



Available online at www.mchandaids.org

INTERNATIONAL JOURNAL of
MATERNAL and CHILD HEALTH and AIDS
ISSN 2161-864X (Online)
ISSN 2161-8674 (Print)
DOI: 10.21106/ijma.342

SHORT RESEARCH COMMUNICATION

Oral Health Problems among Children with Neurodevelopmental Disorders in the United States

Zenab I. Yusuf, MBBS, MPH;¹✉ Deepa Dongarwar, MS;² Rafeek A. Yusuf, MBBS, MPH, MS;³
Hamisu M. Salihu, MD, PhD⁴

¹Menninger Department of Psychiatry and Behavioral Sciences, Baylor College of Medicine, Houston, TX, USA; Houston VA Health Services Research and Development Service Center for Innovations in Quality, Effectiveness and Safety, Michael E. DeBakey VA Medical Center, Houston, TX, USA; and VA South Central Mental Illness Research, Education and Clinical Center, Houston, TX, USA; ²Center of Excellence in Health Equity, Training and Research, Baylor College of Medicine, Houston, TX, USA; ³Department of Management, Policy, and Community Health, University of Texas Health Science Center at Houston, School of Public Health, Houston, TX, USA; ⁴FCM-Adminstration Research, Baylor College of Medicine, Houston, TX, USA; and Center of Excellence in Health Equity, Training and Research, Baylor College of Medicine, Houston, TX, USA

✉Corresponding author email: zenab.yusuf@bcm.edu

ABSTRACT

Children with neurodevelopmental disabilities (NDD) suffer poor oral health problems (OHP) leading to adverse health outcomes. We examined the association between NDD and OHP among children in the United States (US) ages 3-17 years using data from the National Survey of Children's Health (NSCH) 2016-17. The prevalence of OHP was 19.1%. Children with NDD had about 40% greater likelihood of poor oral health compared to their non-NDD counterparts ($p < 0.0001$). Living at or above 200%-300% of the federal poverty level (FPL), private insurance coverage, and living with a least a college educated adult were found to be protective factors against poor oral health among children.

Key words: • Neurodevelopmental disorder • Oral health problems • Children • United States

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1. Introduction

About 1 in 6 children in United States (US) is affected by neurodevelopmental disorders (NDD).¹ Children with NDD are at increased risk of developing oral health problems (OHP) compared to children in the general population.^{2,3} However, research into NDD and oral disease in children is scarce.² NDD consist of a cluster of conditions – Attention Deficit Hyperactivity Disorder (ADHD), Learning disabilities, Autism spectrum disorders (ASD), and Intellectual

disabilities – with abnormal central nervous system development.³ NDD present with either motor function, learning, and verbal/non-verbal communication impairments. In a 12-year period from 1997-2008, overall prevalence of NDD in children 3-17 years in US increased from 11.5% to 13.9%.¹ This 17% increase was due to changes in prevalence of autism, ADHD, and other developmental delays other than intellectual and learning disabilities.¹ Mutual relationship exists between NDD and risk of other health conditions

including OHP.⁴ However, there are relatively few studies and less information regarding OHP in children with NDD in US.⁵ The aim of this study was to identify factors protective of oral health problems in children 3-17 years old with NDD in US using a nationally-representative dataset.

2. Methods

We analyzed the 2016-17 National Survey of Children's Health (NSCH), funded and directed by the Health Resources and Services Administration's Maternal and Child Health Bureau and conducted by US Census Bureau. A sample of 364,150 randomly drawn households with children from the 50 states and District of Columbia were surveyed using self-administered questionnaires. Overall response rate was 40.7%. We limited our analysis to children aged 3-17 years. Our exposure variable was neurodevelopmental disorders (NDD). We created a composite variable for NDD based on survey questions that asked whether the child had ever had any of the following NDD: (1) Down syndrome; (2) Tourette syndrome; (3) Developmental delay; (4) Intellectual disability or mental retardation; (5) Speech problems; (6) Learning disability; (7) Autism/Autism spectrum disorders; (8) Attention Deficit Hyperactivity Disorder (ADHD); and (9) Any neurodevelopmental disorder. The primary outcome was 'oral health problems', defined as 'toothache, bleeding gums, and/or decayed teeth or cavities' in children 17 years and younger. Covariates included: (1) child's gender, (2) child's age, (3) child's race, (4) parent's nativity, (5) primary household language (PHHL), (6) child's family structure, (7) poverty level, (8) highest level of education of adult, and (9) child's insurance type.

We conducted weighted bivariate analysis and weighted survey binomial logistic regression generating odds ratio for the association between NDD and oral health problems. We also estimated the level of potentially preventable OHP that could be achieved through effective prevention of NDD in the population. Accordingly, we computed the population attributable risk (PAR) as follows: $PAR = Pe (OR-1) / [1 + Pe (OR-1)]$. PAR was calculated at 25%, 50%, 75% and 100% effectiveness. All tests of hypotheses were two-tailed with a type I

Table 1. Adjusted association between neurodevelopmental disorders and oral health problems

Exposure Variables	OR	95% CI	p-value
Neurodevelopmental disorders			
No			Reference
Yes	1.41	(1.22-1.64)	<0.0001
Gender			
Female			Reference
Male	1.1	(0.96-1.25)	0.16
Age group			
3-5 years			Reference
6-8 years	1.65	(1.32-2.05)	<0.0001
9-11 years	1.39	(1.12-1.74)	<0.0001
12-14 years	0.98	(0.78-1.22)	0.83
15-17 years	1.01	(0.81-1.26)	0.93
Race of the child			
Non-Hispanic White			Reference
Hispanic	0.6	(0.22-1.65)	0.32
Non-Hispanic Black	1.02	(0.83-1.24)	0.86
Multi-racial/Other, non-Hispanic	1.18	(0.99-1.42)	0.07
Poverty Level			
0-99% FPL			Reference
100%-199% FPL	0.85	(0.69-1.03)	0.1
200%-399% FPL	0.7	(0.57-0.85)	<0.0001
400% FPL or above	0.62	(0.49-0.78)	<0.0001
Primary Household Language			
Hispanic children, non-English PHH language			Reference
Hispanic children, English PHH language	0.89	(0.61-1.29)	0.54
Non-Hispanic child	0.54	(0.19-1.52)	0.24
Insurance Type			
Public only			Reference
Private only	0.75	(0.61-0.93)	0.01
Public and private insurance	1.07	(0.75-1.52)	0.72
Currently uninsured	1.29	(0.98-1.7)	0.07
Parents' Nativity			
Parent (s) born in US			Reference
Any parent born outside US	1.08	(0.88-1.31)	0.47
Other (child born in US, parents are not listed)	1.13	(0.75-1.71)	0.56
Family structure			
Two parents, currently married			Reference
Two parents, not currently married	0.94	(0.75-1.18)	0.6

(Contd...)

Table 1. (Continued)

Exposure Variables	OR	95% CI	p-value
Single parent (mother or father)	1.19	(0.99-1.43)	0.07
Other family type, no parent reported	1.2	(0.88-1.62)	0.24
Highest education of household adult			
Less than high school	Reference		
High school degree or GED	0.73	(0.55-0.97)	0.03
Some college or technical school	0.75	(0.56-1)	0.05
College degree or higher	0.59	(0.44-0.8)	<0.0001

CI=confidence interval; P value=level of significant difference tested for (0.05); OR=odds ratio

error rate set at 5%. The study was approved as exempt by the Institutional Review Board of Baylor College of Medicine.

3. Results

3.1. Sociodemographic Characteristics

A total number of 59,327,138 respondents were analyzed. The sociodemographic characteristics showed that about 19% of the children (66.6 % boys and 33.4% girls) had NDD. These children with NDD were more likely to be non-Hispanic White, living with a single parent, and less likely to have private health insurance, compared to children without NDD.

3.2. Oral Health Problems

The prevalence of OHP in children with NDD was 23.2% (mental retardation); 22.6% (developmental delay); 22.4% (learning disability); 19.7% (Attention Deficit Hyperactivity Disorder (ADHD)); 19.6% (Autism Spectrum Disorder (ASD)); 18.7% (any neurodevelopmental disorder); 17.6% (speech problems); 16.7% (Tourette syndrome); and 16.5% (Down syndrome). Children with NDD had about 40% greater likelihood of OHP compared to their counterparts without NDD (p <0.0001) (Table 1). Living at or above 200%-300% FPL, private insurance coverage, and living with an adult with high school and higher education were found to be protective factors against poor oral health.

Finally, Population Attributable Risk (PAR) computed to assess the burden of OHP on the severity level of NDD provides the estimates of potentially preventable OHP assuming different levels of interventions to address NDDs. Assuming that the prevalence of mild and moderate/severe NDD could be reduced by 75%, OHP would potentially be averted in 93,578 and 23,5148 children, respectively. Similarly, if the intervention was 100% effective among children with mild and moderate/severe NDD, it would result in fewer OHP in 12,4771 and 31,3531, children respectively. Moderate/severe NDD was associated with the greatest burden of potentially preventable excess OHP.

4. Discussion and Global Health Implications

4.1. Discussion

The prevalence of OHP in children with NDD in this study was 19.1%. Our findings are consistent with previous research noting a strong association between NDD and poor oralhealth outcomes.⁵ We showed that having higher income, possession of private insurance, and a minimum of a high school parental education protected children with NDD from OHP.

The global health implications of these findings are noteworthy. First, close attention should be given to severity of NDD when designing intervention programs for children. Second, OHP should be routinely screened for in children with NDD. Finally, to reduce prevalence of oral health disease, interventions should be tailored to meet individual needs of children by targeting these amenable protective factors.

4.2. Limitations

NSCH is a parent/caregiver reported survey subject to recall and report biases. We were unable to establish temporal relationship between OHP and NDD because of the cross-sectional nature of the data. The prevalence reported may be an underestimate of the true prevalence of children with OHP and NDD in US since NSCH covered noninstitutionalized

children only which limits generalizability of our findings. Notwithstanding, to our knowledge, this study is the first to quantitatively predict proportions of OHP that are potentially preventable given different levels of interventions targeted at reducing present levels of mild and moderate to severe NDD within the population. Further research on disparities based on demographic, socioeconomic, and health-related characteristics among children with NDD is warranted to improve understanding of the socioeconomic determinants of OHP in institutionalized and noninstitutionalized children with NDD. Such study results may provide useful information to assist with development of effective interventions and adequate allocation of resources aimed at alleviating this burden.

Compliance with Ethical Standards

Conflicts of Interest: All authors declare that they have no conflict of interest. **Financial Disclosure:** All authors declare that they have no financial disclosure to make. **Funding/Support:** This study was non-funded. **Ethics Approval:** This study was approved as exempt by the Institutional Review Board (IRB) of Baylor College of Medicine, Houston, Texas, USA.

Key Messages

- Demographic and socioeconomic disparities exist in children with NDD and OHP in the U.S.
- Targeted policies, resources, and interventions are needed for this specific vulnerable population of children.

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