Published in final edited form as:

Int J Pediatr Otorhinolaryngol. 2016 September ; 88: 98–103. doi:10.1016/j.ijporl.2016.06.029.

Do Race/Ethnicity or Socioeconomic Status Affect Why We Place Ear Tubes in Children?

Carrie L. Nieman, MD, MPH^a, David E. Tunkel, MD^{a,b}, and Emily F. Boss, MD, MPH^{a,b,c}

^aDepartment of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine; 601 N. Caroline St., 6th Floor, Baltimore, MD 21287, USA

^b Department of Otolaryngology–Head and Neck Surgery, Division of Pediatric Otolaryngology, Johns Hopkins University School of Medicine; 601 N. Caroline St., 6th Floor, Baltimore, MD 21287, USA

^cArmstrong Institute for Patient Safety and Quality, Johns Hopkins University School of Medicine; 750 E Pratt St, 15th Floor, Baltimore, MD 21202, USA

Abstract

Introduction—Despite recent concerns about potential overuse of tympanostomy tube (TT) placement to treat otitis media in children, utilization of this common procedure in the U.S. has been shown to be relatively less common among minority children. It is not known if the indications for TT differ by child race/ethnicity and/or socioeconomic status (SES). Our objective is to analyze the association of patient- and neighborhood-level demographics and SES with clinical indications for TT.

Methods—We conducted a retrospective chart review of children who underwent TT at single urban academic tertiary pediatric care center in a 6-month period (8/2013-3/2014). Children with congenital anomalies or syndromic diagnoses were excluded (50/137 children, 36.5%). Children were grouped by primary TT indication, recurrent acute otitis media (RAOM) or chronic otitis media with effusion (OME). Group characteristics were compared using t-tests and chi-square analyses, and logistic regression was performed to assess the association between demographics and TT indication.

Results—87 children were included in this analysis (mean age=2.8 years, 1–6 years). The most common indication for TT was RAOM (53%), and these children had a mean of 6 AOM episodes/year. Indications for TT varied significantly by the patient's neighborhood SES (median neighborhood income \$70,969.09-RAOM vs \$58,844.95-OME, p-value=0.009) Those undergoing TT for RAOM were less likely to live in a high-poverty neighborhood (OR=0.36, p-value=0.02),

Corresponding Author: Carrie L. Nieman, MD MPH, 601 N. Caroline St., 6th Floor, Baltimore, MD 21287, Phone: 410-955-9772, cnieman1@jhmi.edu.

David Tunkel – dtunkel@jhmi.edu

Emily Boss – erudnic2@jhmi.edu

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Financial Disclosures: None

whereas children who underwent TT for OME were more likely to live in a high-poverty neighborhood. There was no significant difference in indication by race/ethnicity or insurance type.

Conclusions—In this population, TT indications differed by SES. Among children receiving tubes, those from high poverty areas were more likely than those from low poverty neighborhoods to receive tubes for the indication of OME as opposed to RAOM. This finding suggests that concerns for appropriate use of TT in the setting of RAOM may be specific to a more affluent population. Future prospective patient-centered research will evaluate cultural and economic influences for families pursuing TT placement, as well as factors considered by physicians who make surgical recommendations.

Keywords

Otitis Media; Tympanostomy Tubes; Health Disparities; Overuse; Minority Health Care

1.1 INTRODUCTION

Otitis media (OM) is one of the most common reasons children and their families seek pediatric care in the United States, second only to routine health maintenance visits¹. Tympanostomy tube placement (TT) mirrors the high prevalence of OM, and is the most common ambulatory surgery performed on children in the United States^{2,3}. Rates of TT vary internationally, with lower rates in Norway and Australia and higher rates in countries, such as the Netherlands, Iceland, and Denmark⁴⁻⁷. The two broadest indications for TT based on current evidence-based guidelines are recurrent acute otitis media (RAOM) and long-term otitis media with effusion (OME)². While the goals of current practice are to provide patient-centered, evidence-based, and high-value care, potential overuse of common procedures, including TT, raise concerns about the appropriateness of surgery in some circumstances^{8,9}. A recent summit addressing overuse in healthcare selected TT as one of 5 common procedures warranting further scrutiny¹⁰. These national concerns exist alongside concurrent efforts to provide equitable care to children and families and address disparities in healthcare delivery and outcomes observed in children with different race/ethnicity and socioeconomic status (SES).

Race/ethnicity and SES impact pediatric care, including diagnosis, treatment, and outcomes. These sociodemographic differences have been demonstrated for a range of conditions and procedures, including renal and liver transplantation, appendicitis, obesity, asthma, cochlear implantation, sleep-disordered breathing, OM, and TT¹¹⁻¹⁶. Healthcare disparities stem from proposed mechanisms that are multifactorial and evolving¹⁷⁻¹⁹. For OM, a number of factors have been associated with increased risk of OM in children, such as race/ethnicity, SES, exposure to cigarette smoke, and daycare attendance^{16,20-22}. Similarly, rates of TT placement and broad-spectrum antibiotic use for OM vary by race/ethnicity and SES. For example, white children and children with uninterrupted insurance coverage are more likely to undergo TT^{16,23-26}.

Analyses of differences in use of healthcare by race/ethnicity and SES have largely focused on “underuse” of surgery or treatment, or disparities, when compared to white patients, with

relatively limited understanding of potential differences in overuse by race/ethnicity and SES²⁷. Several studies document general concerns of overuse of TT with high rates of guideline-discordant care and large regional variation in the rates of TT^{28,29}. However, there is some evidence from adult literature that overuse of care may be greater among white adults than minorities across a range of procedures and tests²⁷. These findings raise concern about potential differences in TT placement by race/ethnicity and SES that may represent a complex interplay between overuse and underuse of care. The overuse literature within pediatrics is scant, with few studies of overuse specifically evaluating race/ethnicity and SES³⁰.

In order to assess appropriate and equitable use of TT in children, we must also analyze the indications for TT among various patient groups. We sought to evaluate associations between TT indications and patient- and community-level demographic and socioeconomic factors. Based on prior literature, we hypothesized that in one urban healthcare community, children of minorities and low SES were more likely to undergo TT insertion for OME as compared to surgery for RAOM.

1.2 MATERIALS & METHODS

1.2.1 Study Cohort

We retrospectively reviewed charts of children who underwent TT over a 6-month period (8/28/2013-3/27/2014) at a single urban academic tertiary pediatric care center. Patients were evaluated and treated by four clinicians in the division of Pediatric Otolaryngology. A total of 137 children underwent TT during the 6-month period. We excluded children with congenital anomalies or syndromes (n=50), as these children have uniquely high risks for OM and learning/developmental delays, and thus more prominent indications for TT. We therefore analyzed a final study cohort of 87 children with age <18 years. Conduct of this research was approved by the Johns Hopkins School of Medicine Institutional Review Board.

1.2.2 Primary Outcome

The primary outcome of interest was the principle clinical indication for TT, either RAOM or OME, as defined in the operative and clinic notes. When patients had multiple TT indications, the primary TT indication was considered the indication best supported by the patient history and examination findings as documented in the clinic notes. If discrepancy existed between the primary indication in the operative note and clinic notes, the indication for TT from clinic notes were considered to be correct.

1.2.3 Sociodemographic Variables

Demographic and socioeconomic-related variables were the primary co-variates. Patient demographics were obtained from the chart and included patient age at the time of surgery, gender, self-reported race/ethnicity, insurance status, and zip code³¹. Race/ethnicity was categorized as non-Hispanic White, Black, or Other, which included the categories, Asian, other, unknown, and multiracial as defined by the demographics provided in the chart given small sample sizes. We categorized insurance status as a binary variable, private or public

insurance (Medicaid Assistance). No uninsured patients received TT insertion during this time period.

We used the patient's zip code and the US Census Bureau American Factfinder (<http://factfinder.census.gov/>) to collect information about patient's neighborhood, which were used as proxies of family socioeconomic status, specifically neighborhood median household income, poverty level, and racial/ethnic diversity. Neighborhood-level statistics are available by zip code tabulation areas (ZCTA), which approximate zip codes but are not identical, and have been used as single measures or combined into SES indices and used as proxies of SES in a range of studies, including pediatric care³²⁻³⁶. We reported neighborhood median household income as a continuous variable and a categorical variable divided into quartiles. Neighborhood poverty level was reported as a continuous variable and a binary variable, divided by the median poverty level. We defined low-poverty neighborhood as less than or equal to 9.2% poverty and high-poverty neighborhood as greater than 9.2% poverty. Neighborhood racial/ethnic composition was based on the percentage of the ZCTA identified as White.

The clinical history related to otitis media were abstracted from the medical record. We collected the number of OM episodes documented in the chart within the 12 months prior to TT insertion. Documentation of secondhand smoke exposure, live with siblings, daycare or school attendance, history of prematurity, and current diagnosis of speech delay were also abstracted from the medical record.

1.2.4 Data Analysis

An observational, patient-level analysis was performed. Patient demographics were analyzed using descriptive statistics. Distributions of groups by TT indication were compared using t-tests and chi-squared analyses. Logistic regressions was performed to assess the association between social demographics and TT indication. A *p* value of <0.05 was considered significant and was adjusted for multiple comparisons. Stata/IC 11 for Windows (StataCorp LP, College Station, TX) was utilized for all variable coding and statistical analyses.

1.3 RESULTS

87 children without a history of developmental delay and/or craniofacial abnormality underwent TT insertion between August 2013 and March 2014. Patient and neighborhood-level characteristics overall and by TT indication are reviewed in **Table 1** and **Table 2**. Approximately half of the children underwent TT for primary indication of RAOM (n=46) and the other half for chronic OME (n=41). The mean age of the children undergoing TT was 2.8 years (range 1-6 years) with the majority of children 2 years old or younger. The majority of children who had surgery were white (71.3%) and privately-insured (74.7%).

Children with RAOM were younger (mean age 2.33 years vs. 3.34 years for OME, *p* value 0.002), and live in neighborhoods with more than \$10,000 higher median household income (\$70,969 versus \$58,845 for OME, *p* value 0.009). While not significant, children with RAOM were also more likely to be privately-insured (82.6% versus 65.9% for OME, *p* value 0.07). Children with RAOM were more likely to live in a neighborhood with a majority of

White households (88.9% versus 65% for OME, p value 0.008). Children with RAOM were also more likely to live in a neighborhood with less poverty (9.3% versus 14.8% for OME, p value 0.002).

There was no difference in history of secondhand smoke exposure, sibling exposure, daycare attendance, or history of prematurity between children with RAOM and OME. However, children with RAOM were less likely to have a parent-reported diagnosis of speech delay (23.9% versus 51% for OME, p value 0.008). Children treated for RAOM with TT had a mean number of 6 episodes of otitis media in the 12 months prior to TT (range 2-12). Children with OME had a mean of 1.2 episodes of acute otitis media in the 12 months prior to surgery (p value < 0.001).

The potential association between TT indication, demographic variables, socioeconomic status, and clinical history were investigated through a series of bivariate logistic regressions (**Table 3**). Children who underwent TT for RAOM were less likely to live in a high-poverty neighborhood (OR=0.36, 95% CI: 0.15-0.88, p value 0.02, as compared to low-poverty neighborhood) (**Table 3**). Although not significant, children who underwent TT for RAOM were less likely to be black (OR=0.27, 95% CI: 0.07-1.12, p value 0.07, as compared to white) and publicly insured (OR=0.41, 95% CI: 0.15-1.10, p value 0.08, as compared to privately insured). Children who underwent TT insertion for RAOM were more likely to live in a predominately White neighborhood (OR=4.31, 95% CI: 1.39-13.39, p value 0.01, as compared to minority-majority neighborhood) and a neighborhood in the highest quartile of median household income (OR=5.36, 95% CI: 1.45-19.74, p value 0.01, compared to < \$49,576). Likewise, when examining sociodemographic variables and OME the associations reverse.

1.4 DISCUSSION

We identified several associations of race/ethnicity and socioeconomic variables with TT indications. Among children who underwent TT for OME, almost 20% were black compared to 6.5% of children with RAOM. More than a third of the children surgically treated for OME were publicly insured, as compared to 17.4% of children with RAOM. Children who underwent TT for OME were more likely to be black and live in a high-poverty neighborhood. Conversely, children who underwent TT for RAOM more likely to live in a neighborhood that was predominately White and in the highest quartile of median household income.

Only a few studies have measured potential differences in rates of RAOM and OME by race/ethnicity and SES, without consistent results³⁷⁻³⁹. Some studies demonstrated similar rates of RAOM and OME between black and white children, while others found higher rates of OME among black children and in children who are publicly insured^{37,38}. Regarding RAOM, higher rates of frequent OM (defined as 3 or more episodes of OM in the past 12 months) have been found among white children and among children living below poverty, whereas other studies have found a higher prevalence of frequent OM in more affluent children^{40,41}.

Our results, while based on a single institution, mirror findings from another study of infants 0-2 years of age in Pittsburgh, where unadjusted rates of OME were higher among urban, black and publicly insured infants³⁸. Following multivariate analysis, low SES, based on type of insurance and level of maternal education, remained one of the strongest factors associated with OME³⁸. However, other studies, such as Casselbrant et al.'s prospective study of the incidence of RAOM and OME among 138 black infants and 60 white infants demonstrated no difference in incidence by race/ethnicity³⁷. Both studies focused solely on infants 0 to 2 years of age; on the contrary, only approximately 50% of our cohort were less than 2 years old.

Moreover, a recent analysis of tympanostomy tube utilization in the U.S. showed that white children receive tubes far more commonly than black or Hispanic children, however indication for surgery was not ascertained⁴². It is possible that this difference in utilization could be associated with increased rates of tubes placed for RAOM in white children. Internationally, disparities around TT are also found. Indigenous children in Australia have lower rates of TT despite higher rates of OME and areas with higher socioeconomic status and resources were also found to have higher rates of TT⁶.

Multiple environmental, social, and cultural factors have been associated with diagnosis and treatment of recurrent and chronic OM and proposed as pathways to differential rates of OM based on race/ethnicity and SES. Insurance status, maternal education, daycare attendance, breastfeeding, and exposure to secondhand smoke have been associated with OM and, in some cases, specifically to OME^{21,24}. Although we found significant associations between SES and indications for TT, we did not find significant associations for race/ethnicity, the presence of siblings at home, daycare attendance, or secondhand smoke exposure. The lack of significant findings may reflect limitations in the study's sample size and reliance on retrospective chart review. Alternatively, it could imply that larger cultural and environmental factors beyond the child's immediate surroundings have greater impact, or that parent preference to seek health services vary by cultural and socioeconomic factors as well as by provider.

In general, minority and low-income children have fewer physician visits and lower rates of specialist use and the families of low-income children, in particular, are less likely to have medicines prescribed, utilize outpatient services, and more likely to report difficulty in obtaining referrals to specialists⁴³⁻⁴⁶. With more physician visits, greater utilization of services and ease in obtaining referrals to specialty care, children from high-income settings may be more likely to receive care related to OM and, subsequently, referred to an otolaryngologist for RAOM and TT placement. Therefore, these children may receive TT for the indication that may not be as direct of a positive outcome as TT for OME and associated hearing difficulty. As an example, children with private insurance had more episodes of OM, more courses of antibiotics, and more primary care visits in the 6 months leading up to specialist referral than publicly-insured children, whereas children with RAOM and public insurance had a longer time with disease prior to referral compared to children with private insurance⁴⁷. Potential provider bias in referral by primary care physicians or decision for surgery among otolaryngologists based on the patient and family's SES may also contribute to the differences in SES found between TT for RAOM and

OME⁴⁸. Among low-income children with OME, overall lower scores in speech and language may prompt referral for surgical intervention, despite a lack of evidence that OME influences speech and language outcomes for low-income children⁴⁹.

The results of this study are limited by several factors inherent in the study design and available cohort of patients. The overall sample size was small, particularly the number of black (n=11) and minority (n=14) children, which limits the potential strength of association and generalizability of these findings. The cohort represents one tertiary academic center located in an urban U.S. environment and may not reflect the patient population and social or environmental factors in other care settings. More specifically, findings from this study are less relevant and applicable to international care settings where public healthcare access and sociocultural stratifications differ from those in the United States. Future studies that draw from offices of primary care providers would more accurately capture referral rates and management decisions and is an area for further investigation. All data were based on retrospective chart review and we reviewed charts from multiple surgeons without standard reporting of clinical history items relevant to OM and TT, such as secondhand smoke exposure. We utilized searches for key words in the clinic and operative notes and key variables may have been missed or under-reported. Last, no patient- or family-level data were available to assess SES. While the use of zip codes and ZCTAs through the US Census are commonly used as proxies of SES, zip codes may not always align well with ZCTAs^{50,51}.

1.5 CONCLUSION

In order to move toward appropriate and equitable care for children, we must understand the factors that influence the quantity and quality of care provided. As a common condition and frequent procedure, OM and TT represent a model for exploring the interplay between race/ethnicity and SES, along with environmental and cultural factors that contribute to pediatric health and care. Similar to findings from adult ambulatory care of higher rates of overuse among white adults, there is some evidence that black children may be obtaining more appropriate, guideline-concordant care for OM than white children²⁶. However, this must be interpreted with caution given evidence of limited access to specialty care and surgery for OM among black children with frequent ear infections²⁵. This study contributes an additional perspective on the balance of overuse and underuse of TT in children in highlighting the potential influence of race/ethnicity and SES on indications for TT.

ACKNOWLEDGMENTS

The authors would like to acknowledge James Benke for his assistance with initial data collection and case review. Dr. Boss is supported by the Agency for Healthcare Research and Quality Grant #1K08 HS22932-01, Johns Hopkins Clinician Scientist Award, and American Society of Pediatric Otolaryngology Career Development Award. The content in this manuscript is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality. Dr. Nieman is supported by the National Institute on Deafness and Other Communication Disorders #T32 DC000027.

REFERENCES

1. CDC. National ambulatory medical care survey fact sheet: Pediatrics. 2010; NAMCS(FS)-12:2-13.

2. Rosenfeld RM, Schwartz SR, Pynnonen MA, et al. Clinical practice guideline: Tympanostomy tubes in children. *Otolaryngol Head Neck Surg.* 2013; 149(1 Suppl):S1–35. [PubMed: 23818543]
3. Cullen, K.; Hall, M.; Golosinskiy, A. National Health Statistics Reports; No.11. National Center for Health Statistics; Hyattsville, MD: 2011. Ambulatory surgery in the United States, 2006.. Revised2009.Publication (PHS) 2009-1250
4. Engel, J.; Anteunis, L.; Hendriks, J. Otitis media today. Kugler Publications; The Hague: 1999. Treatment with grommets in the netherlands: Incidence in children from birth to 12 years.; p. 451-455.
5. Karevold G, Haapkylä J, Pitkäranta A, Kværner KJ. Otitis media surgery: Large variability between finland and norway. *Int J Pediatr Otorhinolaryngol.* 2007; 71(7):1035–1039. [PubMed: 17482284]
6. Spilsbury K, Kadhim AL, Semmens JB, Lannigan FJ. Decreasing rates of middle ear surgery in western australian children. *Archives of Otolaryngology–Head & Neck Surgery.* 2006; 132(11): 1216–1220. [PubMed: 17116817]
7. Arason VA, Sigurdsson JA, Kristinsson KG, Gudmundsson S. Tympanostomy tube placements, sociodemographic factors and parental expectations for management of acute otitis media in iceland. *Pediatr Infect Dis J.* 2002; 21(12):1110–1115. [PubMed: 12488659]
8. Kale MS, Bishop TF, Federman AD, Keyhani S. Trends in the overuse of ambulatory health care services in the united states. *JAMA internal medicine.* 2013; 173(2):142–148. [PubMed: 23266529]
9. Keyhani S, Kleinman LC, Rothschild M, et al. Clinical characteristics of new york city children who received tympanostomy tubes in 2002. *Pediatrics.* 2008; 121(1):e24–33. [PubMed: 18166541]
10. The Joint Commission and the American Medical Association Convened Physician Consortium for Performance Improvement. Proceedings from the national summit on overuse. 2013
11. Patzer R, Amaral S, Klein M, et al. Racial disparities in pediatric access to kidney transplantation: Does socioeconomic status play a role? *American Journal of Transplantation.* 2012; 12(2):369–378. [PubMed: 22226039]
12. Thammana RV, Knechtle SJ, Romero R, Heffron TG, Daniels CT, Patzer RE. Racial and socioeconomic disparities in pediatric and young adult liver transplant outcomes. *Liver Transplantation.* 2014; 20(1):100–115. [PubMed: 24136785]
13. Guagliardo MF, Teach SJ, Huang ZJ, Chamberlain JM, Joseph JG. Racial and ethnic disparities in pediatric appendicitis rupture rate. *Acad Emerg Med.* 2003; 10(11):1218–1227. [PubMed: 14597498]
14. Wang Y. Disparities in pediatric obesity in the united states. *Adv Nutr.* 2011; 2(1):23–31. [PubMed: 22211187]
15. McDaniel M, Paxson C, Waldfogel J. Racial disparities in childhood asthma in the united states: Evidence from the national health interview survey, 1997 to 2003. *Pediatrics.* 2006; 117(5):e868–e877. [PubMed: 16651291]
16. Smith DF, Boss EF. Racial/ethnic and socioeconomic disparities in the prevalence and treatment of otitis media in children in the united states. *Laryngoscope.* 2010; 120(11):2306–2312. [PubMed: 20939071]
17. Shenassa ED, Stubbendick A, Brown MJ. Social disparities in housing and related pediatric injury: A multilevel study. *Am J Public Health.* 2004; 94(4):633–639. [PubMed: 15054017]
18. Linton JM, Feudtner C. What accounts for differences or disparities in pediatric palliative and end-of-life care? A systematic review focusing on possible multilevel mechanisms. *Pediatrics.* 2008; 122(3):574–582. [PubMed: 18762528]
19. Szanton SL, Gill JM, Allen JK. Allostatic load: A mechanism of socioeconomic health disparities? *Biol Res Nurs.* 2005; 7(1):7–15. [PubMed: 15919999]
20. Uhari M, Mantysaari K, Niemela M. A meta-analytic review of the risk factors for acute otitis media. *Clin Infect Dis.* 1996; 22(6):1079–1083. [PubMed: 8783714]
21. Paradise JL, Rockette HE, Colborn DK, et al. Otitis media in 2253 pittsburgh-area infants: Prevalence and risk factors during the first two years of life. *Pediatrics.* 1997; 99(3):318–333. [PubMed: 9041282]
22. Jones LL, Hassanien A, Cook DG, Britton J, Leonardi-Bee J. Parental smoking and the risk of middle ear disease in children: A systematic review and meta-analysis. *Arch Pediatr Adolesc Med.* 2012; 166(1):18–27. [PubMed: 21893640]

23. Bright RA, Moore RM Jr, Jeng LL, Sharkness CM, Hamburger SE, Hamilton PM. The prevalence of tympanostomy tubes in children in the united states, 1988. *Am J Public Health.* 1993; 83(7): 1026–1028. [PubMed: 8328599]
24. Kogan MD, Overpeck MD, Hoffman HJ, Casselbrant ML. Factors associated with tympanostomy tube insertion among preschool-aged children in the united states. *Am J Public Health.* 2000; 90(2):245–250. [PubMed: 10667186]
25. 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(5):E84–4. [PubMed: 11986490]
26. Fleming-Dutra KE, Shapiro DJ, Hicks LA, Gerber JS, Hersh AL. Race, otitis media, and antibiotic selection. *Pediatrics.* 2014; 134(6):1059–1066. [PubMed: 25404720]
27. KRESSIN NR, GROENEVELD PW. Race/ethnicity and overuse of care: A systematic review. *Milbank Q.* 2015; 93(1):112–138. [PubMed: 25752352]
28. Kleinman LC, Kosecoff J, Dubois RW, Brook RH. The medical appropriateness of tympanostomy tubes proposed for children younger than 16 years in the united states. *JAMA.* 1994; 271(16): 1250–1255. [PubMed: 7710469]
29. Keyhani S, Kleinman LC, Rothschild M, Bernstein JM, Anderson R, Chassin M. Overuse of tympanostomy tubes in new york metropolitan area: Evidence from five hospital cohort. *BMJ.* 2008; 337:a1607. [PubMed: 18835846]
30. Korenstein D, Falk R, Howell EA, Bishop T, Keyhani S. Overuse of health care services in the united states: An understudied problem. *Arch Intern Med.* 2012; 172(2):171–178. [PubMed: 22271125]
31. Kaplan JB, Bennett T. Use of race and ethnicity in biomedical publication. *JAMA.* 2003; 289(20): 2709–2716. [PubMed: 12771118]
32. Krieger N. Overcoming the absence of socioeconomic data in medical records: Validation and application of a census-based methodology. *Am J Public Health.* 1992; 82(5):703–710. [PubMed: 1566949]
33. Bird CE, Seeman T, Escarce JJ, et al. Neighbourhood socioeconomic status and biological 'wear and tear' in a nationally representative sample of US adults. *J Epidemiol Community Health.* 2010; 64(10):860–865. [PubMed: 19759056]
34. Timbie JW, Hussey PS, Adams JL, Ruder TW, Mehrotra A. Impact of socioeconomic adjustment on physicians' relative cost of care. *Med Care.* 2013; 51(5):454–460. [PubMed: 23552439]
35. Griggs JJ, Culakova E, Sorbero ME, et al. Effect of patient socioeconomic status and body mass index on the quality of breast cancer adjuvant chemotherapy. *J Clin Oncol.* 2007; 25(3):277–284. [PubMed: 17159190]
36. Kimes D, Ullah A, Levine E, et al. Relationships between pediatric asthma and socioeconomic/urban variables in baltimore, maryland. *Health Place.* 2004; 10(2):141–152. [PubMed: 15019908]
37. Casselbrant ML, Mandel EM, Kurs-Lasky M, Rockette HE, Bluestone CD. Otitis media in a population of black american and white american infants, 0–2 years of age. *Int J Pediatr Otorhinolaryngol.* 1995; 33(1):1–16. [PubMed: 7558637]
38. Paradise JL, Rockette HE, Colborn DK, et al. Otitis media in 2253 pittsburgh-area infants: Prevalence and risk factors during the first two years of life. *Pediatrics.* 1997; 99(3):318–333. [PubMed: 9041282]
39. Vernacchio L, Lesko SM, Vezina RM, et al. Racial/ethnic disparities in the diagnosis of otitis media in infancy. *Int J Pediatr Otorhinolaryngol.* 2004; 68(6):795–804. [PubMed: 15126021]
40. Auinger P, Lanphear BP, Kalkwarf HJ, Mansour ME. Trends in otitis media among children in the united states. *Pediatrics.* 2003; 112(3):514–520. [PubMed: 12949276]
41. Vakharia KT, Shapiro NL, Bhattacharyya N. Demographic disparities among children with frequent ear infections in the united states. *Laryngoscope.* 2010; 120(8):1667–1670. [PubMed: 20564719]
42. Simon AE, Boss EF, Zelaya CE, Hoffman HJ. Racial and ethnic differences in receipt of pressure equalization tubes among US children, 2014. 2016

43. Flores G, Bauchner H, Feinstein AR, Nguyen US. The impact of ethnicity, family income, and parental education on children's health and use of health services. *Am J Public Health*. 1999; 89(7):1066–1071. [PubMed: 10394317]
44. 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(2):e286–98. [PubMed: 18195000]
45. Kuhlthau K, Nyman RM, Ferris TG, Beal AC, Perrin JM. Correlates of use of specialty care. *Pediatrics*. 2004; 113(3):e249–e255. [PubMed: 14993584]
46. Simpson L, Owens PL, Zedet MW, et al. Health care for children and youth in the united states: Annual report on patterns of coverage, utilization, quality, and expenditures by income. *Ambulatory Pediatrics*. 2005; 5(1):6–e20. [PubMed: 15656707]
47. Patel S, Schroeder JW Jr. Disparities in children with otitis media: The effect of insurance status. *Otolaryngol Head Neck Surg*. 2011; 144(1):73–77. [PubMed: 21493391]
48. van Ryn M, Fu SS. Paved with good intentions: Do public health and human service providers contribute to racial/ethnic disparities in health? *Am J Public Health*. 2003; 93(2):248–255. [PubMed: 12554578]
49. Teele DW, Klein JO, Rosner BA. Otitis media with effusion during the first three years of life and development of speech and language. *Pediatrics*. 1984; 74(2):282–287. [PubMed: 6540437]
50. Krieger N, Waterman P, Chen JT, Soobader MJ, Subramanian SV, Carson R. Zip code caveat: Bias due to spatiotemporal mismatches between zip codes and US census-defined geographic areas--the public health disparities geocoding project. *Am J Public Health*. 2002; 92(7):1100–1102. [PubMed: 12084688]
51. Grubestic TH, Matisziw TC. On the use of ZIP codes and ZIP code tabulation areas (ZCTAs) for the spatial analysis of epidemiological data. *Int J Health Geogr*. 2006; 5:58. [PubMed: 17166283]

Table 1Patient Characteristics by TTI Primary Indication^{*}

	Overall n=87	RAOM n=46	OME n=41	P value
Age, mean years (CI)	2.80 (2.47-3.13)	2.33 (1.91-2.74)	3.34 (2.47-3.13)	0.002
Age Categories, years n,(%)				
0-2 years	45 (51.72)	31 (67.39)	14 (34.15)	0.008
3-4 years	28 (32.18)	10 (21.74)	18 (43.90)	
5+ years	14 (16.09)	5 (10.87)	9 (21.95)	
Race, n (%)				
White	62 (71.26)	36 (78.26)	26 (63.41)	0.16
Black	11 (12.64)	3 (6.52)	8 (19.51)	
Other	14 (16.09)	7 (15.22)	7 (17.07)	
Insurance status, n (%)				
Privately Insured	65 (74.71)	38 (82.61)	27 (65.85)	0.07
Publicly Insured	22 (25.29)	8 (17.39)	14 (34.15)	
Number of OM Episodes, mean (CI)	3.73 (3.04-4.41)	6.02 (5.30-6.75)	1.2 (0.69-1.71)	<0.001
Secondhand Smoke Exposure, n (%)	5 (6.85)	4 (10.53)	1 (2.86)	0.2
Live with siblings, n (%)	48 (70.59)	20 (66.67)	28 (73.68)	0.53
Attend Daycare/School, n (%)	48 (65.75)	28 (71.79)	20 (58.82)	0.24
History of Prematurity, n (%)	12 (17.91)	5 (14.71)	7 (21.21)	0.49
Speech Delay, n (%)	32 (36.78)	11 (23.91)	21 (51.22)	0.008

^{*} Cohort includes patients with no "at risk" features or speech delay only

Table 2Neighborhood Characteristics by TTI Primary Indication^{*}

	Overall n=87	RAOM n=46	OME n=41	P value
Neighborhood Median Income, mean dollars (CI)	65,263.61 (60,619.26-69,907.96)	70,969.09 (64,931.73-77,006.44)	58,844.95 (51,962.11-65,727.79)	0.009
Neighborhood Median Income Quartiles, n (%)				
\$0 - \$49,576	22 (25.88)	7 (15.56)	15 (37.50)	0.08
\$49,576.01 - \$63,163	22 (25.88)	12 (26.67)	10 (25.00)	
\$63,163.01 - \$74,946	20 (23.53)	11 (24.44)	9 (22.50)	
> \$74,946	21 (24.71)	15 (33.33)	6 (15.00)	
Neighborhood Percent White, mean % (CI)	62.96 (57.55-68.37)	70.24 (64.27-76.20)	54.78 (45.84-63.72)	0.004
Neighborhood Percent White, Categories n (%)				
<=50% White	19 (22.35)	5 (11.11)	14 (35.00)	0.008
>50% White	66 (77.65)	40 (88.89)	26 (65.00)	
Neighborhood Percent Living in Poverty, mean % (CI)	11.88 (10.10-13.66)	9.27 (7.33-11.21)	14.82 (11.91-17.72)	0.002
Neighborhood Percent Living in Poverty, categories n (%)				
<=9.2%	43 (50.59)	28 (62.22)	15 (37.50)	0.02
>9.2%	42 (49.41)	18 (37.78)	25 (62.50)	

^{*} Cohort includes patients with no “at risk” features or speech delay only

Table 3Association between demographic and clinical variables and TT Insertion for RAOM[†]

	Univariate OR (95% CI)	p values
Race		
White	REF	
Black	0.27 (0.07-1.12)	0.07
Other	0.72 (0.23-2.31)	0.58
Insurance status		
Private Insurance	REF	
Medicaid	0.41 (0.15-1.10)	0.08
Neighborhood Median Income (cat)		
\$0 - \$49,576	REF	
\$49,576.01 - \$63,163	2.57 (0.75-8.78)	0.13
\$63,163.01 - \$74,946	2.62 (0.74-9.21)	0.13
> \$74,946	5.36 (1.45-19.74)	0.01
Neighborhood Percent White, Categories n (%)		
<=50% White	REF	
>50% White	4.31 (1.39-13.39)	0.01
Neighborhood Percent Living in Poverty, categories n (%)		
Low-poverty	REF	
High-poverty	0.36 (0.15-0.88)	0.02
Secondhand Smoke Exposure	4 (0.42-37.66)	0.23
Live with siblings	0.71 (0.25-2.04)	0.53
Attends daycare/school	1.78 (0.67-4.73)	0.25
History of prematurity	0.64 (0.18-2.27)	0.5
Speech Delay	0.30 (0.12-0.75)	0.01

[†]Note: The reverse of the odds ratios listed would show the association between the variables and TT insertion for OME.