Rurality Effect on Michigan Newborn Hearing Screening

Robert M. Conway, DO[1]; Kylie Smith, DO[2]; Jason Schomer, DO[3]; Caleb J. Fan, MD[1]; Jacob C. Lucas, MD[1]; Seilesh C. Babu, MD[1]

[1]Ascension Providence Hospital, Southfield, MI and Michigan Ear Institute, Farmington Hills, MI; [2]Ascension Macomb-Oakland Hospital, Madison Heights, MI; and [3]Michigan State University College of Osteopathic Medicine, East Lansing, MI

Introduction

Early Hearing Detection and Intervention (EHDI) programs are state-run programs with the goal of detecting and treating congenital hearing loss at the earliest time possible in order to optimize outcomes. These EHDI programs follow the guidelines from the Joint Committee on Infant Hearing in which hearing screening should be performed by 1 month of age; those that fail should have a comprehensive audiologic examination by 3 months of age, and those confirmed to have hearing loss should have intervention by 6 months of age.[1] Adherence to this protocol has been shown to improve language development.[2]

The rate of newborn hearing screening (NBHS) in the United States is extremely high (about 98.4%); however, even given this excellent rate of screening, there were still almost 60,000 newborns without an NBHS in 2019 and even more that were lost to follow-up after a failed initial screen.[3] While many risk factors for those lost to follow-up after NBHS have been identified, it is still unclear how, and to what extent rurality, how rural a location is, has an effect on those who do not follow up on failed hearing screening.

The purpose of this study was to evaluate the effect that rurality has for those that failed an NBHS in Michigan.

Materials & Methods

Study design

- Retrospective review of previously obtained information from the State of Michigan's Newborn Screening Records.
- Newborns who either failed their initial hearing screen or did not receive an NBHS between 2015-2020
- Rural-Urban Continuum Codes (RUCCs) from the U.S. Department of Agriculture classified counties based on their population size, by degree of urbanization, and by adjacency to a metro area.
- RUCCs ranged from 1 (metro areas with 1 million population or more) to 9 (completely rural or less than 2,500 urban population and not adjacent to a metro area, Figure 1.
- RUCCs were applied to the mother's address to be used as a marker for rurality.
- Newborn hearing screening was completed using Distortion Product Otoacoustic Emissions (DPOAE), Auditory Brainstem Response (ABR), or Automated Auditory Brainstem Response (AABR).Newborns were grouped into those that failed an NBHS and those that did not complete screening based on their initial NBHS.
- Excluded if they were transferred to another facility or if they were in the neonatal intensive care unit without an initial screen being performed.

Statistics

- Different groups and variables were then compared using unpaired t-tests for normal data and nonparametric tests were used for data that were not normally distributed using SPSS v 22.0 (IBM Corp., Armonk, N.Y., USA). A *p*-value of less than 0.05 was considered statistically significant.

Results

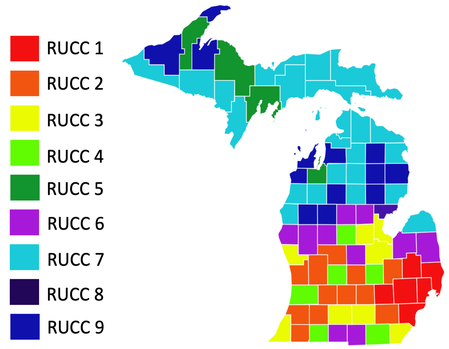

Figure 1. County map of Michigan with corresponding Rural-Urban Continuum Code (RUCC).

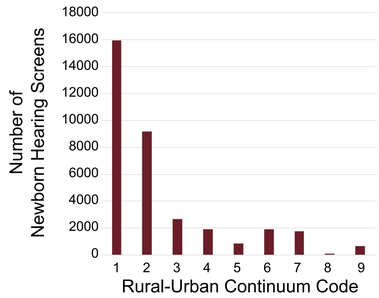

Figure 2. Number of newborn hearing screens by Rural-Urban Continuum Code.

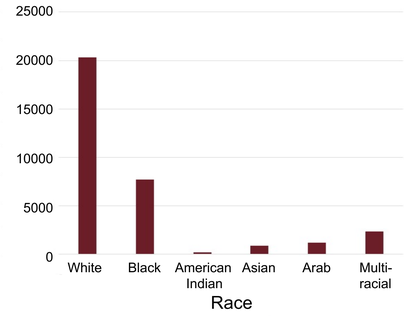

Figure 3. Number of newborn hearing screens by race.

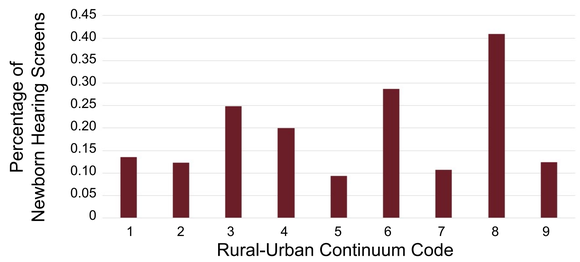

Figure 4. Number of newborn hearing screens with no follow up.

Table 1. Newborn Hearing Screening (NBHS) Outcomes.

	Number	Percent
Failed NBHS		
No rescreen	26379	87.23%
Rescreen	3804	12.58%
No NBHS		
Refusal	3262	68.80%
Equipment Failure	1389	29.30%
Restlessness	90	1.90%

Table 2. Comparison of Rural-Urban Continuum Codes (RUCCs) and Newborn Hearing Screening (NBHS) Outcomes.

	NBHS outcomes		p-value
	Restlessness	Performed	
RUCC (mean)	3	2.2	0.0385
	Follow-up	No Follow-up	
RUCC (mean)	2.3	2.2	<0.001
	Equipment Failure	Performed	
RUCC (mean)	2.8	2.2	<0.001
	Refused	Performed	
RUCC (mean)	4.2	2.2	<0.001
	WNL	Diagnosis	
RUCC (mean)	2.4	2.2	<0.001

Results

- There were 649,524 births reported to Michigan EHDI from 2015-2020
- 34,924 newborns (5.4%) either failed or did not received an NBHS
- Of the 30,241 patients that failed a NBHS, only 12.58% had a rescreen or diagnostic testing (Table 1).
- Leftward skew of RUCCs, with 71.9% of newborns having a RUCC of 1 or 2, indicating a largely urban predominance (Figure 2)
- The majority of newborns undergoing NBHSs were Caucasian or African American; American Indian were the most rural, followed by Caucasian; Arab and African American were the most urban ($p<0.05$, Figure 3).
- AABR was used in 90.4% of cases, while ABR and DPOAE were used in 3.7% and 5.8% of cases, respectively.
- DPOAE (mean RUCC 4.2) was used in more rural locations than either AABR (mean RUCC 2.1) or ABR (mean RUCC 2.0, $p<0.05$).
- As shown in Table 2, parents who were more rural refused a NBHS, experienced equipment failure (both $p<0.001$) or were not able to conduct the screening due to restlessness ($p=0.0385$).

Conclusions

- Of Michigan's 83 counties, the largest group, 44.3%, were considered extremely rural with an RUCC of 7-9.
- Despite RUCC 7-9 accounting for the most counties, an RUCC of 1-2 had the vast majority of NBHSs performed.
- The present study demonstrated that, of newborns who failed an NBHS, only 12.58% went on to receive further screening or diagnostic testing without further EHDI intervention.
- Restlessness, equipment failure, and parents who refused an NBHS were all found to be more rural than those that had an NBHS performed.

Future Directions

- Further investigation into specific barriers that cause suboptimal outcomes in rural communities.
- After identification of barriers, implementation of a protocol to ensure proper follow up and treatment of those who fail NBHS.

References

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2. Bush ML, McNulty B, Shinn JB. Does Adherence to Early Infant Hearing Detection and Intervention Guidelines Positively Impact Pediatric Speech Outcomes? *Laryngoscope*. 2021;131(8):1693-1694. doi:10.1002/lary.28994
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