

Defining Disparities in Cochlear Implantation through the Social Determinants of Health

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ABSTRACT

Hearing loss is a global public health problem with high prevalence and profound impacts on health. Cochlear implantation (CI) is a well-established evidence-based treatment for hearing loss; however, there are significant disparities in utilization, access, and clinical outcomes among different populations. While variations in CI outcomes are influenced by innate biological differences, a wide array of social, environmental, and economic factors significantly impact optimal outcomes. These differences in hearing health are rooted in inequities of health-related socioeconomic resources. To define disparities and advance equity in CI, there is a pressing need to understand and target these social factors that influence equitable outcomes, access, and utilization. These factors can be categorized according to the widely accepted framework of social determinants of health, which include the following domains: healthcare access/quality, education access/quality, social and community context, economic stability, and neighborhood and physical environment. This article defines these domains in the context of CI and examines the published research and the gaps in research of each of these domains. Further consideration is given to how these factors can influence equity in CI and how to incorporate this information in the evaluation and management of patients receiving cochlear implants.

KEYWORDS: cochlear implants, hearing, social determinants of health, equity, disparity

An estimated 1.5 billion people across the globe experience hearing loss and over 430 million are candidates for intervention.¹ Hearing loss has profound impacts on communica-

tion, education, socialization, cognition, and overall well-being across the lifespan.² The prevalence of hearing loss and the need for hearing healthcare is expected to continue to

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rise over the next quarter century. Underserved populations face an even higher prevalence and impact of hearing loss.^{3,4} Evidence-based treatments for hearing loss, such as cochlear implants, can significantly improve hearing-related outcomes and overall quality of life⁵; however, access to and utilization of such devices is neither uniform nor equitable. In spite of this expanding global public health problem, the utilization of hearing devices, including cochlear implants, across the world is less than 15%⁶ and there are significant discrepancies in equitable hearing healthcare access and utilization among different populations. Biological and clinical differences involved in the pathophysiology and manifestation of hearing loss certainly influence outcomes following CI; however, a wide variety of social factors are at play as well. Even when care is accessed, clinical outcomes of cochlear implant recipients may vary widely among different populations⁷ and there is a pressing need to understand and address, in a broader sense, the social factors that influence equity in CI access, utilization, and outcomes. Pursuing equity is an ethical priority as many inequities in healthcare are rooted in discriminatory practices and racism.⁸ Furthermore, promoting equity has economic implications, as health inequities result in billions of lost dollars each year due to increased medical costs and lost productivity.⁹

Health-influencing social factors are categorized according to the widely accepted framework of social determinants of health, which is defined by where people live, work, and play that can either directly or indirectly influence their health and overall quality of life.¹⁰ Additionally, these factors play a role in the severity and the distribution of health disparities. Defining, describing, and addressing the social determinants of health is a priority area for the World Health Organization (WHO) to tackle health inequities, such as CI access differences between different nations.^{11,12} The social determinants of health framework can be divided into five domains which include the following: healthcare access and quality, education access and quality, social and community context, economic stability, and neighborhood and physi-

cal environment.^{10,13} The first domain concentrates accessibility and utilization of healthcare services among patients as well as their health knowledge. For example, this could include type and amount of insurance coverage, provider availability and accessibility, health literacy, and the quality of care. The second domain of the social determinants of health focuses on the accessibility and quality of education and its effects on health outcomes. Examples of factors from this domain include level of education, access to vocational training, parental educational attainment, access to early childhood education, and school-based rehabilitation services. The next domain, social and community context, evaluates the social conditions and connections of individuals and how they impact one's overall health and well-being. This domain incorporates social support systems and networks, community engagement, social integration, and cultural/racial/ethnic social identity. The impact of discrimination based on race, ethnicity, gender, or sexual orientation would be assessed within this domain. Economic stability represents the fourth domain and encompasses individual financial and material resources and how they impact health. Some factors under this domain include employment, income, poverty, debt, or expenses, as well as food and housing security. The final domain of this framework is the neighborhood and physical environment, which involves the relationship between where people live and the impact on their health and well-being. For example, this domain would connect health with the safety and quality of housing, accessibility and utilization of transportation, water and air quality, neighborhood crime, and rurality of household location. These five domains represent a comprehensive framework that can be used to evaluate inequities in any aspect of health or healthcare and these factors, either positively or negatively, influence the health of every single person who is eligible for or who receives a cochlear implant. The objective of this article is to define disparities in CI through the lens of the social determinants and identify targets and methods to promote equity in patients who would benefit from CI.

SOCIAL DETERMINANTS OF HEALTH

Healthcare Access and Quality

Utilization of and access to quality hearing healthcare services influences overall health and hearing-related outcomes for adults and children. Considering the global underutilization of hearing devices, access to care is a critical issue for CI specialists and researchers to evaluate and address. Access to CI care is inherently complex, as it requires transdisciplinary long-term care which is provided by different types of specialists potentially in different locations over the course of a patient's life. A patient's access to any type of healthcare, along with CI care, can be restricted by a variety of different geographic and socioeconomic position (SEP) factors. The geographic location of a patient's household affects a patient's access to CI care. Certainly, CI is not an accessible hearing loss treatment option for every country; however, access to CI care can be exceedingly limited in rural or remote regions of any country. Limitations in rural hearing healthcare access is a pressing issue, as rural adults face a greater burden of age-related hearing loss compared with urban areas.^{14,15} Children residing in rural areas are also more likely to experience delays with every aspect of hearing healthcare including diagnosis of hearing loss, hearing aid amplification, and cochlear implantation.¹⁶⁻¹⁸ Delays in cochlear implantation have negative impacts on speech and language development in children.¹⁹ Furthermore, children from rural areas face greater difficulty in accessing rehabilitation services post-CI surgery due to a lack of local providers thereby increasing costs and travel for families.⁷ Similar findings in adult populations demonstrate that rural adults with hearing loss are delayed in CI compared with their urban peers, which is also related to lack of local access and greater travel distances to cochlear implant centers.²⁰

Insurance coverage or lack thereof represents a key factor influencing if and where healthcare is accessed across a wide range of medical disciplines. Insurance status and type of insurance has been used as a proxy for SEP but may be influenced by various factors including income, employment, or race and ethnicity.

There is evidence that non-white patients and minority ethnic groups are more likely to have public insurance coverage instead of private insurance coverage compared with white patients.²¹ While cochlear implantation is typically covered for children by Medicaid and most private insurance carriers in the United States, the same is not true for adults. Among adults who are insured through Medicaid, cochlear implant coverage is optional depending on the state's criteria. Currently, only approximately 60% of the States offer Medicaid coverage for cochlear implantation in adults.²² Even if CI Medicaid coverage is available, the quality of care that is delivered may be negatively impacted by barriers in obtaining upgraded or replacement equipment, poor reimbursement, limitations in locations of care, limitations in the number of covered appointments, and difficulty in authorization for care.²² In some states, a patient who received a Medicaid-covered cochlear implant as a child may grow out of service eligibility to receive necessary care once they transfer to adult Medicaid coverage.²² Furthermore, there is evidence that Medicaid patients are 50% less likely to receive sequential bilateral cochlear implants compared with those who were privately insured.²³ Furthermore, patients covered by Medicaid were five times more likely to experience post-surgery complications and less likely to comply with follow-up appointments compared with privately insured patients.^{7,23} From a clinic perspective, one major challenge of Medicaid coverage for CI is the low reimbursement rate throughout the continuum of care from surgery to rehabilitation and may lead to limiting access for these patients.²²

While the racial and ethnic health disparities may be influenced by various determinants, there are long-standing differences in access to and quality of healthcare services in a wide range of health conditions based on race and ethnicity. This racial and ethnic disparity has been demonstrated in adult CI research as patients of non-white racial groups are less likely to undergo CI surgery for cochlear implants despite being eligible candidates.²⁴ Similarly, children who are from non-white racial groups are delayed in CI regardless of their insurance type and coverage and are less

likely to be implanted before the age of 2 years compared with white children.²⁵ This racial/ethnic inequity is critical to address considering the developmental implications of early implantation among pediatric patients. In addition to access to care, unconscious bias or discrimination based on race and/or ethnicity from medical professionals may contribute and play a role in the quality of care that patients receive.²¹ Understanding how patients access and utilize hearing healthcare services and the barriers to that care will provide insight and possible solutions on how to increase equitable healthcare for hearing loss.

Education Access and Quality

Educational access and attainment influences health through various pathways. Education attainment intersects with other social determinants of health through its impact on income and higher wages which in turn affects access to healthy food, safe living environments, and insurance coverage.²⁶ Therefore, it is not surprising that there is a correlation between educational attainment and health outcomes in which lower education attainment is associated with poorer health outcomes. Adult CI outcomes have been directly correlated with educational attainment levels. In the area of pediatric CI, parent's educational level has been associated with the utilization of hearing healthcare and with the speech development outcomes of their child. Lower parental education attainment may predict underutilization of speech therapy following pediatric CI.²⁷

Health literacy is directly connected to educational attainment, which in concert influences behaviors that can promote health. Individuals with lower health literacy are less likely to obtain necessary care and may report more difficulty with finding providers compared with those with greater health literacy.²⁸ This inability to understand the language and systems of healthcare plays a role in hearing healthcare, as patients with low health literacy may not be aware of potential treatments of hearing loss and may not seek out hearing healthcare services.²⁹ Consequently, the delay in pursuing hearing services and their duration of hearing loss may influence their clinical outcomes.²⁹

Health literacy also influences the cost of care, as there is a strong correlation with lower health literacy and higher medical expenses among patients with hearing loss.^{30,31} English-fluency, while not directly connected to health literacy, strongly influences communication between patients and providers within the United States and may influence overall health outcomes. There is a link between language barriers, patient satisfaction, care adherence, and utilization of healthcare services.³² The language barriers between parents of deaf or hard of hearing children may influence the timing of hearing healthcare service delivery and therefore hearing outcomes of that child. Addressing the educational needs for patients needing cochlear implantation is a daunting issue; however, there are ample opportunities to promote health literacy of individual patients and the public regarding hearing loss and the evidence-based treatment options. This domain begs for innovation and intervention development.

Social and Community Context

Social support through systems and relationships as well as interactions with individuals and community members can also impact health outcomes.³³ Relationship support enhances overall health and decreases mortality, while the lack of social support and connectedness can precipitate adverse health outcomes. In hearing healthcare, the presence of a strong social support system impacts the timing and delivery of hearing healthcare.³⁴ Moreover, cultural differences and community perspectives on hearing loss can shape how individuals perceive their own hearing loss and the choices they make regarding treatment.³⁵ Social support systems also influence adherence with wearing hearing devices. Children lacking support and behavioral reinforcement at school and within the home are less adherent with wearing their cochlear implants.³⁶ Similarly, elderly adult patients who were nonadherent with cochlear implant usage also lack social support.³⁷ Overall, social support systems can influence hearing healthcare from the onset of the condition to the utilization of hearing devices and services. This social determinants of health (SDH)

domain forms the basis for comprehensive cochlear implant teams that incorporate key social support members and systems into cochlear implant counseling and care delivery.

In addition to support systems, social identity can affect how individuals seek and utilize care, thereby affecting health outcomes. Social identity is defined as an individual's sense of who they are in relation to their group or community.³⁸ Children and adults who are deaf or hard of hearing may experience dissonance in defining their social identity when coexisting among hearing peers and family members. School-aged children with cochlear implants may face challenges in developing close relationships with their peers and this may predispose them to mental health problems.³⁹ Furthermore, adults with hearing loss report marginalization and social isolation due to their hearing loss, which may influence the development of depression in these individuals.^{40,41} In some cases, cochlear implant users may face an identity crisis between the hearing community and the deaf community.⁴² Related to social identity, stigma around deafness and hearing loss heavily influences hearing health behaviors and outcomes. Stigma regarding hearing loss stemming from social contexts has been associated with poor mental health and overall decreased quality of life.^{42,43} Cochlear implant users who identify with the deaf community may perceive more discrimination than those who identify with the hearing world.⁴⁴ In addition to the discrimination based on hearing status, cochlear implant users from non-white racial and ethnic groups experience collateral discrimination.⁴⁴ Discriminatory policies and practices based on social contexts or identity influence not only individual health and healthcare but also other public health due to the impact on other social determinants of health, such as employment, housing, and education.²¹

Economic Stability

Economic stability can influence health outcomes both individually and within a household. Elements of economic stability include employment and income, SEP, as well as food and housing security. These elements can im-

part one's health through various avenues. First, employment directly affects a household's economic stability by providing not only income but also insurance coverage and other benefits. An employed individual or household could still have a low SEP and thereby limited access and availability of information and resources to manage health conditions, such as hearing loss. Patient or families with significant economic instability may not prioritize health and health-care services. Even when financial resources are made available to lower SEP families, those resources are often underutilized.⁴⁵ Families of deaf or hard of hearing children or adults who live closer to the poverty line are less likely to utilize a wide range of medical services, including hearing healthcare.^{46,47} Children from lower-income households are less likely to receive a cochlear implant, in spite of having a higher prevalence of hearing loss compared with those from higher-income families.⁴⁸ Moreover, lower family SEP has been associated with delayed cochlear implantation among children younger than 3 years.⁴⁹ Even after implantation, pervasive disparities remain for CI users of low-income households. Patients from a lower SEP background are more likely to experience postoperative complications, to be nonadherent with follow-up appointments, and to receive only unilateral and not bilateral sequential CI.²³ Furthermore, those same patients experience poorer speech and language outcomes post-CI compared with those of a higher SEP background.⁵⁰ Similarly, adult patients of lower SEP demonstrate poorer speech perception gains after cochlear implantation.⁴⁷

Families of low economic stability also face other challenges that affect health outcomes, such as limited food and housing security. Families who live close to the poverty line are more likely to face food insecurity and have limited access to healthy foods. This is amplified for non-white racial and ethnic groups.⁵¹ Food insecurity is also more prevalent among those with hearing loss than those with normal hearing.⁵² It is intuitive that individuals with lower incomes are also more likely to experience homelessness; however, racial and/or ethnic status influences homeless as demonstrated by the estimate that 40% of the homeless population are African American.⁵³ This is pertinent

because homeless adults tend to have a higher prevalence of chronic diseases, including hearing loss, and experience poorer access to care due to barriers such as lack of health insurance, prioritization of other physical needs, and discriminatory practices by the healthcare system toward this population.⁵⁴ Furthermore, awareness regarding the types and availability of hearing-related resources is poor among homeless adults.⁵⁵ In spite of the availability of cutting edge technology, the hearing healthcare field faces a great dilemma in engaging a diverse population with a wide range of socioeconomic resources and delivering affordable care in a culturally acceptable way.

Neighborhood and Physical Environment

While homelessness represents extreme challenges for health, the location and quality of housing can also influence one's health either positively or negatively. There is a direct relationship between home and neighborhood improvements and overall health within a community.⁵⁶ Poor drinking water, mold, lead exposure, pests, environmental exposures, second-hand smoke exposure, and inadequate heating/cooling are housing condition factors that can negatively affect health. While this SDH domain may seem indirectly related to cochlear implantation outcomes and care, it is feasible that environmental exposures, such as high levels of noise, or overall poor living conditions could increase the chances of developing chronic diseases or infectious diseases and could thereby influence the development or progression of hearing loss. It is valuable to consider this domain in relation to the other domains and the overall health and ability of cochlear implant recipients to pursue a healthy lifestyle. The established neighborhood conditions such as types and access to schools, employment opportunities, crime rates, food access, and healthcare infrastructure are all aspects of neighborhoods where cochlear implant recipients live and each of these factors impact the health of these patients. Again, racial and ethnic inequities are long-standing persistent issues based on neighborhood resources and stability as non-white racial ethnic groups make up a higher population

percentage in neighborhoods with lower resources that could promote health. Consequently, there is a shortage of hearing healthcare specialists in these same resource-poor neighborhoods. For example, transportation to healthcare clinics may be lacking in resource-poor neighbors. This is significant as decreased access to personal or public transportation, which is more common among non-white racial and ethnic groups, directly affects utilization of healthcare and thereby overall health.^{57,58} When hearing specialists neither live nor physically work within these neighborhoods, those community members lack a sense of trust, connection, and engagement with overall hearing healthcare. This physical neighborhood disconnect with cochlear implant centers is difficult to overcome, but opportunities are present to proactively engage key stakeholders and community members to be a part of making meaningful linkages with hearing healthcare teams.⁵⁹

DISCUSSION

This review of the social determinants of health serves to promote awareness of how these factors can influence cochlear implantation and complex hearing healthcare access, utilization, and delivery. While this explanation and discussion of the factors within each domain above is not exhaustive, it provides a framework to inform a more comprehensive understanding of the factors beyond the cochlea and underlying biology that influence hearing health and healthcare. It is critical for providers and researchers to recognize how the social determinants of health influence equity within hearing healthcare and explore unstudied aspects of this framework. Furthermore, this framework can provide mechanistic explanations for variations in outcomes following cochlear implantation. The social determinants of health can provide critical information and insight into the factors that influence hearing health outcomes and each of these domains can be targeted to promote optimal CI-related outcomes for all.

It is difficult to address SDH-rooted disparities without measuring SDH factors and these measures are not part of cochlear implant candidacy evaluations. Although it may not be a

part of traditional evaluation of hearing health-care specialists, providers can utilize a wide array of validated assessment tools to collect social determinant health data on cochlear implant candidates and users. For example, the Centers for Medicare and Medicaid Services Accountable Health Communities created the Health-Related Social Needs Screening Tool.⁶⁰ This 10-item questionnaire gathers data on Medicare and Medicaid patients' social needs related to the different five social determinants of health domains to inform clinical decision-making and potentially impact health outcomes and healthcare costs. The National Association of Communication Health Centers also developed a tool called the "Protocol for Responding to and Assessing Patients' Assets, Risk and Experiences (PRAPARE)."⁶¹ This 21-item tool is a much more comprehensive set of measures that are rooted in public health research and informed by stakeholder input. This inventory focuses on areas where action can be taken to address inequities from a public health perspective. This measure could easily be incorporated into CI candidacy evaluations and could inform CI teams about potential factors that could influence outcomes. A third tool that is publicly available is the Social Needs Screening Tool designed by the American Academy of Family Physicians as part of their EveryOne Project.⁶² This 15-item tool is rooted in clinical practice and has been used to identify basic barriers to care and underlying social needs facing patients. This information can be used to mobilize resources to address those needs in a timely fashion. Further study is needed in this area regarding the value and utility of this information for CI teams and how these data may correlate with cochlear implantation outcomes and if targeting these SDH domains will influence equity in cochlear implantation. In addition to these different quantitative measures of social determinants of health, hearing-related research would benefit from incorporation of mixed methodology which utilizes qualitative methods to better define and describe the complex and interconnected nature of these domains on health. To increase the equitable utilization of cochlear implants and maximize hearing health for all, leaders in cochlear implantation are encouraged to con-

sider and measure factors from each domain of the social determinants of health in their patients and develop informed targeted interventions and programs that address those needs. Comprehensive CI care extends far beyond the cochlea and incorporating social determinants of health information into how care is given and to whom care is given will promote health equity for diverse populations and communities.

CONCLUSION

The five domains of the social determinants of health impact hearing health and healthcare in a wide array of mechanisms over the lifespan. Factors from these domains influence how and when patients receive cochlear implants and can be used in part to explain varying outcomes following cochlear implantation. While collection of SDH data has not been a core component of CI candidacy or postoperative outcome measures, there is a need to better understand how these social determinants of health affect patients' access and utilization of CI-related services. This information can be used by CI teams to develop and implement interventions, programs, and policies that address disparities affecting their patients. Several validated tools can be used to systematically evaluate health-influencing factors from these five domains. Equity in cochlear implantation access, utilization, and outcomes is dependent on whether this information is considered and used.

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CONFLICTS OF INTEREST

There are no conflicts of interests with the content of this manuscript. The authors have no other financial relationships or conflicts of

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