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Health Care Utilisation in the First Year of Life Among Infants of Mothers With Perinatal Depression or Anxiety

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Abstract

Background—Limited information is available on associations between maternal depression and anxiety and infant health care utilisation.

Methods—We analysed data from 24 263 infants born between 1998 and 2007 who themselves and their mothers were continuously enrolled for the infant's first year in Kaiser Permanente Northwest. We used maternal depression and anxiety diagnoses during pregnancy and postpartum to categorise infants into two depression and anxiety groups and examined effect modification by timing of diagnosis (pregnancy only, postpartum only, pregnancy and postpartum). Using generalised estimating equations in multivariable log-linear regression, we estimated adjusted risk ratios (RR) between maternal depression and anxiety and well baby visits (<5 and ≥5), up to date immunisations (yes/no), sick/emergency visits (<6 and ≥6) and infant hospitalisation (any/none).

Results—Infants of mothers with perinatal depression or anxiety were as likely to attend well baby visits and receive immunisations as their counterparts (RR = 1.0 for all). Compared with no depression or anxiety, infants of mothers with prenatal and postpartum depression or anxiety, or postpartum depression or anxiety only were 1.1 to 1.2 times more likely to have ≥6 sick/emergency visits. Infants of mothers with postpartum depression only had marginally increased risk of hospitalisation (RR = 1.2 [95% confidence interval 1.0, 1.4]); 70% of diagnoses occurred after the infant's hospitalisation.

Conclusions—An understanding of the temporality of the associations between maternal depression and anxiety and infant acute care is needed and will guide strategies to decrease maternal mental illness and improve infant care for this population.

Keywords

depression; anxiety; pregnancy; postpartum; immunisations; infant; emergency medical services

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Maternal depression and anxiety may have implications for infant care. Mothers with depression may show lower activity levels and more disengagement with their infants than non-depressed mothers.[1] In general, psychological disorders, including depression, are associated with missing scheduled appointments.[2,3] Conversely, adults with various anxiety disorders may experience anxiety about their health,[4] with resultant increases in health care utilisation for those with severe health anxiety.[5]

Several US studies have examined the association between maternal depressive symptoms[6–10] or diagnosis[11] and infant health care utilisation, although results are mixed. The majority of studies found an association between maternal depression and increased number of infant acute and emergency visits,[8,9,11] and no associations with infant hospitalisation[7,9,11] and well child visits.[6,8,10,11] Two prospective cohort studies examining infant immunisations reported mixed results.[9,10] Only one of the studies, a prospective, community-based study, examined both prenatal and postpartum depression, but did so among a largely low-income, uninsured group of women.[6] The authors found increased risk of hospitalisation among infants of mothers with persistent prenatal and postpartum depression, but no association between maternal depression and attendance at well child visits. Only one US study, of 31 mothers, prospectively examined associations between maternal prenatal anxiety symptoms and infant health care utilisation and found more acute care visits among infants of mothers with prenatal anxiety.[12]

In the general adult population, depression and anxiety are highly correlated[13] and the presence of both may indicate a greater severity of the conditions.[14] In postpartum women, a third of women with major depressive episode have a co-morbid anxiety disorder[15] and 10–50% of women with anxiety symptoms experience co-morbid depressive symptoms.[16] However, we found no studies to date that have examined independent and combined effects of maternal depression and anxiety on infant health care utilisation. Therefore, we examined whether maternal depression and/or anxiety diagnosed during pregnancy or postpartum are associated with well baby visits, immunisations, number of sick/emergency visits and infant hospitalisation.

Methods

We analysed data from Kaiser Permanente Northwest (KPNW), a large non-profit prepaid, federally certified, Joint Commission-accredited, group practice health maintenance organisation in western Oregon and Washington states with 475 337 members as of January 2011. Members include individuals covered by commercial and individual self-pay health plans, Washington State Basic Health Plan (subsidised, Washington state only), Medicare and Medicaid.

Methods to identify pregnancy episodes from multiple KPNW individual-level data systems have been published elsewhere.[17] Briefly, we used an established, complex validated computer algorithm to identify pregnancies.[17] After identifying pregnancy episodes that ended in a livebirth, we used mothers' health insurance identification numbers to link mothers with infants. Infant records were matched to livebirth certificate records using mother's name (maiden and married), date of birth and address, and infant's name, date of

birth and facility of delivery. Race/ethnicity, other demographic characteristics and infant birthweight were obtained from the infants' birth certificates. This study was approved by the CDC and the KPNW Institutional Review Boards.

We matched 46 807 singleton, term infants born between January 1998 and December 2007 to their mother's medical record (97.2% of all live, singleton, term births born during the time period). We limited the sample to infants enrolled in KPNW for their entire first year of life. Therefore, we excluded 70 infants who died and 13 198 infants not enrolled for the entire year. We also excluded 3126 infants who had a major birth defect (ICD-10 codes 740–759) and 642 infants of mothers with diagnosed drug or alcohol dependency. Among 29 771 eligible infants, we excluded 1122 with unreliable information on gestational age at birth, 338 with no data on the delivery hospitalisation and 96 missing information on birthweight. To minimise confounding by severe psychiatric conditions, we excluded all infants of mothers with schizophrenic, bipolar and manic disorders (n = 207), as well as 580 infants of mothers with other mental health diagnoses, who were not also diagnosed with depression or anxiety. Infants whose mothers were not enrolled in KPNW for the first year postpartum were also excluded (n = 3165). The final analytical sample included 24 263 infants of 20 090 mothers; 32% of infants were siblings.

The main exposures under study were active maternal depression and anxiety diagnosed during pregnancy and the year after delivery, hereafter referred to as the 'postpartum period'. We used maternal depression [ICD-9-CM codes 296.20–296.25 (major depressive episode, single episode), 296.30–296.35 (major depressive episode, recurrent episode), 296.82 (atypical depressive disorder), 300.4 (dysthymic disorder), 309.0 (adjustment disorder with depressed mood), 309.1 (prolonged depressive reaction) and 309.28 (adjustment disorder with mixed anxiety and depressed mood)] and anxiety diagnoses [ICD-9-CM codes 300.00–300.02 and 300.09 (anxiety states), 300.20–300.29 (phobic disorders), 300.3 (obsessive compulsive disorders), 300.7 (hypochondriasis), 308.1–308.3 and 308.9 (acute reaction to stress), 309.21 (separation anxiety disorder), 309.24 (adjustment disorder with anxiety), 309.81 (posttraumatic stress disorder) and 313.0 (overanxious disorder)] diagnosed during pregnancy and for the first year after delivery. These could include newly diagnosed or previously diagnosed, but still active conditions. Based on their mother's diagnoses, we grouped infants into two mutually exclusive depression categories (maternal depression diagnosed during pregnancy and/or postpartum, referred to hereafter as 'perinatal depression', and no depression diagnosed during pregnancy or postpartum). We created a similar dichotomous anxiety variable. Mothers could have both depression and anxiety diagnoses.

Infant health care utilisation in the first year of life, the outcome under study, included well child visits, up to date immunisations, infant sick and emergency visits, and infant hospitalisations. Based on the regular well child visit schedule, we dichotomised number of well child visits during the first year of life as <5 and ≥. Infants were considered 'up to date' on their immunisations if, by 8 months of age, they had received three doses of diphtheria, pertussis and tetanus vaccine (DTaP/DTP), two doses of hepatitis B vaccine, three doses of haemophilus influenza vaccine and two doses of polio vaccine. Sick and emergency visits were combined into a single count for each infant, since the most common reasons for each

were similar, and we dichotomised the outcome at the median (<6 and ≥6). Infant hospitalisations were dichotomised into one or more hospitalisations (yes/no) between birth and 52 weeks of age.

Initially, we examined demographic, maternal health and infant health characteristics by depression and anxiety status, using chi-squared tests. Next, we modelled the associations between depression and anxiety and the four infant health care outcomes, using generalised estimating equations to account for multiple observations per woman, or mothers with more than one birth during the time period. Using log-linear regression models to generate risk ratios, we estimated associations between depression and anxiety and well child visits, up to date immunisations, infant sick/emergency visits and infant hospitalisations. In all four models, using a four-level depression variable based on timing of diagnosis (none, pregnancy only, pregnancy and postpartum, or postpartum only), we examined effect modification of the association between maternal depression and the outcome by timing of diagnosis. We did the same for maternal anxiety. In addition to independent effects of depression and anxiety, using an interaction term between the two dichotomous variables, we also assessed whether results differed for women with both diagnoses. We conducted sensitivity analyses excluding from each of the four final models the 15% of mother–infant pairs where the mother was not enrolled throughout pregnancy and, separately, the 639 (2.6%) women with depression and/or anxiety as well as another mental health diagnosis.

We determined the demographic, maternal health and infant health characteristics that may potentially confound the association between mental health and infant health care utilisation by reviewing published literature and constructing directed acyclic graphs considering causal mechanisms. To be included in a model, the confounder must have been associated with either exposure (depression or anxiety) and also associated with the outcome among the unexposed. Confounders included in the four separate multivariable models varied by outcome and included maternal age, race/ethnicity, education, marital status, parity, hypertension/preeclampsia, Medicaid status, postpartum tobacco use and gestational age at delivery. We also compared median number of sick/emergency visits per infant by maternal depression and anxiety status for the seven most commonly coded reasons for the visit using the non-parametric Wilcoxon rank sum test.

Results

Among the women in our sample, 13.4% had a perinatal depression diagnosis, 7.3% had a perinatal anxiety diagnosis and 3.7% received both a perinatal depression and an anxiety diagnosis. Of depressed women, 27.3% also had anxiety and 16.4% also had another mental health condition. Of anxious women, 50.0% also had depression and 18.5% also had another mental health condition. In general, compared with mothers with no depression diagnosis, mothers with perinatal depression were slightly younger and less educated, had more children and were more likely to be White, single/widowed/divorced, covered by Medicaid, hypertensive during pregnancy and smokers (Table 1). Compared with women who were not depressed, depressed women were more likely to have early-term deliveries (37 to 38 weeks), as opposed to late-term deliveries (≥39 weeks). Women with a perinatal anxiety diagnosis were more likely than women without anxiety to be White, less educated and

single/widowed/divorced, have more children, use tobacco, have a hypertensive disorder of pregnancy and have an early-term delivery.

No associations were seen between perinatal depression or anxiety and attendance at well baby visits [adjusted risk ratio (aRR) = 1.0 for both] (Table 2). Similarly, no associations were found between perinatal depression or anxiety and infant immunisations.

The association between maternal depression and infant hospitalisation was modified by timing of diagnosis. Infants of mothers with depression diagnosed during the postpartum period only had marginally increased risk of hospitalisation (aRR = 1.2 [95% confidence interval (CI) 1.0, 1.4]) compared with infants of mothers with no depression. No associations were found with prenatal diagnoses. Of the 128 hospitalisations among infants of mothers with depression diagnosed postpartum, 70.3% occurred before the mother's diagnosis. Likewise, infants of mothers with postpartum anxiety also had marginally elevated risk of infant hospitalisation (aRR = 1.2 [95% CI 1.0, 1.6]). However, for both depression and anxiety, the lower confidence interval crossed 1.0.

The associations between number of infant sick/emergency visits and maternal depression and anxiety were also modified by timing of maternal depression and anxiety. Compared with infants of mothers with no depression, infants of mothers with depression diagnosed during pregnancy and the postpartum period (aRR = 1.1 [95% CI 1.0, 1.2]) or during the postpartum period only (aRR = 1.2 [95% CI 1.1, 1.2]) were more likely to have ≥6 sick/emergency visits. Infants of mothers with anxiety during pregnancy and postpartum (aRR = 1.2 [95% CI 1.1, 1.3]) and postpartum only (aRR = 1.1 [95% CI 1.0, 1.2]) also had slightly elevated risk of ≥6 sick/emergency visits compared with infants of mothers with no anxiety. No clinically significant interactions between depression and anxiety were found with any of the four outcomes. Excluding mothers not enrolled throughout pregnancy or mothers with additional mental health diagnoses did not change results.

The number of visits per infant was higher for infants of mothers with perinatal depression or anxiety compared with infants of mothers with no depression or anxiety for six of the seven most common reasons for sick/emergency visits (upper respiratory infection, otitis media, other infection, other respiratory conditions, worried well and injury; $P < 0.01$ for all) (data not shown). The number of visits per infant did not vary by depression ($P = 0.4$) or anxiety status ($P = 0.1$) for feeding problems.

Comment

In general, mothers with perinatal depression or anxiety diagnoses were as likely to access preventive health care services for their infants as mothers with no perinatal depression or anxiety. However, infants of mothers with depression or anxiety diagnosed during the postpartum period had more sick/emergency visits and increased risk of hospitalisation than infants of mothers with no depression or anxiety. There was no indication that infants of mothers with depression or anxiety were more likely to experience certain types of problems over others, as six of the top seven reasons for sick/emergency visits were uniformly elevated for this group. Although co-morbid depression and anxiety was common in our

population, we found no effect modification between the two conditions and neither variable substantially confounded the other.

With regards to anxiety, our results were similar to the only other US study, which prospectively examined the association between prenatal anxiety and infant health care utilisation.[12] In that study, 31 White, married, middle class women were screened for maternal anxiety during their second trimester of pregnancy and data from their infants' medical record were gathered through 1 year of age. The authors found increased rates of acute care visits and no difference in well child visits among infants of mothers with prenatal anxiety. Our study found increased risk of ≥6 sick/emergency visits among infants of mothers with anxiety during pregnancy and postpartum or postpartum only and no associations between perinatal anxiety and well child visits and infant immunisations. We found no evidence that the increase in sick/emergency visits was unwarranted, but we were limited by the use of administrative data. Additionally, a prospective cohort study from Australia and a cross-sectional study from Canada found no association between maternal anxiety and infant primary care[18,19] or emergency visits.[18]

Several US-based studies have examined the association between maternal depressive symptoms[6–10] or diagnosis[11] and infant health care utilisation. Our study differed from the others by examining both diagnosed depression and anxiety, effect modification by timing of diagnosis, and both preventive and acute infant health care utilisation. Similar to our study, most,[6,8,10,11] but not all,[9] previous studies found no association between maternal depression and infant attendance at well child visits. Two prospective cohort studies examined maternal depression and infant and early childhood immunisations, with one finding no association,[10] similar to ours, and the other finding decreased immunisation rates among children of depressed mothers.[9] The latter study, by Minkovitz and colleagues, followed children through 33 months and found that timely receipt of care declined with increasing age.[9] It is unclear whether our population would have similar results with extended follow-up.

Similar to our findings, three studies found increases in acute care or emergency visits among infants and children of mothers with depression after childbirth,[8,9,11] while one did not.[10] The latter study included children up to 5 years of age, which may account for the discrepancy in findings.[10] Minkovitz and colleagues found increased odds of emergency visits among infants of depressed mothers, but no difference in number of sick visits.[9] Sills and colleagues examined data from Kaiser Permanente of Colorado from 1997 to 2002 and found small increases in mean numbers of sick and emergency visits among infants of depressed mothers.[11] The authors noted that there may be limited clinical significance of the small increases in sick and emergency visits, although there may be larger financial implications for families and health insurers. Future studies should assess whether mothers with depression or anxiety access care for their infants unnecessarily during the course of an illness, or whether these infants are more prone to illness.

Increases in hospitalisations among infants of depressed mothers were found in three[6,9,11] of four prospective cohort studies;[7] however, in two studies,[9,11] these increases did not reach statistical significance. We found increased risk of hospitalisation in infants of mothers with

depression diagnoses in the postpartum period only, although the lower confidence interval of the estimate crossed 1.0. Approximately 70% of these infant hospitalisations occurred before the mother's depression diagnosis, suggesting that having a child hospitalised may influence the onset of depression. Prospective studies assessing maternal depression frequently during the postpartum period are needed to delineate whether maternal depression increases the likelihood of infant hospitalisation or whether infant hospitalisations increase the occurrence or diagnosis of maternal depression.

We did not examine treatment for depression or anxiety in our sample of mothers and cannot assess whether treatment modifies associations between depression or anxiety and infant health care outcomes. However, in a KPNW sample of infants born between 1998 and 2001, many of whom are included in this analysis, almost all (93%) mothers with diagnosed depression received either counselling or medication or both for their depression.[20] It is unknown what percentage of women insured by KPNW with diagnosed anxiety receives treatment.

The data we used were from administrative databases and electronic medical records which yield some limitations. The exposures, diagnosed depression or anxiety, have high specificity, but lower sensitivity and there are likely women in the sample with undiagnosed depression or anxiety, which could drive results towards the null. Length of the depressive or anxious episode, whether the condition was initially diagnosed before the pregnancy began and whether conditions documented more than once during the pregnancy and postpartum period were distinct episodes are unknown. We did not examine whether specific anxiety or depression diagnoses are more associated with outcomes than others, although these conditions are heterogeneous.

Approximately 3% of singleton, term births occurring during the study period could not be matched to a maternal record and were excluded from the analysis. Maternal information on these births was unavailable and comparisons between included and excluded maternal–infant pairs could not be made. However, because our sample includes over 97% of births during the time period, selection bias likely has little effect on our results. Finally, the results may not be generalisable to uninsured US mothers and infants and those with different demographic characteristics or with infant outcomes that we excluded from our analysis.

In summary, similar rates of preventative care visits between infants of mothers with and without depression and anxiety are encouraging and show that maternal depression and anxiety may not inhibit health care providers from monitoring infants' health. However, future studies are needed to understand the temporality of the associations between maternal depression and anxiety and increased infant acute care to provide support and target timing of assessment, treatment and referral services. The possible association between postpartum depression and infant hospitalisation may indicate a need to provide support and referral services to parents of hospitalised infants, which could improve parental mental health and subsequent infant care and bonding after discharge.

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Table 1

Infant and maternal characteristics by maternal perinatal depression and anxiety statuses[a]

	No depression diagnosis, *n* (%)	Depression diagnosis, *n* (%)	*P*-value	No anxiety diagnosis, *n* (%)	Anxiety diagnosis, *n* (%)	*P*-value
Total	21 004 (86.6)	3259 (13.4)		22 486 (92.7)	1777 (7.3)	
Maternal characteristics						
Age (years)			0.002			0.65
<25	5524 (26.3)	956 (29.3)		5995 (26.7)	485 (27.3)	
25–29	6922 (33.0)	1009 (31.0)		7357 (32.7)	574 (32.3)	
30–34	5745 (27.4)	851 (26.1)		6129 (27.3)	467 (26.3)	
≥35	2813 (13.4)	443 (13.6)		3005 (13.4)	251 (14.1)	
Race/ethnicity			<0.0001			<0.0001
White	15 602 (74.3)	2747 (84.3)		16 876 (75.1)	1473 (82.9)	
Black	781 (3.7)	86 (2.6)		809 (3.6)	58 (3.3)	
Hispanic	1766 (8.4)	212 (6.5)		1840 (8.2)	138 (7.8)	
Asian	2497 (11.9)	132 (4.1)		2557 (11.4)	72 (4.1)	
Other/unknown	358 (1.7)	82 (2.5)		404 (1.8)	36 (2.0)	
Education (years)			0.01			0.003
<12	3925 (22.2)	655 (24.5)		4208 (22.3)	372 (25.4)	
12	4395 (24.9)	676 (25.3)		4690 (24.8)	381 (26.0)	
>12	9351 (52.9)	1344 (50.2)		9984 (52.9)	711 (48.6)	
Marital status			<0.0001			<0.0001
Married/separated	16 131 (85.8)	2308 (79.6)		17 159 (85.2)	1280 (81.3)	
Single/divorced/widowed	2678 (14.2)	592 (20.4)		2975 (14.8)	295 (18.7)	
Parity			0.0001			0.001
0	8427 (42.2)	1178 (38.2)		8972 (41.9)	633 (38.3)	
1	6783 (34.0)	1084 (35.1)		7306 (34.1)	561 (33.9)	
2	2925 (14.6)	499 (16.2)		3128 (14.6)	296 (17.9)	
≥3	1843 (9.2)	327 (10.6)		2006 (9.4)	164 (9.9)	
Medicaid			<0.0001			0.11
Yes	1396 (6.7)	280 (8.6)		1537 (6.8)	139 (7.8)	
No	19 608 (93.4)	2979 (91.4)		20 949 (93.2)	1638 (92.2)	

	No depression diagnosis, *n* (%)	Depression diagnosis, *n* (%)	*P*-value	No anxiety diagnosis, *n* (%)	Anxiety diagnosis, *n* (%)	*P*-value
Gestational hypertension/preeclampsia			<0.0001			0.001
Yes	2453 (11.7)	499 (15.3)		2692 (12.0)	260 (14.6)	
No	18 551 (88.3)	2760 (84.7)		19 794 (88.0)	1517 (85.4)	
Postpartum tobacco use			<0.0001			<0.0001
Maternal use	1814 (8.6)	598 (18.4)		2088 (9.3)	324 (18.2)	
Household use[b]	1467 (7.0)	253 (7.8)		1597 (7.1)	123 (6.9)	
None	15 112 (72.0)	2125 (65.2)		16 064 (71.4)	1173 (66.0)	
Unknown	2611 (12.4)	283 (8.7)		2737 (12.2)	157 (8.8)	
Gestational age at delivery (weeks)			<0.0001			0.0001
37–38	4837 (23.0)	927 (28.4)		5275 (23.5)	489 (27.5)	
≥39	16 167 (77.0)	2332 (71.6)		17 211 (76.5)	1288 (72.5)	

[a] Diagnosed during pregnancy or up to 1 year postpartum.

[b] Tobacco use by a household member other than the infant's mother.

Table 2

Associations between perinatal depression and anxiety and infant health care utilisation

	n (%)	Unadjusted RR [95% CI]	Adjusted RR [95% CI]
≥5 well baby visits by 12 months of age[a]			
Depression			
No depression	16 435 (78.3)	Reference	Reference
Depression	2478 (76.0)	1.0 [1.0, 1.0]	1.0 [1.0, 1.0]
Anxiety			
No anxiety	17 579 (78.2)	Reference	Reference
Anxiety	1334 (75.1)	1.0 [1.0, 1.0]	1.0 [1.0, 1.0]
Received all recommended immunisations[b]			
Depression			
No depression	16 079 (76.6)	Reference	Reference
Depression	2420 (74.3)	1.0 [1.0, 1.0]	1.0 [1.0, 1.0]
Anxiety			
No anxiety	17 181 (76.4)	Reference	Reference
Anxiety	1318 (74.2)	1.0 [1.0, 1.0]	1.0 [1.0, 1.0]
≥1 infant hospitalisations between 0 and 52 weeks of age[c]			
Depression			
No depression	1093 (5.2)	Reference	Reference
Pregnancy only	29 (5.1)	1.0 [0.7, 1.4]	1.0 [0.7, 1.4]
Pregnancy and postpartum	49 (5.9)	1.1 [0.8, 1.5]	1.1 [0.8, 1.4]
Postpartum only	128 (6.9)	1.3 [1.0, 1.5]	1.2 [1.0, 1.4]
Anxiety			
No anxiety	1187 (5.3)	Reference	Reference
Pregnancy only	24 (5.0)	0.9 [0.6, 1.4]	0.9 [0.6, 1.3]
Pregnancy and postpartum	15 (5.0)	0.9 [0.5, 1.5]	0.9 [0.5, 1.5]
Postpartum only	73 (7.4)	1.3 [1.0, 1.6]	1.2 [1.0, 1.6]
≥6 sick/emergency visits[a]			
Depression			
No depression	9158 (43.6)	Reference	Reference
Pregnancy only	270 (47.8)	1.1 [1.0, 1.2]	1.0 [0.9, 1.1]
Pregnancy and postpartum	429 (51.8)	1.1 [1.0, 1.2]	1.1 [1.0, 1.2]
Postpartum only	1032 (55.3)	1.2 [1.2, 1.3]	1.2 [1.1, 1.2]
Anxiety			
No anxiety	9941 (44.2)	Reference	Reference
Pregnancy only	232 (48.0)	1.0 [0.9, 1.1]	1.0 [1.0, 1.2]
Pregnancy and postpartum	168 (55.6)	1.2 [1.1, 1.3]	1.2 [1.1, 1.3]
Postpartum only	548 (55.2)	1.1 [1.1, 1.2]	1.1 [1.0, 1.2]

[a] Adjusted for age, education, marital status, Medicaid status, race/ethnicity, parity, hypertension/preeclampsia, tobacco use and early-term birth.

[b] Adjusted for age, education, marital status, Medicaid status, race/ethnicity, parity, hypertension/preeclampsia and tobacco use.

[c] Adjusted for age, education, marital status, Medicaid status, tobacco use and early-term birth.

RR, risk ratio; CI, confidence interval.