UNIVERSITY OF MIAMI
DEPARTMENT of PSYCHOLOGY

Identifying Risk for Autism Spectrum Disorder Using Newborn Hearing Screening

HARVARD MEDICAL SCHOOL

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INTRODUCTION

Autism spectrum disorder (ASD) refers to a group of developmental disorders characterized by social and communication problems, repetitive behaviors, and limited interests that affects 1 in 59 children[1]. Although behavioral signs of ASD are present between 6-12 months, the median age of diagnosis is approximately 4 years.

Auditory brainstem response (ABR) is a quick, noninvasive test routinely used to screen for hearing impairment in newborns around the world and is a promising biomarker for early identification of ASD risk (see *Figure 1*). ABR measures the response of the auditory nerve and brainstem to sound. Preliminary studies identified prolongation of the ABR (particularly wave V which is generated by the upper brain stem) in infants and children with ASD but replication is needed[2].

Figure 1: **ABR newborn hearing screening**

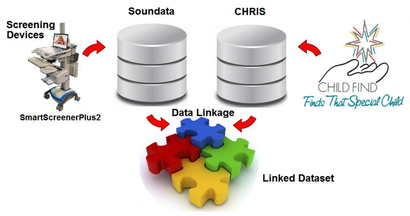


Figure 2: **Database linkage process**

METHOD

Two secondary datasets were integrated using exact and probabilistic data linkage techniques (see *Figure 2*).

ABR data, acquired using Smart Screener-Plus2, were obtained from the Soundata database (MEDNAX®). ABR recordings were conducted at 35 dB normal Hearing Level (nHL) at a rate of 77 and 79 for the right and left ear, respectively. A typical suprathreshold ABR consists of three major peaks (I, III, and V). The negative trough occurring after peak V is typically easily detectable and is labeled as V' (or SN_{10}; see *Figure 3*). Signal phase represents the phase angle of the response group delay which indicates the latency of the peak components.

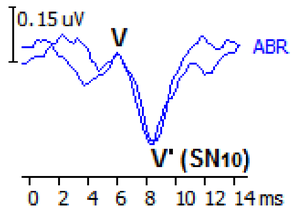


Figure 3: **Test-retest repeatability of ABR waveform acquired at 35dB nHL for newborn hearing screening only showing V and V' component**

Preschool developmental disability data were obtained from the Florida Department of Education Children's Registry and Information System (CHRIS) database.

RESULTS

Results are provided for 64 children with ASD (83% males) and 98,715 children in the comparison group (50% males). Wave V' latency was significantly prolonged for children with ASD in the right ear (t=2.821, p =.005, d = .35) and marginally significantly prolonged in the left ear (t=1.949, p=.051, d = .24; see *Figure 4*). Signal phase showed a significant increase for children with ASD in the left ear (t=2.40, p = .016, d = .30) and a marginally significant increase in the right ear (t=1.94, p =.053, d = .24; *see Figure 5*).

Figure 4: Mean V' Latencies

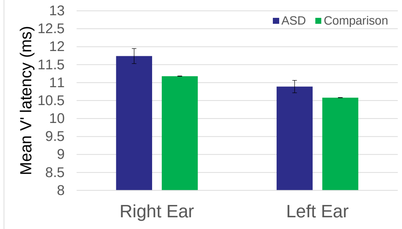
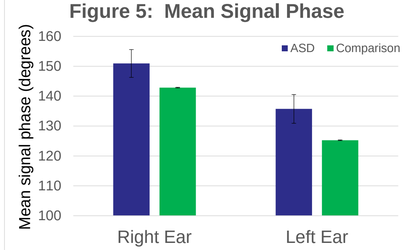


Figure 5: Mean Signal Phase



DISCUSSION

Latency prolongations and signal phase increases were identified in newborns later diagnosed with ASD indicating that these newborns have slower brain responses to sounds. These findings support previous findings and suggest that data from an existing newborn screening test have the potential to provide neurological information that could identify newborns at greater risk for ASD and, in conjunction with early behavioral signs, be used to diagnose ASD at younger ages. More research is needed to determine if newborn screening ABR results can be used to identify increased risk for ASD specifically or developmental delay more generally.

REFERENCES

[1]Baio, J., Wiggins, L., Christensen, D. L., et al. (2018). Prevalence of autism spectrum disorder among children aged 8 years – Autism and developmental disabilities monitoring network, 11 sites, United States, 2014. *MMWR Surveillance Summaries, 67 (No. 6)*, 1-23.

[2]Miron, O., Beam, A. L., & Kohane, I. S. (2018). Auditory brainstem response in infants and children with autism spectrum disorder: A meta-analysis of wave V. *Autism Research, 11,* 355-363.

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