Demographic Disparities Among Children With Frequent Ear Infections in the United States

Kalpesh T. Vakharia, MD; Nina L. Shapiro, MD; Neil Bhattacharyya, MD

Objectives/Hypothesis: To evaluate current racial/ethnic and socioeconomic disparities in the prevalence of frequent ear infections (FEI) among children in the United States.

Study Design: Cross-sectional study.

Methods: The National Health Interview Survey (years 1997 to 2006) was utilized to evaluate children who were reported by their parent/guardian to have "3 or more ear infections during the past 12 months." Demographic variables evaluated included age, sex, race/ethnicity, income level, and insurance status. Multivariate analyses determined the influence of demographic variables on the prevalence of FEI in children.

Results: Among an annualized population of 72.6 million children (average age, 8.55 ± 0.19 years), 4.65 ± 0.07 million children ($6.6 \pm 0.1\%$) reported FEI. FEI was more commonly reported in white ($7.0 \pm 0.1\%$) and Hispanic ($6.2 \pm 0.2\%$) than in black ($5.0 \pm 0.2\%$) and other race/ethnic groups ($4.5 \pm 0.3\%$, $P < .001$). A larger portion of children in households below the poverty level reported FEI ($8.0 \pm 0.3\%$, $P < .001$). Of children with no health insurance $5.4 \pm 0.3\%$ had FEI. On multivariate analysis, black, Hispanic and other race/ethnic group had decreased odds ratio for FEI relative to white children (odds ratios: 0.63, 0.76, and 0.60, respectively, all $P < .001$). Income below poverty level also predicted FEI (odds ratio, 1.322, $P < .001$), whereas lack of insurance coverage did not ($P = .181$).

Conclusions: Despite increasing awareness, there are still notable racial/ethnic and socioeconomic disparities among children with FEI. Further efforts to eliminate these disparities and improve the care of children with FEI are needed.

Key Words: Otitis media, disparities, access to care, epidemiology.

Level of Evidence: 2c

Laryngoscope, 120:1667–1670, 2010

INTRODUCTION

Otitis media is one of the most common and burdensome ailments of childhood. Over 80% of children are diagnosed with at least one episode of acute otitis media by the age of 3 years with over one half of children being diagnosed before their first birthday.[1] In the United States an estimated 24.5 million office visits in 1990 were related to otitis media; the annual cost of medical and surgical treatment is estimated at between $3 billion and $5 billion.[2–4] Frequent acute otitis media is defined as ≥ 3 episodes of acute otitis media. Children suffering from frequent otitis media (frequent ear infections [FEI] in layman's terms) suffer greater disease burden and quality-of-life impact and might be candidates for surgical interventions for their frequent otitis media

There has been a change in the prevalence of numerous diseases over the decades including acute otitis media, with an increase in the prevalence of otitis media being reported in the 1980s and 1990s.[4,5] An understanding of the size and distribution of the population of children with FEI is important because it is often these patients who will require more invasive and costly treatments.

Ethnic and socioeconomic disparities exist among patients with numerous diseases, such as colorectal and cervical cancer, cardiovascular disease, and diabetes.[6–9] Various ethnic groups have been found to have less access to insurance coverage, preventive resources, and primary and specialty care.[7] The first step toward improving these disparities is recognition of the problem and its immensity. Only after recognition of the problem can healthcare providers, health policy makers, and
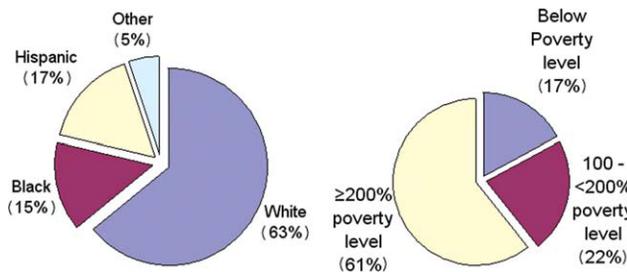
Fig. 1. (A) Ethnic/racial distribution of children in the population being evaluated. (B) Income distribution in the population being evaluated. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

Race/Ethnicity	Proportion of Children With FEI ± Standard Error (%)	Proportion of Children Without FEI ± Standard Error (%)
White	7.0 ± 0.1	93.0 ± 0.1
Black	5.0 ± 0.2	95.0 ± 0.2
Hispanic	6.2 ± 0.2	93.8 ± 0.2
Other	4.5 ± 0.3	95.5 ± 0.3

FEI = frequent ear infections.

governmental agencies target efforts toward improving the care of those patients who are identified to likely be in need of additional health resources. An awareness of the prevalence and distribution of children afflicted with FEI is especially important during the current state of healthcare reform and potential reallocation of healthcare funding. The National Health Interview Survey (NHIS) is a large-scale, household-based interview survey of a statistically representative sample of the US civilian, noninstitutionalized population that can provide epidemiological data on various diseases.[10,11] The objectives of this study were to determine the prevalence of FEI ($\geq$3 episodes/year) among US children over a 10-year period from 1997 to 2006 and to identify associated socioeconomic and race/ethnic characteristics of these children by utilizing this database.

MATERIALS AND METHODS

The NHIS data for the calendar years 1997 to 2006 (inclusive) sample were analyzed. This was a completely deidentified publicly available data set; therefore, institutional review board approval was not required. The data set was restricted to sampled children based on the child flag variable within the data set. For each child, demographic data and weighting variable data were extracted along with information for the disease condition: frequent ear infections (FEI, defined as 3 or more ear infections in the previous 12 months). The presence of FEI was determined based on the response to the question: "During the past 12 months, has your child had three or more ear infections?" Therefore, the FEI variable might aggregate and include cases of acute otitis media, otitis media with effusion, and otitis externa.

In addition to standard demographic information, data for race/ethnicity, income level, and insurance status were extracted. In the NHIS database race/ethnicity was classified as white, black/African-American, Hispanic, and other. Income level was characterized relative to the poverty level, which is determined by the US Census Bureau each year. Patients were divided into three groups: 1) income below poverty level, 2) income $\geq$100% but <200% of the poverty level for that year, or 3) income $\geq$200% of the poverty level. Insurance status was classified as a binary variable based on whether or not the child was covered by health insurance currently active at the time of the survey.

Standard demographic information was computed for the childhood population. Next, univariate analysis was conducted to determine the relationships between the presence or absence of FEI and race/ethnic status, income level, and insurance sta-

tus. Multivariate logistic regression was then conducted to determine the influence of these variables, as well as age and sex on the prevalence of FEI (dependent variable). Odds ratios were computed for significant variables. Statistical significance was set at $P < .05$.

RESULTS

The study population consisted of 7.26×10^7 children (annualized) with an average age of 8.55 ± 0.19 years; $51.1 \pm 0.2\%$ were male and $48.9 \pm 0.2\%$ were female. The population was composed of children of different race/ethnicities and income level as presented in Figure 1A and 1B. Overall, $6.3 \pm 0.1\%$ of children did not have current health insurance at the time of survey.

Annually, 4.65 ± 0.07 million children were reported to have FEI for a corresponding yearly prevalence of $6.6 \pm 0.1\%$ of children. With respect to sex, male children ($6.6 \pm 0.1\%$ of male children) were slightly more affected than female children ($6.3 \pm 0.1\%$ of female children) ($P = .026$). FEI was more commonly reported in white and Hispanic children than in black and other racial/ethnic groups (Table I) ($P < .001$).

Additionally, there were significant differences in the prevalence of FEI in children when stratified according to household income level ($P < .001$). A significantly larger proportion of children in households below the poverty level reported FEI compared to their counterparts in homes above the poverty level (Table II). In contrast, with respect to health insurance coverage, $5.4 \pm 0.3\%$ of those children with no health insurance at the time of survey reported FEI versus $6.4 \pm 0.1\%$ among those with active health insurance ($P = .001$).

After adjusting for demographics variables that were possibly associated with FEI, including age, sex, income level, and insurance status with multivariate

Income Level	Children With FEI ± Standard Error (%)	Children Without FEI ± Standard Error (%)
Below poverty level	8.0 ± 0.3	92 ± 0.3
100% – <200% poverty level	6.9 ± 0.2	93.1 ± 0.2
$\geq$200% poverty level	6.6 ± 0.1	93.4 ± 0.1

FEI = frequent ear infections.

TABLE III.
Multivariate Regression Analysis for Presence of FEI in Children by Demographic Risk Factor*

Variable	OR for FEI	95% CI	P Value
Income level			.001
Below poverty level	1.322	1.194-1.463	
100% − <200% poverty level	1.089	1.002-1.183	
≥200% poverty level	Reference		
Race/ethnicity			.001
White	Reference		
Black	0.632	0.568-0.702	
Hispanic	0.760	0.696-0.829	
Other	0.598	0.505-0.709	

*Controlling for age, sex, and insurance status.
FEI = frequent ear infections; OR = odds ratio; CI = confidence interval.

logistic regression, there was a statistically significant association between the annual prevalence of FEI and the child's race/ethnicity and income level (both $P <$ .001). Insurance status was not significant in the multivariate model ($P =$ .181). In the multivariate analysis, black, Hispanic and other ethnic group children had a statistically significant decreased odds ratios for FEI (Table III) compared to white children. In addition, children with household income below the poverty level had a significantly increased odds for FEI (Table III).

DISCUSSION

This study defines the current prevalence of FEI along with apparent socioeconomic and race/ethnic disparities in a large, representative sample population of children in the United States. There are relatively few reports and none as current as this one regarding the population based prevalence of FEI. An understanding of the prevalence and of the socioeconomic and racial/ethnic disparities in the at-risk population might help pediatricians, otolaryngologists, and other healthcare providers target efforts toward treating the populations more likely to be at risk for ear infections.

A 1997 study reported an increase in the prevalence of FEI among US children.[5] However, the combination of our review of the literature and our data suggest that there has been a steady decrease in the prevalence of FEI over the past 20 years. In 1988, the NHIS reported an FEI prevalence of 9% in children under 18 years, and 17% in children under 6 years; in 1997 the NHIS estimated the prevalence of FEI in children under 18 years to be 8%.[12,13] Our data (from 1997–2006, inclusive), reflects an overall annualized prevalence of 6.6 ± 0.1% of children under 18 years in the United States with FEI. This supports the downward trend in the annual incidence of FEI in this country. Historically, FEI has been more frequently reported in male children; a small difference in the prevalence between male and female children was seen in our data set (6.6 ± 0.1 % vs. 6.3 ± 0.1%).[5] The overall decline in prevalence of FEI is likely

multifactorial and might be related to early vaccination, as well as aggressive medical treatments with antibiotics and surgical interventions. Recent data have shown that improvements in air quality might also be linked to the declining prevalence of FEI.[14] Although the percentage of individuals affected with FEI might have declined over the years, the raw number of children affected remains substantial in number.

Results of our analysis on racial and ethnic variations among children with FEI revealed a larger percentage of the white population of children to have FEI compared to black, Hispanic, and other race/ethnic children. Additionally, our logistic regression analysis, which controls for multiple variables, revealed that nonwhite parents were less likely to report FEI in their children. A similar racial/ethnic disparity has been described previously by authors who have evaluated the epidemiology of FEI in the 1980s and 1990s.[5,12,13,15] Although this disparity has been consistent across the past few decades, its etiology is unknown. There might be anatomic differences, cultural factors, or differences in organism susceptibility to account for the racial/ethnic disparity. Alternatively, the disparity might be a reflection of a difference in level of education or access to healthcare resources rather than a true difference in prevalence of FEI; nonwhite children might have had unrecognized otitis media. The disparity might also reflect the relative overdiagnosing of the condition in white children and a relative underdiagnosing of the condition in nonwhite children. Nonetheless, numerous studies have found that in general, African-American, Hispanic, and Native American children are less likely to have their medical care needs met and have less access to medical care compared to their white counterparts.[16–19]

In the early and mid 1980s, the prevalence of frequent and recurrent ear infections was more common among children above the poverty level, as reported by Lanphear et al. and Hardy et al.[5,13] However, Auinger et al. reported an increase in prevalence of repeated otitis media in children below the poverty level when they compared the prevalence in a sampling of the population from 1988 to 1991 to that from 1991 to 1994.[4] In our study a larger percentage of children below the poverty level (8.0 ± 0.3 %) were reported to have FEI compared to those children in a household with an income level at 100% to <200% of the poverty level (6.9 ± 0.2%) or ≥200% of the poverty level (6.6 ± 0.1%). Additionally, children with household income below the poverty level had higher odds for FEI. This finding held true even after adjustment for other demographic variables, including race, indicating the likely influence of socioeconomic status on the prevalence of FEI. In the past FEI was thought to be a disease of the affluent, but our data suggest that this is no longer the case.

This data set identifies a small but significant percentage of the children with FEI who have no insurance coverage. The percentage of uninsured with FEI is similar to what has been reported in the literature by other authors in the 1990s.[12] In comparing our data with what has already been published, we recognize that

little progress has been made toward improving health-care coverage, as evidenced by the similar percentages of uninsured children with FEI that still exist. In this current era of healthcare reform it will be important to determine how to reach out to the population of children with FEI whose inadequate health insurance coverage limits their options for treatment.

This study has some limitations that warrant discussion. The NHIS is a data set based on a survey of parents who report on the presence of ear infection in their children rather than based on medical records and physician diagnosis. The survey is also unable to differentiate between the different types of ear infections, such as acute otitis media, otitis media with effusion, and otitis externa. Moreover, the survey is not designed to correlate the presence of FEI with the type and number of interventions. Additionally, the current methodology relies on self-reported race/ethnicity status. Therefore, it is possible that some children might be misclassified when compared to genetic or genealogical evaluations of their race/ethnicity. Nonetheless, self-reporting of race/ethnicity status is commonplace and practically employed at several levels including hospital registration and the US Census.

Despite these limitations, valuable, contemporary information about the prevalence and the characteristics of children with FEI has been documented. These data will serve as a foundation for future work, which will explore the racial/ethnic disparities and inequalities related to access to healthcare that exist in the population of children with FEI. The current data will still help otolaryngologists and primary care physicians obtain a better understanding of the current size and the demographics of the population of children they will encounter in their practice.

CONCLUSION

There has been a decrease in prevalence of FEI among children in the United States over the past few decades. However, there are still disparities in the prevalence of FEI among different racial/ethnic groups and across economic levels. Despite the decrease in prevalence there is still a significant percentage of children with FEI who lack health insurance who might consequently have limited access to diagnostic and therapeutic interventions for their condition. Future studies aimed at further understanding the impact of the racial/ethnic and socioeconomic disparities within the population of children with FEI identified here will be important in the current era of healthcare reform.

BIBLIOGRAPHY

1. Teele DW, Klein JO, Rosner B. Epidemiology of otitis media during the first seven years of life in children in greater Boston: a prospective, cohort study. *J Infect Dis* 1989;160: 83–94.
2. Schappert SM. Office visits for otitis media: United States, 1975–90. *Adv Data* 1992:1–19.
3. Rovers MM. The burden of otitis media. *Vaccine* 2008;26: G2–G4.
4. Auinger P, Lanphear BP, Kalkwarf HJ, Mansour ME. Trends in otitis media among children in the United States. *Pediatrics* 2003;112:514–520.
5. Lanphear BP, Byrd RS, Auinger P, Hall CB. Increasing prevalence of recurrent otitis media among children in the United States. *Pediatrics* 1997;99:E1.
6. Brookfield KF, Cheung MC, Lucci J, Fleming LE, Koniaris LG. Disparities in survival among women with invasive cervical cancer: a problem of access to care. *Cancer* 2009; 115:166–178.
7. Nelson A. Unequal treatment: confronting racial and ethnic disparities in health care. *J Natl Med Assoc* 2002;94: 666–668.
8. Roberts LW, Johnson ME, Brems C, Warner TD. Ethical disparities: challenges encountered by multidisciplinary providers in fulfilling ethical standards in the care of rural and minority people. *J Rural Health* 2007;23(suppl): 89–97.
9. Kanna B, Narang TK, Atwal T, Paul D, Azeez S. Ethnic disparity in mortality after diagnosis of colorectal cancer among inner city minority New Yorkers. *Cancer* 2009; 115:5550–5555.
10. Bhattacharyya N. Contemporary assessment of the disease burden of sinusitis. *Am J Rhinol Allergy* 2009;23: 392–395.
11. Bhattacharyya N. Does annual temperature influence the prevalence of otolaryngologic respiratory diseases? *Laryngoscope* 2009;119:1882–1886.
12. Park CH, Kogan MD, Overpeck MD, Casselbrant ML. Black-white differences in health care utilization among US children with frequent ear infections. *Pediatrics* 2002; 109:E84–4.
13. Hardy AM, Fowler MG. Child care arrangements and repeated ear infections in young children. *Am J Public Health* 1993;83:1321–1325.
14. Bhattacharyya NS, Shapiro NL. Air quality improvements and the prevalence of frequent ear infections in children. *Otolaryngol Head Neck Surgery* 2010;142:242–246.
15. Infante-Rivard C, Fernandez A. Otitis media in children: frequency, risk factors, and research avenues. *Epidemiol Rev* 1993;15:444–465.
16. Flores G, Tomany-Korman SC. Racial and ethnic disparities in medical and dental health, access to care, and use of services in US children. *Pediatrics* 2008;121:e286–e298.
17. Newacheck PW, Hughes DC, Stoddard JJ. Children's access to primary care: differences by race, income, and insurance status. *Pediatrics* 1996;97:26–32.
18. Weinick RM, Krauss NA. Racial/ethnic differences in children's access to care. *Am J Public Health* 2000;90: 1771–1774.
19. Shi L. Experience of primary care by racial and ethnic groups in the United States. *Med Care* 1999;37: 1068–1077.