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Linguistic and behavioral performance of bilingual children with hearing loss

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ABSTRACT

Objective: To compare the English and non-English language performance of deaf or hard-of-hearing (DHH) children raised in homes where English was not the primary language to their typically hearing peers from similar language backgrounds.

Methods: Case control study of bilingual DHH children with unilateral or bilateral non-fluctuating hearing loss defined as the most recent PTA between 26 and 70 dB in one or both ears. Typically hearing controls included bilingual siblings and children recruited from the General Pediatrics practice. Subjects completed the OWLS-II, a validated English language proficiency tool. The subject's parents completed the Child Behavioral Checklist, an assessment of problem behavior; the Student Oral Language Observation Matrix (SOLOM), an assessment of the child's non-English home language; and a study questionnaire on the child's medical, social, and language history.

Results: 26 typically hearing controls, 15 children with bilateral hearing loss, and 18 children with unilateral hearing loss participated. The groups were similar in age, sex, insurance status, place of birth, age at arrival in the US, and maternal education status. Performance on the English language oral composite was significantly lower amongst the bilateral hearing loss group (BHL: 66.9, 95% CI [56.2–77.7]; UHL: 82.9, 95% CI [75.6–90.2]; NH: 84.4, 95% CI [79.5–89.3], p = 0.002). Performance on the SOLOM was significantly lower in bilateral hearing loss group. (BHL: 18.6, 95% CI [15.9–21.3]; UHL: 19.8, 95% CI [17.1–22.4]; NH: 22.3, 95% CI [20.6–24.0], p = 0.036).

Conclusions: Bilingual children with bilateral hearing loss are at increased risk for poor oral expressive and receptive language development. These children comprise a particularly vulnerable population who might benefit from additional focused interventions to support their language development.

1. Introduction

The percentage of persons speaking a language other than English at home in the United States has risen steadily from 11% in 1980 to over 20% in 2011 [1]. In typically hearing children, bilingualism is thought to be advantageous. Studies have demonstrated more advanced phonological skills [2], improved executive function [3], and even superior social skills as compared to their monolingual peers [4].

Children who are deaf or hard-of-hearing (DHH), even those who are not cochlear implant candidates, have poorer outcomes in areas of language development, school performance, and behavior than typically hearing children [5]. This is true even of children with unilateral hearing loss (UHL), who were once thought to perform at levels equal to their typically hearing peers [6]. One study comparing children with UHL to their typically hearing siblings demonstrated higher problem scores in school competency, attention, and ADHD type problems on the Child Behavioral Checklist, a caregiver reported tool used to identify problem behavior, in the DHH cohort [7].

Historically, some clinicians and educators have discouraged DHH children from learning a second language out of concern that, in the setting of already impaired language acquisition, the addition of a second language may lead to further delays. Few studies have investigated the speech and language outcomes of bilingual DHH children. The majority of these studies have focused on children with

Abbreviations: DHH, Deaf or Hard of Hearing; TH, typically hearing; UHL, unilateral hearing loss; BHL, bilateral hearing loss

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cochlear implants. These studies have generally concluded that bilingual proficiency is attainable in implanted children [5,8–10]. Exception to this are two studies conducted in German children and another in Italian children, which identified significantly poorer expressive and receptive language performance [11,12]. However, many of these aforementioned studies lacked a comparator group against which language performance was assessed. In a cohort study on the impact of moderate-to-profound hearing loss involving 20 bilingual and 20 monolingual children, there was no significant difference between groups on expressive and receptive performance with the Preschool Language Scales 4th edition [13]. Of note, there is substantial heterogeneity in the descriptions of bilingual subjects in the literature, with criteria ranging from “children in bilingual homes,” [11] foreign language speaking parents with “limited English proficiency,” [13] and “expos[ure] to a second language with varying amounts of intensity [9].”

Although some work has been done comparing monolingual and bilingual children with hearing loss, and bilingual children with cochlear implants, little research has been conducted on bilingual children with non-profound hearing loss and how they fare in comparison to their typically hearing peers with similar language backgrounds. In particular, the growing population of English-language learners - children raised in households where the primary language spoken is not English - may be at particular risk for language delay in the setting of hearing loss. This is especially important in light of a recent national database study demonstrating that adolescents from racial/ethnic minority backgrounds have a higher prevalence of hearing loss compared to the non-Hispanic white adolescents [14]. Goals of interventions in bilingual DHH children might be more realistically aligned to outcomes seen in typically hearing children with similar language backgrounds, rather than monolingual DHH peers. The purpose of this study was to compare the English language performance and behavioral concerns of DHH children raised in homes where English was not the primary language to their typically hearing peers from similar language backgrounds.

2. Materials and methods

2.1. Study design

This was a single center, case control study of patients receiving care at the University of California, San Francisco. This study was approved by the Committee on Human Research at UCSF.

2.2. Patient population

For the purposes of our study, bilingualism in children is defined as living in households where the primary language spoken at home is not English. The parents of included children self-identified as not having English as their preferred language for medical communication. All children regularly used the non-English language and had varying lengths of exposure to English. For shorthand, we use the term “bilingual” in the remainder of the manuscript to describe this linguistic background. Potential participants in the hearing loss group were identified from the Pediatric Otolaryngology and Audiology clinics at UCSF as children with a diagnosis of hearing loss, defined as an audiogram demonstrating an air-conduction pure tone average (PTA) or speech reception threshold (SRT) > / = 26 dB in at least one ear.

Typical hearing controls were recruited either from among siblings of DHH children enrolled in the study, or children identified from the UCSF General Pediatrics practice to meet the aforementioned criterion as “bilingual.” Typical hearing was defined as children who had successfully passed their most recent annual hearing screening and had no history of prior ear surgery.

Children were excluded if they met basic audiologic criteria for cochlear implantation (PTA/SRT > / = 70 dB in both ears), had a diagnosis of temporary or fluctuating hearing loss, or if they carried a diagnosis of developmental or intellectual delay.

2.3. Materials

OWLS-II Listening Comprehension (LC) and Oral Expression (OE) scales are validated tests of English language proficiency that are administered by a speech-language pathologist. A score for both the LC and OE and an overall oral composite score are generated. The scores account for the child's age and have a standardized mean score of 100 with a standard deviation of 15. This test was selected as it has been previously used in studies of deaf and bilingual children, which would facilitate comparison with prior literature. The Child Behavioral Checklist (CBCL) is a validated parent-report questionnaire for assessing behavior and social development. The Student Oral Language Observation Matrix (SOLOM) is a rating scale originally devised for teachers to assess a student's language based on observation and has been used in audiology studies as a way for parents to report on their child's non-English language proficiency [10,15]. A study questionnaire was administered to collect demographic information about the child's past medical history, language exposure, English language education, parent familiarity with English, and other socioeconomic information. The child's SRT/PTA at the time of first diagnosis was recorded, as this was felt to best reflect the auditory ability of the child during the earliest critical period of auditory and linguistic development. This data about the child and family was used to identify potential predictors and covariates.

2.4. Procedures

All participants and parents were provided with materials in their language of choice, and in-person and telephone interpreters were used during study procedures. The OWLS-II was administered to study subjects by a licensed speech-language pathologist. While subjects completed testing, their parents completed the study questionnaire, CBCL, and SOLOM. Subjects were compensated for their time.

2.5. Statistics

We hypothesized that bilingual children with hearing loss would have lower performance on the OWLS LC and OE subscales than bilingual children with typical hearing. In order to detect a 9 point difference on the OWLS-II oral composite score with a standard deviation of 12 points on a two tailed test with an alpha of 0.05 and a beta of 0.20, the estimated sample size was 28 subjects per group. T-tests and one-way ANOVA were used to compare continuous variables. Chi-square tests were used for categorical variables. Non-parametric tests, Mann-Whitney U and Kruskal-Wallis H, were used for variables with a non-normal distribution and Fisher's exact test was used when the expected count was less than 5 in greater than 80% of cells in the analysis of categorical variables. Statistical analysis was completed using IBM SPSS Statistical Package 24.

3. Results

There were a total of 59 subjects enrolled, with 26 typically hearing controls (TH), 15 children with bilateral hearing loss (BHL), and 18 children with unilateral hearing loss (UHL). There were no differences between groups in age, sex, self-identified race/ethnicity, insurance status, place of birth (United States or not), age at arrival in the US, parent comfort with English, or maternal education status. In general, our cohort had low socioeconomic status, low rates of maternal education, and low parent-reported comfort with English (Table 1).

The most common types of hearing loss were congenital sensorineural hearing loss (39%) and aural atresia (36%). Hearing loss was most frequently identified at birth either by newborn hearing screening