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The association between time of birth and fetal injury resulting in death

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KEY WORDS
Time of birth
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Objective: In obstetrics, the care of patients in labor or with emergencies takes place day and night. Birth-related injury is among the worst of obstetric outcomes. This study sought to examine the relationship between time of birth and fetal injury resulting in death.
Study design: The Birth-Related Neurologic Injury Compensation Association (NICA) is a Florida organization that pays for the care of infants >2500 g with birth-related brain or spinal cord injury resulting in permanent impairment. We conducted a case-control study using all deaths from the NICA database from 1989 to 2002. Data were collected on the antepartum, intrapartum, and postpartum care of the mother and fetus/child. Time of birth was identified for all cases and compared with a randomly selected control group of 1000 births in 1996 from Florida.
Results: Eighty deaths were identified in the NICA database of 447 total cases. Of the 80 cases, 36/80 (45%) were born from 11 PM to 8 AM. Of the 999 controls (1 certificate sealed for adoption) 281 (28.1%) were born from 11 PM to 8 AM. This yields an odds ratio of 2.09 (95% CI 1.29-3.40) for the association of nighttime birth with fetal injury resulting in death.
Conclusion: Fetuses sustaining injuries resulting in death were more than twice as likely as controls to have been born from 11 PM to 8 AM. Further studies are needed to determine the factors that affect this association and what changes might need to be made to optimize care regardless of time of day or night.

Nighttime work is essential for the care of patients. This is true throughout the health care system. Perhaps more than any other field of medicine, however, obstetrics is associated with nighttime work. Labor and delivery and emergencies regularly occur throughout the 24 hours of the day, and the image of the obstetrician being awakened in the middle of the night to deliver a baby is ingrained in our collective consciousness.

Physicians, however, are not the only ones working at night in fields that involve public safety. In many other industries, such as transportation, nuclear power, and the military, people have to work at night. Interestingly, all of these industries have guidelines or regulations governing nighttime work.[1] There is evidence from these industries that nighttime work poses risks.[2]

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Table I Comparison of demographic and delivery data

	NICA (n = 80)	Controls (n = 999)	*P* value
Maternal age	28.9	27.3	.095
Parity (median)	1	1	.928
Gestational age	38.8	38.6	.458
Race			
White	46.9%	58.9%	.0076
Black	21.0%	18.9%	
Hispanic	22.2%	19.0%	
Other	9.9%	3.2%	
Mode of delivery			
NSVD	12.3%	70.7%	< .0001
Cesarean	71.7%	21.4%	
Vacuum	12.3%	6.4%	
Forceps	3.7%	1.5%	

In medicine, however, the topic of time of day and poor outcomes has not received as much attention as other areas relating to patient safety. For example, the 2000 Institute of Medicine report *To Err is Human* concluded that the health care system fails to ensure that patients are safe or that the quality of care they receive is high.[3] But there was little focus on time of day and poor outcomes. This is especially remarkable for a field like obstetrics when one considers how absolutely central nighttime work is to the duties of obstetric providers and the safety of their patients.

We sought to address the issue of the relationship between time of day and obstetric outcomes by examining the association between nighttime birth and fetal injury during labor and delivery, which resulted in the death of the child.

Material and methods

We performed a case-control study using as cases births from 1989 to 2002 that had been submitted to Florida's Birth-Related Neurologic Injury Compensation Association (NICA). NICA was established in 1988 by the Florida legislature. It provides compensation without litigation to children and families who suffer a birth-related neurologic injury while being cared for by a NICA-participating physician. For the purposes of NICA, a birth-related neurologic injury is a brain or spinal cord injury occurring to a live-born infant with a birth weight of at least 2500 g. The injury must be caused by oxygen deprivation or mechanical injury, and occur during the course of labor, delivery, or resuscitation in the immediate postdelivery period in a hospital. The injury must have rendered the infant permanently and substantially mentally and physically impaired. The legislation does not apply to genetic or congenital abnormalities.[4]

The research protocol was approved by the Institutional Review Boards of the University of South Florida and Tampa General Hospital. For the purposes of this study, all cases in the NICA database (80) in which there was death of the child were assessed. All 80 of the children had evidence of severe injury at the time of birth. Data were collected on the antepartum, intrapartum, and postpartum care of the mother and fetus/child. Time of birth was identified for all cases. Two reviewers (ACU, WFO) reviewed all cases and assigned a cause of injury for each case.

To establish a control group, 1000 births from 1996 (the midpoint year of the study) were chosen. To select these 1000 births, 1000 random numbers were generated from 1 to 189,678 (the number of birth certificates registered in the state of Florida in 1996.) One of the birth certificates was sealed for adoption, yielding 999 available birth certificates to review. All birth certificate data were collected, with emphasis on time of birth for each delivery. No NICA cases from 1996 were included in the set from which controls were selected, thus ensuring that no cases were included as controls.

Normally distributed continuous variables were compared with a Student *t* test and frequency data with chi-square analysis. Parity was compared with a Mann-Whitney *U*-test. Odds ratios and 95% confidence intervals were calculated to assess the association between time of birth and fetal injury resulting in death. Multivariate analysis was performed using logistic regression. In general, multivariate models were tested that included all variables with trends towards significance on univariate analyses ($P < .10$) as well as any variable suspected of being a confounder clinically. Analysis was performed with SPSS 11.5 (SPSS, Inc, Chicago, IL).

Results

From 1989 to 2002, 447 total cases were registered with NICA. Of these 447 cases, 80 cases resulted in the death of the child. In all 80 cases, there was evidence of significant neurologic injury at the time of birth. Deaths occurred most often during the immediate neonatal period, but ranged up to 7 years. Characteristics of the 80 cases are presented in Table I. In 1996 in the state of Florida, there were 189,678 births. From this group, 999 births were randomly selected through random number generation. Characteristics of these 999 controls are presented in Table I. On average, the mothers of the case children were slightly older than the mothers of the controls, but this difference was not statistically significant. Parity and gestational age did not differ between cases and controls. Significantly more of the NICA cases were black or Hispanic compared with controls. In our 1996 control group, 21.4% of births were via cesarean and the rate of operative vaginal delivery was 7.9%.