

The Association of Social Factors and Time Spent in the NICU for Mothers of Very Preterm Infants

Stephanie L. Bourque, MD, MScS,^a Blair W. Weikel, MPH,^a Mauricio A. Palau, MD,^a Jennifer C. Greenfield, MSW, PhD,^b Anne Hall, MD,^a Susanne Klawetter, LCSW, PhD,^c Madalynn Neu, RN, FAAN, PhD,^d Jessica Scott, MA,^a Pari Shah, LCSW,^b Kristi L. Roybal, MSW,^b Sunah S. Hwang, MD, MPH, PhD^a

ABSTRACT OBJECTIVES: Evaluate the association between maternal social factors and maternal time spent in the NICU for very preterm infants admitted to 4 level III and IV NICUs.

METHODS: In this prospective observational cohort study, we enrolled mother–infant dyads whose infants were born <32 weeks' gestation. Enrollment occurred after 2 weeks of NICU exposure, when maternal social factors and demographic information was collected. Maternal time spent in the NICU was abstracted from the electronic medical record and was dichotomized into 0 to 6 days and ≥ 6 days per week. Demographic differences between the 2 groups were compared by using χ^2 tests. Logistic regression was used to assess the independent association between maternal social factors and the average number of days per week spent in the NICU.

RESULTS: A total of 169 mother–infant dyads were analyzed. Maternal social factors associated with more time spent in the NICU included an annual household income of >\$100 000, compared with those with an annual household income of <\$50 000 (adjusted odds ratio [aOR]: 5.68; 95% confidence interval [CI] 1.77–18.19), a travel time <30 minutes to the NICU (compared with those who traveled >60 minutes [aOR: 7.85; 95% CI 2.81–21.96]), and the lack of other children in the household, compared with women with other children (aOR: 3.15; 95% CI 1.39–7.11).

CONCLUSIONS: Maternal time spent in the NICU during a prolonged birth hospitalization of a very preterm infant differed by socioeconomic status, travel time, and presence of other dependents. Strategies to better identify and reduce these disparities to optimize engagement and, subsequently, improve infant health outcomes is needed.

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Address for Correspondence: Stephanie L. Bourque, MD, MScS, Neonatology MS 8402, 13121 E 17th Ave, Aurora, CO 80045. E-mail: stephanie.bourque@childrenscolorado.org

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^aSection of Neonatology, Department of Pediatrics, School of Medicine and ^dCollege of Nursing, University of Colorado Anschutz Medical Campus, Aurora, Colorado; ^bGraduate School of Social Work, University of Denver, Denver, Colorado; and ^cSchool of Social Work, Portland State University, Portland, Oregon

Over 10% of US-born infants are born preterm with birth hospitalizations lasting weeks to months.^{1,2} In contrast to mothers who deliver healthy term newborns, mothers of preterm infants have starkly different birth experiences, with limitations on the frequency and quantity of direct care they can provide to their preterm infants, given the need for specialized medical care for various conditions, particularly for very preterm infants, <32 weeks' gestation. Previous qualitative work from our group revealed several barriers to maternal engagement during birth hospitalization, including the stress and trauma of preterm delivery and subsequent NICU hospitalization, presence of many tubes and wires within the physical environment of the NICU, and lack of available paid leave.^{3,4} Conversely, facilitators to engagement included strong family social support, the privacy of single-family rooms within the NICU, and families establishing a trusted relationship with their medical provider team.

Although the initial birthing and infant care experience of families of preterm infants contrast greatly from their term counterparts, a growing body of literature has revealed that parental engagement in the medical and developmental care of their preterm infants is critically important. Family integrated care, defined as parental engagement in all aspects of their neonate's care during hospitalization, is associated with several positive outcomes, including higher breastfeeding rates, shorter hospitalization, and lower parental anxiety scores.⁵ Similarly, the use of kangaroo care is associated with many physiologic and behavioral short- and long-term benefits for preterm infants.^{6,7} Although we have some greater understanding of the positive impact of integrating parents into NICU care, we know little about the barriers and facilitators mothers experience in being able to provide care of their infants during the prolonged hospitalization, particularly in regions of the United States where the distance traveled from a primary residence to the hospital may be high.

To address this gap in the literature, we sought to investigate a broad array of maternal social factors such as race and ethnicity, marital status, and presence of other dependents and their association with the average days per week spent in the NICU in 4 level III and IV NICUs during the birth hospitalization of their very preterm infants.

METHODS

Cohort

For this prospective observational cohort study, we recruited mother–infant dyads from 4 NICUs. A total of 3 sites are level III NICUs, and 1 site is a level IV NICU. One level III unit serves as the regional safety net hospital in an urban area, another is the primary academic delivery hospital for the state, and the third serves a small city ~60 miles from the metro area. The level IV unit, situated in a suburban area, serves a broad multistate catchment area for the region. Combined, the units have a total of 191 beds and admit an average of 2900 infants each year. All sites include in-house labor and delivery services, including a high-risk delivery service for the level IV unit, which primarily admits outborn infants. A total of 3 of the 4 units provide private or semiprivate rooms, and all units provide sleeping accommodations for families either at the bedside or in close proximity to the NICU.

Maternal inclusion criteria included mothers with infants born at <32 weeks' gestation, a primary language of English or Spanish, no diagnosed psychiatric disorders, and no recorded or stated illicit substance use. Infant inclusion criteria included birth at <32 weeks' gestation and no congenital birth defects. Dyads were enrolled before 34 weeks postmenstrual age and had been admitted to the NICU for at least 2 weeks. Dyads were managed through to NICU discharge, including potential back transport within the 4 study sites.

Maternal and Electronic Medical Record Documentation

At enrollment, mothers completed an initial questionnaire including self-

reported social factors, such as race and ethnicity, marital status, highest completed level of education, insurance payer, mode and average time of travel to the NICU, and presence of other children in their household. All surveys were completed while in the NICU either via a Health Insurance Portability and Accountability Act of 1996–compliant data platform (research electronic data capture) accessed on a provided iPad or on paper, on the basis of participant preference.⁸ Surveys were available in English and Spanish.

Throughout the NICU hospitalization, bedside nursing staff documented maternal presence at the bedside and other family members' presence in the infant's electronic medical record (EMR). For all admitted infants, charting was completed hourly at the level IV NICU and during scheduled infant care times in the other 3 NICUs. These data were subsequently extracted by Health Data Compass program, which serves as a health data warehouse and provides EMR data for 3 of the participating hospitals.⁹ The Compass data warehouse integrates EMR and hospital billing data and, through advanced algorithms, can link these clinical data to other state and public data sources. Independent chart abstraction was used to extract maternal time spent in the NICU for the fourth hospital. In addition, mothers completed weekly time-tracking diaries, noting when they were present at the bedside. For this analysis, EMR documentation was used because of inconsistencies and the overall incompleteness of maternal documentation within the weekly self-reported time-tracking diaries.¹⁰

Primary Outcome

We defined maternal time spent in the NICU as the average number of days spent in the NICU per week of infant birth hospitalization, as documented in the EMR by bedside nursing staff. Days spent in the NICU was dichotomized into average days per week as 0 to 6 days and ≥ 6 days.

Covariates

Covariates in our analysis included the maternal demographics of race and ethnicity, marital status, highest completed level of education, mode of delivery, insurance status, mode and duration of travel time to the NICU, and presence of other children in the home.

Statistical Analysis

We calculated the average days per week that the mother was present in the NICU during birth hospitalization and dichotomized, on the basis of natural distribution, the average days per week as 0 to 6 days and ≥ 6 days. Maternal demographic differences between the 2 groups and selected maternal and infant characteristics by hospital of admission were compared by using χ^2 tests. The following maternal characteristics were included a priori in the adjusted model: maternal race and ethnicity, average travel time to the NICU, and presence of other children. All other variables that were significant at ≤ 0.1 were considered for inclusion in the model. Logistic regression was used to assess the independent association between these maternal demographics and average number of days per week spent in the NICU during the birth hospitalization. We used forward regression modeling, comparing models' Akaike information criterion values to assess for fit. Additional variables were included in the model if they decreased the Akaike information criterion by ≥ 2 points to achieve the best fit and most parsimonious model. Analyses were conducted by using SAS version 9.4 (SAS Institute, Inc, Cary, NC). This study was approved by the university's institutional review board.

RESULTS

Cohort Description

A total of 203 women were consented for study enrollment between June 2017 and December 2019 (Fig 1). Supplemental Figure 3 reveals the geographic catchment area for the enrolled cohort, encompassing a total of 10 states. After accounting

for infant death, transfer, and study non-compliance, a final cohort of 169 infants were included in the analysis. Among these preterm infants, 20% ($n = 34$) were admitted to the level IV NICU, 7% ($n = 13$) to the regional safety net hospital level III NICU, and 15% ($n = 27$) to the NICU outside of the greater metro area, with the remainder of the cohort admitted to the metro area level III academic NICU. Overall, 62% ($n = 105$) of women were between ages of 25 and 35 years, 57% ($n = 95$) identified as non-Hispanic white, and the majority (82% [$n = 136$]) were married or living with a partner (Table 1).

Bivariate Results

In the bivariate analysis evaluating maternal characteristics by time in the NICU, mothers with a higher annual income, full-time pre-NICU employment, and shorter travel time to the NICU were more likely to spend ≥ 6 days per week in the NICU (Table 1). Conversely, women with other children present in the home were less likely to spend ≥ 6 days per week in the NICU. There was no significant difference in maternal time spent in the NICU by maternal age, race and/or ethnicity, marital status, educational attainment, or mode of travel to the NICU. Maternal time in the NICU decreased throughout birth hospitalization. In Fig 2, we outline the mean visitation, in days per week, and represent the initial 7 weeks of

NICU admission, a period in which 80% of the study cohort remained hospitalized, and the week before discharge for all infants.

In evaluation of maternal and infant characteristics by hospital (Table 2), infants admitted to the nonmetro level III unit were more likely to be larger and older, with an average birth weight of 1588 ± 362 g ($P < .001$) and gestational age of 30.3 ± 1.4 weeks ($P < .001$). There was no difference by hospital of admission in infant sex ($P = .6$) or 5-minute Apgar score ($P = .3$). Women whose infants were admitted to the level IV regional unit were more likely to be non-Hispanic white, have a higher annual household income, and be married or living with a partner, compared with the other units. There was no difference by hospital of admission in overall maternal age, completed education, presence of other children, or mode of travel or time traveled to the NICU.

Multivariable Results

In the adjusted analysis (Table 3), maternal social factors associated with a higher time spent in the NICU each week revealed that women with an annual household income of $\geq \$100,000$ were more likely to spend ≥ 6 days a week in the NICU, compared with those with an annual household income of $< \$50,000$ (adjusted odds ratio [aOR]: 5.68; 95%

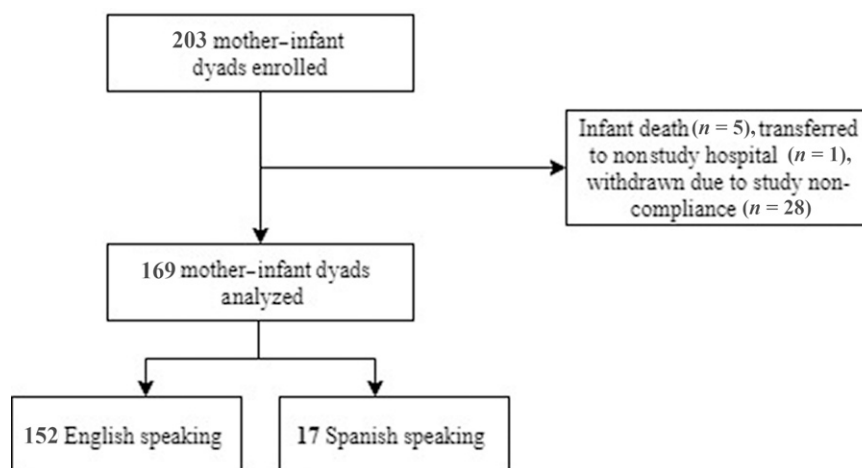


FIGURE 1 Flow diagram of study participants.

TABLE 1 Maternal Sociodemographic Characteristics by Average Days per Week Spent in the NICU During Birth Hospitalization

	Days per Week			<i>P</i>	OR (95% CI)
	Total, <i>n</i> (%)	0 to <6, <i>n</i> (%)	≥6, <i>n</i> (%)		
Maternal age				.36	
<25 y	34 (20)	13 (38)	21 (62)		1.1 (0.5–2.5)
25–35 y	105 (62)	43 (41)	62 (59)		Reference
>35 y	30 (18)	8 (27)	22 (73)		1.9 (0.8–4.7)
Race and ethnicity				.05	
Non-Hispanic white	95 (57)	30 (32)	64 (68)		Reference
Other	70 (43)	33 (47)	37 (53)		0.4 (0.3–1.0)
Annual household income				.08	
<\$50 000	71 (44)	32 (45)	39 (55)		Reference
\$50 000–\$99 000	51 (32)	17 (33)	34 (67)		1.6 (0.8–3.5)
≥\$100 000	38 (24)	9 (24)	29 (76)		2.6 (1.1–6.4)
Insurance status				<.01	
Private	91 (55)	25 (27)	66 (73)		Reference
Public or uninsured	74 (45)	38 (51)	36 (49)		0.4 (0.2–0.7)
Marital status				.87	
Married or living with partner	136 (82)	52 (38)	84 (62)		1.1 (0.5–2.4)
Other status	30 (18)	11 (37)	19 (63)		Reference
Highest completed education				.13	
High school degree or less	47 (28)	22 (47)	25 (53)		0.6 (0.3–1.4)
Some college or associate's degree	44 (27)	19 (43)	25 (57)		0.7 (0.3–1.6)
Bachelor's degree	49 (30)	17 (35)	32 (65)		Reference
Master's degree or higher	25 (15)	5 (20)	20 (80)		2.1 (0.7–6.7)
Mode of travel to NICU				.49	
Personal car	146 (88)	54 (37)	92 (63)		Reference
Other mode	20 (12)	9 (45)	11 (55)		0.7 (0.3–1.8)
Travel time to NICU				<.01	
<30 min	87 (51)	25 (29)	62 (71)		Reference
30–60 min	57 (34)	20 (35)	37 (65)		0.7 (0.4–1.5)
>60 min	25 (15)	19 (76)	6 (24)		0.1 (0.1–0.4)
Pre-NICU employment				<.01	
Working full-time	102 (62)	30 (29)	72 (71)		Reference
Other status	62 (38)	32 (52)	30 (48)		0.4 (0.2–0.8)
Other children				<.01	
Yes	98 (58)	46 (47)	52 (53)		Reference
No	71 (42)	18 (25)	53 (75)		2.6 (1.3–5.1)

OR, odds ratio; —, not applicable.

confidence interval [CI] 1.77–18.19). Compared with women with other children, those with no other children in the household had a 3.15 times higher odds of spending ≥6 days a week in the NICU (aOR: 3.15; 95% CI 1.39–7.11). The time spent in the NICU differed by travel time: compared with women who traveled >60 minutes from home to the NICU, those who traveled <30 minutes were

much more likely to spend ≥6 days a week in the NICU (aOR: 7.85; 95% CI 2.81–21.96). Evaluation of maternal time spent in the NICU revealed no significant difference by maternal reported race and/or ethnicity.

DISCUSSION

In this prospective cohort study of mothers of infants born <32 weeks from 4 NICUs, we

found that a higher annual household income, a shorter travel time to the NICU, and the absence of other children in the home were independently associated with more days each week spent in the NICU during birth hospitalization.

Our results call attention to several issues and barriers that families may encounter during a prolonged birth hospitalization of a very preterm infant. They include the

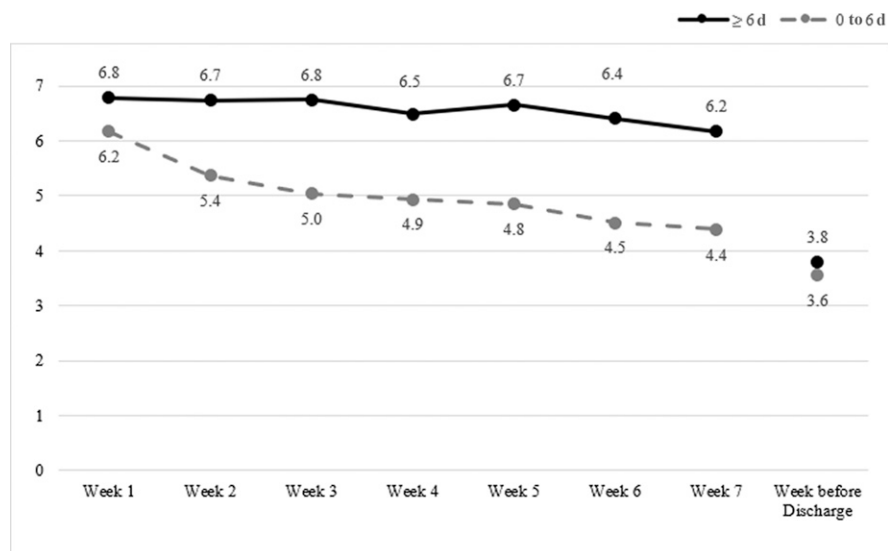


FIGURE 2 Mean maternal time in the NICU in days per week.

disparities in the availability or lack thereof of paid family leave and the broader financial burden for families with limited financial resources. Indeed, our cohort demonstrated decreased maternal time in the NICU throughout birth hospitalization, highlighting the likely several competing interests a mother faces during this time, including potential return to the workplace. These issues highlight the impact of social determinants of health (SDOHs), the environmental and economic conditions in which individuals are born and live, on both the hospitalized preterm infant and the family unit.¹¹ SDOHs broadly contribute to health inequities, such as preterm birth, with known disparities by factors including maternal race and/or ethnicity, education, and marital status.^{12,13}

In our study, conducted before to the onset of the coronavirus disease 2019 pandemic, participating hospitals had varied sibling visitation policies. Policies ranged from siblings under the age of 12 years being provided a playroom outside the unit but being prohibited from entering the patient areas to siblings of all ages having unrestricted access with supervision in single patient rooms, along with the availability of drop-in child care on-site. Despite these seemingly generous accommodations, participating women in

our study without other dependents at home had a >3 times higher odds of spending ≥ 6 days a week in the NICU, compared with women with other dependents at home. Undoubtedly, the coronavirus disease 2019 pandemic has worsened this disparity, with universal stricter visitation policies and the exclusion of sibling visitation throughout hospitalization.

Similar to previous studies in which researchers evaluated the distance from home to hospital, we found that increased travel time to the NICU was significantly associated with less maternal time spent in the NICU.¹⁴ Our cohort included infants admitted from a wide geographic catchment area of the Rocky Mountain west and beyond, resulting in a significant distance from home to hospital for several families. Access to acute obstetrical and neonatal care for nonurban dwelling women is becoming an increasing concern; low access to perinatal facilities in the noncoastal western region ranges from 75.5% to 81.7% of the population residing within 60 minutes of such facility.¹⁵ This contrasts starkly to the Northeast and California, where local perinatal care access rates are >97%. The rural–urban gap to accessing care is widening; between 2002 and 2013, an increased percentage of nonurban women

experienced longer travel distances to access both obstetrical and advanced neonatal care.¹⁶ Loss of these rural obstetrical services has been associated with subsequent increases in nonhospital births and preterm births.¹⁷ With decreased access to perinatal care close to home, antenatal transfer of high-risk pregnant women and postnatal transfer of preterm infants is often necessary.

Although perinatal transfer may be unavoidable, opportunities for back transport closer to maternal residence, once an infant is deemed medically stable, should be considered. Evaluation of back transport within a geographically similar cohort within the Rocky Mountain region revealed that overall prevalence of back transport was low and medically stable infants (defined as low flow nasal cannula and full enteral feedings) remained admitted to a higher level of neonatal care for 4 additional weeks.¹⁸ Although regional variation in the prevalence of back transport exists, this represents a potential opportunity for greater family engagement closer to home and without a significant difference in the length of stay, whereas pursuing back transport must be balanced with resource availability, parental agreement, cost, care quality, and the risk of requiring readmission to a higher level of care.^{19–21}

In this work, we highlight the need and importance of standardized screening for and subsequently addressing SDOHs during birth hospitalization.²² The NICU hospitalization affords a unique opportunity for this work, given the presence of preterm birth disparities and the often prolonged hospitalization of weeks to months; however, in previous work, researchers have found that screening for basic needs, aside from employment status, are inconsistently assessed.²³ These basic needs, including housing and food insecurity, child care, transportation, and utility necessities, were assessed <40% of the time.²³ Adoption of SDOH screening within the outpatient pediatric community has been successful, with the leverage of existing clinic infrastructure and social

TABLE 2 Selected Infant and Maternal Demographics by Hospital

	Total	Academic Suburban Level III	Safety Net Urban Level III	Nonmetro Level III	Regional Level IV	<i>P</i>
Total, <i>n</i> (%)	169	35 (21)	12 (7)	24 (14)	98 (58)	
Maternal characteristics, <i>n</i> (%)						
Maternal age						.16
<25 y	34 (20)	7 (20)	5 (42)	7 (29)	15 (15)	
25–35 y	105 (62)	21 (60)	6 (50)	16 (67)	62 (63)	
>35 y	30 (18)	7 (20)	1 (8)	1 (4)	21 (21)	
Race or ethnicity						<.01
Non-Hispanic white	94 (57)	24 (71)	1 (8)	13 (62)	56 (58)	
Other	70 (43)	10 (29)	11 (92)	8 (38)	41 (42)	
Annual household income						<.01
<\$50 000	71 (44)	10 (30)	8 (80)	7 (33)	46 (48)	
\$50 000–\$99 000	51 (32)	8 (24)	2 (20)	9 (43)	32 (33)	
≥\$100 000	38 (24)	15 (45)	0 (0)	5 (24)	18 (19)	
Insurance status						<.01
Private	91 (55)	22 (63)	0 (0)	12 (62)	57 (58)	
Public or uninsured	74 (45)	13 (37)	12 (100)	9 (43)	41 (42)	
Marital status						.07
Married or living with partner	136 (82)	34 (97)	9 (75)	17 (81)	76 (78)	
Other status	30 (18)	1 (3)	3 (25)	4 (19)	22 (22)	
Highest completed education						.2
High school degree or less	47 (28)	7 (20)	7 (58)	5 (24)	28 (29)	
Some college or associate's degree	44 (27)	10 (29)	5 (42)	6 (29)	23 (24)	
Bachelor's degree	49 (30)	12 (34)	0	6 (29)	31 (32)	
Master's degree or higher	25 (15)	6 (17)	0	4 (19)	15 (15)	
Mode of travel to NICU						.4
Personal car	146 (88)	31 (89)	9 (75)	20 (95)	86 (88)	
Other mode	20 (12)	4 (11)	3 (25)	1 (5)	12 (12)	
Travel time to NICU						.12
<30 min	87 (51)	12 (35)	8 (67)	14 (58)	53 (54)	
30–60 min	57 (34)	12 (35)	4 (33)	8 (33)	32 (33)	
>60 min	25 (25)	10 (29)	0 (0)	2 (8)	13 (13)	
Pre-NICU employment						<.01
Working full-time	102 (62)	21 (60)	2 (17)	18 (86)	61 (64)	
Other status	62 (38)	14 (40)	10 (83)	3 (14)	35 (36)	
Other children						.58
Yes	98 (58)	20 (57)	9 (75)	15 (63)	54 (55)	
No	71 (42)	15 (43)	3 (25)	9 (37)	44 (45)	
Infant characteristics						
Birth wt, g, mean (SD)	1253 (435)	1291 (436)	1184 (363)	1564 (338)	1172 (432)	<.01
Gestational age, wk, mean (SD),	28.6 (2.4)	28.5 (2.2)	28.3 (2.7)	30.2 (1.4)	28.2 (2.5)	<.01
Sex, <i>n</i> (%)						.58
Male	95 (56)	21 (60)	7 (58)	16 (67)	51 (52)	
Female	74 (44)	14 (40)	5 (42)	8 (33)	47 (48)	
5-min Apgar, mean (SD)	7.5 (1.4)	7.7 (1.4)	7.4 (1.6)	7.9 (1.1)	7.4 (1.4)	.34

—, not applicable.

TABLE 3 Odds of Spending ≥ 6 d per Week in the NICU During Birth Hospitalization

	aOR (95% CI)
Race and ethnicity	
Non-Hispanic white	Reference
Other	0.71 (0.32–1.56)
Annual household income	
<\$50 000	Reference
\$50 000–\$99 999	1.74 (0.72–4.24)
\geq \$100 000	5.68 (1.77–18.19)
Travel time to NICU	
<30 min	7.85 (2.81–21.96)
30–60 min	5.86 (2.02–17.02)
>60 min	Reference
Other children	
Yes	Reference
No	3.15 (1.39–7.11)

Adjusted for maternal race and ethnicity, annual household income, and time travel to NICU and other children.

work support, a method that has not yet been widely adopted by inpatient providers.²⁴

For effective integration of SDOH screening into routine clinical care in the NICU, recognizing and addressing the disparate experiences of certain families will be essential. For instance, despite the typical availability and involvement of social workers within the NICU, existing gaps were highlighted in a recent qualitative study including families of color and with low socioeconomic status.²⁵ Many families reported being unaware of the scope of social work's role or available services, placing an undue burden on families to seek out this information on their own. In addition, families with limited English-language proficiency will require special attention. Families who primarily speak Spanish report being less comfortable asking questions to their medical team and have been associated with a decreased ability to correctly identify their infant's diagnosis, factors that may contribute to overall decreased parental engagement in the NICU.^{26,27} Additional factors that need to be considered include substance use disorders, mental health conditions, and other experiences of trauma among some families. SDOH screening in the NICU will need to occur with approaches that

integrate principles of trauma-informed care and stigma and bias reduction.

The strengths of this study include using an interdisciplinary (medicine, nursing, and social work) approach to study design and recruiting mother–infant dyads from multiple sites that represent a broad population reflective of the state's demographics.²⁸ In this study, we also included a wide-ranging look at the social factors impacting time in the NICU beyond race and ethnicity and socioeconomic status, as typically defined by only income and/or insurance status. Limitations to this study include the use of cross-sectional data at study enrollment, which has the potential to change over time during a prolonged birth hospitalization, depending on individual circumstances. Although this study recruited both English- and Spanish-speaking families, the overall number of Spanish-speaking mothers enrolled was small, resulting in the inability to analyze data by primary language. Potential enrollment bias, favoring English- and Spanish-speaking families who were available for consent either in-person or by telephone must also be acknowledged. Although English and Spanish are the primary 2 languages spoken by families served by the participating hospitals, evaluation of other languages, especially those without as readily available interpreters and translated written materials, are crucial to reduce language discordance.

CONCLUSIONS

Maternal time spent in the NICU during a prolonged birth hospitalization of a very preterm infant differed by socioeconomic status, travel time, and presence of other dependents. Strategies to better identify through standardized SDOH inpatient screening and reduce these disparities to optimize engagement and, subsequently, improve infant health outcomes is needed.

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