ORIGINAL
ARTICLES

Who to Refer for Speech Therapy at 4 Years of Age Versus Who to "Watch and Wait"?

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Objective To examine predictors of speech disorder resolution versus persistence at age 7 years in children with speech errors at age 4 years.

Study design Participants were drawn from a longitudinal, community cohort. Assessment at age 4 years (N = 1494) identified children with speech errors. Reassessment at age 7 years allowed categorization into resolved or persistent categories. Logistic regression examined predictors of speech outcome, including family history, sex, socioeconomic status, nonverbal intelligence, and speech error type (delay vs disorder).

Results At age 7 years, persistent errors were seen in over 40% of children who had errors at age 4 years. Speech symptomatology was the only significant predictor of outcome (P = .02). Children with disordered errors at age 4 years were twice as likely to have poor speech outcomes at age 7 years compared with those with delayed errors.

Conclusions Children with speech delay at age 4 years seem more likely to resolve, and this might justify a "watch and wait" approach. In contrast, those with speech disorder at age 4 years appear to be at greater risk for persistent difficulties, and could be prioritized for therapy to offset long-term impacts. *(J Pediatr 2017;■■:■■-■■).*

D evelopmental speech disorders are common in preschool children, with estimates from community cohort studies suggesting 3.5% to 5% of 4-year-olds are affected.[1-3] Children with this condition have no known cause for their impairment (eg, no diagnosis of brain lesion, intellectual impairment, craniofacial or genetic disorder, or hearing impairment). The presence of a developmental speech disorder may be debilitating in itself, with associated psychosocial impacts, literacy difficulties, and restricted educational and employment outcomes longer-term.[4-7] Not surprisingly, given the prevalence of these disorders, parents frequently seek help from general practitioners (GPs) and pediatricians on this issue. However, population-based study of predictors of speech disorder recovery versus persistence into the middle school years to guide referral practice is lacking.[2]

A range of sociodemographic and early developmental factors are commonly hypothesized to predict speech outcome, including sex, socioeconomic status, maternal education, early language skills, early feeding skills, intelligence, and family history.[1,3,8-14] These findings are based largely on clinical studies[8-11] or derived from preschool children.[1] One population-based cohort has examined speech outcome into the middle school years; the Avon Longitudinal Study of Parents and Children (ALSPAC).[3,13,14] Methods involved resource-intensive transcription and analysis of connected speech.[3,13,14] Further to sociodemographic and cognitive-linguistic factors, a promising area of investigation for prediction of speech outcomes has been the predictive value of specific speech symptomatology (eg, type of speech error).[8,15] "Proportion" of speech errors was most predictive of poor outcomes at 8 years in the ALSPAC cohort.[14] Rating the proportion of errors alone is nonspecific for a child's speech diagnosis and does not inform intervention.

The most commonly used clinical diagnostic system denotes speech error patterns as being "delayed" or "disordered."[16] Speech error diagnosis is critical for intervention planning and prognosis.[17] A delay is an error that occurs in typical speech development but that is delayed relative to 90% of peers (eg, patterns that reduce consonant clusters such as "bue" for "blue." This error would be appropriate until 3 years 11 months but is considered as delayed in a 4-year 5-month old child).[18] Disordered speech is characterized by atypical errors seen in less than 10% of the typical population at any age (eg, backing sounds to more posterior mouth position such as "keddy" for "teddy"; removing initial consonants such as "og" for "dog").[18] Critically, the predictive value of speech error

ALSPAC	Avon Longitudinal Study of Parents and Children
GFTA-2	Goldman-Fristoe Test of Articulation-Second Edition
GPs	General practitioners
PCC	Percent consonants correct
SES	Socioeconomic status
SEIFA	Socioeconomic Indexes for Areas

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type (delay vs disorder) to inform prognosis remains unexplored in a longitudinal population or community cohort sample. Findings might guide practitioners regarding referral to speech therapy. Thus, this study examined children with speech errors at age 4 years, drawn from a longitudinal community cohort study of language and literacy, to determine predictors associated with speech recovery vs persistence at age 7 years.

Methods

Participants were recruited from a community cohort study, the Early Language in Victoria Study. Between September 2003 and April 2004, 1910 infants aged 7 to 10 months were recruited into Early Language in Victoria Study from 6 local government areas in Melbourne, Australia.[19] The government areas were selected from the census-based Socioeconomic Indexes for Areas (SEIFA) Index for Relative Socioeconomic Disadvantage, and included 2 from each of 3 tiers, representing low, middle, and high socioeconomic status (SES) communities. A higher SEIFA scores indicates greater advantage. Primary recruiters were a universal nursing service for families with infants through 6-year-olds, the Victorian Maternal and Child Health service. All eligible families were invited to participate. A small number of participants were recruited via local newspapers and at hearing screening sessions also offered by the universal nursing service. Children with known disabilities (eg, genetic syndromes, hearing loss) were excluded. At baseline, parents were required to have adequate English skills to complete written questionnaires. For further recruitment details see Reilly et al.[19] Ethics approval was obtained from the Royal Children's Hospital Human Research Ethics Committee (HREC#23018). Written consent was obtained from all parents.

At age 4 years, all eligible participants received face-to-face assessment of speech and language (N = 1494). Children with variables that could confound speech performance were excluded (ie, neurodevelopmental disabilities, genetic conditions, craniofacial disorders, or a non-English speaking background). Four years of age is a critical time for examining outcomes because it is a common age for GP or pediatrician referral of children with speech disorder.[2] Speech sound errors were identified in 160/1494 (11%), and each child was eligible for repeat assessment at age 7 years. Speech assessment data at ages 4 and 7 years were available for 93 participants. Reasons for loss to follow-up included participants declined further follow-up (54), lost to contact (4), unavailable for assessment (4) failure to complete the assessment, (1) and unusable audio recordings (4). No statistically significant differences were found at age 7 years between participants (n = 93) and nonparticipant (n = 67) groups on demographic variables including SEIFA, sex, family history, and nonverbal IQ (Table I; available at www.jpeds.com).

Procedures
Outcome. At ages 4 and 7 years, participants' speech production was examined using the standardized Goldman Fristoe

Test of Articulation-Second Edition (GFTA-2)[20] Sounds-in-Words subtest, one of the most commonly used standardized speech tests in clinical practice.[21] Research assistants were formally trained in the GFTA-2 procedures and followed a set administration protocol. The Diagnostic Evaluation of Articulation and Phonology Inconsistency subtest was also administered at age 4.[22] Both the GFTA-2[20] and DEAP[22] require children to name single words in response to picture stimuli. Two experienced speech pathologists examined participants' productions of all words across both time points. Percent consonants correct (PCC) ratings were determined as a measure of intelligibility and severity of speech disorder at ages 4 and 7 years. At age 4 years, speech errors were independently categorized as delayed or disordered by 2 authors and confirmed with consensus rating. Mean agreement was 96.8%. Delay and disorder were defined as per Dodd et al.[18] At age 7 years, data were analyzed to determine whether speech errors had persisted or resolved.

Predictor Variables. Predictors commonly reported in the literature were examined, including sex, SES, nonverbal IQ, speech symptomatology (proportion denoted by percent consonants correct; error type of delay versus disorder), language ability, family history of speech disorder, and having had speech therapy[1,3,8-14] at some time between 4 and 7 years of age.

Statistical Analyses
Univariate group comparisons were conducted across resolved and persistent groups (Table II). Logistic regression was conducted with Stata v 13.1 software (StataCorp, College Station, Texas) to identify predictors of outcome at age 7 years. Predictors with statistically significant association ($P < .05$) from the univariate comparisons were included in the multivariable (adjusted) model, along with sex, nonverbal IQ, and SEIFA disadvantage index as covariates (Table II). Exploratory post hoc analyses were then conducted to determine whether any of the predictor variables significantly influenced resolved or persistent status in the "delayed" and "disordered" diagnostic groups at age 7 years (Tables III and IV; available at www.jpeds.com). This exploratory analyses requires conservative interpretation because of the risk of false positives attributable to the number of variables examined relative to the small sample size of the disordered group.

Results

At age 7 years, just under 60% of all children with speech errors at age 4 years had resolved (Table V). When examined according to type of speech error, over two-thirds (69.6%) of children with speech delay had resolved errors by age 7 years. By contrast, only two-fifths (40.5%) with disordered speech at age 4 years had resolved errors at age 7 years. Children with persistent errors at age 7 years did show some positive change in PCC over time but did not increase these proxy intelligibility ratings to an age appropriate level.[26] Children with delayed speech at age 4 years had a mean PCC of 77 (SD = 12), and