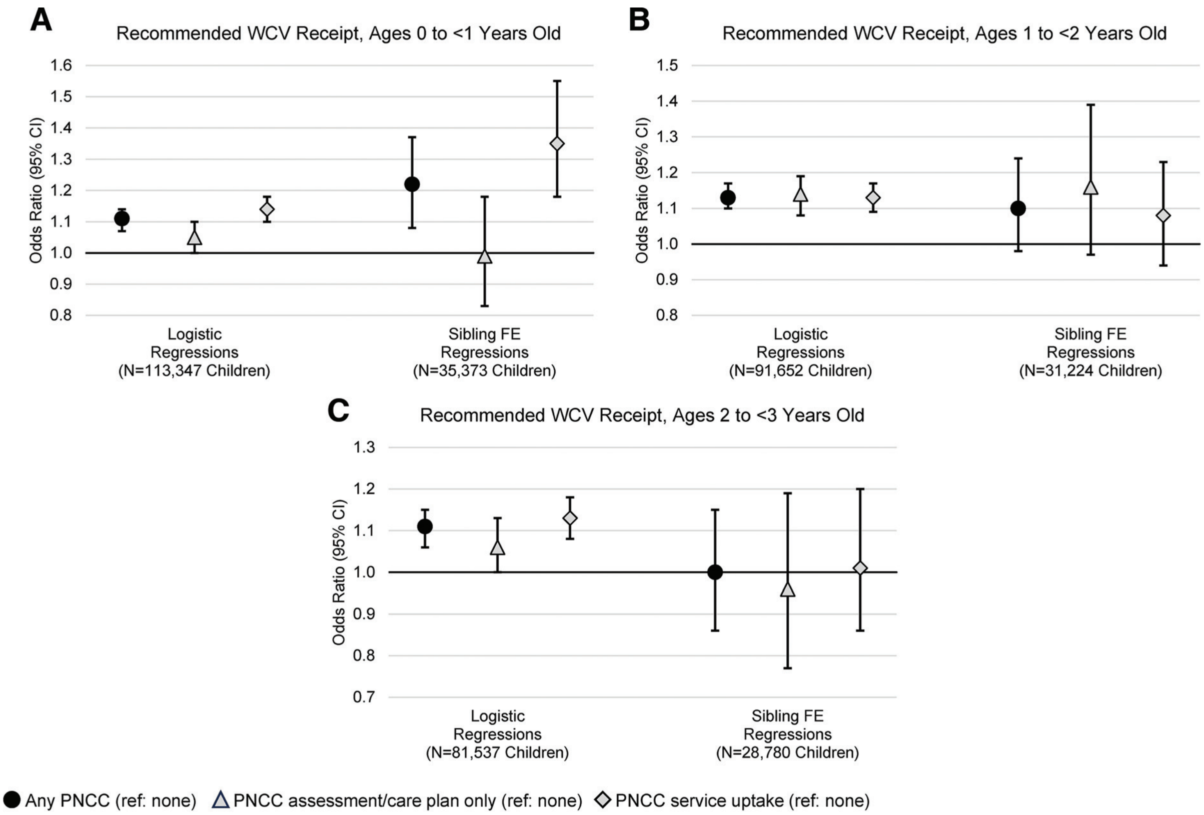


Notes: Maternal PNCC receipt is measured during pregnancy. All conventional logistic regressions cluster standard errors at the mother-level and adjust for the following control variables: maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity. All sibling fixed effects regressions adjust for the following control variables: maternal characteristics at delivery (age; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.
Abbreviations: CI, confidence interval; FE, Fixed Effects; PNCC, Prenatal Care Coordination; WCV, well-child visit.

increase children's WCV receipt in the second year of life. This potential benefit possibly weakens as children age out of infancy. Nonetheless, it is evidence of PNCC's enduring impact on children's preventive care.

If PNCC promotes WCV receipt in addition to improving birth outcomes,[5,6] then increasing PNCC receipt is a subsequent goal. Despite wide eligibility criteria, only 26% of pregnant beneficiaries received PNCC assessments, and 17% received services beyond assessment. The likely crux of low program uptake is insufficient governmental support for PNCC across the state. PNCC clinicians have cited that state- and county-level funding does not adequately support the staffing and resource infrastructure needed to serve beneficiaries who seek PNCC services, let alone to expand PNCC outreach to the broader population of pregnant Medicaid beneficiaries.[14] This is exemplified by the low reimbursement level for PNCC services—a maximum of $888 per beneficiary during the observation period of this study.[14,43] To circumvent the obstacle of insufficient funding, PNCC-providing institutions in urban areas can leverage strong ties with local community health or social service agencies to maximize program enrollment and quickly connect participating beneficiaries to helpful resources.[13,14] Conversely, PNCC-providing institutions in more rural—and often more resource deprived—areas often cannot rely on outside organizations to enroll and serve beneficiaries. This generates large geographic disparities in PNCC utilization, with relatively high and stable PNCC receipt in urban areas and relatively low and declining PNCC receipt in rural areas.[27,44] Still, even PNCC outreach in urban Wisconsin (~33% any contact)

Figure 4. Results from adjusted logistic regressions of recommended well-child visit on maternal Prenatal Care Coordination receipt.



Notes: Maternal PNCC receipt is measured during pregnancy. All conventional logistic regressions cluster standard errors at the mother-level and adjust for the following control variables: maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity. All sibling fixed effects regressions adjust for the following control variables: maternal characteristics at delivery (age; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.The American Academy of Pediatrics provides the recommended number of annual well-child visits, which decreases with age: 6 visits at age 0 to <1 year; 3 visits at age 1 to <2 years; 2 visits at age 2 to <3 years; and 1 visit annually from age 3 to 21 years. Thus, the threshold for meeting the recommended WCV receipt decreases with age, and having any WCV receipt at age 3 to <4 years is equivalent to having the recommended receipt of WCVs.
Abbreviations: CI, confidence interval; FE, Fixed Effects; PNCC, Prenatal Care Coordination; WCV, well-child visit.

falls short of the full population of pregnant Medicaid beneficiaries.[44]

With new evidence of PNCC's benefit to families, the need to enhance program outreach and implementation is clearer. Increased funding for PNCC-providing institutions, dedicated PNCC research at the state-level, and extended PNCC coverage from 60-days postpartum to 1-year postpartum are policy strategies to expand program impact.[13,14,44] Future scholarship that builds on this work—particularly research that directly engages with PNCC clinicians and recipients to assess programmatic strengths and opportunities for expansion—is critical to informing policy and developing local or institutional interventions to enhance PNCC administration.

It is worth considering the temporal generalizability of the findings since we did not have access to data that covered the Coronavirus Disease 2019 (COVID-19) pandemic. COVID-19 interrupted prenatal care, WCV, and social service systems.[45–50] Likewise, obstetric care coordination clinicians presumably had greater difficulty connecting beneficiaries to services,[51] or care coordination services may have suspended. This could have nullified the potential benefits of obstetric care coordination services on health care receipt. If COVID-19 weakened or stopped obstetric care coordination services, how could they improve health outcomes, including WCV receipt? Some care coordination programs quickly adopted tele-health practices to maintain service provision throughout the pandemic,[52,53] so benefits to health care receipt may have persisted. Nonetheless, the extent to which COVID-19 impaired obstetric care coordination programs—and whether obstetric care coordination programs have moved past or adapted to pandemic-induced disruptions—is uncertain. This motivates 2 needs: studying obstetric care coordination programs with COVID-19-era data to evaluate their present outreach and impact; and revitalizing beneficial obstetric care coordination programs that halted during the pandemic.

This study has several strengths: we analyzed a large population-based birth cohort with more recent data compared with similar studies,[15,25,26] and our estimation method prevented bias from family-level and sibling-invariant confounding.[37] Still, there are limitations. Estimates are prone to bias from unobserved sibling-*varying* confounders, such as income or place of residence. As noted previously, we did not have COVID-19-era data, which may curb temporal generalizability. Lastly, Wisconsin's demographic makeup could limit the study's generalizability. The difference in the racial/ethnic composition of Medicaid births in Wisconsin per our estimates versus nationwide is striking (1.9% vs 1.2% American Indian/Alaska Native NH; 4.9% vs 3.6% Asian/Pacific Islander NH; 18.4% vs 22.1% Black NH; 16.3% vs 35.1% Hispanic; 55.3% vs 35.3% White NH).[54] Further, Wisconsin is characterized by high levels of racial geographic segregation.[55] Given that race impacts obstetric care coordination receipt and WCV attendance,[18–20,23,27,44] our results may not fully translate to other states.

In sum, our findings suggest that PNCC improves children's WCV receipt in the first 2 years of life. Future research should investigate how PNCC timing and dosage alters this impact and whether PNCC affects other health care service receipt, such as childhood vaccination rates.

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References

1. Hill IT. Improving state Medicaid programs for pregnant women and children. Health Care Financ Rev 1990;Spec No:75–87.
2. Gallagher J, Botsko C, Schwalberg R. *Influencing Interventions to Promote Positive Pregnancy Outcomes and Reduce the Incidence of Low Birthweight and Preterm Infants*. Washington, DC: Health Systems Research, Inc; 2004.
3. Garite RJ, Manuck TA. Should case management be considered a component of obstetrical interventions for pregnancies at risk of preterm birth? Am J Obstet Gynecol 2023;228:430–7.
4. Wisconsin Department of Health Services. Prenatal Care Coordination. Accessed November 10, 2024. Available at: https://www.dhs.wisconsin.gov/pncc/index.htm.
5. Van Dijk JW, Anderko L, Statzer F. The impact of Prenatal Care Coordination on birth outcomes. J Obstet Gynecol Neonatal Nurs 2011;40:98–108.
6. Mallinson DC, Larson A, Berger LM, Grodsky E, Ehrenthal DB. Estimating the effect of Prenatal Care Coordination in Wisconsin: a sibling fixed effects analysis. Health Serv Res 2020;55:82–93.
7. Buescher PA, Roth MS, Williams D, Goforth CM. An evaluation of the impact of maternity care coordination on Medicaid birth outcomes in North Carolina. Am J Public Health 1991;81:1625–9.
8. Reichman NE, Florio MJ. The effects of enriched prenatal care services on Medicaid birth outcomes in New Jersey. J Health Econ 1996;15:455–76.
9. Slaughter JC, Issel LM, Handler AS, Rosenberg D, Kane DJ, Stayner LT. Measuring dosage: a key factor when assessing the relationship between prenatal case management and birth outcomes. Matern Child Health J 2013;17:1414–23.
10. Roman L, Raffo JE, Zhu Q, Meghea CI. A statewide Medicaid enhanced prenatal care program. JAMA Pediatr 2014;168:220–7.
11. Hillemeier MM, Domino ME, Wells R, et al. Effects of maternity care coordination on pregnancy outcomes: propensity-weighted analyses. Matern Child Health J 2015;19:121–7.
12. Sabo S, Wightman P, McCue K, et al. Addressing maternal and child health equity through a community health worker home visiting intervention to

reduce low birth weight: retrospective quasi-experimental study of the Arizona Health Start Programme. BMJ Open 2021;11:e045014.

13. Greene MZ, Tran-Smith B, Moua P. Beyond common outcomes: client's perspectives on the benefits of Prenatal Care Coordination. medRxiv 2022. Posted April 14, 2022.
14. Greene MZ, Gillespie KH, Dyer RL. Contextual and policy influences on the implementation of Prenatal Care Coordination. Policy Polit Nurs Pract 2023;24:187–97.
15. Meghea C, Raffo JE, Zhu Q, Roman L. Medicaid home visitation and maternal and infant healthcare utilization. Am J Prev Med 2013;45:441–7.
16. Hillemeier MM, Domino ME, Wells R, et al. Does maternity care coordination influence perinatal health care utilization? Evidence from North Carolina. Health Serv Res 2018;53:2368–83.
17. Moreno MA. The well-child visit. JAMA Pediatr 2018;172:104.
18. Lee H, Crowne S, Faucetta K, et al. *An Early Look at Families and Local Programs in the Mother and Infant Home Visiting Program Evaluation-Strong Start: Third Annual Report*. New York, NY: MDRC; 2016.
19. Strobel NA, Arabena K, East CE, et al. Care co-ordination interventions to improve outcomes during pregnancy and early childhood (up to 5 years). Cochrane Database Syst Rev 2017;2017: CD012761.
20. Heitzman M, Weitzel J, Kroll S, Zabler B. Client experiences in a prenatal home visiting program: a prenatal care coordination program evaluation. Public Health Nurs 2019;36:653–9.
21. Wolf ER, O'Neil J, Pecsok J, et al. Caregiver and clinician perspectives on missed well-child visits. Ann Fam Med 2020;18:30–4.
22. Abdus S, Selden TM. Adherence with recommended well-child visits has grown, but large gaps persist among various socioeconomic groups. Health Aff (Millwood) 2013;32:508–15.
23. Wolf ER, Donahue E, Sabo RT, Nelson BB, Krist AH. Barriers to attendance of prenatal and well-child visits. Acad Pediatr 2021;21:955–60.
24. Centers for Medicare & Medicaid Services. *Quality of Care for Children in Medicaid and CHIP: Findings from the 2020 Child Core Set*. Baltimore, MD: Centers for Medicare & Medicaid Services; 2021.
25. Meghea C, You Z, Raffo JE, Roman L. Medicaid home visitation and maternal and infant care and health: a reassessment of program effectiveness. Mich J Public Health 2020;10:5.
26. Mallinson DC, Elwert F, Ehrenthal DB. Spillover effects of Prenatal Care Coordination on older siblings beyond the mother-infant dyad. Med Care 2023;61:206–15.
27. Larson A, Berger LM, Mallinson DC, et al. Variable uptake of Medicaid-covered Prenatal Care Coordination: the relevance of treatment level and service context. J Community Health 2019;44:32–43.
28. Wisconsin Department of Health Services. ForwardHealth online handbook: published policy through 10/31/2018, Prenatal Care Coordination. Accessed November 12, 2024. Available at: https://www.forwardhealth.wi.gov/kw/archive/PNCC110118.pdf.
29. Wisconsin Department of Health Services. ForwardHealth Prenatal Care Coordination pregnancy questionnaire instructions. July 2024. Accessed November 12, 2024. Available at: https://www.dhs.wisconsin.gov/forms/f0/f01105a.pdf.
30. Wisconsin Department of Health Services. Prenatal Care Coordination questionnaire. Accessed November 12, 2024. Available at: https://www.forwardhealth.wi.gov/kw/html/PNCCPregnancyQuestionnaire.html.
31. Tom JO, Tseng CW, Davis J, Solomon C, Zhou C, Mangione-Smith R. Missed well-child care visits, low continuity of care, and risk of ambulatory care-sensitive hospitalizations in young children. Arch Pediatr Adolesc Med 2010;164:1052–8.
32. Pittard WB 3rd. Well-child care in infancy and emergency department use by South Carolina Medicaid children birth to 6 years old. South Med J 2011;104:604–8.
33. Tiwari T, Rai N, Brow A, Tranby EP, Boynes SG. Association between medical well-child visits and dental preventive visits: a big data report. JDR Clin Trans Res 2019;4:239–45.
34. Hagan JF, Shaw JS, Duncan PM. *Bright Futures Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017.
35. Centers for Disease Control and Prevention. NCHS urban-rural classification scheme for counties. Accessed November 12, 2024. Available at: https://www.cdc.gov/nchs/data-analysis-tools/urban-rural.html.
36. Bohn C, Vogel M, Poulain T, et al. Birth weight increases with birth order despite decreasing maternal pregnancy weight gain. Acta Paediatr 2021;110: 1218–24.
37. Gunasekara FI, Richardson K, Carter K, et al. Fixed effects analysis of repeated measures data. Int J Epidemiol 2014;43:264–9.
38. Khoshnood B, Lelong N, Houyel L, EPICARD Study Group, et al. Prevalence, timing of diagnosis and mortality of newborns with congenital heart defects: a population-based study. Heart . 2012;98:1667–73.
39. Horbar JD, Carpenter JH, Badger GJ, et al. Mortality and neonatal morbidity among infants 501 to 1500 grams from 2000 to 2009. Pediatrics 2012;129:1019–26.
40. Elwert F. Graphical causal models. In: Morgan SL, ed. *Handbook of Causal Analysis for Social Research*. Springer Dordrecht; 2013:245–73.

41. StataCorp LLC. *Stata Statistical Software: Release 18*. College Station, TX: StataCorp LLC; 2023.
42. Wolf ER, Hochheimer CJ, Sabo RT, et al. Gaps in well-child visit attendance among primary care clinics serving low-income families. Pediatrics 2018; 142:e20174019.
43. Wisconsin Department of Health Services. Wisconsin Medicaid Fee Schedule for Prenatal Care Coordination Services. July 2008. Accessed January 15, 2025. Available at: https://www.forwardhealth.wi.gov/wiportal/content/provider/maxFee/pdf/pnccmaxfees.pdf.spage.
44. Mallinson DC, Gillespie KH. Racial and geographic variation of Prenatal Care Coordination receipt in the state of Wisconsin, 2010-2019. J Community Health 2024;49:732–47.
45. Liu CH, Goyal D, Mittal L, Erdei C. Patient satisfaction with virtual-based prenatal care: implications after the COVID-19 pandemic. Matern Child Health J 2021;25:1735–43.
46. Futterman I, Rosenfeld E, Toaff M, et al. Addressing disparities in prenatal care via telehealth during COVID-19: prenatal satisfaction survey in East Harlem. Am J Perinatol 2021;38:88–92.
47. Javaid S, Barringer S, Compton SD, et al. The impact of COVID-19 on prenatal care in the United States: qualitative analysis from a survey of 2519 pregnancy women. Midwifery 2021;98:102991.
48. Kujawski SA, Yao L, Wang HE, Carias C, Chen Y. Impact of the COVID-19 pandemic on pediatric and adolescent vaccinations and well child visits in the United States: a database analysis. Vaccine 2022;40:706–13.
49. Witt WP, Harlaar N, Palmer A. The impact of COVID-19 on pregnant women and children: recommendations for health promotion. Am J Health Promot 2023;37:282–8.
50. McCoyd JLM, Curran L, Candelario E, Findley PA, Hennessey K. Social service providers under COVID-19 duress: adaptation, burnout, and resilience. J Soc Work (Lond) 2023;23:85–102.
51. Ojo A, Beckman AL, Weiseth A, Shah N. Ensuring racial equity in pregnancy care during the COVID-19 pandemic and beyond. Matern Child Health J 2022; 26:747–50.
52. Daily C, Gresh A, Hamilton ER, Marea CX. Adapting group prenatal care for telehealth: a COVID-era innovation to address barriers to care for Latinx clients. J Midwifery Women's Health 2024. Published online October 28.
53. Wolcott C, Wanger L, Penny L. Connecting group care patients to mental health and food resources during the COVID-19 pandemic. Ann Fam Med 2022; 20:180.
54. Centers for Medicare & Medicaid Services. *2024 Medicaid & CHIP Beneficiaries at a Glance: Maternal Health*. 2024. Accessed January 15, 2025. Available at: https://www.medicaid.gov/medicaid/benefits/downloads/2024-maternal-health-at-a-glance.pdf.
55. Alabab-Moser J. Are Black people in Wisconsin concentrated in the southeastern part of the state? Wisconsin Watch. December 19, 2023. Accessed November 10, 2024. Available at: https://wisconsinwatch.org/2023/12/wisconsin-milwaukee-black-population-census-fact-brief/.

Appendix

Medical Insurance Billing Codes

The identified live delivery with the following Current Procedural Technology values: 59400, 59409, 59410, 59414, 59510, 59514, 59515, 59610, 59612, 59614, 59618, 59620, and 59622.

We identified Prenatal Care Coordination receipt with the following Health care Common Procedure Coding System values: care coordination assessment (H1000), care coordination planning (H1002, H1002 U2), education (H1003), follow-up home visit (H1004), and case management (T1016 TH).

We identified well-child visits with the following Health care Common Procedure Coding System values: well-child visit at age <1 year (99381, 99391), and well-child visit at age 1 to 4 years (99382, 99392).

Prenatal Care Coordination Eligibility Criteria

To enroll in Prenatal Care Coordination, pregnant Medicaid beneficiaries need to be <18 years old at assessment or report at least 4 of 31 self-reported risk factors on a questionnaire. The criteria are intentionally broad to maximize outreach. The risk factors are listed below.

1. <20 years old
2. 35+ years old
3. Hispanic ethnicity
4. Non-White race (American Indian/Alaska Native, Asian, Black/African American, Hawaiian/Pacific Islander, other)
5. Incomplete high school education or high school education/equivalent only.
6. Currently unmarried
7. Started prenatal care in second or third trimester
8. No prenatal care appointment yet
9. Currently receiving benefits from the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
10. Body mass index: <18.1 or 25+
11. Would have preferred a later timing of pregnancy or did not want to be pregnant at all.
12. Prior preterm birth (gestational age <37 weeks)
13. Prior pregnancy loss or miscarriage, 20 weeks or later
14. Prior pregnancy loss (planned or unplanned) or miscarriage, earlier than 20 weeks
15. Prior low birth weight delivery (<2,500 grams)
16. <18 months between last pregnancy and current pregnancy
17. Any health condition (asthma; chlamydia, gonorrhea, syphilis, or genital herpes; diabetes; high blood pressure/hypertension; seizures of epilepsy; urinary tract infection; other illness, infection, or condition requiring ongoing medical care)
18. Any dental concerns (loose teeth, bleeding gums, or bad taste/smell)
19. Any tobacco use (including e-cigarettes) during pregnancy
20. Any alcohol use during pregnancy
21. Any drug use during pregnancy (including drugs that were not prescribed or drugs that were used in a way other than how they were prescribed)
22. Symptoms of depression
23. High stress level
24. Any concerns about mental health or substance use
25. Any housing concerns in the past three months
26. Feeling unsafe with where they live
27. In the past month, had to skip meals, did not eat when hungry, or used a food pantry because they did not have enough money for food
28. Any problems that prevent health care receipt or attending social service appointments
29. Has ever been physically, sexually, emotionally, or verbally abused by a current partner, ex-partner, or someone close
30. Does not have someone in their life that they can count on for help
31. Limited English language proficiency

Sources

Wisconsin Department of Health Services. ForwardHealth Online Handbook: Published Policy through 10/31/2018, Prenatal Care Coordination. Accessed November 12, 2024. https://www.forwardhealth.wi.gov/kw/archive/PNCC110118.pdf

Wisconsin Department of Health Services. ForwardHealth Prenatal Care Coordination Pregnancy Questionnaire Instructions. July 2024. Accessed November 12, 2024. https://www.dhs.wisconsin.gov/forms/f0/f01105a.pdf

Wisconsin Department of Health Services. Prenatal Care Coordination Questionnaire. Accessed November 12, 2024. https://www.forwardhealth.wi.gov/kw/html/PNCCPregnancyQuestionnaire.html

Post Hoc Analysis

We conducted a post hoc analysis to examine whether the association between maternal Prenatal Care Coordination (PNCC) receipt and children's well-child visit (WCV) receipt at age 3 to <4 years old varied by prior WCV receipt during 0 to <3 years old. Per our hypothesis, PNCC may increase participating families' receipt of preventive care, including WCV attendance. If PNCC receipt impacts children's WCV receipt at age 3 to <4 years old, it may be due to greater consistency of care—that is, PNCC promotes the continuity of WCV receipt in the first 3 years of life, which in turn improves WCV receipt in the fourth year of life.

Our post hoc analysis consisted of the following steps. First, we limited our sample to children with continuous Medicaid enrollment for 48 months (4 years) post-birth (n = 73,598 children). These are the only sampled children for which we can observe WCV receipt at 3 to <4 years old. Second, we categorized children based on the number of years during birth to <3 years old in which they had at least 1 WCV annually:

- no WCVs during 0 to <3 years old
- 1 year with any WCVs
- 2 years with any WCVs
- 3 years with any WCVs

Third, for each of these groups, we cross-tabulated any WCV receipt at 3 to <4 years old by PNCC receipt. This determined whether the descriptive relationship between PNCC receipt at WCV receipt in the fourth year of life varied by consistency of WCV receipt during 0 to <3 years old. Finally, we repeated adjusted conventional regressions of any WCV receipt at 3 to <4 years old on PNCC receipt in 2 groups: 0 to 2 years of any WCV receipt per year, age 0 to <3 years old; and 3 years of any WCV receipt per year, age 0 to <3 years old. This determined whether adjusted associations between PNCC receipt at WCV receipt at 3 to <4 years old varied on consistency of WCV receipt at 0 to <3 years old.

Cross-tabulations in Table A7 signal a positive descriptive relationship between PNCC receipt and WCV receipt at 3 to <4 years old regardless of the consistency of prior WCV receipt. However, adjusted regression results in Table A8 indicate that the association between PNCC receipt and WCV receipt at age 3 to <4 years old may be stronger among children with inconsistent prior WCV receipt (ie, children who had at least 1 year during 0 to <3 years old in which they did not have any WCV services).

We interpret these post hoc results cautiously. It is possible that, for families with consistent initial WCV attendance, there might be little behavior to impact. Nonetheless, this warrants a more formal and in-depth analysis on care coordination in pregnancy, preventive care receipt for children, and variation by the family's continuity of health care receipt.

Appendix Tables

Table A1. Prenatal Care Coordination Initiation and Service Frequency Among Those with Any Program Exposure

	Any PNCC	PNCC Assessment/Care Plan Only	PNCC Service Uptake
Sample size (Children), N	29,444	10,099	19,345
Trimester of first PNCC contact, N (%)			
1st trimester	10,356 (35.2)	3,309 (32.8)	7,047 (36.4)
2nd trimester	19,088 (64.8)	6,790 (67.2)	12,298 (63.6)
3rd trimester	0 (0)	0 (0)	0 (0)
PNCC service frequency, N (%)*			
One billed service	–	–	1,011 (5.2)
Two billed services	–	–	2,016 (10.4)
Three billed services	–	–	2,314 (12.0)
Four billed services	–	–	2,342 (12.1)
Five or more billed services	–	–	11,662 (60.3)

*PNCC service frequency was only measured among those with PNCC service uptake beyond the care planning stage.
Abbreviation: PNCC, Prenatal Care Coordination.

Table A2. Background Characteristics of the Sibling-Only Sample, Medicaid-Paid Births in Wisconsin During 2011–2015 (n = 35,373 Children)

Variables	Overall	PNCC Receipt		
		None	Assessment/Care Plan Only	Service Uptake
Sample size, N (row %)	35,373 (100)	26,552 (75.1)	3,082 (8.7)	5,739 (16.2)
Outcomes				
Any WCV receipt, %*				
Age: 0 to <1 year	97.2	96.7	98.4	98.4
Age: 1 to <2 years	88.2	87.1	91.0	91.2
Age: 2 to <3 years	76.6	75.4	78.7	81.0
Age: 3 to <4 years	69.5	68.4	70.5	73.9
Recommended WCV receipt, %*				
Age: 0 to <1 year (6+ visits)	26.1	26.0	25.6	26.6
Age: 1 to <2 years (3+ visits)	38.9	38.2	41.8	40.4
Age: 2 to <3 years (2+ visits)	20.6	19.6	22.4	24.2
Age: 3 to <4 years (1+ visits)	69.5	68.4	70.5	73.9
Maternal characteristics				
Age (years), mean (SD)	25.5 (5.0)	26.0 (5.0)	25.0 (4.8)	23.9 (5.0)
Race/ethnicity, N (%)				
American Indian/Alaska Native (NH)	803 (2.3)	590 (2.2)	121 (3.9)	92 (1.6)
Asian/Pacific Islander (NH)	2,340 (6.6)	1,937 (7.3)	206 (6.7)	197 (3.4)
Black (NH)	7,072 (20.0)	4,542 (17.1)	491 (15.9)	2,039 (35.5)
Hispanic	5,725 (16.2)	3,935 (14.8)	608 (19.7)	1,182 (20.6)
White (NH)	18,283 (51.7)	14,672 (55.3)	1,554 (50.4)	2,057 (35.8)
Multiple (NH)	998 (2.8)	740 (2.8)	[Suppressed]	[Suppressed]
Other (NH)	152 (0.4)	136 (0.5)	[Suppressed]	[Suppressed]
Nativity, N (%)				
Native-born (United States)	30,414 (86.0)	22,882 (86.2)	2,631 (85.4)	4,901 (85.4)
Foreign-born	4,959 (14.0)	3,670 (13.8)	451 (14.6)	838 (14.6)
Maternal education, N (%)				
No HS diploma	7,925 (22.4)	5,275 (19.9)	795 (25.8)	1,855 (32.3)
HS diploma/equiv. only	14,949 (42.3)	11,189 (42.1)	1,284 (41.7)	2,476 (43.1)
Some college	10,547 (29.8)	8,350 (31.5)	887 (28.8)	1,310 (22.8)
Undergraduate degree	1,672 (4.7)	1,490 (5.6)	[Suppressed]	[Suppressed]
More than undergraduate degree	280 (0.8)	248 (0.9)	[Suppressed]	[Suppressed]
Marital status, N (%)				
Unmarried	22,612 (63.9)	15,985 (60.2)	2,125 (68.9)	4,502 (78.5)
Married	12,761 (36.1)	10,567 (39.8)	957 (31.1)	1,237 (21.5)
Residence county urbanicity, N (%)†				
Large central metro	10,779 (30.5)	7,250 (27.3)	792 (25.7)	2,737 (47.7)
Large fringe metro	2,574 (7.3)	1,610 (6.1)	627 (20.3)	337 (5.9)
Medium metro	4,414 (12.5)	3,858 (14.5)	177 (5.7)	379 (6.6)
Small metro	8,402 (23.8)	6,393 (24.1)	861 (27.9)	1,148 (20.0)
Micropolitan	4,216 (11.9)	3,404 (12.8)	334 (10.8)	478 (8.3)
Non-core	4,988 (14.1)	4,037 (15.2)	291 (9.4)	660 (11.5)
Chronic hypertension, N (%)				
Not reported	34,705 (98.1)	26,079 (98.2)	3,030 (98.3)	5,596 (97.5)
Reported	668 (1.9)	473 (1.8)	52 (1.7)	143 (2.5)
Chronic diabetes, N (%)				
Not reported	35,102 (99.2)	26,361 (99.3)	3,052 (99.0)	5,689 (99.1)
Reported	271 (0.8)	191 (0.7)	30 (1.0)	50 (0.9)

Continued

Table A2. Continued

Variables	Overall	PNCC Receipt: None	Assessment/Care Plan Only	Service Uptake
Delivery characteristics				
Parity, N (%)				
First birth	7,008 (19.8)	4,439 (16.7)	666 (21.6)	1,903 (33.2)
Second birth	11,651 (32.9)	8,927 (33.6)	1,064 (34.5)	1,660 (28.9)
Third birth	8,081 (22.9)	6,324 (23.8)	702 (22.8)	1,055 (18.4)
Fourth or later birth	8,633 (24.4)	6,862 (25.8)	650 (21.1)	1,121 (19.5)
Any congenital anomalies of newborn, N (%)‡				
Not reported	35,236 (99.6)	26,446 (99.6)	[Suppressed]	[Suppressed]
Reported	137 (0.4)	106 (0.4)	[Suppressed]	[Suppressed]
Newborn NICU admission, N (%)				
Not reported	33,079 (93.5)	24,851 (93.6)	2,902 (94.2)	5,326 (92.8)
Reported	2,294 (6.5)	1,701 (6.4)	180 (5.8)	413 (7.2)

Notes: All percents are column percents unless otherwise specified. In accordance with data use agreements, we suppressed cells with small sample sizes.

*Measuring well-child visit receipt beyond the first year of life requires longer durations of continuous Medicaid enrollment post-birth. As such, our sample size (and the denominator for percentages) decreases as we measure later outcomes.

- WCVs measured at age 1 to <2 years: 31,224 children (88.3% of sibling sample)
- WCVs measured at age 2 to <3 years: 28,780 children (81.4% of sibling sample)
- WCVs measured at age 3 to <4 years: 26,453 children (74.8% of sibling sample)

†Maternal residence county urbanicity is determined with the National Center for Health Statistics 2013 Urban-Rural Classification Scheme, which we linked to the maternal county of residence on the birth record using the county's name. The only "large central metro" county in Wisconsin is Milwaukee County.

‡Congenital anomalies as reported on the birth record include anencephaly, meningomyelocele/spina bifida, cyanotic congenital heart disease, congenital diaphragmatic hernia, omphalocele, gastroschisis, limb reduction defect, cleft lip, cleft palate, down syndrome, suspected chromosomal disorder, and hypospadias.

Bold defines the types of variable.

Abbreviations: HS, high school; NH, non-Hispanic; NICU, neonatal intensive care unit; PNCC, Prenatal Care Coordination; SD, Standard deviation.

Table A3. Results from Conventional and Sibling Fixed Effects Logistic Regressions of Any Well-Child Visit on Maternal Prenatal Care Coordination Receipt, Unadjusted and Adjusted

	Conventional Logistic Regressions		Sibling Fixed Effects Regressions	
	Unadjusted	Adjusted OR*	Unadjusted	Adjusted OR†
Age: 0 to <1 years	113,347	113,347	36,546	36,546
Sample size (Children), N				
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	2.38 (2.15-2.64)	1.92 (1.73-2.13)	1.72 (1.24-2.39)	1.48 (1.05-2.08)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.76 (1.52-2.03)	1.57 (1.36-1.81)	1.94 (1.22-3.09)	1.75 (1.08-2.82)
Service uptake	2.92 (2.56-3.34)	2.23 (1.95-2.55)	1.59 (1.07-2.34)	1.32 (0.88-1.98)
Age: 1 to <2 years				
Sample size (Children), N	91,652	91,652	32,108	32,108
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.45 (1.37-1.52)	1.31 (1.25-1.39)	1.54 (1.29-1.83)	1.24 (1.03-1.50)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.32 (1.22-1.43)	1.25 (1.16-1.36)	1.80 (1.38-2.35)	1.40 (1.05-1.85)
Service uptake	1.52 (1.43-1.62)	1.35 (1.27-1.44)	1.42 (1.15-1.74)	1.17 (0.94-1.45)
Age: 2 to <3 years				
Sample size (Children), N	81,537	81,537	29,560	29,560
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.24 (1.19-1.29)	1.14 (1.09-1.18)	1.08 (0.95-1.23)	0.93 (0.81-1.07)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.11 (1.04-1.17)	1.06 (0.99-1.12)	1.06 (0.87-1.29)	0.90 (0.73-1.10)
Service uptake	1.32 (1.26-1.38)	1.18 (1.13-1.24)	1.09 (0.94-1.27)	0.95 (0.81-1.11)
Age: 3 to <4 years				
Sample size (Children), N	73,598	73,598	27,155	27,155
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.17 (1.13-1.21)	1.08 (1.04-1.12)	1.10 (0.97-1.25)	1.01 (0.88-1.15)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.00 (0.95-1.06)	0.96 (0.91-1.01)	1.16 (0.96-1.41)	1.05 (0.86-1.28)
Service uptake	1.27 (1.21-1.32)	1.15 (1.10-1.20)	1.08 (0.93-1.24)	0.99 (0.85-1.14)

Notes: All conventional logistic regressions clustered standard errors at the mother-level. Conventional logistic regressions sample from all children, and sibling fixed effects regressions sample only from children with in-sample siblings.
*Adjusted regressions included the following control variables: maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.
†Adjusted regressions included the following control variables: maternal characteristics at delivery (age; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.
Abbreviations: CI, confidence interval; OR, odds ratio; PNCC, Prenatal Care Coordination.

Table A4. Results from Conventional and Sibling Fixed Effects Logistic Regressions of Recommended Well-Child Visit Receipt on Maternal Prenatal Care Coordination Receipt, Unadjusted and Adjusted

	Conventional Logistic Regressions		Sibling Fixed Effects Regressions	
	Unadjusted	Adjusted*	Unadjusted	Adjusted†
Age: 0 to <1 years (6+ WCVs)				
Sample size (Children), N	113,347	113,347	36,546	36,546
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.11 (1.08-1.15)	1.11 (1.07-1.14)	1.34 (1.19-1.50)	1.22 (1.08-1.37)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.05 (0.99-1.10)	1.05 (1.00-1.10)	1.04 (0.88-1.24)	0.99 (0.83-1.18)
Service uptake	1.15 (1.11-1.19)	1.14 (1.10-1.18)	1.51 (1.32-1.72)	1.35 (1.18-1.55)
Age: 1 to <2 years (3+ WCVs)				
Sample size (Children), N	91,652	91,652	32,108	32,108
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.13 (1.09-1.16)	1.13 (1.10-1.17)	1.29 (1.15-1.45)	1.10 (0.98-1.24)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.13 (1.07-1.18)	1.14 (1.08-1.19)	1.36 (1.15-1.62)	1.16 (0.97-1.39)
Service uptake	1.13 (1.09-1.17)	1.13 (1.09-1.17)	1.27 (1.11-1.44)	1.08 (0.94-1.23)
Age: 2 to <3 years (2+ WCVs)				
Sample size (Children), N	81,537	81,537	29,560	29,560
PNCC (Binary), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.19 (1.14-1.23)	1.11 (1.06-1.15)	1.03 (0.90-1.19)	1.00 (0.86-1.15)
PNCC (Categorical), OR (95% CI)				
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.09 (1.03-1.16)	1.06 (0.99-1.13)	0.98 (0.80-1.22)	0.96 (0.77-1.19)
Service uptake	1.24 (1.19-1.30)	1.13 (1.08-1.18)	1.06 (0.90-1.24)	1.01 (0.86-1.20)

Notes: All conventional logistic regressions clustered standard errors at the mother-level. Conventional logistic regressions sample from all children, and sibling fixed effects regressions sample only from children with in-sample siblings. The American Academy of Pediatrics provides the recommended number of annual well-child visits, which decreases with age: 6 visits at age 0 to <1 year; 3 visits at age 1 to <2 years; 2 visits at age 2 to <3 years; and 1 visit annually from age 3 to 21 years. Thus, the threshold for meeting the recommended WCV receipt decreases with age, and having any WCV receipt at age 3 to <4 years is equivalent to having the recommended receipt of WCVs.

*Adjusted regressions included the following control variables: maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.

†Adjusted regressions included the following control variables: maternal characteristics at delivery (age; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.

Abbreviations: CI, confidence interval; OR, odds ratio; PNCC, Prenatal Care Coordination; WCV, well-child visit.

Table A5. Additional Regression Results from Sensitivity Analyses

	Sample: Sibling Births Only	Sample: No Newborn Congenital Anomaly*		Sample: No NICU Admission		Sample: Continuous Medicaid Enrollment, 48 Months Post-birth		Sample: Controlling for Gestaional Hypertension and Gestational Diabetes	
	Conventional Logistic Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)
Outcome: Any WCV Receipt									
Age: 0 to <1 years									
Sample size (Children), N	35,373	112,827	35,122	105,121	31,443	73,598	26,453	113,347	36,546
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	2.01 (1.78-2.27)	1.91 (1.73-2.12)	1.46 (1.04-2.05)	1.91 (1.72-2.12)	1.34 (0.93-1.94)	1.77 (1.51-2.08)	1.66 (0.98-2.79)	1.92 (1.73-2.12)	1.49 (1.06-2.11)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.49 (1.26-1.75)	1.56 (1.35-1.80)	1.69 (1.04-2.74)	1.58 (1.36-1.84)	1.51 (0.90-2.54)	1.46 (1.17-1.83)	1.67 (0.82-3.39)	1.57 (1.36-1.81)	1.77 (1.09-2.86)
Service uptake	2.58 (2.17-3.06)	2.22 (1.94-2.54)	1.32 (0.88-1.99)	2.19 (1.91-2.52)	1.24 (0.80-1.93)	2.03 (1.66-2.50)	1.65 (0.89-3.05)	2.23 (1.95-2.55)	1.34 (0.89-2.01)
Age: 1 to <2 years									
Sample size (Children), N	31,224	91,282	31,022	85,116	27,841	73,598	26,453	91,652	32,108
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.26 (1.18-1.35)	1.32 (1.25-1.39)	1.25 (1.03-1.50)	1.32 (1.25-1.39)	1.27 (1.04-1.55)	1.31 (1.23-1.40)	1.16 (0.93-1.43)	1.31 (1.24-1.38)	1.25 (1.03-1.50)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.17 (1.06-1.29)	1.25 (1.16-1.36)	1.39 (1.04-1.84)	1.25 (1.15-1.36)	1.42 (1.06-1.91)	1.26 (1.14-1.38)	1.21 (0.88-1.66)	1.25 (1.16-1.36)	1.41 (1.06-1.87)
Service uptake	1.31 (1.21-1.42)	1.35 (1.27-1.44)	1.18 (0.95-1.46)	1.36 (1.27-1.45)	1.20 (0.95-1.51)	1.35 (1.25-1.45)	1.13 (0.89-1.45)	1.35 (1.26-1.44)	1.17 (0.94-1.45)
Age: 2 to <3 years									
Sample size (Children), N	28,780	81,210	28,597	75,766	25,709	73,598	26,453	81,537	29,560
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.09 (1.04-1.15)	1.14 (1.09-1.18)	0.93 (0.81-1.07)	1.13 (1.09-1.18)	0.89 (0.77-1.03)	1.14 (1.09-1.19)	0.93 (0.80-1.07)	1.14 (1.09-1.18)	0.93 (0.81-1.07)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.01 (0.94-1.09)	1.06 (0.99-1.12)	0.89 (0.73-1.10)	1.05 (0.99-1.12)	0.85 (0.68-1.05)	1.05 (0.99-1.12)	0.89 (0.71-1.10)	1.06 (0.99-1.12)	0.90 (0.73-1.10)
Service uptake	1.14 (1.08-1.21)	1.19 (1.13-1.24)	0.95 (0.82-1.11)	1.18 (1.13-1.24)	0.91 (0.77-1.08)	1.20 (1.14-1.26)	0.95 (0.81-1.12)	1.18 (1.13-1.24)	0.95 (0.81-1.11)

Continued

Table A5. Continued

	Sample: Sibling Births Only	Sample: No Newborn Congenital Anomaly*		Sample: No NICU Admission		Sample: Continuous Medicaid Enrollment, 48 Months Post-birth		Sample: Controlling for Gestaional Hypertension and Gestational Diabetes	
	Conventional Logistic Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)
Age: 3 to <4 years									
Sample size (Children), N	26,453	73,299	26,285	68,400	23,655	73,598	26,453	73,598	27,155
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.05 (0.99-1.10)	1.08 (1.04-1.12)	1.02 (0.89-1.16)	1.08 (1.04-1.12)	1.00 (0.87-1.15)	1.08 (1.04-1.12)	1.01 (0.88-1.15)	1.08 (1.04-1.12)	1.01 (0.88-1.15)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	0.91 (0.85-0.98)	0.96 (0.90-1.01)	1.07 (0.88-1.30)	0.97 (0.91-1.02)	1.06 (0.86-1.30)	0.96 (0.91-1.01)	1.05 (0.86-1.28)	0.96 (0.91-1.01)	1.05 (0.86-1.28)
Service uptake	1.13 (1.07-1.19)	1.15 (1.10-1.21)	0.99 (0.86-1.15)	1.15 (1.10-1.21)	0.97 (0.83-1.13)	1.15 (1.10-1.20)	0.99 (0.85-1.14)	1.15 (1.10-1.20)	0.99 (0.85-1.14)
Outcome: Recommended WCV Receipt									
Age: 0 to <1 years (6+ WCVs)									
Sample size (Children), N	35,373	112,827	35,112	105,121	31,443	73,598	26,453	113,347	36,546
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.13 (1.09-1.17)	1.11 (1.07-1.14)	1.21 (1.07-1.36)	1.10 (1.07-1.14)	1.20 (1.06-1.36)	1.04 (0.99-1.08)	1.17 (1.01-1.36)	1.11 (1.07-1.14)	1.22 (1.08-1.37)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.07 (1.01-1.13)	1.04 (0.99-1.09)	0.98 (0.82-1.17)	1.04 (0.99-1.09)	0.98 (0.81-1.18)	1.00 (0.95-1.06)	1.03 (0.82-1.28)	1.05 (0.99-1.10)	1.00 (0.83-1.19)
Service uptake	1.16 (1.12-1.21)	1.14 (1.10-1.18)	1.34 (1.17-1.54)	1.14 (1.10-1.18)	1.33 (1.15-1.55)	1.06 (1.01-1.10)	1.25 (1.06-1.48)	1.14 (1.10-1.18)	1.35 (1.18-1.55)
Age: 1 to <2 years (3+ WCVs)									
Sample size (Children), N	31,224	91,282	31,022	85,116	27,841	73,598	26,453	91,652	32,108
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.12 (1.08-1.16)	1.13 (1.10-1.17)	1.10 (0.98-1.24)	1.13 (1.10-1.17)	1.06 (0.93-1.20)	1.13 (1.09-1.17)	1.12 (0.98-1.28)	1.13 (1.09-1.17)	1.10 (0.97-1.24)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.11 (1.05-1.18)	1.14 (1.08-1.19)	1.16 (0.97-1.38)	1.14 (1.08-1.19)	1.10 (0.91-1.33)	1.12 (1.07-1.19)	1.21 (0.99-1.47)	1.14 (1.08-1.19)	1.16 (0.97-1.39)
Service uptake	1.13 (1.08-1.18)	1.13 (1.09-1.17)	1.08 (0.94-1.23)	1.13 (1.09-1.18)	1.04 (0.90-1.20)	1.14 (1.09-1.18)	1.08 (0.93-1.25)	1.13 (1.09-1.17)	1.07 (0.93-1.22)

Continued

Table A5. Continued

	Sample: Sibling Births Only	Sample: No Newborn Congenital Anomaly*		Sample: No NICU Admission		Sample: Continuous Medicaid Enrollment, 48 Months Post-birth		Sample: Controlling for Gestaional Hypertension and Gestational Diabetes	
	Conventional Logistic Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)	Conventional Logistic Regression Or (95% CI)	Sibling Fixed Effects Regression Or (95% CI)
Age: 2 to <3 years (2+ WCVs)									
Sample size (Children), N	28,780	81,210	28,597	75,766	25,709	73,598	26,453	81,537	29,560
PNCC (Binary)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Any	1.08 (1.03-1.13)	1.11 (1.06-1.15)	1.00 (0.86-1.16)	1.12 (1.07-1.16)	0.96 (0.83-1.12)	1.10 (1.06-1.15)	0.96 (0.83-1.12)	1.11 (1.06-1.15)	0.99 (0.86-1.15)
PNCC (Categorical)									
None	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.03 (0.95-1.11)	1.06 (1.00 to 1.13)	0.96 (0.77-1.19)	1.07 (1.01-1.14)	0.88 (0.70-1.10)	1.05 (0.99-1.12)	0.91 (0.73-1.13)	1.06 (0.99-1.13)	0.97 (0.78-1.20)
Service uptake	1.10 (1.04-1.16)	1.13 (1.08-1.18)	1.02 (0.87-1.20)	1.14 (1.09-1.20)	1.01 (0.85-1.20)	1.13 (1.08-1.18)	0.99 (0.84-1.18)	1.13 (1.08-1.18)	1.01 (0.86-1.19)

Notes: Maternal PNCC receipt is measured during pregnancy. All conventional logistic regressions cluster standard errors at the mother-level and adjust for the following control variables: maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity. All sibling fixed effects regressions adjust for the following control variables: maternal characteristics at delivery (age; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity. The American Academy of Pediatrics provides the recommended number of annual well-child visits, which decreases with age: 6 visits at age 0 to <1 year; 3 visits at age 1 to <2 years; 2 visits at age 2 to <3 years; and 1 visit annually from age 3 to 21 years. Thus, the threshold for meeting the recommended WCV receipt decreases with age, and having any WCV receipt at age 3 to <4 years is equivalent to having the recommended receipt of WCVs.

*Congenital anomalies as reported on the birth record include anencephaly, meningomyelocele/spina bifida, cyanotic congenital heart disease, congenital diaphragmatic hernia, omphalocele, gastroschisis, limb reduction defect, cleft lip, cleft palate, down syndrome, suspected chromosomal disorder, and hypospadias.

Abbreviations: CI, confidence interval; NICU, neonatal intensive care unit; OR, odds ratio; PNCC, Prenatal Care Coordination; WCV, well-child visit.

Table A6. Results from Sibling Fixed Effects Logistic Regressions of Well-Child Visit Receipt on Maternal Prenatal Care Coordination Receipt, Stratified on Differential Exposure to Any Prenatal Care Coordination Receipt Across Pregnancies

	Subsample: Sibling Pairs with Constant PNCC Exposure or PNCC Exposure in the First Pregnancy Only (n = 30,936 Children [15,468 Pairs])	Subsample: Sibling Pairs with Constant PNCC Exposure or PNCC Exposure in the Second Pregnancy Only (n = 28,312 Children [14,156 Pairs])
Outcome: Any WCV Receipt		
Age: 0 to <1 years		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.66 (0.96-2.86)	1.43 (0.79-2.59)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.88 (0.94-3.77)	1.36 (0.64-2.93)
Service uptake	1.52 (0.81-2.82)	1.48 (0.76-2.85)
Age: 1 to <2 years		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.28 (0.98-1.69)	1.18 (0.83-1.68)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.43 (0.99-2.06)	1.36 (0.86-2.19)
Service uptake	1.20 (0.89-1.63)	1.11 (0.77-1.62)
Age: 2 to <3 years		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	0.88 (0.73-1.06)	0.87 (0.67-1.14)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	0.80 (0.63-1.03)	0.89 (0.62-1.28)
Service uptake	0.93 (0.75-1.14)	0.87 (0.65-1.15)
Age: 3 to <4 years		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.19 (0.99-1.43)	0.80 (0.63-1.02)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.30 (1.01-1.69)	0.79 (0.58-1.09)
Service uptake	1.14 (0.93-1.40)	0.80 (0.62-1.04)
Outcome: Recommended WCV Receipt		
Age: 0 to <1 years		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.36 (1.15-1.60)	1.01 (0.80-1.27)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.06 (0.85-1.34)	0.76 (0.57-1.02)
Service uptake	1.52 (1.27-1.82)	1.18 (0.92-1.52)
Age: 1 to <2 years		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.12 (0.94-1.33)	1.00 (0.80-1.25)

Continued

Table A6. Continued

	Subsample: Sibling Pairs with Constant PNCC Exposure or PNCC Exposure in the First Pregnancy Only (n = 30,936 Children [15,468 Pairs])	Subsample: Sibling Pairs with Constant PNCC Exposure or PNCC Exposure in the Second Pregnancy Only (n = 28,312 Children [14,156 Pairs])
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.12 (0.89-1.41)	0.97 (0.73-1.29)
Service uptake	1.12 (0.93-1.35)	1.01 (0.80-1.28)
Age: 2 to <3 uears		
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.10 (0.89-1.36)	0.89 (0.69-1.15)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.04 (0.79-1.38)	0.95 (0.68-1.32)
Service uptake	1.13 (0.90-1.42)	0.87 (0.66-1.14)

Notes: All regressions included the following control variables: maternal characteristics at delivery (age; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity. The American Academy of Pediatrics provides the recommended number of annual well-child visits, which decreases with age: 6 visits at age 0 to <1 year; 3 visits at age 1 to <2 years; 2 visits at age 2 to <3 years; and 1 visit annually from age 3 to 21 years. Thus, the threshold for meeting the recommended WCV receipt decreases with age, and having any WCV receipt at age 3 to <4 years is equivalent to having the recommended receipt of WCVs.
Abbreviations: CI, confidence interval; OR, odds ratio; PNCC, Prenatal Care Coordination; WCV, well-child visit.

Table A7. Post-Hoc Analysis: Cross-Tabulations of Well-Child Visit Receipt at 3 to <4 Years-Old by Maternal Prenatal Care Coordination Receipt, Stratified on Consistency of Prior Well-Child Visit Receipt (n = 73,598 Children)

		PNCC Receipt		
	Overall	None	Assessment/Care Plan Only	Service Uptake
Subsample: No WCVs, Age 0 to <3 years old				
Sample size (Children), N	747	653	47	47
Any WCV receipt, Age 3 to <4 years old, N (Col. %)	126 (16.9)	105 (16.1)	8 (17.0)	13 (27.7)
Subsample: 1 year with any WCVs, Age 0 to <3 years old				
Sample size (Children), N	3,706	2,966	278	462
Any WCV receipt, Age 3 to <4 years old, N (Col. %)	1,167 (31.5)	896 (30.2)	83 (29.9)	188 (40.7)
Subsample: 2 years with any WCVs, Age 0 to <3 years old				
Sample size (Children), N	14,825	10,985	1,381	2,459
Any WCV receipt, Age 3 to <4 years old, N (Col. %)	8,540 (57.6)	6,239 (56.8)	777 (56.3)	1,524 (62.0)
Subsample: 3 years with any WCVs, Age 0 to <3 years old				
Sample size (Children), N	54,320	38,710	5,095	10,515
Any WCV receipt, Age 3 to <4 years old, N (Col. %)	41,819 (77.0)	29,706 (76.7)	3,847 (75.5)	8,266 (78.6)

Abbreviations: Col., column; PNCC, Prenatal Care Coordination; WCV, well-child visit.

Table A8. Post-Hoc Analysis: Results from Adjusted Conventional Logistic Regressions of Any Well-Child Visit at Age 3 to <4 Years-Old on Maternal Prenatal Care Coordination Receipt, Stratified on Consistency of Prior Well-Child Visit Receipt (n = 73,598 Children)

	Subsample: 0 to 2 Years of Any WCV Receipt Per Year, Age 0 to <3 Years Old (n = 19,278 Children)	Subsample: 3 Years of Any WCV Receipt Per Year, Age 0 to <3 Years Old (n = 73,598 Children)
PNCC (Binary), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Any	1.14 (1.06-1.22)	1.01 (0.96-1.06)
PNCC (Categorical), OR (95% CI)		
None	1 [Reference]	1 [Reference]
Assessment/Care plan only	1.00 (0.90-1.11)	0.91 (0.85-0.98)
Service uptake	1.23 (1.13-1.33)	1.07 (1.01-1.13)

Notes: Maternal PNCC receipt is measured during pregnancy. All conventional logistic regressions cluster standard errors at the mother-level and adjust for the following control variables: maternal characteristics at delivery (age; race/ethnicity; nativity; education; marital status; residence county urbanicity; chronic hypertension; chronic diabetes) and parity.
Abbreviations: CI, confidence interval; OR, odds ratio; PNCC, Prenatal Care Coordination; WCV, well-child visit.