The rise of opioid use in America has led to an increase in infants born with Neonatal Abstinence Syndrome (NAS). The rates of opioid use disorder at delivery hospitalization have increased 333% from 1994-2014, reaching epidemic proportions. There is limited research discussing the long-term effects of NAS, despite the rapid rise of opioid use. A systematic review was conducted to gather information on the long-term characteristics associated with neonatal abstinence syndrome, available assessments, and treatment methods. This paper discusses the following characteristics associated with NAS: drugs, growth, environment, speech language & hearing deficits, behavioral deficits, cognitive deficits, neurological deficits, and dysphagia. Research indicates that opioid exposed infants overall have reduced developmental outcomes compared to typically developing peers. In addition, this review discusses assessments and treatments for infants and children with NAS. Further research is critical to predict specific long-term speech and language deficits, developmental outcomes, and improved treatment related to NAS. 

NAS syndrome occurs as a result of the sudden cessation of fetal exposure to substances that were used or abused during pregnancy by the mother (Kocherlakota, 2014). Clinical symptoms vary from mild tremors to more intense symptoms such as seizures (McQueney & Murphy-O’Konen, 2016). NAS babies present with tremors, irritability, excessive crying, diarrhea and sporadic seizures. The type of the opioid, dose, and timing of exposure influence the severity and risks of withdrawal symptoms (McQueney & Murphy-O’Konen, 2016). 

In addition to the preterm effects, children exposed to opioids in utero are exposed to postnatal environmental challenges. Mothers of NAS babies lead less stable lifestyles. Pregnant women using opioids characteristically are unmarried, unemployed, less educated, less insured, and lack proper nutrition (Kocherlakota, 2014). The purpose of this review is to examine the long-term characteristics associated with NAS, assessments, and treatment methods for early intervention and preschool populations. Long-term effects of neonatal abstinence syndrome often are underreported. This paper explores the following characteristics associated with Neonatal Abstinence Syndrome: 1) drugs, 2) growth, 3) environment, 4) speech language & hearing deficits, 5) behavioral deficits, 6) cognitive deficits, 7) neurological deficits and 8) dysphagia. 

Methods & Analysis 

• The initial search consisted of key word searches in databases through the University of Delaware’s DELICAT Discovery system.
• Search terms consisted of “long term effects Neonatal Abstinence Syndrome”, “developmental deficits associated with Neonatal Abstinence Syndrome”, “benefits of early intervention”, and additional terms.
• Several hundred articles were produced by the searches.
• After examining the articles, 80 were selected for further review
• Articles were excluded that focused on developmental outcomes of older elementary, middle, and high school students.
• References from articles were used to discover additional related articles. Overall, fifty-nine articles were included along with four ASHA websites. 

Long-term Developmental Effects of Neonatal Abstinence Syndrome and Intervention

Caten Cordes

Postnatal Factors that Influence Development in NAS

Drug Exposure

- Morphine, heroin, methadone, butorphanol, paracetamol, cisapride, and antibiotics are the leading substances that cause NAS.
- Factors that increase severity of NAS include maternal smoking, methadone usage, infants born at term, polypharmacy and mixed babies (Kocherlakota, 2014).
- Morphine and methadone are common treatments used to withdraw symptoms.

Environment

- Clinical et al. (1996) compared the outcomes of children born to heroin dependent mothers raised by biological families versus being raised by adoptive families. Research findings discovered that environment has a detrimental effect on long-term outcomes.
- Studies have found that children with NAS have shorter stature compared to typically developing peers. This is linked to in-utero methadone treatments. Behavioral deficits include ADHD, behavioral disturbances, and tantrums. Research gives evidence of permanent alterations in brain structure which impacts cognition. 
- Children with NAS display multiple deficits. Speech and language deficits consist of poor speech development, weak categorization, and language organizational skills. Hearing is affected by high rates of otitis media in childhood and is linked to in-utero methadone treatments. Behavioral deficits include ADHD, behavioral disturbances, and tantrums. Research gives evidence of permanent alterations in brain structure which impacts cognition.
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Socioeconomic Status

- Hoff & Tan (2015) determined that children from low socioeconomic status (SES) families had lower rates of language development compared to children from high SES families.
- Mothers with less SES talk less, use smaller vocabulary, are more straightforward in their speech, and ask fewer questions than higher SES mothers.

Conclusions & Future Directions

- Due to the rise of opioid use in America and the increase in infants born with NAS, speech language pathologists will see increasing numbers of children with a history of opioid exposure as infants as part of their caseloads. The sequelae of prenatal opioid exposure are considerable, and these children require a multi-disciplinary team to address them. Although neurological, growth, speech, language, cognitive and behavioral problems have been documented, the causes of these difficulties are due to several factors. These include not only exposure to and withdrawal to opioids, but also confounding factors such as premature birth, long stay in the hospital, adverse social factors. Poor neurobehavioral outcomes are associated with prenatal opioid exposure (Jernigan et al., 1996). The findings conclude that children with NAS display multiple deficits. Speech and language deficits consist of poor speech development, weak categorization, and language organizational skills. Hearing is affected by high rates of otitis media in childhood and is linked to in-utero methadone treatments. Behavioral deficits include ADHD, behavioral disturbances, and tantrums. Research gives evidence of permanent alterations in brain structure which impacts cognition. This affects attention, concentration, short-term memory, and working memory. In addition, these children are at risk for developmental growth impairment.

- Formal assessments, listed under speech and language assessments, should be used in conjunction with informal measures. Teacher input, parent input, observations, informal language samples, and additional informal probes should all be taken into consideration before implementing a plan of treatment.

- Intervention must incorporate a multi disciplinary approach between professionals, speech language therapists, and families to maximize the child’s overall quality of life (Bhutia et al., 2018). Intervention needs to include positive reinforcement and numerous exposures within different contexts. Caregivers need to be educated on treatment so they can promote generalization for the child at home. Further research is needed to better address the needs of infants with NAS to accurately predict long-term developmental outcomes of NAS children.

Speech Sound Disorder Intervention

- Research indicates that opioid exposed infants overall have reduced developmental outcomes compared to typically developing peers.
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Speech Sound Disorder Intervention

- Behavioral & Motor (2015) concluded that speech therapy improves language and language organizational skills.
- Opioid exposed children have difficulties with language categorization and organizational skills (Gewolb, McHenry Baker, & Moskowitz, 2001). 
- Untreated these children need to be guided in long-term delays and management to achieve their goals (Buchholz, 1994).
- Children with NAS display multiple deficits. Speech and language deficits consist of poor speech development, weak categorization, and language organizational skills.
- Dysplasia
- Speech Language & Hearing Deficits
- Neurological Deficits
- Behavoir
- Cognition
- Postnatal Factors that Influence Development in NAS
- NAS Syndrome and Intervention

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