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The Impact of Sociodemographic Factors on Rates of Tympanostomy Tube Placement for Pediatric Otitis Media

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Abstract

Objective. To identify the impact of race, ethnicity, and socioeconomic status (SES) on the rate of tympanostomy tube placement.

Study Design. Retrospective medical review and population-level analyses.

Setting. Tertiary referral center.

Methods. Demographic and population-level characteristics (age, gender, race, insurance status, and ZIP code) compared to the regional, health system, and otolaryngology clinic demographics.

Results. Among 38,461 children diagnosed with otitis media (OM) 61.4% were white, 27.4% were black, 32.7% had private insurance, and 18.2% were Hispanic. Among patients seen in the pediatric ear, nose, and throat (ENT) clinics, 70.0% were white, 20.0% were black, 46.6% had private insurance, and 14.9% were Hispanic. Further disparity was noted among those receiving tympanostomy tubes: 75.6% white, 15.6% black, 61.9% private insurance, and 11.7% Hispanic. Higher rates of tube placement were noted for those of white race [odds ratio, OR: 1.96, (95% confidence interval, CI: 1.85-2.04), <.001] and non-Hispanic ethnicity [OR: 1.67, (95% CI: 1.56-1.75), <.001]. Geographically, rates of tube placement were significantly lower in areas with higher deprivation indices, areas with lower proportions of white residents, and areas with the lowest median incomes. These markers correlate strongly with black race and Hispanic ethnicity. Lower rates of tube placement were also seen in majority white locales with higher deprivation indices and lower median incomes.

Conclusion. Rates of access to pediatric ENT clinics, and of tube placement, are significantly lower for those of Hispanic ethnicity and black race than for non-Hispanic white children. Higher rates of tube placement were noted among white children and those with private insurance. Lower rates of tube placement were seen in areas of lower SES regardless of racial demographics.

Keywords

health care disparities, socioeconomic factors, social determinants of health

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Otitis media (OM) affects 90% of all children and is the most common diagnosis of pediatric illness in the United States.[1,2] OM is the most common indication for antimicrobial therapy and surgery in young children as well as the most common cause of hearing loss in children leading to speech, educational, and other developmental delays.[3] OM results in approximately $5 billion annually in US health care expenditures.[4]

There are well-defined guidelines for surgical intervention in OM, namely the placement of pressure equalization tubes (PETs).[5] Some studies have shown that black and Hispanic children have lower rates of OM diagnoses and are less likely to see an otolaryngologist or receive PET placement compared to white children.[6–9] Decreased rates of diagnosis and surgical intervention are not necessarily indicative of decreased incidence of disease and may be reflective of socioeconomic factors impeding access to care. Barriers to access are complex and may include household income, housing conditions, social support, parental educational attainment, and child school performance. These barriers become pervasive when subject to geographic segregation perpetuated by systemic racism and discrimination.

Milwaukee is one of the most hypersegregated cities in the nation.[10] In the last 20 years, Milwaukee has only reduced its segregation rate by 3.5 points, while other metropolitan cities have reduced their segregation rates by at least 10 points in the same timespan.[11,12] Many

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neighborhoods remain predominantly black and still suffer from greater poverty, lower life expectancy, and higher incidence of chronic diseases than predominantly white neighborhoods.[13] The only academic medical center in the region is located in a predominantly white and wealthy enclave within Milwaukee County. This jurisdiction is distinct from the City of Milwaukee. In addition, most of the satellite pediatric ear, nose, and throat (ENT) clinics are in white residential neighborhoods in the surrounding suburbs. Location alone may segregate adherence to standards of care and reinforce chronic medical underserving in non-white or economically depressed patient populations.

Indeed, our previous work has shown differences in access and outcomes for common otolaryngologic care in specific demographics in our region.[14,15] The current study sought to examine rates of evaluation by pediatric ENT, and the rate of PET placement, among differing sociodemographic groups across a segregated and economically disparate geographic locale.

Methods

OTO Clinomics is a department-wide clinical outcomes platform used to investigate determinants of disease and response to treatment (IRB# 00045896). This platform utilizes the Clinical Research Data Warehouse (CRDW), part of the Clinical and Translational Science Institute (CTSI) of Southeast Wisconsin (UL1TR001436). The CRDW extracts a mirror of the Children's Wisconsin electronic health record and stores this in a Jupyterhub database. Within the Jupyterhub environment we performed data extraction and statistical analyses on children between the age of 0 and 17 diagnosed with OM between 2009 and 2019. This manuscript has not been submitted or published elsewhere. All study activities were approved by The Medical College of Wisconsin/Froedtert Health Institutional Review Board (PRO00045896).

Patient Demographics and Study Design

Clinical and demographic data were extracted from the Jupyterhub for all patients seen at Children's Wisconsin who were diagnosed with OM (ICD10: H92.11, H92.12, H92.13, H95.89, T85.890, H65.01, H65.02, H65.03, H65.04, H65.05, H65.06, H65.191, H65.192, H65.193, H65.194, H65.195, H65.196, H65.21, H65.22, H65.23, H65.31, H65.32, H65.33, H65.491, H65.492, H65.493, H65.91, H65.92, H65.93, H66.001, H66.002, H66.003, H66.004, H66.005, H66.006, H66.90, H66.91, H66.92, H66.93) those seen by pediatric ENT, and those who underwent tympanostomy tube placement. Demographic data for age, sex, race, ethnicity, and insurance status were similarly extracted from the medical record. Geocoding was used to identify ZIP code of residence and linked to population-level data from the 2020 Census recorded by the United States Census Bureau. The area deprivation index (ADI) measure was used to provide rankings of neighborhoods by socioeconomic disadvantage in our region. This measure includes theoretical domains of income, education, employment, and housing quality.[16] ADI and census data are integrated into our CTSI Clinical Data Warehouse to facilitate studies evaluating health care and social determinants of health.

Statistical Analysis

The proportion of patients within each demographic group was compared between those diagnosed with OM, those seen by pediatric ENT, and those who underwent PET placement. Odds ratios (ORs) with 95% confidence intervals (CIs) and P values were calculated by 2-by-2 χ^2 test. All statistical tests were performed using R language (3.6.1) within the Jupyterhub environment.

Results

There were 38,461 children diagnosed with OM between 2009 and 2019 (**Table 1**). Comparable to the demographic profile of Milwaukee County, 61.4% of children with OM were white (Milwaukee County: 64.2%), 27.4% black (Milwaukee County: 27.2%), and 2.6% Asian (Milwaukee County: 4.7%). Approximately 8% and 9% of children were of other racial identity or race was unknown. Ethnicity of those with OM also mirrored the local county with 80.0% identifying as non-Hispanic (Milwaukee County: 83.5%) and 18.2% as Hispanic/Latino (Milwaukee County: 16.5%). More males than females were diagnosed with OM (56.4% vs 43.6%), slightly more than the 51.0% male proportion of those in Milwaukee County under the age of 18 years.

Evaluated in Pediatric ENT Clinics

Among the 38,461 children with at least one diagnosis of OM, 56.98% (n = 21,916) were seen in the pediatric ENT clinics. Comparison and analysis of sociodemographic factors was made between those seen by a pediatric ENT, and those without any pediatric ENT contact. There was an increased likelihood of seeing a pediatric ENT for males [OR: 1.16 (CI: 1.11-1.20, $P < .01$], whites (OR: 2.33 (CI: 2.22-2.44), $P < .001$], and non-Hispanics [OR: 1.63 (CI: 1.56-1.72), $P < .001$]. Blacks [OR: 0.42 (CI: 0.40-0.44), $P < .001$], Asians [OR: 0.72 (CI: 0.63-0.91), $P < .001$], and Hispanics [OR: 0.59 (CI: 0.56-0.62), $P < .001$] all had significantly lower likelihood of seeing a pediatric ENT.

Patients with private health insurance had statistically significantly higher odds of being seen by a pediatric ENT [OR: 5.55 (CI: 5.26-5.55), $P < .001$] when compared with public health insurance [OR: 1.61 (CI: 1.53-1.69), $P < .001$]. These data may be confounded by the lack of insurance data in a high proportion of those with a diagnosis of OM (34.4%) as compared to those seen by a pediatric ENT (16.0%).

Tubes Placed

Overall, 32.66% (n = 12,563) of children with at least one instance of diagnosis of OM (n = 38,461) ultimately received

tympanostomy tubes. While males had a higher likelihood of seeing a pediatric ENT, there was equal likelihood once being seen by a pediatric ENT of having tubes placed between males and females (**Table 2**). However, a continued increased likelihood of higher levels of intervention was seen for whites [OR: 1.33 (CI: 1.26-1.38), $P < .001$], non-Hispanics [OR: 1.31 (CI: 1.23-1.40), $P < .001$], and those with private insurance [OR: 1.85 (CI: 1.78-1.96), $P < .001$] (**Figure 1**). In contrast, blacks [OR: 0.74 (CI: 0.69-0.78), $P < .001$], Asians [OR: 0.80 (CI: 0.68-0.94), $P < .001$], and Hispanics [OR: 0.75 (CI: 0.70-0.81), $P < .001$] had lower likelihood of this surgical intervention (**Figure 2**).

Overall, the median age of those who received tubes (1.78 years) was lower than the median age of those seen

Table 1. Demographic Characteristics of Otitis Media Diagnosis in Relation to ENT Consultations and Tube Placements

	Otitis media diagnosis	Not seen in ENT	Seen in ENT	Tubes placed
Median age	38,461 (100%) 2.09 y	16,545/38,461 = 43.02% 1.77 y	21,916/38,461 = 56.98% 2.33 y	12,563/38,461 = 32.66% 1.78 y
Sex				
Male	21,705/38,461 = 56.40%	9,000/16,545 = 54.4%	12,705/21,916 = 58.0%	7,339/12,563 = 58.4%
Female	16,756/38,461 = 43.60%	7545/16,545 = 45.6%	9211/21,916 = 42.0%	5224/12,563 = 41.6%
Race				
White	23,602/38,461 = 61.40%	8,270/16,545 = 50.0%	15,332/21,916 = 70.0%	9,497/12,563 = 75.6%
Black	10,538/38,461 = 27.40%	6162/16,545 = 37.2%	4376/21,916 = 20.0%	1963/12,563 = 15.6%
Asian	985/38,461 = 2.60%	501/16,545 = 3.0%	484/21,916 = 2.2%	224/12,563 = 1.8%
Unknown	1392/38,461 = 3.60%	612/16,545 = 3.7%	780/21,916 = 3.6%	411/12,563 = 3.3%
Other	1944/38,461 = 5.10%	1000/16,545 = 6.0%	944/21,916 = 4.3%	468/12,563 = 3.7%
Insurance[a]				
Private	12,586/38,461 = 32.7%	2296/16,545 = 13.9%	10,213/21,916 = 46.6%	7773/12,563 = 61.9%
Public	12,163/38,461 = 31.6%	4276/16,545 = 25.8%	7887/21,916 = 36.0%	4589/12,563 = 36.5%
Other	29/38,461 = .10%	11/16,545 = 0.1%	18/21,916 = 0.1%	9/12,563 = 0.1%
Self-funded	437/38,461 = 1.1%	143/16,545 = 9.9%	294/21,916 = 1.3%	192/12,563 = 1.5%
Ethnicity				
Hispanic/Latino	7019/38,461 = 18.2%	3758/16,545 = 22.7%	3261/21,916 = 14.9%	1473/12,563 = 11.7%
Not Hispanic/Latino	30,780/38,461 = 80.0%	12,483/16,545 = 75.4%	18,297/21,916 = 83.5%	10,919/12,563 = 86.9%
Unknown	662/38,461 = 1.7%	304/16,545 = 1.8%	358/21,916 = 1.6%	171/12,563 = 1.4%

Abbreviation: ENT, ear, nose, and throat.
[a]Insurance categories do not total 100% due to unknown insurance status, particularly among those not seen in ENT.

Table 2. Odds Ratios for Otitis Media Diagnosis, ENT Consultations, and Tube Placements by Sex, Race, and Ethnicity

	Not seen in ENT vs seen in ENT (odds ratios, 95% CI, *P* value)	OM Dx vs seen in ENT (odds ratios, 95% CI, *P* value)	OM Dx vs tube placement (odds ratios, 95% CI, *P* value)	Seen in ENT vs tube placement (odds ratios, 95% CI, *P* value)
Sex				
Male	1.16, (1.11, 1.2), <0.001	1.06, (1.03, 1.10), <.001	1.09, (1.04, 1.12), <.001	1.02 (0.97, 1.06), .419
Female	0.86, (0.83, 0.9), <.001	0.94, (0.91, 0.97), <.001	0.93, (0.88, 0.96), <.001	0.98, (0.93, 1.03), .419
Race				
White	2.33, (2.22, 2.44), <.001	1.47, (1.41, 1.52), <.001	1.96, (1.85, 2.04), <.001	1.33, (1.27, 1.39), <.001
Black	0.42, (0.40, 0.44), <.001	0.66, (0.64, 0.69), <.001	0.49, (0.47, 0.52), <.001	0.74, (0.70, 0.79), <.001
Asian	0.72, (0.64, 0.82), <.001	0.86, (0.77, 0.96), .007	0.69, (0.60, 0.8), <.001	0.81, (0.68, 0.94), .007
Other	0.96, (0.86, 1.08), .467	0.98, (0.90, 1.08), .702	0.9, (0.81, 1.01), .067	0.91, (0.81, 1.03), .159
Unknown	0.70, (0.64, 0.77), <.001	0.85, (0.78, 0.92), <.001	0.72, (0.65, 0.81), <.001	0.86, (0.77, 0.96), .009
Ethnicity				
Hispanic/Latino	0.60, (0.56, 0.63), <.001	0.78, (0.75, 0.82), <.001	0.60, (0.56, 0.63), <.001	0.76, (0.71, 0.81), <.001
Non- Hispanic/ Latino	1.64, (1.56, 1.72), <.001	1.27, (1.2, 1.32), <.001	1.67, (1.56, 1.75), <.001	1.32, (1.23, 1.41), <.001
Unknown	0.88, (0.76, 1.03), .128	0.95, (0.83, 1.08), .421	0.79, (0.67, 0.93), .006	0.83, (0.69, 1), .048

Abbreviations: CI, confidence interval; ENT, ear, nose, and throat.

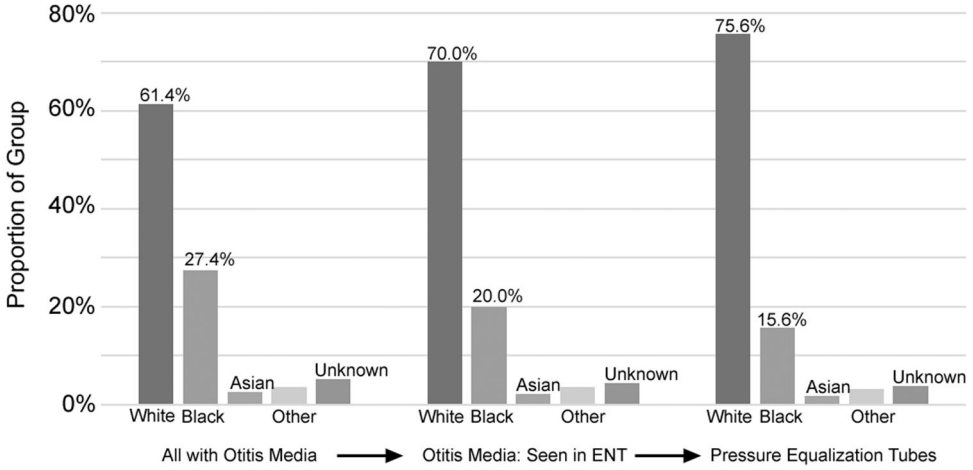

Figure 1. Racial representation of the proportion of patients diagnosed with otitis media, patients seen by ear, nose, and throat, and patients who received pressure equalization tubes.

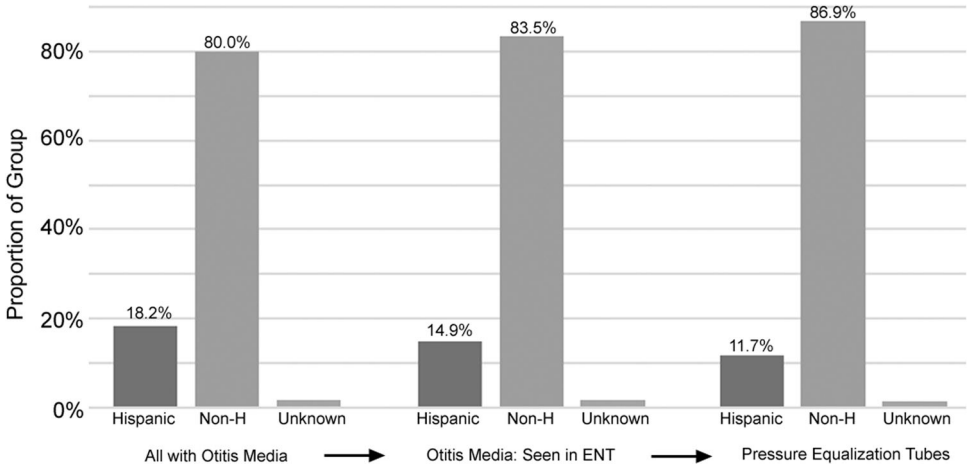

Figure 2. Ethnic representation of the proportion of patients diagnosed with otitis media, patients seen by ear, nose, and throat, and patients who received pressure equalization tubes.

by a pediatric ENT (2.33 years) (**Table 1**). Among those with tubes placed, there was no difference in median age between males (1.931 years) and females (1.984 years). However, while whites (1.937 years) and blacks (1.938 years) were of similar age at the time of tube placement, Asians were notably older (2.337 years). Older age at the time of tube placement was also noted when comparing those with public insurance (2.087 years) to those with private insurance (1.871 years), as well as Hispanics (2.208 years) to non-Hispanics (1.916 years).

Tube placement rates per diagnosis of OM were further assessed with regard to geography and associated sociodemographic factors (**Figure 3**). The rate of tube placement per diagnosis of OM within a ZIP code ranged from less than 10% to over 90% (**Figure 3A**). Areas of lowest tube placement rates were in central Milwaukee (arrow) and in the exurban to rural western regions of the counties comprising Southeast Wisconsin. Areas of lowest rates of tube placement, correlated geographically with areas of the highest deprivation indices (**Figure 3B**), lowest white proportions (**Figure 3C**), and/lowest median income levels (**Figure 2D**).

Discussion

Our study investigated the rate of pediatric evaluation and tympanostomy tube placement per diagnosis of OM among children in Southeastern Wisconsin. We found access to pediatric ENT services and rates of tympanostomy tube placement correlated with sociodemographic factors. Lower socioeconomic status (SES), black race, and Hispanic ethnicity had a negative impact on pediatric otolaryngology care for the most common pediatric disease and associated surgical intervention.

As previously noted, Milwaukee is one of the most segregated cities in the United States; segregation being a strong predictor of black socioeconomic disadvantage.[17,18] SES has been determined to be the fundamental cause for observed social inequalities and racial differences in health.[18,19] Otolaryngologic studies have also seen a

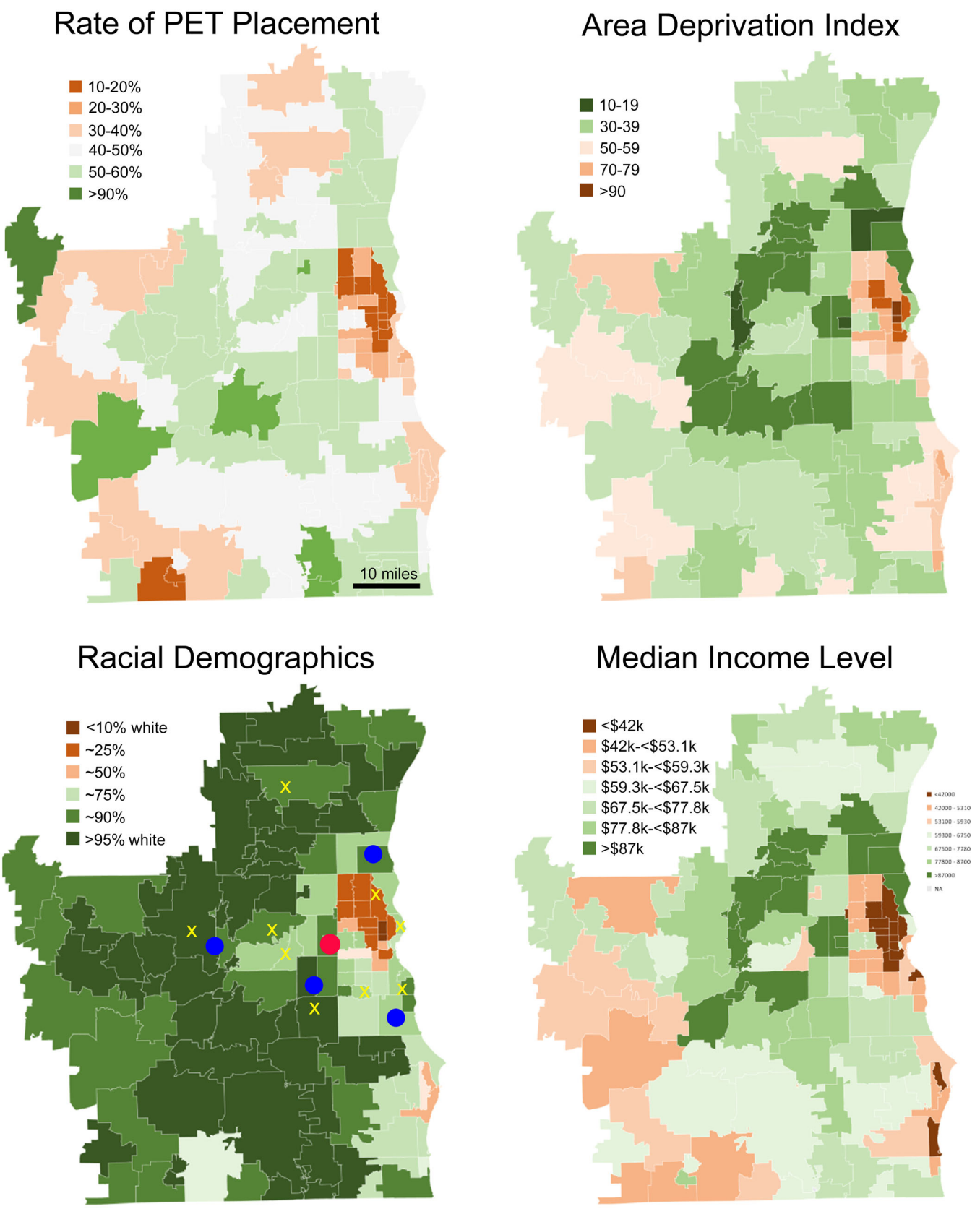

Figure 3. Geographic representation of rates of pressure equalization tube (PET) placement procedures per ZIP code, area deprivation index per ZIP code, racial demographics per ZIP code, and median income level per ZIP code across southeastern Wisconsin. The arrow denotes central Milwaukee; areas of lowest tube placement rates. The red dot denotes the location of the main medical center and ear, nose, and throat clinic. The blue dots denote the location of our satellite pediatric clinics. The yellow Xs denote the private/community practices that place tubes.

correlation between race, ethnicity, SES, and surgical management of OM.[20–22]

Smith and Boss performed a qualitative systematic review of studies reporting racial and ethnic factors versus socioeconomic factors in the diagnosis and treatment of OM.[8] While several of the studies showed divergent results of the impact of race and ethnicity, the authors found evidence overall that socioeconomic deprivation increases the risk of OM. A later study using the National Health Interview Survey examined racial and ethnic differences in ear tube placement.[7] Non-Hispanic whites had greater rates of ear tube placement compared to blacks, unexplained by other socioeconomic factors. Further, rates of being seen by pediatric ENT were significantly lower in females, blacks, Hispanics, and Asians.

The AAO-HNSF guidelines on tympanostomy tube placement for OM note 2 general types of OM with respective indications for surgery: (1) OM with effusion and (2) acute OM.[5] Prior study suggests that indications for tympanostomy tube placement may differ by SES.[23] High poverty status was related to having OM with effusion as an indication for tympanostomy tube placement as opposed to more affluent groups in which the diagnosis of recurrent acute OM was more often the indicator for surgery. It is possible that there is overutilization of tube placement in affluent areas relying on the simpler acute otitis media criterion for surgery. In contrast, regardless of race or ethnicity, patients with lower SES in urban and exurban areas were less likely to have tympanostomy tubes placed (**Figure 3A**). Contributors either to the overutilization of tubes in wealthy areas or under-utilization of tubes in SES-depressed areas may be secondary to clinic locations outside the City of Milwaukee (**Figure 3C**, blue dots). Locations of private/community practicing clinics and their locations as they relate to the locations of the satellite clinics of our health system are shown by the yellow Xs on **Figure 3C**.

Patel et al investigated the rate of ear tube placement at ambulatory surgery centers in affluent areas in Florida and New York versus nonaffluent areas.[24] Affluent areas with privately owned centers had increased rates of tube placement when compared to centers in less affluent areas, or those which were not privately owned. In our population, all ear tube placements were all at hospital system sites, but our higher rates of tube placement for insured patients, those from areas of higher median income, and those from areas of lower ADI, similarly demonstrate a disparity in tube placement between affluent and less affluent communities. Other cities served predominately by large academic medical centers with high segregation indices (ie, Philadelphia, Detroit, and St. Louis), may wish to perform similar analyses in relation to observed health disparities.

Our study also found age of ear tube placement to differ by sociodemographic factors. There was significant difference by race, Asian patients were significantly older than white and black patients at tube placement ($\bar{X}$ 2.337 years). There was also a difference in those with private insurance when compared to public insurance. Patients with private insurance were more likely to receive ear tubes earlier in age than those with public insurance. There was also a slight difference in age between Hispanic and non-Hispanic patients, with Hispanic patients receiving tubes at older ages.

Limitations

There are several limitations to this study. First, data were limited to patients cared for by pediatric otolaryngologists at Children's Wisconsin. Though a significant amount of care for children in the Milwaukee area is provided through our hospital system, there is an unknown cohort of children cared for outside of the system whose data were not included. We also do not have direct information as to the indications for tube placement and cannot ascertain whether guidelines were followed strictly.

Conclusion

Distinct differences in the rates of being seen by pediatric ENT, and in having tubes placed, were noted by race and ethnicity as well as by population-level socioeconomic measures such as median income and area deprivation. Further study is necessary to understand drivers of such disparity and to implement strategies to ensure equitable access and intervention for higher levels of care for all.

Author Contributions

Jazzmyne A. Adams, acquisition and interpretation of data, drafting of manuscript, critical revision of manuscript for important intellectual content; **Valerie Flanary**, study concept and design, drafting of the manuscript, critical revision of the manuscript for important intellectual content; **Abigail Thomas**, study concept and design, critical revision of the manuscript for important intellectual content; **Ling Tong**, acquisition, analysis, and interpretation of data. statistical analysis; **Kristen Osinski**, acquisition, analysis, and interpretation of data; **Jake Luo**, acquisition, analysis, and interpretation of data, statistical analysis; **David R. Friedland**, study concept and design, drafting of the manuscript, critical revision of the manuscript for important intellectual content.

Disclosures

Competing interests: The authors note no competing interests relevant to this study.

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References

1. Centers for Disease Control and Prevention (CDC). Direct and indirect effects of routine vaccination of children with

7-valent pneumococcal conjugate vaccine on incidence of invasive pneumococcal disease—United States, 1998-2003. *MMWR Morb Mortal Wkly Rep*. 2005;54(36):893-897.
2. Schappert SM. Office visits for otitis media: United States, 1975-90. *Adv Data*. 1992;214:1-19.
3. Bess FH, Dodd-Murphy J, Parker RA. Children with minimal sensorineural hearing loss: prevalence, educational performance, and functional status. *Ear Hear*. 1998;19(5):339-354.
4. Suaya JA, Gessner BD, Fung S, et al. Acute otitis media, antimicrobial prescriptions, and medical expenses among children in the United States during 2011-2016. *Vaccine*. 2018;36(49):7479-7486.
5. Rosenfeld RM, Tunkel DE, Schwartz SR, et al. Clinical practice guideline: tympanostomy tubes in children (update). *Otolaryngol Head Neck Surg*. 2022;166(1_suppl):S1-S55.
6. Bhattacharyya N, Shapiro NL, Vakharia KT. Influence of race and ethnicity on access to care among children with frequent ear infections. *Otolaryngol Head Neck Surg*. 2010;143(5):691-696.
7. Simon AE, Boss EF, Zelaya CE, Hoffman HJ. Racial and ethnic differences in receipt of pressure equalization tubes among US children, 2014. *Acad Pediatr*. 2017;17(1):88-94.
8. 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.
9. Bhattacharyya N, Shay SG. Epidemiology of pediatric tympanostomy tube placement in the United States. *Otolaryngol Head Neck Surg*. 2020;163(3):600-602.
10. Fernandez J. How Milwaukee became a hyper-segregated city. *Shepard Express*. 2020.
11. Frey WH. *Black-White Segregation Edges Downward Since 2000, Census Shows*. Brookings; 2018. https://www.brookings.edu/articles/black-white-segregation-edges-downward-since-2000-census-shows/
12. Reeves R, Rodrigue E. *Milwaukee, Segregation, and the Echo of Welfare Reform*. Brookings; 2016. https://www.brookings.edu/articles/milwaukee-segregation-and-the-echo-of-welfare-reform/
13. Nowakowski A. *Segregation's impact on metro Milwaukee health disparities*. WUWN. 2017.
14. Poetker DM, Friedland DR, Adams JA, Tong L, Osinski K, Luo J. Socioeconomic determinants of tertiary rhinology care utilization. *OTO Open*. 2021;5(2):2473974x211009830.
15. Harvey E, Stark K, Friedland DR, et al. Impact of demographics and clinical features on initial treatment pathway for vestibular schwannoma. *Otol Neurotol*. 2022;43(9):1078-1084.
16. Kind AJH, Buckingham WR. Making neighborhood-disadvantage metrics accessible—the neighborhood atlas. *N Engl J Med*. 2018;378(26):2456-2458.
17. Williams DR, Lawrence JA, Davis BA. Racism and health: evidence and needed research. *Annu Rev Public Health*. 2019;40:105-125.
18. Williams DR, Collins C. Racial residential segregation: a fundamental cause of racial disparities in health. *Public Health Rep*. 2001;116(5):404-416.
19. House JS, Kessler RC, Herzog AR. Age, socioeconomic status, and health. *Milbank Q*. 1990;68(3):383-411.
20. Ambrosio A, Brigger MT. Surgery for otitis media in a universal health care model: socioeconomic status and race/ethnicity effects. *Otolaryngol Head Neck Surg*. 2014;151(1):137-141.
21. Guys N, Ramsey T, Kandinov A, et al. Interplay between socioeconomic status and otitis media disease burden in resource-rich and resource-poor nations. *Otol Neurotol*. 2018;39(9):e817-e824.
22. Lasisi AO, Sulaiman OA, Afolabi OA. Socio-economic status and hearing loss in chronic suppurative otitis media in Nigeria. *Ann Trop Paediatr*. 2007;27(4):291-296.
23. Nieman CL, Tunkel DE, Boss EF. Do race/ethnicity or socioeconomic status affect why we place ear tubes in children? *Int J Pediatr Otorhinolaryngol*. 2016;88:98-103.
24. Patel TA, McCoy JL, Belsky MA, et al. Effect of insurance type on postoperative tympanostomy tube follow-up. *Otolaryngol Head Neck Surg*. 2022;166(6):1078-1084.