Newborn Risk Factors for Subsequent Physical Abuse Hospitalizations

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abstract

OBJECTIVES: To describe the prevalence of risk factors for abuse and newborns' risks for physical abuse hospitalizations during early infancy.

METHODS: We created a nationally representative US birth cohort using the 2013 and 2014 Nationwide Readmissions Databases. Newborns were characterized by demographics, prematurity or low birth weight (LBW), intrauterine drug exposure, and medical complexity (including birth defects). Newborns were tracked for 6 months from their birth hospitalization, and subsequent abuse hospitalizations were identified by using *International Classification of Diseases, Ninth Revision* codes. We calculated adjusted relative risks (aRRs) with multiple logistic regression, and we used classification and regression trees to identify newborns with the greatest risk for abuse on the basis of combinations of multiple risk factors.

RESULTS: There were 3 740 582 newborns in the cohort. Among them, 1247 (0.03%) were subsequently hospitalized for abuse within 6 months. Among infants who were abused, 20.4% were premature or LBW, and 4.1% were drug exposed. Premature or LBW newborns (aRR 2.16 [95% confidence interval (CI): 1.87–2.49]) and newborns who were drug exposed (aRR 2.86 [95% CI: 2.15–3.80]) were independently at an increased risk for an abuse hospitalization, but newborns with medical complexity or noncardiac birth defects were not. Publicly insured preterm or LBW newborns from rural counties had the greatest risk for abuse hospitalizations (aRR 9.54 [95% CI: 6.88–13.23]). Publicly insured newborns who were also preterm, LBW, or drug exposed constituted 5.2% of all newborns, yet they constituted 18.5% of all infants who were abused.

CONCLUSIONS: Preterm or LBW newborns and newborns who were drug exposed, particularly those with public insurance and residing in rural counties, were at the highest risk for abuse hospitalizations. Effective prevention directed at these highest-risk newborns may prevent a disproportionate amount of abuse.

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WHAT'S KNOWN ON THIS SUBJECT: Current physical abuse prevention strategies have had inconsistent and marginal effectiveness. A better stratification of newborn infants' risk for physical abuse may prove valuable in informing the allocation of preventive services and improving their effectiveness.

WHAT THIS STUDY ADDS: Using a nationally representative birth cohort, we report on risk factors for physical abuse that can be readily ascertained at birth. Five percent of newborns were identified as accounting for 1 in 5 infants who are abused and should be targets for secondary prevention.

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Despite considerable attention having been directed toward child physical abuse prevention, rates of abusive head trauma and abuse hospitalizations have remained stable or increased in recent years.[1–6] To make prevention more effective and efficient, evidence-based prevention efforts have increasingly been directed toward the children who are at the highest risk.[7–9] These initial efforts at targeting prevention have been encouraging, but additional data are needed to improve risk stratification.[10–13]

Given that infants are disproportionately victims of physical abuse and of abuse-related fatalities,[3,5] the identification of perinatal risk factors may be of particular importance. Three clinical perinatal conditions that have been associated with or theorized as having higher risk for physical abuse but have lacked either prevalence data or consistent associations with abuse risk are prematurity and low birth weight (LBW), intrauterine drug exposure, and medical complexity. Intrauterine drug exposure and neonatal abstinence syndrome (NAS) have been associated with increased risk for maltreatment in general, but their associations with physical abuse are less clear.[14–18] Given their increased burden and stress related to care, children with medical complexity have been hypothesized to be at greater risk for maltreatment.[19,20] Data have been used to support such a theory for maltreatment in general[21,22] and neglect[23] but not consistently for physical abuse.[23,24] To better inform future abuse-prevention efforts, a more comprehensive reporting of the prevalence of risk factors, the relative risks (RRs) of abuse, and how multiple risk factors may affect an infant's risk is needed.

Therefore, using a nationally representative US birth cohort, we sought to (1) describe the prevalence of perinatal risk factors for abuse among young infants who are abused (with an emphasis on prematurity and LBW, intrauterine drug exposure, and medical complexity, including birth defects) and (2) describe a newborn's risk for a physical abuse hospitalization during early infancy (ie, within 6 months of discharge from the birth hospitalization) while controlling for confounding variables (eg, neighborhood- and individual-level poverty).

METHODS

Our study was a retrospective, nationally representative birth cohort study in which we used the 2013 and 2014 Nationwide Readmissions Databases (NRDs) to identify and track newborns for 6 months from their birth hospitalizations for abuse hospitalization.

Data Source

The NRD is part of the Healthcare Cost and Utilization Project, which is sponsored by the Agency for Healthcare Research and Quality, and it was specifically designed to support national readmission analyses for all payers and the uninsured. The NRD contains deidentified *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) discharge codes and patient demographics. Linkage numbers allow for the tracking of patients for readmissions across hospitals within a state but only within a single database year (ie, patients could not be tracked between the 2013 and 2014 database years). To provide US national-level readmission estimates for patients <1 year of age, the 2013 and 2014 NRDs included weighted samples that were obtained from 2006 hospitals in 9 states (2013 NRD) and 2048 hospitals in 12 states (2014 NRD). The Office of Research Integrity at Children's Mercy Hospital deemed our study as involving nonhuman subjects and exempt from institutional board review.

Study Population

All newborns who were discharged from their birth hospitalizations (ICD-9-CM codes V30 to V39) from January 1, 2013, through June 30, 2013, and from January 1, 2014, through June 30, 2014, were included in the birth cohort. Because patients cannot be tracked between database years, the inclusion of newborns only from the first 6 months of each database year allowed for all newborns to have a uniform 6-month follow-up window. Newborns with in-hospital mortality during their birth hospitalizations were excluded. Weighted counts of newborns that reflected the total US population were used for all analyses.

Predictor Variables

All predictor variable data were collected for infants at the time of their newborn discharges. The ICD-9-CM codes that we used to define predictor and outcome variables are listed in Supplemental Table 4. Preterm and LBW newborns were identified as those born at <37 weeks' gestation and with a birth weight of <2500 g or intrauterine growth restriction. Newborns were identified as drug exposed if they were diagnosed with intrauterine drug or alcohol exposure (ie, narcotics, hallucinogenic agents, cocaine, alcohol, or fetal alcohol syndrome) or if they were diagnosed with NAS. We identified newborns with medical complexity using complex chronic conditions (CCCs), a previously developed classification scheme. CCCs are defined as "any medical conditions that can be reasonably expected to last at least 12 months (unless death intervenes) and to involve either several different organ systems or 1 organ severely enough to require specialty pediatric care and probably some period of hospitalization in a tertiary care center."[25] Newborns' total number of CCCs was our primary measure for medical complexity. We also chose

a priori to test subcategories of CCCs. Newborns with technology-dependent CCCs (eg, gastrostomy and tracheostomy) were identified given their higher demands of care. We differentiated prematurity from prematurity with associated medical complexity (eg, bronchopulmonary dysplasia) using prematurity-related CCCs. Finally, birth defects were identified by using ICD-9-CM codes (as defined by the National Birth Defects Prevention Network[26]), and they included the following 7 categories: cardiac (eg, hypoplastic left heart and ventricular septal defect), central nervous system (eg, spina bifida), orofacial (eg, cleft lip and/or palate), gastrointestinal (eg, intestinal atresia), genitourinary (eg, renal agenesis and/or hypoplasia), musculoskeletal (eg, diaphragmatic hernia and limb deficiencies), and chromosomal defects (eg, trisomy 21). Birth defects were initially tested in aggregate as well as by individual organ systems to allow for comparisons with findings from previous literature. Birth defects were subsequently collapsed into cardiac and noncardiac categories because of null findings and for ease of presentation.

Other predictor variables included length of stay for the newborn hospitalization as well as newborn demographics, including sex, insurance payer type (an indicator of individual-level poverty), quartile of median household income for the newborn's zip code of residence (an indicator of community-level poverty), and the urban-rural category of the newborn's county of residence according to the National Center for Health Statistics urban-rural classification scheme.[27] Urban-rural categories included (1) dense central metropolitan (counties containing the majority of a metropolitan statistical area with a population of >1 million people), (2) fringe or small metropolitan (counties in metropolitan statistical areas with populations of <1 million people), (3) micropolitan (counties outside metropolitan statistical areas containing a town with a population of 10 000–49 999 people), and (4) rural (counties with towns with 0–9999 persons).

Outcome Measure

All newborns were tracked for 6 months after discharge from their birth hospitalizations for any abuse hospitalizations. Abuse hospitalizations were identified by using a validated and previously used ICD-9-CM coding scheme. Hospitalizations qualified as being abuse related if they met any of the following criteria: (1) ICD-9-CM codes for an injury and abuse, (2) ICD-9-CM codes for an injury and assault, (3) ICD-9-CM codes for retinal hemorrhages or anoxic brain injury and abuse, or (4) any ICD-9-CM code for abusive head trauma (Supplemental Table 4).[3,28–30]

Statistical Analysis

The frequencies of abuse hospitalizations in the birth cohort were calculated. χ^2 tests were used in bivariate analyses. Multiple logistic regression modeling was used to calculate the adjusted odds for any abuse hospitalization, which were then converted to adjusted relative risk (aRR) ratios with 95% confidence intervals (CIs) given the extremely rare nature of abuse hospitalizations.[31] Only covariates with $P < .1$ in bivariate analyses were used as inputs in the regression modeling. Classification and regression tree (CART) modeling was used to identify newborns with multiple risk factors who had the greatest risk for abuse hospitalization. We used CART modeling to accomplish this by identifying the factors most predictive for abuse hospitalization and then sequentially splitting the newborn population into 2 groups (newborns who had and did not have a particular factor). In CART modeling, we used nonparametric conditional inference trees and hypothesis test–based stopping rules in the R software party package. The absolute risks and RRs for physical abuse hospitalization for each typology of newborn identified in CART modeling were calculated. All statistical analyses were performed by using SAS version 9.3 (SAS Institute, Inc, Cary, NC) and R version 3.2.0 (R Core Team, Vienna, Austria), with $P < .05$ being considered statistically significant.

RESULTS

There were 3 740 582 newborns included in the birth cohort. Among newborns in the cohort, 1247 (0.03%) were subsequently hospitalized for abuse within 6 months of being discharged from their newborn hospitalizations. These equated to 6-month abuse hospitalization rates of 36.3 per 100 000 newborns in 2013 and 30.4 per 100 000 newborns in 2014.[3]

Bivariate Results

Compared with infants who were not abused, infants who were abused were more likely to be boys, have public insurance, and have a lower quartile of median household income (Table 1). Prematurity and LBW were more common among infants who were abused compared with infants who were not abused (20.4% vs 9.4%; $P < .001$). Intrauterine drug exposure and NAS were also more common among infants who were abused (4.1% vs 0.9%; $P < .001$). Generally, infants who were abused did not differ from infants who were not abused in our multiple measures for medical complexity. For instance, infants who were abused and infants who were not abused did not differ in their numbers of total CCCs. No newborns with technology-dependent CCCs or prematurity-related CCCs were subsequently hospitalized for abuse. Cardiac birth defects were more common among

TABLE 1 Demographic and Clinical Characteristics of Infants in the Birth Cohort at the Time of Their Newborn Hospitalizations

Patient Characteristics	Overall, *N* (%)	No Abuse Hospitalization, *n* (%)	Any Abuse Hospitalization, *n* (%)	*P*[a]
Total patients	3 740 582	3 739 335 (99.97)	1247 (0.03)	
Male sex	1 917 493 (51.3)	1 916 797 (51.3)	696 (55.8)	.001
Insurance payer type				<.001
Public	1 714 906 (45.8)	1 714 000 (45.8)	906 (72.7)	
Private	1 771 891 (47.4)	1 771 624 (47.4)	267 (21.4)	
Other	253 784 (6.8)	253 711 (6.8)	73 (5.9)	
Median household income for newborn zip code of residence				<.001
Lowest	875 150 (23.7)	874 777 (23.7)	374 (30.3)	
Less than average	955 552 (25.9)	955 199 (25.9)	353 (28.6)	
Greater than average	1 019 462 (27.6)	1 019 106 (27.6)	356 (28.8)	
Highest	843 987 (22.8)	843 834 (22.9)	153 (12.4)	
Urban-rural category of newborn county of residence				<.001
Large central metropolitan	1 949 082 (52.1)	1 948 518 (52.1)	564 (45.2)	
Fringe or small metropolitan	1 250 554 (33.4)	1 250 094 (33.4)	460 (36.9)	
Micropolitan	330 137 (8.8)	329 982 (8.8)	155 (12.5)	
Rural	210 808 (5.6)	210 741 (5.6)	68 (5.4)	
Length of stay, d				<.001
1–3	3 285 022 (87.8)	3 283 980 (87.8)	1042 (83.5)	
4–7	269 654 (7.2)	269 585 (7.2)	68 (5.5)	
≥8	185 906 (5.0)	185 769 (5.0)	137 (11.0)	
Preterm or LBW	351 544 (9.4)	351 290 (9.4)	254 (20.4)	<.001
Intrauterine drug exposure or NAS	33 220 (0.9)	33 169 (0.9)	51 (4.1)	<.001
Total No. CCCs				.07
0	3 634 950 (97.2)	3 633 742 (97.2)	1209 (96.9)	
1	94 491 (2.5)	94 452 (2.5)	39 (3.1)	
≥2	11 141 (0.3)	11 141 (0.3)	0 (0.0)	
Technology-dependent CCC	1862 (0.0)	1862 (0.0)	0 (0.0)	.43
Prematurity-related CCC	30 448 (0.8)	30 438 (0.8)	10 (0.8)	.85
Cardiac birth defects	52 296 (1.4)	52 259 (1.4)	37 (2.9)	<.001
Noncardiac birth defects[b]	28 169 (0.8)	28 158 (0.8)	11 (0.9)	.54

[a] Results of χ^2 tests.

[b] Six noncardiac–organ-system types of birth defects did not differ in abuse hospitalization and were therefore presented in aggregate.

infants who were abused (2.9% vs 1.4%; $P < .001$), but infants who were abused and infants who were not abused did not differ in any of the other types of birth defects; therefore, they were presented in aggregate.

aRRs for Abuse Hospitalization

After adjustment, newborns with public insurance had the greatest RR of having an abuse hospitalization (aRR 3.17; 95% CI: 2.75–3.66; Table 2). Zip code–based median household income had a lower association with physical abuse, with only the highest income quartile having a reduced risk. Independent of other factors, premature and LBW newborns (aRR 2.16; 95% CI: 1.87–2.49) and newborns who were drug exposed (aRR 2.86; 95% CI: 2.15–3.80) were at increased risk for abuse hospitalization. When analyzed in aggregate, the presence of any birth defect was associated with increased risk (aRR 1.5; 95% CI: 1.1–2.0). However, this association was driven solely by cardiac defects, which was the only measure of medical complexity that remained independently associated with abuse risk after regression modeling.

Identification of the Newborns at Highest Risk by Using CART Modeling

We used CART modeling to identify 4 typologies of newborns with the greatest risk for abuse hospitalization by stratifying them on different combinations of insurance payer type, preterm and LBW status, urban-rural residence, and drug exposure (Fig 1). Publicly insured newborns who were either preterm and LBW or drug exposed accounted for 3 of the 4 newborn typologies. Combined, these 3 typologies constituted only 5.2% of all newborns, yet they constituted 18.5% of all infants who were hospitalized for abuse. Publicly insured preterm and LBW newborns residing in rural counties had the greatest risk for abuse hospitalization (aRR 9.54; 95% CI: 6.88–13.23; Table 3). They represented 0.3% of all newborns and 5.7% of all rural newborns, but they accounted for 3.0% of all abuse hospitalizations and 54.4% (37 of 68) of all rural infants who were hospitalized for abuse. Publicly insured newborns who were exposed to drugs (aRR 5.05; 95% CI: 3.54–7.21) and publicly insured preterm and LBW newborns from nonrural counties (aRR 3.27; 95% CI: 2.77–3.85) were the second and third highest-risk typologies, respectively.

TABLE 2 aRRs and 95% CIs for Child Physical Abuse Hospitalization Within 6 Months of Infant Discharge From Newborn Hospitalization

Patient Characteristics	aRR (95% CI)
Sex	
Male	1.21 (1.08–1.36)
Female	Reference
Insurance payer type	
Public	3.17 (2.75–3.66)
Private	Reference
Other	1.69 (1.30–2.20)
Zip code–based income quartile	
Lowest	Reference
Less than average	1.02 (0.88–1.18)
Greater than average	1.15 (0.99–1.34)
Highest	0.77 (0.63–0.94)
Patient residence	
Dense central metropolitan	Reference
Fringe or small metropolitan	1.22 (1.08–1.39)
Micropolitan	1.45 (1.21–1.74)
Rural	1.07 (0.82–1.38)
Preterm or LBW	2.16 (1.87–2.49)
Intrauterine drug exposure or NAS	2.86 (2.15–3.80)
Cardiac birth defects	1.50 (1.12–2.01)

All demographic and clinical variables with $P < .1$ in bivariate analyses were included in the model. The total number of newborn CCCs was not retained in the model because of a lack of significance.

DISCUSSION

To properly inform abuse-prevention programs, both the prevalence and RR of newborn risk factors are necessary. Ideally, child abuse-prevention programs would include such data to target newborns at the greatest risk, allowing for more efficient and, potentially, effective interventions. Using a nationally representative birth cohort of 3.7 million US newborns, we report risk factors' prevalence, identify risk factors independently associated with physical abuse hospitalization, and (through CART modeling) identify infants with multiple risk factors who had the greatest risk for abuse hospitalization during early infancy. We found that prematurity, LBW, and intrauterine drug exposure but not an infant's medical complexity or noncardiac birth defect(s) were independently associated with risk for abuse hospitalization during early infancy. In the aforementioned CART modeling, we identified ~5% of newborns with multiple risk factors who accounted for a disproportionate number of abuse hospitalizations (~1 in 5). Our results may be useful in informing the future allocation and/or development of secondary abuse-prevention modalities.

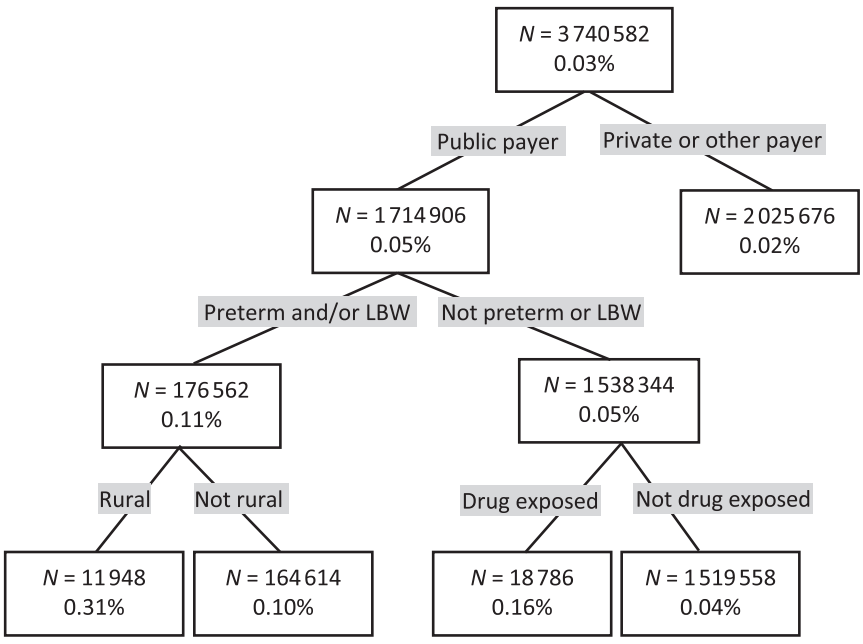

FIGURE 1
CART model used to identify newborns with the greatest risk for physical abuse on the basis of combinations of multiple risk factors. The number of newborns with each typology (*N*) and the percentage of newborns of each typology who were hospitalized for physical abuse are shown. Newborns at lower risk compared with the full cohort (those with private insurance or another payer) are not shown for ease of viewing.

Prematurity and LBW have consistently been independently associated with maltreatment in general[23,32–34] and physical abuse specifically,[13,24,33,35] but their prevalence among infants who are abused has not been adequately reported. We found that 1 in 5 young infants who were abused had a history of prematurity and LBW. Prematurity and LBW newborns were at an approximately twofold increased risk for abuse during early infancy, which is similar to previous findings.[24,35] When preterm and LBW newborns were also poor (ie, they had public insurance) and from rural counties, their risk for abuse hospitalization was ~10-fold higher than all other newborns and threefold higher than similar preterm and LBW infants who were poor and from nonrural counties. However, rural residence was not independently associated with abuse hospitalization in our sample, and previous studies have been inconsistent in how physical abuse[36,37] and maltreatment in general[38,39] may vary across the urban-rural spectrum. These data

TABLE 3 The Prevalence and Risk for Abuse Hospitalization Among the 4 Typologies of Newborns Identified in CART Modeling

Newborn Typology	Total Newborns, *N*	% of All Newborns	Infants Who Were Abused, *n*	% of Typology Abused	RR (95% CI)[a]	% of All Infants Who Were Abused and Meet Typology Description
Publicly insured, preterm or LBW, and rural	11 948	0.3	37	0.3	9.54 (6.88–13.23)	3.0
Publicly insured, preterm or LBW, and not rural	164 614	4.4	163	0.1	3.27 (2.77–3.85)	13.1
Publicly insured, term, and drug exposed	18 786	0.5	31	0.2	5.05 (3.54–7.21)	2.5
Publicly insured, term, and not drug exposed	1 519 558	40.6	675	0.04	1.72 (1.54–1.93)	54.1

[a] RR calculated as the risk among each newborn typology compared with all other newborns.

suggest that although rural residence may not be independently associated with abuse risk, residing in a rural area may increase the risk for abuse among some unique newborn populations. Our results support the inclusion of preterm and LBW newborns in secondary prevention programs, particularly when they are poor and live in rural counties.

We found that ~4% of infants who were hospitalized for abuse had a history of intrauterine drug exposure or NAS. Intrauterine drug exposure and/or NAS have consistently been shown to be associated with child maltreatment in general,[14,15,18] neglect specifically,[16,18] and continued parental drug use.[17] Researchers in these previous studies have either not assessed physical abuse specifically[14,15] or had null findings, possibly because of smaller sample sizes.[16,17] Using a birth cohort of 1 million Australian newborns, Uebel et al[18] found that children <14 years of age with a history of NAS were at increased risk of future hospitalization for assault (potentially including peer-on-peer violence) but not physical abuse specifically after accounting for confounding variables. We found that, independent of poverty and other factors, young infants with a history of intrauterine drug exposure and/or NAS were at nearly threefold increased risk for abuse hospitalization and had 5 times the risk when they were also publicly insured. Although our results reveal that most newborns who are drug exposed will not be hospitalized for abuse during early infancy, their increased risk should be considered when assessing and supporting substance abusing mothers and their newborns. Further study is needed to test this association for individual substances and account for other salient factors, such as duration of abuse, protective factors, and maternal ability to engage in treatment.

Overall, we found that infants with medical complexity or birth defects were not at an increased risk for abuse hospitalization during early infancy. When we measured birth defects simply as being present or not present, newborns with any birth defect were at an increased risk for physical abuse, which is similar to results from a large military cohort.[24] However, we determined that this association was driven solely by cardiac defects. Why cardiac defects would uniquely be associated with an increased risk of abuse is unclear because they are no more likely than other birth defects to share risk factors with abuse (such as low socioeconomic status indicators).[40] Our findings are similar to those from a large Texas birth cohort of infants with trisomy 21, spina bifida, and cleft lip and/or palate who were not at an increased risk for physical abuse.[23] We consider there to be 5 potential explanations for our null findings concerning medical complexity, the first being that our results are accurate. Second, our measures for medical complexity may not accurately capture caregiver burden and stress. Third, infants with more severe medical complexity and caregiver burden may more often be provided support (eg, in-home nursing), which could mitigate their risk. Fourth, the peak time for physical abuse among infants with medical complexity may be outside our 6-month window. Finally, medical complexity may only confer additional risk for abuse in the presence of other factors (eg, a mother who abuses substances). Regardless, given their general lack of association and low prevalence, infants with medical complexity do not appear to constitute a newborn population demanding special, targeted abuse-prevention efforts.

An important next step but outside the scope of this study is to assess how best to prevent physical abuse among higher-risk newborns once they have been identified. Several interventions (including home visiting and nursery-based parental education) have been used in an attempt to prevent abuse in this young age group. Some home visiting-programs have reduced child maltreatment, but these reductions have been inconsistent and only marginally effective.[7,41–45] Additionally, although there is minimal evidence that home visiting

may reduce child maltreatment among mothers who abuse substances,[46] it remains uncertain how effective home visiting may be for preterm and LBW newborns.[47] Future research is needed to test the effectiveness of existing prevention strategies among the aforementioned higher-risk newborn populations and which program features may prove most efficacious.

The findings of this study should be viewed in light of several limitations. First, because of the limitations of the NRDs, we were limited in how long we could track newborns for abuse hospitalization. However, the first 6 months of an infant's life is a period with high rates of abuse and abuse-related fatality.[3,30] Second, the NRDs did not allow for an assessment of individual, family, and community psychosocial contributors to abuse risk, such as maternal educational attainment, marital status, or caregiver mental illness.[48] Third, we could not control for social and preventive interventions that some newborns would have almost certainly received. This may have altered our risk calculations. Fourth, this study is susceptible to coding limitations and inaccuracies inherent to all administrative data research. For example, we may have underestimated the incidence of intrauterine drug exposure and identified more severely affected newborns because only those cases that were clinically identified and coded as such would have been captured. The identification of abuse hospitalization has good specificity (>90%) but a sensitivity of ~75%, indicating that some abuse hospitalizations are likely to have been missed.[28,29] Fifth, if children were hospitalized for abuse in states different from their birth hospitalizations, they would not have been captured. Finally, our findings may not be generalizable to other forms of maltreatment or cases of physical abuse that do not require hospitalization.

CONCLUSIONS

Using a nationally representative US birth cohort, we identify perinatal risk factors associated with risk for physical abuse hospitalization during early infancy as well as the prevalence of these risk factors among newborns relative to their disproportionate prevalence among young infants who are abused. Our results support an increased recruitment and retention of premature and LBW newborns and newborns who are drug exposed in secondary abuse-prevention programs, particularly when these infants are publicly insured and reside in rural areas. In doing so, our results suggest that a disproportionate amount of physical abuse may be preventable.

ABBREVIATIONS

aRR: adjusted relative risk
CART: classification and regression tree
CCC: complex chronic condition
CI: confidence interval
ICD-9-CM: *International Classification of Diseases, Ninth Revision, Clinical Modification*
LBW: low birth weight
NAS: neonatal abstinence syndrome
NRD: Nationwide Readmissions Database
RR: relative risk

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