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Racial and Ethnic Differences in Receipt of Pressure Equalization Tubes among US Children, 2014

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Abstract

Objectives—Pressure equalization tube (PET) placement (also referred to as tympanostomy tube placement) is among the most common ambulatory surgical procedures performed on U.S. children. Over twenty years ago, differences by race/ethnicity in the national prevalence of having had PETs placed were documented. Whether these differences persist is unknown.

Methods—We used data from the 2014 National Health Interview Survey to examine the percentage of children 0-17 years of age that have ever undergone PET placement. Unadjusted logistic regression with predictive margins was used to assess the relationship between having received PETs and race/ethnicity, as well as other clinical, socioeconomic, and geographic factors. Multivariable logistic regression was used to determine whether other factors could account for any observed differences by race/ethnicity.

Results—Overall, 8.9% of children 0 to 17 years of age had undergone PET surgery. By race/ethnicity, 12.6% of non-Hispanic white children received PETs, which was significantly greater than the 4.8% of non-Hispanic black, 4.4% of Hispanic, and 5.6% of non-Hispanic other/multiple race children that had this surgery ($p < 0.001$ for all comparisons). In multivariable analysis, the

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adjusted prevalence for non-Hispanic white children (10.8%) was greater than for non-Hispanic black (5.4%) and Hispanic (5.8%) children ($p < 0.001$ for both comparisons).

Conclusion—Nearly 9% of U.S. children have had PETs placed. Non-Hispanic white children still have a greater prevalence of PET placement compared with non-Hispanic black and Hispanic children. These differences could not be fully explained by other demographic, clinical, socioeconomic, or geographic differences between racial/ethnic groups.

Keywords

pressure-equalizing tubes; tympanostomy tubes; ventilation tubes; grommets; disparities

Introduction

Surgical placement of pressure equalization tubes (PETs), also referred to as tympanostomy tubes, has long been a focus of the pediatric health utilization literature. PET placement is among the most common ambulatory surgical procedures conducted with general anesthesia on children in the United States.^{1, 2} The two main indications for PETs are recurrent acute otitis media (RAOM) and chronic otitis media with effusion (COME). Clinical practice guidelines have been formulated to help practitioners determine when PET placement is warranted.³⁻⁵ Notably, the clinical practice guideline on treatment of acute otitis media in children issued in 2013 by the American Academy of Pediatrics was the first guideline to recommend PET placement as one option for treatment of some children with RAOM.⁴ This recommendation was further clarified in subsequent clinical practice guidelines that specifically focused on PETs by the American Academy of Otolaryngology—Head and Neck Surgery.⁵

There has been considerable concern about overuse of PET placement in the U.S.,⁶ and pediatricians and surgeons have not consistently complied with guidelines that outline acceptable indications for PET surgery.⁷⁻⁹ More than 20 years ago, two nationally representative studies establishing the rates of PET placement were published,^{10, 11} both finding white children to have greater rates of PETs compared to non-white children. Either an overuse among white children or inadequate adherence to guidelines for non-white children, may be in part responsible for observed differences in prevalence of PETs by racial/ethnic groups. However, since those studies, there have been important changes in the healthcare landscape surrounding PET tube placement, including changes in their utilization due to pneumococcal vaccination,¹²⁻¹⁵ changes in children's health insurance coverage over the intervening time period,^{16, 17} increased focus on disparities in healthcare,^{18, 19} the release of relevant clinical practice guidelines,³⁻⁵ and new science concerning their use.²⁰⁻²³ Given these myriad changes, the current overall prevalence of PET surgery in the US, as well as whether differences by race/ethnicity still persist, is unknown.

In this study, we examined the prevalence of having undergone PET placement among U.S. children and determined whether any racial/ethnic differences in the prevalence of PET surgery still exist. Also, if differences by race/ethnicity in the prevalence of PETs were observed, we investigated whether demographic characteristics, socioeconomic factors, clinical factors, or geographic differences might have explained these differences.

Methods

Data Source—This study analyzed data from the 2014 National Health Interview Survey (NHIS), a cross-sectional, multistage, in-person, population health survey representative of the U.S. civilian, non-institutionalized population which is conducted continuously throughout each calendar year by the National Center for Health Statistics (NCHS).²⁴ The data for this study were largely obtained from the survey's Sample Child component (n=13,380). Race/ethnicity and insurance were obtained from the survey's household and family core components, respectively. Within each participating family, one child 0-17 years of age (the “sample child”) was randomly selected, and health-related information was obtained from a parent or other knowledgeable adult within the household. The data on PETs were from a 2014 hearing supplement, developed and implemented with collaboration and funding from the National Institutes of Health's National Institute on Deafness and Other Communication Disorders. The final or unconditional response rate for the 2014 sample child file was 66.6%.²⁴ Final, or unconditional, response rates take into account both sample child and family level participation rates.²⁵ County-level data from the NCHS urban-rural data categorization²⁶ (see below) and the 2013-2014 Area Resource File²⁷ were used to characterize the counties from which respondents came. These county-specific data are available from restricted-use NCHS files which can only be accessed in the NCHS Research Data Center. The NHIS data collection has been approved by the NCHS Ethics Review Board. No further review was required for this data analysis.

Outcome Variables

The main outcome variable of interest was receipt of PETs, based on responding positively when asked “Did [the child] ever have a tube placed in one or both ears to drain fluid from the ear(s)?” Also of interest was the age at which the child first had PET placement based on response when asked “At what age did [the child] FIRST have an ear tube placed in one or both ears to drain fluid from the ear(s)?” Response categories in the survey for this question were: <6 months, 6-11 months, 12-17 months, 18-23 months, 2-3 years, 4-5 years, 6-8 years, and 9 or more years.

Main independent variable

The main independent variable was race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic other/multiple race, Hispanic). Hispanic origin includes people of any race. Children categorized as non-Hispanic white and non-Hispanic black included those for whom the respondent identified these respective race groups as the single best group that described the race of the child and no other race group was identified. Respondents who identified multiple race groups, or other race groupings (American Indian/Alaska Native, Asian, and Native Hawaiian and Other Pacific Islander) to describe the race of the child were included in the non-Hispanic other/multiple race category. Race responses of “other race” and unspecified multiple race were treated as missing, and then race was imputed by NCHS if these were the only race responses.²⁸ Imputation by NCHS was conducted using a two-stage, hot-deck, single imputation.²⁸ Further information on this imputation can be found online in Appendix 1.

Covariates

Covariates explored included demographic characteristics, socioeconomic indicators, clinical factors, and geographic variables. Demographic characteristics (in addition to race/ethnicity) included sex and current age of child at the time of the survey. Indicators of socioeconomic status included highest level of education in the family, insurance status, and the ratio of family income to federal poverty level (FPL).²⁵ Clinical factors included respondent-reported child's health status, current child's asthma status, age at which the child first had an earache or ear infection, and whether the child has had three or more ear infections in the past 12 months. Geographic variables included U.S. census region, NCHS urban-rural status codes,²⁶ and the number of children (<19 years of age) per practicing otolaryngologist in the county.²⁷ Detailed categorizations and definitions of all covariates are available online in Appendix 1.

Analysis

The proportion of all children 0-17 years who have undergone PET placement surgery was calculated. Among those that had PET surgery, the age at which they first received PETs was identified. Some younger children in the survey may not yet have undergone PET placement, but may in the future. Only 5% of children in this study, however, received PETs at 6 years of age or older. Therefore, to estimate the percentage of children who will receive tubes during childhood, we examined the subgroup of children 6-17 years of age, nearly all of whom likely had already received PETs if they were going to receive them. Similarly, to estimate age distribution at which children are likely to receive PETs, we examined only those children 6-17 years of age.

The percentage of children that received PETs in each demographic, socioeconomic, clinical, and geographic category was calculated, and survey-weighted unadjusted logistic regression with PET placement vs. no PET placement as the dependent variable was used to determine significant differences compared to reference categories within each variable. All independent variables were found to be significant in unadjusted logistic regression ($F < 0.01$ for all variables) and, hence, all independent variables were entered into multivariable analysis. Survey-weighted multivariable logistic regression with predictive margins was conducted using PET placement vs. no PET placement as the dependent variable and race/ethnicity as the main independent variable of interest. For simplicity, results from multivariable models are presented as adjusted percentages. All analyses used sample weights to create nationally representative estimates and accounted for the complex sample design of the survey. Sample weights are adjusted for non-response and post-stratified by age/sex/race/ethnicity classes based on population estimates produced by the U.S. Census Bureau. Several sensitivity analyses were considered, methodological details of which can be found in Appendix 1 and results of which can be seen in Appendix 2 and Appendix Table 1.

Missing Data—Of the 13,380 children in the 2014 sample child file, 54 (0.4%) were missing information on whether they had ever had PET placement. There were no missing data for age, sex, region, urban-rural status, and children per otolaryngologist in the county. Race/ethnicity was missing 11.5%, but singly-imputed values provided in the NHIS were

used for all analyses.²⁸ Income-to-poverty ratio was missing 16.3% in the sample child file, but multiply imputed values from NCHS were used in all analyses.²⁹ Age at first ear infection was missing 730 observations (5.5%). All other variables were missing less than 1% of observations. The final analytic sample for children 0-17 included 12,530 observations (excluded were 6.4% of full sample with missing values). The final analytic sample for children 6-17 included 8,246 children (excluded were 8.2% of full sample with missing values).

Results

Overall, 8.9% of children 0 to 17 years of age (n= 1,020) had undergone PET surgery (Table 1). Restricting the sample to children 6-17 years of age, 10.5% (n=795) had received PETs. Among children 0-17 years of age that had received PETs, 19.5% had their first PET surgery between 6 and 11 months of age, 21.8% between 12-18 months, and 26.8% between 2 and 3 years. This distribution was similar among children 6-17 years of age who had had PET placement.

In unadjusted analysis, 12.6% of non-Hispanic white children had undergone PET surgery, which was greater than the 4.8% of non-Hispanic black children, 5.6% of non-Hispanic other/multiple race children, and 4.4% of Hispanic children that had received PETs (p<0.001 for all comparisons) (Table 2). Also in unadjusted analysis, 2.5% of children 0-1 years of age (at the time of the survey) had undergone PET surgery, which was significantly lower than the 7.5% of children 2-5 years of age, 10.3% of children 6-11 years of age, and 10.7% of children 12-17 years of age. By sex, 9.9% of boys had undergone PET surgery, which was significantly greater than the 7.8% of girls that had undergone PET surgery.

Children in families where the highest level of education was a high school degree/GED (6.5%) and where the highest level of education was less than a high school degree (5.0%) were less likely to have received PET surgery than those in families where the highest level of education was more than a college degree (10.2%). About 6.8% of children with Medicaid/SCHIP/other state program insurance and 6.4% of children who were uninsured had received PET surgery which was lower than the percentage among children with any private insurance (10.6%) and children in families at <100% of FPL (6.4%) and those in families at 100 - <200% of FPL (6.7%) were significantly less likely to have received PET than children in families at >400% of FPL (11.5%).

Children with fair or poor health (16.8%) were significantly more likely to have received PET surgery than those in excellent or very good health (8.6%). Children with current asthma (15.0%) were significantly more likely to have received PET than those without current asthma (8.3%). Children that had their first ear infection or earache at <6 months of age (28.4%) were significantly more likely to have received PET surgery than those who had their first ear infection/earache at 6-11 months (17.4%), 12-17 months (10.4%), 18-23 months (9.1%), 2-3 years (7.1%), 4-5 years (8.5%), 6-8 years (3.0%), and 9 years (3.3%), as well as children that have never had an ear infection or earache (0.9%). Children that had 3 or more ear infections in the past 12 months (29.8%) were significantly more likely to have received PET than those who had not (7.8%).

Children living in the Midwest (11.1%) or the South (10.3%) were significantly more likely than children in the Northeast (7.1%) to have undergone PET placement. Children living in a large central-metro area (5.7%) were less likely to have received PET placement than those living in large fringe-metro (9.3%), medium and small metro (10.3%), and micropolitan and non-core (12.1%) areas. Children in counties in the lowest decile of children per practicing otolaryngologist in the county (<3,684 children per practicing otolaryngologist) (8.0%) were significantly less likely to have received PET placement than children in counties with no practicing otolaryngologists (12.9%).

After adjustment for all covariates, race/ethnicity was still a significant predictor of PET surgery. After adjustment, 10.8% of non-Hispanic white children had received PET placement, which was significantly greater than the 5.4% of non-Hispanic black children ($p<0.001$), 7.1% of non-Hispanic other/multiple race children ($p<0.01$), and 5.8% of Hispanic children that had received PETs ($p<0.001$) (Table 3).

Among demographic characteristics, age and sex remained significant in multivariable models (Table 3). All socioeconomic status indicators (insurance, income to poverty ratio, highest level of family education) lost significance in multivariable analysis (data not shown). All clinical factors (age of first ear infection or earache, having had three or more ear infections within the past 12 months, and health status) remained significant in multivariable models, with the exception of asthma status. In sensitivity analysis that included only U.S. Census region among geographic variables, 7.3% of children in the Northeast had PET placement, which was significantly smaller than the 9.2% of children in the Midwest ($p<0.05$) and 10.4% of children in the South ($p<0.01$), but not significantly different than the 6.7% of children in the West, that had received PET placement.

Discussion

This study is the first to assess national prevalence of PET surgery in over two decades. Overall, 8.9% of U.S. children have undergone PET surgery, suggesting many children will undergo this procedure requiring general anesthesia. However, differences by race/ethnicity still persist with non-Hispanic white children having 2.6 times (95% confidence interval [CI]: 1.9-3.4) the prevalence of having received PETs compared to non-Hispanic black children and 2.8 times (CI: 2.2-3.5) the prevalence of having received PETs compared to Hispanic children. These differences could not be explained by other demographic factors, sociodemographic factors (including income and insurance), clinical factors, or geographic factors (including physician supply) available in these data.

The reason for these differences are unclear, as they could be due to unmeasured clinical factors, genetic predisposition, access to both general pediatric and specialty care, cultural preferences, patient choice, or individual care provided. Some emerging evidence suggests that, among children receiving PET placement, white children may be more likely to receive PET placement for RAO, while black children were more likely to receive PET placement for COME.³⁰ However, until 2013, PET placement was not suggested in guidelines for the treatment of AOM prior to 2013.^{4, 31} Most children who received PET placement in this study would have had placement prior to 2013. Prior to 2013, reviews of the literature

disagreed on whether enough evidence existed to conclude that that PET placement reduced episodes of AOM during the first six months after placement,²⁰⁻²² but all agreed that there was not evidence to make conclusions about impact after six months. Together, the findings of higher rates of PET in white children from this study, that white children are more likely to receive PET for RAOM, and varying conclusions in the literature and guidelines about the use of PET placement for RAOM may suggest overuse of PET in white children, although further research would be needed to make this conclusion with certainty. Nonetheless, this would be consistent with the findings of a 2012 symposium on overuse in medicine organized by The Joint Commission and the American Medical Association noted that there was “indirect evidence in the literature that tympanostomy tubes may be overused for isolated brief otitis media with effusion (OME) and infrequent acute otitis media (AOM) in otherwise healthy children”.⁶ Nonetheless, although the data can provide population prevalence of PET surgery, they cannot directly tell us about unmet need for tubes, or appropriateness of PET surgery.

Direct comparisons with earlier studies of the national prevalence of PET utilization are challenging. Studies by Bright et. al,¹¹ and Kogan, et. al.¹⁰ that used data from 1988 and 1991 respectively, cannot be directly compared to our analysis due to differences in methodology and age groups examined (see Online Appendix 3 for details). Nonetheless, although neither prior study can be directly compared to our analysis, both demonstrate that differences between race/ethnicity groups are not new. Our study suggests that these differences still exist: non-Hispanic white children have PET surgery more commonly than other racial or ethnic groups.

Kogan, et. al. found that insurance status, but neither income nor maternal education, was related to PET placement in both unadjusted and adjusted analyses.¹⁰ In our study, we found insurance status, income, and highest level of education in family to be related in unadjusted analysis, but largely not in multivariable analysis. To further explore this, we considered three additional multivariable models, each examining the relationship between PET placement and a single socioeconomic indicator (insurance, highest level of education in family, income to poverty ratio), and adding only race/ethnicity as an additional independent variable. None of these models showed a significant effect for the socioeconomic indicator included ($F > 0.05$ for each), although race/ethnicity remained significant in each. This finding suggests that race/ethnicity may be the driving factor behind the unadjusted relationships observed with these socioeconomic indicators.

This study has limitations. First, the data have limited clinical information and do not, for example, allow one to identify the clinical indication for PET placement (COME vs. RAOM), which might have shown important differences between groups. Also, some comorbidities that may be relevant as risk factors for PET (for example, cleft palate) or factors that are related to acute otitis media (for example, breastfeeding and participation in daycare³²) are not identified in the NHIS or have high rates of missing data (for example, birth weight). Also, immunization status is not included in the survey, although our sensitivity analysis of children <6 years of age (see online Appendices) would have placed nearly all these children in the time period after licensing of the 13-valent pneumococcal vaccine. In general, results were similar for this analysis as described above. Recall bias may

be problematic as well, as discussed above. Also, our variable of having had three or more ear infections in the last 12 months represents the 12 months before the survey, and does not necessarily include the period prior to PET placement, which would have been more useful for the analysis.

Conclusion

Overall, nearly 1 in 11 children in the U.S. have undergone PET surgery. Differences in receipt of this common surgical procedure persist by child race and ethnicity, with non-Hispanic white children having more than 2.5 times the prevalence of having had PET surgery compared with non-Hispanic black and Hispanic children. These differences could not be fully explained by clinical, socioeconomic, or geographic differences between racial/ethnic groups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

COME	Chronic otitis media with effusion
CI	Confidence Interval
NCHS	National Center for Health Statistics
NHIS	National Health Interview Survey
NMIHS	National Maternal and Infant Health Survey
PET	Pressure equalization tubes
RAOM	Recurrent acute otitis media
SE	Standard Error
U.S.	United States

What's new

The current epidemiology of pressure equalization tube placement is unknown. Overall, nearly 9% of U.S. children have had pressure equalization tubes placed. Non-Hispanic white children have a greater prevalence of tube placement compared with non-Hispanic black and Hispanic children.

Table 1
Percent of U.S. children who have undergone pressure equalization tube placement and percent distribution of age of U.S. children at first placement of pressure equalization tubes for children 0-17 years of age and children 6-17 years of age

	Children 0-17 years of age, % (SE)	Children 6-17 years of age, % (SE)
Percent who have received pressure equalization tubes	8.9 (0.4)	10.5 (0.5)
Age at which pressure equalization tubes were first received		
<6 months	4.5 (0.8)	4.0 (0.7)
6-11 months	19.5 (1.7)	18.8 (2.0)
12-17 months	21.8 (2.1)	19.5 (2.3)
18-23 months	10.9 (1.3)	10.4 (1.2)
2-3 years	26.8 (2.0)	27.5 (2.1)
4-5 years	11.6 (1.4)	13.5 (1.8)
6-8 years	3.8 (0.8)	4.9 (1.0)
9+ years	1.2 (0.4)	1.5 (0.5)

Table 2
Unadjusted percentage of U.S. children 0-17 years of age having undergone pressure equalization tube placement, by clinical, socioeconomic, and geographic characteristics

Socioeconomic and Demographic Characteristics	% of children having received pressure equalization tubes (SE)
Total	8.9 (0.4)
Demographic characteristics	
Race/Ethnicity	
Non-Hispanic white (ref)	12.6 (0.6)
Non-Hispanic black	4.8 (0.7) †††
Non-Hispanic other/multiple race	5.6 (0.8) †††
Hispanic	4.4 (0.5) †††
Age	
0-1 years (ref)	2.5 (0.7)
2-5 years	7.5 (0.7) †††
6-11 years	10.3 (0.7) †††
12-17 years	10.7 (0.7) †††
Sex	
Male (ref)	9.9 (0.5)
Female	7.8 (0.5) ††
Socioeconomic Indicators	
Highest level of education in family	
Greater than college (ref)	10.2 (1.0)
College degree	10.2 (0.8)
Some college/associates degree/technical school	9.9 (0.7)
High school degree/GED	6.5 (0.8) ††
Less than high school degree	5.0 (0.7) †††
Insurance	
Any private insurance (ref)	10.6 (0.6)
Public insurance only	6.8 (0.5) †††
Other insurance	8.5 (2.0)
Uninsured	6.4 (1.4) †
Poverty status (ratio of family income to FPL)	
>400% (ref)	11.5 (0.8)
200% - 400%	10.2 (0.8)
100- <200%	6.7 (0.6) †††
<100%	6.4 (0.6) †††
Clinical factors	

Socioeconomic and Demographic Characteristics	% of children having received pressure equalization tubes (SE)
Health Status	
Excellent or very good (ref)	8.6 (0.4)
Good	10.0 (1.0)
Fair or poor	16.8 (3.4) ^{††}
Current asthma	
No	8.3 (0.4)
Yes	15.0 (1.6) ^{†††}
Age at first ear infection or earache	
<6 months (ref)	28.4 (1.7)
6-11 months	17.4 (1.2) ^{†††}
12-17 months	10.4 (1.3) ^{†††}
18-23 months	9.1 (1.9) ^{†††}
2-3 years	7.1 (1.0) ^{†††}
4-5 years	8.5 (2.1) ^{†††}
6-8 years	3.0 (1.2) [*] ^{†††}
9 years	3.3(1.1) [*] ^{†††}
never	0.9 (0.2) ^{†††}
3 or more ear infections in past 12 months	
No	7.8 (0.4)
Yes	29.8 (2.6) ^{†††}
Geographic factors	
U.S. Census Region	
Northeast (ref)	7.1 (0.8)
Midwest	11.1 (0.9) ^{††}
South	10.3 (0.7) ^{††}
West	5.5 (0.4)
Urban-Rural Status	
Large central-metro (ref)	5.7 (0.5)
Large fringe-metro	9.3 (0.8) ^{†††}
Medium and small metro	10.3 (0.6) ^{†††}
Micropolitan and non-core	12.1 (1.3) ^{†††}
Children per practicing otolaryngologist in county ^{**}	
<3,684 (0-10%) (ref)	8.0 (1.1)
3,684-5,714 (11-20%)	8.4 (1.2)
>5,714-7,484 (21-40%)	7.2 (0.7)
>7,484—10,785 (41-60%)	8.3 (0.7)

Socioeconomic and Demographic Characteristics	% of children having received pressure equalization tubes (SE)
>10, 785-20,338 (61-80%)	9.0 (0.8)
>20,338-107,511 (81-86%)	9.2 (1.6)
No otolaryngologists in county (>86 –100%)	12.9 (1.2) ^{††}

[†] p<0.05 compared to reference

^{††} p<0.01 compared to reference

^{†††} p<0.001 compared to reference

* data are not statistically reliable due to less than 30 observations having received pressure equalization tubes or relative standard error >30%.

** See online appendix for details of categorization of children per otolaryngologist in county. Percents presented reflect the percent of the distribution of children in the sample.

Table 3
Adjusted percentages of children having undergone pressure equalization tube placement,
by clinical variables and race/ethnicity

	Adjusted percent* of having received pressure equalization tubes (SE)
Total	8.9 (0.3)
Demographic characteristics	
Race/Ethnicity	
Non-Hispanic white (ref)	10.8 (0.5)
Non-Hispanic black	5.4 (0.8) ^{†††}
Non-Hispanic other/multiple race	7.2 (1.0) ^{††}
Hispanic	5.8 (0.7) ^{†††}
Age	
0-1 years (ref)	2.8 (0.7)
2-5 years	6.9 (0.6) ^{††}
6-11 years	10.3 (0.6) ^{†††}
12-17 years	10.4 (0.6) ^{†††}
Sex	
Male (ref)	9.7 (0.5)
Female	8.0 (0.5) [†]
Clinical factors	
Health Status	
Excellent or very good (ref)	8.6 (0.4)
Good	9.8 (0.9)
Fair or poor	16.0 (3.0) ^{††}
Current asthma	
No	8.7 (0.3)
Yes	10.3 (1.0)
Age at first ear infection or earache	
<6 months (ref)	24.0 (1.4)
6-11 months	14.5 (1.0) ^{†††}
12-17 months	9.4 (1.1) ^{†††}
18-23 months	8.7 (1.8) ^{†††}
2-3 years	6.4 (0.9) ^{†††}
4-5 years	7.4 (1.8) ^{†††}
6-8 years	2.8 (1.1) ^{†††}
9 years	2.5 (0.9) ^{†††}
never	1.2 (0.2) ^{†††}

	Adjusted percent* of having received pressure equalization tubes (SE)
3 or more ear infections in past 12 months	
No	8.0 (0.3)
Yes	19.0 (1.7) ^{†††}

[†] p<0.05 compared to reference

^{††} p<0.01 compared to reference

^{†††} p<0.001 compared to reference

* results are adjusted for all other variables presented as well as current insurance status, highest level of education in the family, poverty status, U.S. census region, urban-rural status, and number of children per otolaryngologist in the county.