Otitis Media in Language Impaired and Normal Children

L'otite moyenne chez les enfants atteints de troubles du langage et chez les enfants normaux

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Abstract

The relationship between otitis media in early childhood and language development and disorders was examined in both language-impaired (LI) and normal subjects. LI and normal children, with and without a history of chronic otitis media, matched on several demographic variables, were compared longitudinally on perceptual-motor, cognitive, linguistic, academic, and social-emotional performance. Results indicated that, for both the LI and normal groups, there were surprisingly few significant differences, in any domain studied, between children with and without a history of chronic otitis media. The results are considered preliminary due to the small sample size and the limitations intrinsic to retrospective parental report data.

Résumé

La relation entre l'otite moyenne au début de l'enfance et le développement et les troubles du langage a été étudiée tant chez les sujets souffrant de troubles du langage que chez les sujets normaux. Ces deux groupes, qui ont et n'ont pas été atteints d'otites moyennes chroniques, ont été comparés longitudinalement sur les plans du rendement percepto-moteur, cognitif, linguistique, scolaire et socio-émotionnel. Les résultats indiquent que, pour les sujets normaux at ceux souffrant de troubles du language, il y avait peu de différences significatives pour toutes les variables étudiés, entre les enfants qui ont et n'ont pas été atteints d'otites moyennes chroniques. De tels résultats sont considérés comme préliminaires en raison du faible échantillon et des limites propres aux données rétrospectives transmises par les parents.

Otitis media (OM), or inflammation of the middle ear, is a common disease of infancy and early childhood which, in its chronic form, has been shown to result in hearing loss in many children affected (Olmsted, Alvarez, & Eversden, 1964; Kaplan, Fleshman, Bender, Baum, & Clark, 1973; Bluestone et al., 1983). Due to the deleterious effects of chronic OM on hearing, and the effects of hearing loss on language/learning development (Kirkwood & Kirkwood, 1983; Leviton, 1980; Mustain, 1979; Menyuk, 1980), it has been hypothesized that children with chronic OM may be at increased risk for language disorders. Holm and Kunze (1969) published the first report linking a history of chronic OM with impaired performance on linguistic tasks. In the ensuing years, numerous studies have been published reporting a positive correlation between a history of chronic OM and impaired language development (see Kavanaugh, 1986, for review). However, studies suggesting a causal relationship between a history of chronic OM and language impairment have been criticized on methodological grounds. Leviton (1980), in reviewing this literature, pointed out the lack of important control of other factors known to affect language development (such as IQ, socio-economic status, language stimulation in the home, etc.) in many studies postulating a relationship between chronic OM and language disorders. Furthermore, in many studies, children's language abilities were assessed during a current episode of OM. Thus, it was not possible to determine whether lower scores on language tests were the result of a history of chronic OM in early life, current hearing loss at the time of language testing, or general malaise in an ill child.

Approaching the issue from the opposite angle, several researchers have examined the incidence of OM in children referred for language or learning disabilities, and found it to be significantly higher than that found in children with normal development (Zinkus and Gottlieb, 1980; Gottlieb, Zinkus, & Thompson, 1979; Zinkus, Gottlieb, & Schapiro, 1978). Unfortunately, these studies suffer the same methodological constraints as those previously reviewed, with the additional criticism of failure to adequately document incidence of OM (Paradise, 1981; Ventry, 1980).

More recent studies have addressed these methodological concerns by adopting prospective, longitudinal designs which allow incidence and severity of episodes of OM to be documented, hearing to be tested on a regular basis, and language and learning development to be monitored (Menyuk, 1979; Silva, Chalmers, & Stewart, 1986; Marchant, Shurin, Turczyk, Wasikowski, Tutihasi, & Kinney, 1984; Teele, Klein, & Rosner, 1984; Friel-Patti, Finitzo-Hieber, Conti, & Brown, 1982; Feagans, Sanyal, Henderson, & Collier,

1985). These studies demonstrated an increase in hearing loss in children with chronic OM, as well as delayed or disordered language development. However, some studies have also demonstrated an increase in other developmental disabilities, notably lower IQ and attention deficit, in children with a history of chronic OM (Hersher, 1978; Howie, 1979; Silva, Kirkland, Simpson, Stewart, & Williams, 1982). In contrast to the above studies, which have reported an association between OM and language impairment, there have been a number of studies which have failed to find clear evidence of a relationship between the occurrence of OM and subsequent language problems (Roberts, Sanyal, Burchinal, Collier, Ramey, & Henderson, 1985; Hubbard, Paradise, McWilliams, Elster, & Taylor, 1985; Fischler, Todd, & Feldman, 1985; Wright, Sell, McConnell, Sitton, Thompson, Vaughn, & Bess, 1988).

In a recent review of the type of language, memory, perceptual, and attention deficits frequently reported in children with a history of chronic OM, Zinkus (1986) proposed that a simple one-to-one relationship between OM and language disorders may not exist. In his own studies he found that the effects of OM are different for different children. He suggests that some children may be at risk for certain developmental difficulties and the occurrence of OM leads to their expression. Eimas and Clarkson (1986) arrived at a similar position based on their detailed studies of speech perceptual abilities of children, with or without a history of chronic OM and language disorders. They proposed that there may be a genetic predisposition for language or academic deficits which is exacerbated by the occurrence of OM. They suggest that comparing the development of language impaired children, either with or without a history of chronic OM, as well as normal children, with or without a history of OM, may help to clarify the relationship between OM and language development.

Such a study was done by Bishop and Edmundson (1986). They compared the performance of language impaired (LI) children, with and without a history of OM, on several language measures at ages 4-0 and 4-6, and found no differences between the groups on any measure. However, they did find that the LI-OM children were more likely to have had perinatal risk factors, suggesting a possible interaction of risk factors in the etiology of language impairments in this group.

As part of the San Diego longitudinal study, Evaluating the Outcomes of Preschool Impairments in Language (1979-1989), a large, well-selected group of children with developmental language delay and well-matched control children were studied from ages four through eight years. (See Tallal, Curtiss, & Kaplan, 1988, for an overview.) Using this longitudinal cohort, we focus here on a comparison between developmental outcomes of LI children with a history of chronic OM and LI children without a history of OM. Control children, with and without a history of chronic OM, were also compared developmentally.

The rationale behind the present study was as follows. If chronic OM, *per se*, can cause or contribute to language impairments, then it might be expected that LI-OM children would show a different linguistic profile (and perhaps a different pattern of linguistic growth) than LI children who have not had OM and, therefore, would be presumed to have a different etiology. Also, there may be two classes of LI-OM children: those for whom OM was a primary etiological factor and those for whom some other etiology was primary, but who additionally had multiple episodes of OM. The latter group might be expected to show more marked deficits because the occurrence of OM could compound or intensify a pre-existent language impairment. The use of normal control children, with and without a history of OM, allows for an evaluation of whether the effects of OM on language development are similar in normal and LI populations.

In addition to examining linguistic performance, the present study also compares OM and non-OM children on measures of perceptual, motor, and cognitive function, academic performance, and social-emotional characteristics, which may be in some way affected by the occurrence of chronic OM. Also, the present study compares groups on the incidence of prenatal and postnatal risk factors and the presence or absence of affected parents, which may interact with OM in the etiology of LI. The design of the study, overall, is similar to the design used by Bishop and Edmundson (1986), using a larger range of dependent measures and a longer longitudinal time period.

Methods

Subjects

Subject selection for the San Diego longitudinal study has been described in detail elsewhere (Ziegler, Curtiss, & Tallal, 1990). In brief, 101 LI children, meeting strictly defined criteria for inclusion, and 60 normally developing children, carefully matched on age, IQ, race, and SES were recruited. All children were four years old at the beginning of the study.

At the time of induction, parents were asked to fill out a detailed medical history questionnaire on their child. As part of this questionnaire, information pertaining to incidence and treatment of ear infections was obtained. The questions pertaining to history of OM are shown in Table 1. In addition to the written questionnaire, the primary care-giver of

Table 1. Ear infection questionnaire.

1. How many different episodes of ear infections has this child had in his/her lifetime?
2. How many of these have been treated with medication prescribed by a physician?
3. How many episodes of ear infection have occurred during the past year that required treatment by a physician?
4. Does your child presently have tubes in his/her ears?
5. If YES on the above question, does you child have tubes in one ear or both ears?
6. If your child no longer has tubes in his/her ears but had them in the past, please answer the following questions.
   -Age tubes were placed in the ear(s)
   -How long were the tubes in the ears before coming out?

each child was interviewed to determine history and treatment of OM. Based on the research literature, a child was classified for the purposes of this study as having a history of OM if it was reported that they had five or more treated cases of OM before the age of 4 years.

Fourteen of the children, who met all of the study criteria as language impaired, were classified as having a history of chronic OM. Of the matched controls inducted into the study, nine were classified as having a history of chronic OM.

Materials

For each child in the study, a detailed assessment of perceptual, motor, cognitive, and linguistic abilities and of social-emotional development was done over a five year period, using both standardized and experimental tests. Also, at the beginning of the study each parent filled out questionnaires assessing prenatal and postnatal risk factors. After school entry, academic skills were assessed. A detailed description of test procedures has been reported elsewhere (Tallal, Dukette, & Curtiss, 1988); the measures used are briefly summarized below.

Several measures of perceptual functioning were examined in years 1, 3, and 5 of the study. Nonverbal auditory and visual perception, sequencing, and serial memory were assessed using Tallal's Repetition Test (Tallal, 1980a). Verbal auditory discrimination was assessed using the Goldman-Fristoe-Woodcock Test (GFW; Goldman, Fristoe, & Woodcock, 1970) and also an experimental test assessing discrimination of computer generated stimuli incorporating rapidly changing formant transitions, /ba/ vs /da/ (Tallal & Piercy, 1974).

Two measures of cognitive performance were used in years 1, 3 and 5: (1) an experimental paired associate memory task; and (2) a Piagetian seriation task. Several measures of language skills were used in years 1, 3, and 5. Articulation was assessed using the Arizona Articulation Proficiency Scale (AAPS) (Fudala, 1980). Receptive and expressive morphological, syntactic, and semantic skills were assessed using the Curtiss-Yamada Comprehensive Language Examination (CYCLE) (Curtiss, Yamada, & Tallal, 1989). Also, expressive (ELA), receptive (RLA), and overall language age (LA) were determined in years 1, 3, and 5 using a battery of standardized language tests. In year 1, these tests included: the Sequenced Inventory of Communication Development (SICD) (Hedrick, Prather, & Tobin, 1979); the Northwest Syntax Screening Test (NSST) (Lee, 1971); the Carrow Elicited Language Inventory (CELI) (Carrow, 1974); and the Children's Token Test (DiSimoni, 1970). In years 3 and 5 these tests included: the Clinical Evaluation of Language Function (CELF) (Semel & Wiig, 1980); the Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 1981); the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, McCarthy, & Kirk, 1968); the Children's Token Test; and the Expressive One-Word Picture Vocabulary Test (EOWVT) (Gardner, 1979).

The following academic skills were assessed in year 5: (1) reading vocabulary and (2) reading comprehension, using the Gates-MacGinitie Test (Gates & MacGinitie, 1972); (3) decoding skills using the Gates-McKillop Test (Gates & McKillop, 1966); (4) spelling from the Comprehensive Test of Basic Skills (CTBS) (McGraw-Hill, 1973); (5) writing nonsense words; and (6) math skills from the CTBS. Intellectual development was assessed in years 1 and 5 using the Arthur Adaptation of the Leiter International Performance Scale (Arthur, 1949). Social/emotional development was assessed in years 1 and 5 using the Child Behavior Checklist (CBCL) (Achenbach, 1979).

Prenatal and postnatal risk factors were assessed using detailed medical history questionnaires filled out by parents in year 1 of the study. The prenatal questionnaire included 30 items assessing risk factors and health conditions occurring during pregnancy. The postnatal questionnaire included 43 items assessing complications during delivery and child medical history. Also, parents were asked to indicate whether either parent had a language or learning disorder.

Table 2. Comparison of OM and non-OM groups: demographic variables and risk factors.

	Normal Group			LI Group		
	non-OM mean *(sd)*	OM mean *(sd)*	*t*-value*	non-OM mean *(sd)*	OM mean *(sd)*	*t*-value*
SES	2.41 (0.78)	2.79 (0.95)	1.15	3.08 (0.88)	2.96 (1.34)	0.41
Prenatal	3.11 (1.99)	2.86 (2.04)	0.31	3.30 (2.77)	3.86 (2.35)	0.70
Postnatal	3.89 (2.78)	4.17 (2.99)	0.23	3.95 (3.05)	5.00 (2.58)	1.16
Age	4.40 (0.29)	4.31 (0.29)	0.85	4.36 (0.29)	4.30 (0.30)	0.78

Table 3. Comparison of OM and non-OM groups: IQ and language measures at year 1.

	Normal Group			LI Group		
	non-OM mean *(sd)*	OM mean *(sd)*	*t*-value*	non-OM mean (sd)	OM *(*mean *(sd)*	*t*-value*
Leiter IQ	111.8 (7.9)	110.0 (7.6)	0.65	109.5 (12.2)	109.7 (11.5)	0.07
Language tests (raw)						
SICD-rec	90.2 (2.7)	92.7 (8.0)	0.91	80.6 (7.8)	80.9 (6.2)	0.14
SICD-exp	108.9 (4.6)	108.3 (4.8)	0.02	91.4 (8.4)	90.4 (8.0)	0.40
NSST-rec	26.0 (3.4)	24.9 (3.9)	0.87	18.4 (5.5)	19.6 (5.3)	0.76
NSST-exp	24.6 (3.6)	24.1 (4.5)	0.35	5.7 (6.4)	5.0 (5.5)	0.36
CELI	56.7 (14.2)	56.8 (10.1)	0.03	4.7 (10.0)	1.9 (6.7)	1.32
Token	36.1 (11.6)	34.9 (13.9)	0.28	12.5 (11.4)	13.4 (10.1)	0.26

* All *t*-values ns, $p>0.05$.

Results

In the first stage of analysis OM and non-OM children were compared on demographic variables and prenatal and postnatal risk factors, as well as on IQ and language performance. Separate analyses were performed for LI and normal children. For continuously distributed variables, *t*-tests were used to compare groups (see Tables 2 and 3). These analyses indicated that, for both the LI and normal groups, OM and non-OM children did not differ significantly on any variable. For categorical variables (see Table 4) chi-square tests were used to test for differences in distribution between OM and non-OM children (both groups combined). Results showed no significant difference for sex ($x^2 = 0.025$) or for presence of an affected parent ($x^2 = 0.003$).

For all subsequent analyses, two subsets of non-OM children were used to provide a closer match between groups. These subsets were matched to the OM groups for sex, SES, prenatal and postnatal risk factors, and presence of an affected parent. There were also no significant differences between groups on age or IQ (see Tables 5 and 6).

Table 4. Frequency of categorical variables: all subjects.

	non-OM	OM
Sex (male/female)	80/46	15/8
Affected parent (yes/no)*	56/60	10/11

* Data missing for several subjects

Also, only children who remained in the study for all five years were used. Thus there were four groups: (1) LI children with OM (N=11); (2) LI children without OM (N=11); (3) normal children with OM (N=8); and (4) normal children without OM (N=8).

Each dependent variable, except for the academic measures, was analyzed using a 2 (group) by 2 (OM status) by N (year) analysis of variance, with repeated measures on year, which had either 2 or 3 levels depending on the dependent variable. Measures of academic performance were analyzed using a 2 (group) by 2 (OM-status) analysis of variance. For each variable, mean values (averaged across all years) are presented in Table 7; *F*-values and significance levels for main effects and interactions are presented in Tables 8 and

Table 5. Comparison of matched OM and non-OM groups.

	Normal Group			LI Group		
	non-OM mean *(sd)*	OM mean *(sd)*	*t*-value*	non-OM mean *(sd)*	OM mean *(sd)*	*t*-value*
SES	2.56 (0.75)	2.79 (0.56)	0.56	2.95 (1.06)	2.95 (1.51)	0.00
Prenatal	2.86 (1.68)	2.86 (2.04)	0.00	4.18 (3.34)	4.18 (2.56)	0.00
Postnatal	4.25 (2.12)	4.17 (2.99)	0.06	5.27 (2.65)	5.27 (2.72)	0.00
Age	4.54 (0.26)	4.33 (0.30)	1.47	4.17 (0.20)	4.25 (0.28)	0.72
Leiter IQ	115.00 (5.70)	109.5 (7.90)	1.59	113.90 (14.80)	107.10 (10.90)	1.23

* All *t*-values ns, $p>0.05$.

Table 6. Frequency of categorical variables: matched groups.

	non-OM	OM
Sex (male/female)	12/7	12/7
Affected parent (yes/no)*	9/9	9/8

* Data missing for 3 subjects

9. Since the focus of the present study is on the effects of chronic OM, effects not involving the OM factor will not be discussed in detail. Generally, the main effects for group indicated that the normal children performed better than the LI children, while the main effects for year indicated improvement across time for both groups. For some variables there was a group by year interaction, indicating a different rate of improvement for LI and normal children.

For the OM factor, only three variables showed a significant main effect or interaction. On the paired associate test, although there was no main effect for OM-status, there was a significant OM-status by group interaction ($F=3.68$, $p<0.05$). For the LI group, OM children performed substantially less well on this task than non-OM children; for the normal group, the differences, while in the same direction, were less marked. On the academic test of writing nonsense words, there was also a significant group by OM-status interaction ($F=7.47$, $p<0.01$), although again the main effect for OM-status was not significant. For the LI group, non-OM children performed better than OM children, while for the normal group, OM children performed better than non-OM children. On the test of decoding skills, there was a main effect for OM-status ($F=7.22$, $p<0.01$) and a significant group by OM-status interaction ($F=7.71$, $p<0.01$) indicating that for the normal group, OM children performed better than the non-OM children, while for the LI group, there was no difference between OM and non-OM children. These results for the normal group are difficult to interpret. It would not be predicted under any current model that normal OM children would perform better than normal non-OM children. Due to the number of variables analyzed and small group size, these results may reflect a Type I statistical error.

Discussion

The results of this study indicated that there were very few differences between children with a history of chronic OM, as defined for this study, and children without a history of OM on a wide range of perceptual, motor, cognitive, linguistic, academic, social-emotional, and demographic variables. The only significant main effect for OM status occurred on one academic measure, on which normal OM children actually performed better than their non-OM counterparts. For the LI group there were no significant differences related to OM status.

These results do not support the hypothesis that OM, *per se,* is a primary etiological factor in the development of language disorders. If this hypothesis were true, then it would be predicted that (1) normal OM children, compared to non-OM children, should show some deficits, even if not classified as specifically LI; and (2) OM-LI children might show different performance profiles than non-OM LI children, who presumably have a different etiological basis. The second prediction must be qualified, however, since it is possible for similar group performance profiles to result from different etiological factors. For example, with respect to OM, this might be the case if non-OM LI children suffer from specific auditory perceptual deficits, as has been posited by Tallal (Tallal, 1980b; Tallal, Stark, & Mellits, 1985a; Tallal, Stark, & Mellits, 1985b) who found that auditory perceptual deficits closely predict the pattern and extent of speech perception and language comprehension deficits in LI children. It is possible that the effects of such perceptual deficits on language learning may not be significantly differ-

Table 7. Mean values for dependent variables.

	Normal Group		LI Group	
	non-OM mean *(sd)*	OM mean *(sd)**	non-OM mean *(sd)*	OM mean *(sd)*
Perceptual tests (%):				
Nonverbal visual	64.2 (7.4)	63.5 (6.5)	45.5 (9.1)	42.8 (11.4)
Nonverbal auditory	60.2 (16.8)	65.8 (13.3)	43.9 (20.2)	41.5 (14.6)
Auditory memory	24.3 (9.9)	24.5 (12.1)	13.1 (10.4)	11.0 (9.6)
GFW	96.4 (3.1)	98.0 (1.7)	88.8 (6.9)	88.5 (5.4)
Ba-da discrimination	50.0 (21.2)	56.4 (17.8)	38.3 (23.7)	30.4 (21.0)
Motor tests (%):				
Nonverbal	44.7 (7.8)	44.9 (6.0)	35.4 (6.8)	32.9 (10.0)
Verbal	54.3 (5.5)	51.4 (10.3)	40.1 (7.9)	35.5 (8.9)
Cognitive tests:				
Leiter IQ	111.0 (7.5)	111.5 (7.1)	109.4 (12.1)	102.8 (12.4)
Paired associate (raw)	4.4 (1.6)	3.6 (2.2)	3.8 (1.8)	2.5 (1.5)
Seriation (raw)	4.4 (0.4)	4.5 (0.8)	3.6 (1.3)	3.2 (1.3)
Language tests:				
AAPS (%)	97.7 (2.3)	96.9 (2.8)	89.9 (5.9)	88.8 (8.6)
Morphology (%)	70.8 (8.5)	71.2 (10.3)	39.5 (12.3)	40.0 (15.1)
Syntax (%)	65.2 (6.8)	67.2 (7.8)	45.1 (8.3)	44.6 (12.4)
Semantics (%)	77.9 (6.7)	79.6 (6.9)	55.4 (8.1)	55.0 (13.1)
ELA (years)	7.2 (0.6)	7.3 (0.6)	5.7 (0.7)	5.5 (0.7)
RLA (years)	6.9 (0.8)	6.9 (1.0)	5.4 (0.9)	5.5 (0.9)
LA (years)	7.0 (0.7)	7.1 (0.8)	5.5 (0.7)	5.5 (0.8)
Behavioral tests:				
CBCL (raw)	14.5 (8.9	23.8 (15.9)	36.0 (22.9)	35.6 (13.9)
Academic tests (raw scores):				
Reading vocabulary	102.4 (41.9)	112.1 (59.5)	55.0 (38.0)	59.8 (42.2)
Reading comprehension	70.3 (34.9)	75.5 (54.4)	26.4 (22.6)	30.3 (22.2)
Decoding	3.0 (2.4)	12.3 (7.3)	5.5 (3.0)	5.3 (4.8)
Spelling	97.9 (56.1)	87.8 (61.9)	52.1 (54.6)	49.0 (43.3)
Nonsense words	7.7 (7.6)	10.3 (6.7)	5.8 (4.3)	2.3 (2.1)
Math	57.5 (30.5)	63.0 (35.3)	44.0 (26.1)	32.3 (26.5)

ent from those that may result from the transient hearing impairments caused by OM, although the mechanism of disruption would be different in the two cases. Thus the present study cannot rule out the possibility of different etiological mechanisms resulting in quite similar patterns of cognitive, language, and learning profiles.

The present study has statistical limitations which must be borne in mind in interpreting the results. Because of the large number of comparisons, there is an increased risk of a Type I statistical error, that is, of finding statistically significant results on the basis of chance. However, because only one of the comparisons on the OM factor reached statistical significance, Type I errors are not a problem in this study. Given the small sample sizes used in the present study, there is also an increased risk of a Type II statistical error, that is, of failing to find a statistically significant effect because of limitations of statistical power. This is a more

Table 8. F-values for main effects and interactions for dependent variables.

	Group	OM-status	Year	G*OM	G*Y	OM*Y	G*OM*Y
Perceptual tests:							
Nonverbal visual	43.53***	0.34	162.33***	0.12	3.99*	0.50	0.07
Nonverbal auditory	13.78***	0.09	59.18***	0.53	0.79	0.41	0.47
Auditory memory	12.91***	0.07	74.02***	0.12	5.25**	0.56	0.07
GFW	27.04***	0.16	45.69***	0.34	8.50***	0.86	0.28
Ba/da discrimination	7.25*	0.01	11.23***	1.05	0.88	0.09	0.60
Motor tests:							
Nonverbal	16.52***	0.19	171.77***	0.26	1.15	0.19	2.01
Verbal	30.14***	1.91	132.96***	0.10	2.94	0.92	0.92
Cognitive tests:							
Leiter IQ	2.12	0.73	8.14**	0.99	1.20	0.95	0.72
Paired Associate	2.12	3.19	104.17***	3.68*	0.21	0.39	1.03
Seriation	8.51**	0.16	133.57***	0.27	0.47	0.46	0.96
Language tests:							
AAPS	16.66***	0.25	54.33***	0.01	19.53***	0.03	0.51
Morphology	60.64***	0.01	138.73***	0.00	4.55*	0.17	0.02
Syntax	48.39***	0.06	199.74***	0.17	0.04	0.17	0.39
Semantics	57.79***	0.05	148.05***	0.12	1.83	0.27	0.02
ELA	57.43***	0.01	827.64***	0.68	0.01	0.34	1.07
RLA	24.10***	0.04	390.32***	0.13	0.35	0.63	1.63
LA	41.45***	0.01	742.90***	0.03	0.18	0.43	0.31
Behavioral tests:							
CBCL	8.78**	0.63	0.23	0.74	0.77	0.00	0.03

* $p<0.05$ ** $p<0.01$ *** $p<0.005$

serious problem in the present study because we are reporting an absence of differences between OM and non-OM groups. However, two considerations argue against the occurrence of Type II errors in this study. First, examination of the mean values in Table 7 indicates that for most variables the mean values for the OM and non-OM groups are very close. Thus, the failure to find statistically significant differences does not simply reflect a lack of statistical power. Second, the direction of differences in mean values is almost as likely to favor the OM group as the non-OM group, again suggesting a lack of effect of OM *per se* on performance.

The data reported in this study are based entirely on retrospective parental report of chronic OM. Thus, there are several limitations intrinsic to these data. For the children in the OM groups important information about age at onset,

Table 9. F-values for main effects and interactions for academic measures.

	Group	OM status	G*OM
Academic tests:			
Reading vocabulary	2.76	0.95	0.13
Reading comprehension	5.62*	0.32	0.00
Decoding	1.80	7.22*	7.71**
Spelling	0.91	0.02	0.08
Nonsense words	2.52	0.10	7.47**
Math	0.63	0.05	1.25

* $p<0.05$ ** $p<0.01$ *** $p<0.005$

age at each occurrence, days of treatment, duration of episodes, and follow-up findings were not available. Similarly, data pertaining to otoscopy, immittance (confirming the presence/absence of fluid in the middle ear) and, most importantly, hearing at the time of an episode of OM were not available. Thus, there is no way to determine which of the children experienced hearing loss accompanying the OM episodes and to what degree and duration the hearing threshold was elevated. For the children in the non-OM groups it is not possible to rule out "silent" or asymptomatic episodes of OM, which are known to occur in young children (Roland, Finitzo, Friel-Patti, Brown, Stephens, Brown, & Coleman, 1989). These are critical limitations to the use of retrospective parental report data that must be kept firmly in mind when interpreting the data presented here. As such, these data should be considered preliminary.

Despite these limitations, the results of the present study lend little support to the hypothesis that OM is a primary cause of language disorders in children. Nevertheless, it is suggested that these results be interpreted with caution until further studies comparing LI and normal children with or without chronic OM can be conducted, using larger sample sizes, a prospective design, and appropriate measures of hearing status.

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