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## ABSTRACT

The project reported in this paper examined the relationship between the occurrence of otitis media with effusion (OME) during the first 3 years of life, and speech, language, and classroom performance during the school years. Fifty-five high-risk children between the ages of 2.6 and 8 years participated in a speech assessment; 34 high-risk 5-year-olds participated in a language assessment. The children were socioeconomically disadvantaged and attended a day care program at a child development center. Results did not show a relationship between the number of days of OME in the first 3 years of life and either the total number of common phonological processes observed during the preschool years or language measures at age 5. Early OME was associated with the total number of phonological processes used by children between the ages of 4.6 and 8 years. In summary, for socioeconomically disadvantaged children attending day care centers, the magnitude of any adverse speech or language outcome associated with early childhood OME is small and more likely when children are of school age. (JDD)

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OTITIS MEDIA IN EARLY CHILDHOOD AND ITS RELATIONSHIP  
TO LATER SPEECH AND LANGUAGE

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## INTRODUCTION

The relationship between the occurrence of otitis media with effusion (OME) during the first 3 years of life and later speech and language development was examined in a group of socioeconomically disadvantaged children who attended a research day-care program. Study children were part of a longitudinal multidisciplinary program in which the number of episodes of OME, the duration of each episode, and the psychoeducational development of each child were charted prospectively from infancy.

## MATERIALS AND METHODS

Study Population

The children studied attended the Frank Porter Graham Child Development Center, a multidisciplinary research day-care program. Study children were identified at birth as biologically normal and classified as at risk for poor school performance because of socioeconomic and cultural factors. Children entered the day-care program of the Center between the ages of 6 weeks and 3 months. They attended the Center for five full days a week, 50 weeks a year until entry into kindergarten. While in the day-care program, children received complete medical care provided by two pediatricians and two nurse practitioners. Each

weekday, nurses reviewed the children's health status. Physical examinations, including ear examinations, were performed when parents, day-care teachers, or medical staff observed signs or symptoms of illness in a study child.

### Otitis Media Experience

During the study period (1975 to 1986), the diagnosis of OME was based on the findings of pneumatic otoscopy. OME was diagnosed when middle ear fluid was seen or when the mobility of the tympanic membrane was markedly reduced or absent. Between 1978 and 1986, tympanometry using the tympanogram classification of Jerger (1), was used to corroborate the OME diagnosis. During symptom-free periods, the middle ear status of the children was monitored once a month by otoscopy and tympanometry. Throughout the study, ears with persistent effusion were examined every 2 weeks until the effusion resolved. A total OME score (Total OME[0-3]) for each child was calculated by summing the total number of days with episodes of unilateral OME and bilateral OME over the first three years of life. (See Roberts, Sanyal and Burchinal (2) for additional details.)

### Speech Measures

Between 1982 and 1986, the speech and language of all FPG high-risk children between the ages of 2 1/2 and 8 years were assessed. Children were tested in the fall of each year in an IAC sound-treated room. Testing occurred if a child had passed a hearing screening and had a Type A or C tympanogram using

Jerger's (1) tympanogram classifications. First, speech was assessed using the Goldman Fristoe Test of Articulation and then language was examined during a 15 minute conversational speech sample. Responses on the articulation tests were coded live using narrow transcription, and both speech and language outcomes were recorded on audiotape. Inter-examiner agreement based on 10% of the test sessions was 87.2% for narrow transcription of consonant sounds.

Each consonant on the articulation test was coded for phonological processes according to Ingram's (3) classification. Phonological processes are systematic simplifications of adult words or error patterns in sound usage. Dialect features were coded, but excluded from the analysis. A Total Phonological Process (TPP) score for each child was computed by summing the frequency of the following phonological processes that are common in the developing speech of normal children: deletion of final consonant, consonant cluster reduction, fronting, stopping, liquid gliding, reduplication, assimilation and unstressed syllable deletion. TPP was selected as the primary speech variable in the analyses, because individual phonological processes were observed infrequently after age 4:

#### Language Measures

To compute language measures, fifteen minutes of a conversational speech sample were transcribed and segmented based on the communication unit. Each child's transcribed language sample was processed by Systematic Analysis of Language Trans-

cripts (SALT), a computer program for language analysis. The language measures were 1) mean number of words per communication unit, 2) mean number of dependent clauses (adjectival, adverbial and noun clauses) per communication unit, 3) the ratio of the total number of different words to the total number of communication units, 4) the ratio of the total number of different conjunction words excluding "and" to the total number of communication units, and the 5) mean number of utterances per turn.

## RESULTS

### OME and Speech Measures

Fifty-five high-risk children participated in the speech study. Fifty-one were black and 4 were white; 37 were boys and 18 were girls. The mean and median number of days of total OME (0-3) were 242.6 and 196.0 respectively; these ranged from 8 to 931 days. Table 1 shows that, while there is a marked decrease in children's use of phonological processes between the ages of 3 and 4 years, the number of processes becomes relatively stable with only a gradual decline after the age of 4 years. Since children between the ages of 2 1/2 and 8 years were tested annually, each child contributed 1 to 5 observations to these data.

In our first analysis, we used Spearman correlations to determine whether a linear relationship existed between ranks on

total OME(0-3) and TPP at any given age. No significant ( $p > .05$ ) correlations between total OME(0-3) and TPP were found (See Table 1). However, though not significant, all rank-order correlations observed in the 4 through 8 year-olds were in the hypothesized direction.

Second, a growth curve approach was used to determine if OME was related to indices of speech development during the period in which the phonological processes were exhibiting their greatest change. TPP was transformed by computing natural logarithms after recording each zero as .1. Individual linear polynomial growth curves were fit to the transformed data of 18 children who had at least 3 observations of OME over time and whose first articulation test was given when they were between 2 1/2 and 3 1/2 years of age. Two indices of development were estimated: the intercept (i.e., the predicted Log of TPP at age 3) and the linear slope associated with age in months. No significant relationships between OME and these indices were found; the Spearman correlation of total OME(0-3) with the intercept was  $r = .07$  ( $p = .79$ ) and with the rate of change (the slope) was  $r = .01$  ( $p = .97$ ).

In a third analysis, we examined the age period during which phonological processes exhibited little change, that is, the TPP observed when children were 4 1/2 years or older. Forty-five children were tested one to three times after the age of 4 1/2. The median of these one to three scores was selected as a robust measure of central tendency of TPP during these years.

Figure 1 shows the plot of the relationship between the median number of TPP and Total OME(0-3). The plotting symbol indicates the number of times each child was tested after the age of 4 1/2 years. Spearman rank-order correlations were used to test the association between OME and the median of TPP, weighted by the number of times TPP was assessed after 4 1/2 years of age. A small, but significant rank order correlation ( $r=.35$ ;  $p=.017$ ) was observed. Even after partialing out median age of testing, the parameter reflecting the observed association was still significant ( $t(42)=.22$ ,  $p=.035$ ). Median age was a nonsignificant predictor, ( $t(42)=-1.3$ ,  $p=.21$ ) suggesting that the observed association is probably not explained by age.

#### OME and Language Measures

Thirty-four high-risk five-year-olds participated in the language study. Thirty-two were black and 2 were white; 24 were boys and 10 were girls. The language sample for each child taken closest to 60 months of age was used in the language analysis. Table 2 shows the means and medians on each language measure. To determine if a relationship existed between ranks on total OME (0-3) and the language measures, Spearman rank-order correlations were conducted. As shown in Table 2, no significant ( $p>.05$ ) correlations were found.

#### DISCUSSION

The results of this exploratory study did not show a



relationship between the number of days of OME in the first 3 years of life and either the total number of common phonological processes observed during the preschool years or language measures at age 5. Early OME was associated with the total number of phonological processes used by children between the ages of 4 1/2 and 8 years. However, this finding should be interpreted carefully, since the final speech analysis was conducted because of trends observed in the first analysis and not on a priori hypotheses. Moreover, these data were subjected to multiple analyses.

Whether early OME has detrimental effects on later speech and language, has been debated. Early OME has been shown to be related to delay in speech and language development in preschool and school-aged children (4-7). However, the results of these studies are not conclusive (8,9). In the present study, OME history and speech and language development were documented prospectively and OME history was documented more intensively than in previous studies. In summary, for socioeconomically disadvantaged children, attending day-care, the magnitude of any adverse speech or language outcome associated with early childhood OME is small and more likely when children are school age.

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Table 1. Means and Medians for Total Number of Phonological Processes and Correlations with OME across Age

	AGE (in years)					
	3 (N=27)	4 (N=25)	5 (N=24)	6 (N=30)	7 (N=29)	8 (N=19)
Mean	22.5	6.2	2.9	3.1	0.9	1.4
SD	13.6	6.0	2.1	4.2	1.5	1.9
Median	20.0	4.0	3.0	2.0	0.0	1.0
Spearman Coefficient	-.04	.29	.31	.29	.18	.10
P value	.85	.16	.15	.13	.34	.69

Table 2. Means and Medians for Language Measures and Correlations with OME

	Mean # of Words per communication unit	Mean # of dependent clauses per communication unit	# of different words / # of communication units	# of different conjunctions / # of communication units	# of different pronouns / # of communication units
Mean	3.80	.13	1.26	.06	.11
SD	.60	.05	.21	.04	.06
Median	3.75	.11	1.24	.04	.10
Spearman Coefficient	-.04	.17	-.03	.20	.09
P value	.83	.33	.89	.26	.62

## LEGEND

Figure 1. Plot of medians of total common phonological processes by number of days with otitis media with effusion during the first 3 years of life (total OME (0-3)).

