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Country Differences in Older Men’s Hearing Difficulty Disadvantage

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Abstract

Objectives: Hearing difficulty is prevalent in older adulthood and projected to increase via global aging, particularly among men. Currently, there is limited research on how this gender disparity might vary by country.

Methods: Using 2018 data (n=29,480) from the Health and Retirement Study (HRS) international family of studies, we investigate gender disparities in hearing difficulty among respondents ages 55–89 from the United States (n=12,566), Mexico (n=10,762), and Korea (n=6,152) with country-specific ordinal logistic regression models that progressively adjust for demographic, social, and health indicators.

Results: In the United States, men’s hearing difficulty disadvantage was consistently observed. In Mexico, men’s hearing difficulty disadvantage was explained by the interactive effect of gender and age group but resurfaced after adjusting for comorbidities. In Korea, there was consistently no gender difference in hearing difficulty.

Discussion: Our results illustrate highlight the heterogeneity in older men’s hearing difficulty disadvantage among a diverse group of aging countries.

Keywords

age group; comorbidities; disablement process; global aging; hearing loss

BACKGROUND

Hearing loss is increasingly being recognized as a global health issue (Wilson et al., 2017). Hearing loss occurs when any part of the auditory (hearing) system does not function properly, resulting in a partial or complete inability to hear sounds in one or both ears (West et al., 2020). Hearing loss can be caused by a variety of factors, including damage to

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the auditory system, age-related changes, genetic predisposition, noise exposure, or certain medical conditions. In 2019, 20.3% of the world's population (1 in 5 people) reported hearing loss, with an estimated 56.1% expected by 2050 (Haile et al., 2021). Hearing loss is more common at older ages around the world, with 62.1% of people with hearing loss aged 50 or older (Haile et al., 2021). Hearing loss is the third leading cause of years lived with disability for people of all ages and the leading cause for individuals ages 70 and older (Haile et al., 2021), underscoring the importance of understanding the burden of hearing loss in a rapidly aging world. Research has also documented that hearing loss is associated with an extensive array of negative outcomes, including depression, anxiety, social isolation, poorer cognition, and worse self-rated health (Contrera et al., 2017; Cutler & Ilinca, 2020; Shukla et al., 2020; Wells et al., 2020; West, 2017).

Despite the prevalence and negative impacts of hearing loss among older adults, there are limited country comparisons of its prevalence (Tsimpida et al., 2023), thus precluding our ability to understand how cultural and contextual factors may shape patterns of hearing difficulty. As has been stated in other fields, country comparisons of population patterns offer different, oftentimes better, understandings of the quality and quantity of health inequities (Ólafsdóttir & Beckfield, 2020) and are becoming more common as comparable national data have become available (Cutler & Ilinca, 2020; Hong et al., 2020). It follows that country comparisons of hearing difficulty could have implications for identifying and potentially reducing the global burden of hearing difficulty. One primary way country comparisons could improve our knowledge of hearing difficulty is by contextualizing gender-related differences in hearing. Prior research documents that men of all ages in the United States (U.S.) are at increased risk for both incident hearing loss and a greater prevalence of hearing loss compared to women (Agrawal et al., 2008; Hoffman et al., 2017, 2019). Older men's hearing loss disadvantage also appears globally such as in Canada (Mick et al., 2021), Australia (Mitchell et al., 2011), and throughout Europe (Hansen et al., 2024)

Studying these gender differences by country is important for several reasons. First, identifying country- and gender-specific risk factors for hearing issues can aid in the development of preventive strategies. If certain economic, health, and social factors contribute more significantly to hearing difficulty in one gender in one or more countries, targeted awareness campaigns and workplace interventions can be implemented. For instance, gender roles and cultural norms may lead to differential exposure to risk factors over the life course that negatively impacts men more than women (Reavis et al., 2023). This may present as differential occupational noise exposure in the U.S. where men have traditionally been more likely than women to be employed in noisy occupations such as manufacturing, construction, and mining (Lie et al., 2016; Themann & Masterson, 2019). Studying these differences by country can provide insights into the societal context, helping to design interventions that are culturally sensitive and account for gender-specific challenges. Second, recognizing gender differences internationally may also influence the development of tailored treatment approaches. Sex-linked biological factors may make men more vulnerable to hearing difficulty, as research has shown that estrogen and its signaling pathways may play a protective role for women (Reavis et al., 2023). Thus, biological factors that differ between genders may impact the effectiveness of certain treatments and medications. Finally, this topic has implications for health care disparities. Proper

evidence enables health care providers and policymakers to develop targeted interventions and ensure that both men and women have equal access to preventive measures, diagnosis, and treatment. This is particularly important in light of findings from a systematic review that there is limited inclusion of women in clinical trials that evaluate the management of hearing loss (Pittman et al., 2021). Taken together, research on gender differences in hearing difficulty by country can help identify gaps in current knowledge and areas that require further investigation which, in turn, can guide future research efforts and resource allocation.

Hearing loss in older adults is associated with various demographic, health, and social factors. Hearing loss is common among older adults, especially the oldest age groups (Goman & Lin, 2016). Those with lower levels of education generally have greater reports of hearing loss than those with higher levels of education (Goman et al., 2020; Tsimpida et al., 2023; West & Lynch, 2021). Various social characteristics have been found to be associated with greater hearing loss among older adults such as being unmarried (Garcia Morales et al., 2023), small social network sizes (Ogawa et al., 2019), lower wealth (West, 2017), and rural residence (Johnson, 2004). Also, older adults with comorbidities report higher rates of hearing loss, especially those with arthritis, dementia, depression, diabetes, heart problems, and hypertension (Besser et al., 2018; Deal et al., 2019).

Per the existing literature, we examine men's hearing difficulty disadvantage by country (i.e., U.S.; Mexico; Korea) and control for demographic, social, and health indicators that could help explain this gender disparity. Previous research in this area has primarily focused on the occupational conditions that put men at higher risk of hearing loss than women (Kovalova et al., 2016; Lie et al., 2016; Nelson et al., 2005). We build on this area of research by examining men's hearing difficulty disadvantage among a culturally and economically diverse group of aging countries to help contextualize what other factors inform this gendered phenomenon.

METHODS

Data

The current analysis draws on three existing, nationally representative, prospective surveys of older adults with internationally coordinated survey instruments: the Health and Retirement Study (HRS) from the U.S. (Sonnega et al., 2014), the Mexican Health & Aging Study (MHAS) (Wong et al., 2017), and the Korean Longitudinal Study of Ageing (KLoSA) (Boo & Chang, 2006). We restricted our sample to those ages 55–89 (n=33,568) due to the youngest 2018 KLoSA respondents being 55 years old and to ages 89 and younger to minimize the potential influence of selective survival at advanced ages. We first removed respondents who were missing reports of hearing difficulty (n=1,045) those who reported being “legally deaf” (n=4) (see explanation in next paragraph). Following, we removed respondents who reported hearing aid usage (n=2,491) to help capture reports of hearing difficulty that were not influenced by an assistive device as well as those missing any other covariate (n=555), leading to an analytical sample of n=29,480. The sample sizes for each country are as follows: United States (n=12,566), Mexico (n=10,762), and Korea (n=6,152).

Dependent Variable

Respondents in all three surveys were asked to provide a self-report of their hearing albeit with slightly different response options. HRS respondents were asked, “Is your hearing excellent, very good, good, fair, or poor?” and responded on a 5-point scale (“excellent”, “very good”, “good”, “fair”, “poor”). MHAS respondents were asked, “How is your hearing/auditory range?” and responded on a 6-point scale (“excellent”, “very good”, “good”, “fair”, “poor”, “legally deaf”). KLoSA respondents were asked, “How good is your hearing?” and responded on a 5-point scale (“very good”, “good”, “fair”, “poor”, and “very poor”). We dropped the “legally deaf” responses from MHAS (n=4) so that all three surveys could be analyzed with a 5-point Likert item. We renamed the KLoSA responses to match the HRS and MHAS. As such, across all three countries, a higher score indicates greater hearing difficulty: excellent=1, very good=2, good=3, fair=4, and poor=5.

Independent Variable

Gender.—Respondents were asked to report their sex (male; female) which we labeled as men (reference) and women, respectively.

Covariates

We adjusted for demographic, socioeconomic, health, and social characteristics related to hearing difficulty. *Age* is a continuous variable that ranges from 55–89. To test for generalizability and possibly top-code all countries at age 90, we initially administered a sensitivity analysis (not shown) to explore gender differences in visual difficulty at ages 90+ by country (i.e., Korea; Mexico; U.S.). However, we only observed a gender difference in visual difficulty at ages 90+ in the U.S. Due to the lack of generalizability at ages 90+, we omitted respondents ages 90+ from the sample. *Age Group* is a categorical variable composed of seven categories: 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and 85–89. *Education* is a categorical variable, harmonized by the Gateway to Global Aging Data (GGAD, 2023), that measures three educational attainment groups: less than lower secondary (reference), upper secondary/vocational training, and tertiary education. *Marital Status* is a categorical variable that was recoded to measure three groups: married/partnered (reference), separated/divorced/never married, and widowed. We combined the separated/divorced and never married respondents into the same category due to KLoSA having a particularly small number of respondents who reported being never married (n=55). *Place* is a dichotomous measure that indicates whether the respondent lives in an urban (reference) or rural locality. *Household Size* is a count variable of the number of people living in the respondent’s residence (range: 1–17). *Household Wealth* is a continuous variable that measures total assets in the home in the country’s currency: HRS=nominal U.S. dollars (USD); MHAS=nominal pesos; and KLoSA=10,000 Korean won. We harmonized these measures by converting reports from MHAS and KLoSA to USD while considering the 2018 average conversion rate of the Mexican peso (Exchange Rates, 2024a) and Korean won (Exchange Rates, 2024b). *Comorbidities* is a count variable that measures if respondents reported any of the six following diagnoses: hypertension, diabetes, lung condition, heart condition, stroke, and arthritis (range: 0–6).

Missingness Analysis

Supplemental Table 1 shows missing variables by country. There were 972 missing reports of hearing difficulty from Mexico due to a skip pattern assigned to MHAS proxy respondents. We compared descriptive statistics between Mexican respondents who answered the hearing difficulty question versus those missing this variable. Compared to those who did not report their hearing, those who did and were sequentially included in the current study had slightly fewer women respondents (−2.7%) as well as a younger average age (−3.8 years). Per these small demographic differences between the MHAS sample that did not answer the hearing difficulty question versus those who did, we retained Mexico in our analyses.

Analytic Strategy

First, we computed weighted descriptive statistics for our sample by country and gender, with t-tests to analyze gender differences by country. Next, we used age group-specific linear regression models by country to test for gender differences in reports of hearing difficulty. Finally, we computed country-specific analyses with progressively adjusted ordinal logistic regression models that test for gender differences in reporting hearing difficulty. In these models, we first estimated reports of hearing difficulty for men and women while controlling for and age group (Model 1). We then sequentially added blocks of covariates to determine if certain factors were more useful in explaining observed differences in hearing difficulty, including an interaction term between gender and age group (Model 2), social factors (i.e., education; marital status; place; household size; logarithm odds of household wealth) (Model 3), and comorbidities (Model 4). All analyses were conducted in Stata, release 18 standard edition (SE) and accounted for complex survey design using sample weights.

RESULTS

Sample Characteristics

Table 1 presents the sample characteristics by country and gender, with p-values demonstrating statistically significant gender differences. Men reported significantly higher rates of hearing difficulty in the U.S. and Mexico but not Korea. Women reported significantly higher rates of less than upper secondary education in Mexico and Korea. Reports of upper secondary education/vocational training were significantly higher among women in the U.S. but significantly higher among men in Mexico and Korea. Rates of tertiary education were significantly higher for men in all three countries. Men were statistically significantly more likely to be married/partnered than women in all three countries whereas women were more likely to be widowed. Women were significantly more likely to be divorced/separated/never married than men in the U.S. and Mexico, though men were significantly more likely in Korea. In Mexico, men were significantly more likely than women to be rural residents. Men lived in significantly larger households than women in the U.S. and Korea but not in Mexico. Men lived in households with significantly greater wealth than women in all three countries. Women reported significantly higher comorbidity counts in all three countries.

Gender Differences by Country and Age Group

To assess men's hearing difficulty disadvantage at older ages, we examined the gender difference of hearing difficulty by country and age group (Figure 1). All mean scores of hearing difficulty by country, age group, and gender can be found in Supplemental Table 2. In the U.S. and Mexico, men consistently reported more hearing difficulty than women across all age groups. In the U.S., men's hearing difficulty disadvantage was statistically significant across every age group: 55–59 ($p=0.000$), 60–64 ($p=0.000$), 65–69 ($p=0.000$), 70–74 ($p=0.000$), 75–79 ($p=0.000$), 80–84 ($p=0.004$), and 85–89 ($p=0.035$). In Mexico, the difference in men's hearing difficulty disadvantage fluctuated by age group but was only statistically significant at ages 70–74 ($p=0.000$) and 80–84 ($p=0.000$). In Korea, men reported greater rates of hearing difficulty than women at most ages, except for ages 55–59 and 85–89, although none of these gender differences were statistically significant.

Multivariable Analyses

Table 2 shows adjusted ordinal logistic regression odds ratios of reporting hearing difficulty among respondents in the U.S. In Model 1, men reported a statistically significant greater odds of hearing difficulty than women ($OR=1.51$; $CI=1.41, 1.61$; $p=0.000$). Compared to respondents ages 55–59, statistically significant greater odds of hearing difficulty were reported among all other age groups: 60–64 ($OR=1.24$; $CI=1.13, 1.37$; $p=0.000$), 65–69 ($OR=1.35$; $CI=1.23, 1.49$; $p=0.000$), 70–74 ($OR=1.37$; $CI=1.22, 1.53$; $p=0.000$), 75–79 ($OR=1.69$; $CI=1.51, 1.89$; $p=0.000$), 80–84 ($OR=2.17$; $CI=1.92, 2.46$; $p=0.000$), and 85–89 ($OR=2.57$; $CI=2.17, 3.03$; $p=0.000$). Adding the gender and age group interaction term (Model 2) slightly attenuated the gender difference but did not explain men's hearing difficulty disadvantage, nor were there any statistically significant differences among the gender and age group interaction groups when compared to women ages 55–59. However, the odds of hearing difficulty slightly decreased among respondents ages 60–64 ($OR=1.21$; $CI=1.06, 1.37$; $p=0.003$) and 70–74 ($OR=1.27$; $CI=1.10, 1.47$; $p=0.002$).

Adding social factors (Model 3) also did not help explain men's hearing difficulty disadvantage. However, compared to respondents with less than lower secondary education, those with upper secondary education/vocational training ($OR=0.55$; $CI=0.50, 0.60$; $p=0.000$) and tertiary education ($OR=0.39$; $CI=0.35, 0.43$; $p=0.000$) reported a statistically significant lower odds of hearing difficulty. Compared to married/partnered respondents, greater odds of hearing difficulty were reported among those who were widowed ($OR=1.13$; $CI=1.02, 1.25$; $p=0.021$). Compared to urban respondents, rural respondents had a higher odds of hearing difficulty ($OR=1.19$; $CI=1.10, 1.28$; $p=0.000$). Household size had a positive association with the odds of reporting hearing difficulty ($OR=1.06$; $CI=1.03, 1.09$; $p=0.000$). The logarithm odds of household wealth had a negative association with the odds of reporting hearing difficulty ($OR=0.98$; $CI=0.97, 0.98$; $p=0.000$). Also, the odds of reporting hearing difficulty significantly increased among those ages 70–74 ($OR=1.31$; $CI=1.13, 1.53$; $p=0.000$), men ages 70–74 ($OR=1.28$; $CI=1.01, 1.62$; $p=0.041$), and men ages 75–79 ($OR=1.27$; $CI=1.01, 1.60$; $p=0.041$).

Finally, in Model 4, adding comorbidities did not help explain men's hearing difficulty disadvantage. However, comorbidities had a positive association with the odds of reporting

hearing difficulty (OR=1.20; CI=1.16, 1.23; p=0.000). Also, the odds of reporting hearing difficulty were statistically significantly lowered among those ages 60–64 (OR=1.16; CI=1.02, 1.31; p=0.024) and ages 65–69 (OR=1.22; CI=1.07, 1.39; p=0.002). Also, respondents ages 70–74, men ages 70–74, men ages 75–79, and widows no longer had a statistically higher odds of hearing difficulty.

Table 3 shows adjusted ordinal logistic regression results among respondents in Mexico. In Model 1, men reported a statistically significant greater odds of hearing difficulty than women (OR=1.25; CI=1.16, 1.34; p=0.000). Compared to those ages 55–59, a statistically significant greater odds of hearing difficulty were reported among all other age groups: 60–64 (OR=1.25; CI=1.11, 1.39; p=0.000), 65–69 (OR=1.58; CI=1.41, 1.77; p=0.000), 70–74 (OR=1.74; CI=1.55, 1.94; p=0.000), 75–79 (OR=2.16; CI=1.90, 2.45; p=0.000), 80–84 (OR=3.24; CI=2.78, 3.79; p=0.000), and 85–89 (OR=3.91; CI=3.16, 4.84; p=0.000). Adding the gender and age group interaction term (Model 2) fully explained men's hearing difficulty disadvantage. Compared to women ages 55–59, the odds of hearing difficulty were significantly higher among men ages 70–74 (OR=1.49; CI=1.19, 1.87; p=0.000) and men ages 80–84 (OR=1.70; CI=1.24, 2.31; p=0.000). Also, those ages 60–64 no longer had a statistically significant different odds of reporting hearing difficulty.

Adding social factors (Model 3) did not contribute to a gender difference in the odds of hearing difficulty. However, compared to those with less than lower secondary education, those with upper secondary education/vocational training (OR=0.67; CI=0.55, 0.81; p=0.000) and tertiary education (OR=0.54; CI=0.48, 0.61; p=0.000) reported a statistically significant lower odds of hearing difficulty. Compared to married/partnered respondents, those who were divorced/separated/never married had a lower odds of hearing difficulty (OR=0.87; CI=0.78, 0.98; p=0.019). Compared to urban respondents, rural respondents had statistically significant higher odds of hearing difficulty (OR=1.14; CI=1.05, 1.23; p=0.001). Household wealth had a negative association with the odds of reporting hearing difficulty (OR=0.98; CI=0.97, 0.99; p=0.000). Also, the odds of reporting hearing difficulty statistically significantly decreased among men ages 70–74 (OR=1.45; CI=1.16, 1.82; p=0.001) and men ages 80–84 (OR=1.61; CI=1.18, 2.20; p=0.003). Adding comorbidities (Model 4) contributed to men's statistically significant greater odds of hearing difficulty (OR=1.18; CI=1.01, 1.39; p=0.037). Comorbidities had a positive association with the odds of reporting hearing difficulty (OR=1.19; CI=1.16, 1.23; p=0.000). The odds of reporting hearing difficulty were significantly lower among those ages 65–69 (OR=1.29; CI=1.11, 1.50; p=0.001) and age 70–74 (OR=1.23; CI=1.05, 1.44; p=0.011), while the odds hearing difficulty significantly increased among rural respondents (OR=1.16; CI=1.07, 1.26; p=0.000). There was no longer a statistically significant different odds of hearing difficulty for respondents who were divorced/separated/never married.

Table 4 shows adjusted ordinal logistic regression results among respondents in Korea. In Model 1, there was no statistically significant gender difference in the odds of reporting hearing difficulty. However, compared to respondents ages 55–59, a statistically significant greater odds of hearing difficulty were reported among all other age groups: 60–64 (OR=1.21; CI=1.03, 1.42; p=0.018), 65–69 (OR=1.88; CI=1.60, 2.21; p=0.000), 70–74

(OR=2.71; CI=2.30, 3.20; p=0.000), 75–79 (OR=4.52; CI=3.82, 5.34; p=0.000), 80–84 (OR=7.09; CI=5.86, 8.58; p=0.000), and 85–89 (OR=11.68; CI=8.99, 15.18; p=0.000).

Adding the gender and age group interaction (Model 2) did not contribute to a gender difference in the odds of reporting hearing difficulty. However, compared to women ages 55–59, the odds of hearing difficulty were statistically significantly lower among men ages 70–74 (OR=0.71; CI=0.51, 0.99; p=0.041). Adding social factors (Model 3) did not contribute to a gender difference in the odds of hearing difficulty. However, compared to those with less than lower secondary education, those with upper secondary education/vocational training (OR=0.78; CI=0.69, 0.89; p=0.000) and tertiary education (OR=0.71; CI=0.59, 0.85; p=0.000) reported a statistically significant lower odds of hearing difficulty. Compared to married/partnered respondents, lower odds of hearing difficulty were reported among those who were widowed (OR=0.84; CI=0.72, 0.98; p=0.022). Household wealth had a negative association with the odds of reporting hearing difficulty (OR=0.99; CI=0.98, 1.00; p=0.018). Also, the odds of reporting hearing difficulty were no longer statistically significantly different among respondents ages 60–64 and men ages 70–74. Adding comorbidities (Model 4) did not contribute to a gender difference in the odds of reporting hearing difficulty. Comorbidities had a positive association with the odds of reporting hearing difficulty (OR=1.16; CI=1.10, 1.22; p=0.000).

DISCUSSION

Our results highlight the heterogeneity of older men's hearing difficulty disadvantage among a diverse group of aging countries. Specifically, men's hearing difficulty disadvantage was consistently observed and could not be explained by the covariates in the U.S. In Mexico, men's hearing difficulty disadvantage was explained by the interactive effect of gender and age group in Mexico but resurfaced after adjusting for comorbidities. In Korea, there was consistently no gender difference in hearing difficulty. Additionally, men's hearing difficulty disadvantage varied greatly by age group within each country. As such, our study underscores the utility of examining country differences in a rapidly aging world.

Results from the current study reveal notable gender differences by age group. In the U.S., men's hearing difficulty disadvantage was significant across all age groups, although these differences declined at older ages. In contrast, men's hearing difficulty disadvantage in Mexico increased at older ages and was only significant at certain age groups (i.e., 70–74; 80–84). In Korea, there was no gender difference in hearing difficulty within any age group. It is possible that Mexico's increase in men's hearing difficulty disadvantage at older ages is due to the country's recent increase in life expectancy (Aburto et al., 2018). As for Korea, it has been documented that older men have a higher prevalence of hearing difficulty than older women (Jun et al., 2015), although our observation of no gender difference within every age group warrants further examination. Overall, these findings should inspire future research that investigates what factors influence this notable distinction in non-Western contexts.

Our findings from Mexico conflict with existing literature that finds no gender difference in reports of hearing difficulty between older men and women in the state of Tlaxcala

(Graue-Hernández et al., 2019). In the current study, we drew on nationally representative data and found that older men in Mexico, indeed, have a hearing difficulty disadvantage. However, after including an interaction term between gender and age group, we no longer observed a gender difference; that is, compared to the youngest women, older men had notably higher odds of hearing difficulty and this pattern persisted when social and health factors were accounted for in the models. This finding indicates that Mexican men in advanced ages are at greater risk of hearing difficulty than women. Although adjusting for comorbidities reintroduced men's hearing difficulty disadvantage, our study and existing literature highlight that older women in Mexico have higher rates of comorbidity than older men in Mexico (Rojas-Huerta et al., 2022). Such findings have important implications, as knowing the demographics of individuals at higher risk for hearing loss can assist healthcare providers and policymakers in more effectively planning and allocating appropriate services for screening, prevention, diagnosis, and treatment. Future research should examine occupational history and health care access, as these concepts are highly gendered and associated with hearing loss (Garcia Morales et al., 2023; Lie et al., 2016; Themann & Masterson, 2019; Wilson et al., 2017).

The findings from Korea are not consistent with prior research using objective hearing loss measurements which tend to find that the prevalence of hearing loss is higher in men (Jun et al., 2015). More recent research has shown that being male is associated with the incidence of hearing loss, but not with the deterioration over time, as the authors called for more research into the sex differences in hearing loss (Oh et al., 2023). In our study, it is possible that these null gender findings are due to health policy change; specifically, in 2015, hearing aid subsidies from the National Health Insurance Service (NHIS) in South Korea increased by approximately \$1,000 USD which resulted in an increased prevalence of diagnosed hearing loss (Yoon et al., 2023). Moreover, this finding lends support to suggestions by other researchers that changing environmental and lifestyle factors may result in less stark differences in hearing loss between men and women (Homans et al., 2017). Overall, the heterogeneity in gender differences documented in the current study provides nuance to the existing literature that largely focuses on men's hearing difficulty disadvantage in Western, high-income countries (Agrawal et al., 2008; Hoffman et al., 2017, 2019; Mick et al., 2021; Mitchell et al., 2011).

Among all countries, the patterns of hearing difficulty were consistent with established socioeconomic gradients. Namely, those with lower levels of education had greater reports of hearing difficulty which is consistent with the existing literature (Goman et al., 2020; Tsimpida et al., 2023; West & Lynch, 2021). However, the effect of education on hearing difficulty varied by country. Specifically, reports of moderate and high education had a particularly strong effect on hearing difficulty in the U.S., was comparatively moderate in Mexico, and had the smallest effect in Korea. In the U.S., education level is a robust predictor of adult health. Adults with more education tend to have better overall health, live longer, spend more of their years in good health, and are less likely to develop morbidities and disability when compared to less educated adults (Hummer & Lariscy, 2011; Zajacova & Lawrence, 2018). Moreover, education is associated with a higher likelihood of being employed, better employment prospects, and having employment-related health insurance—all of which are resources that are more concentrated among more highly educated groups

in the U.S. (Ross & Wu, 1995). To the contrary, South Korea has experienced a more recent educational expansion, with provision of free primary education in 1959 and middle school between 1985 and 2005 (Ministry of Education - Republic of Korea, 2016). The increased level of average years of schooling and rate of this increase are higher in South Korea than most other Asian countries that are also rapidly developing (Lee & Francisco, 2010). Women, in particular, have made considerable strides in educational attainment in Korea, although these gains have not yet translated to better labor market outcomes (OECD, 2012).

We observed other social characteristics and their association with hearing difficulty: marital status, place, household size, and household wealth. First, marital status is important in the context of hearing difficulty as significant others serve a supporting role in the success of hearing healthcare (Hickson et al., 2014). Prior research has suggested that hearing function may decrease in response to spousal loss but that this association is not statistically significant (Song & Kim, 2024). In the current study, individuals experiencing widowhood had a high risk of hearing difficulty in the U.S. and Korea which may have negative implications for the uptake of hearing rehabilitation strategies as these populations age and experience widowhood.

Second, existing research indicates that place of habitation (rural versus urban living locations) has a marked impact on the prevalence of hearing loss (Johnson, 2004) as well as one's ability to seek or utilize hearing healthcare services (Chan et al., 2017). Consistent with this research, we found that rural residents in the U.S. and Mexico reported more hearing loss than urban residents. In contrast, there was no place of habitation difference in Korea which may be attributable to a steadily declining mortality gap in rural localities of Korea in recent decades (I. Kim, 2023). These results highlight the need to investigate barriers to care and to expand access to hearing healthcare for rural populations in the U.S. and Mexico.

Third, older adults with hearing loss have smaller social networks than their peers without hearing loss (Ogawa et al., 2019). In the current study, our social network proxy variable (household size) was only associated with hearing difficulty in the U.S. Household size is possibly sensitive to hearing loss in the U.S. due the high rates of independent living in Western societies (Mudrazija et al., 2020). Finally, we found that greater household wealth was protective of reporting hearing difficulty which aligns with past research (Tsimpida et al., 2023). Household wealth may be particularly important in the case of hearing difficulty, as access to medical care and health insurance can be resources in preventing hearing loss.

Comorbidities had a positive association with hearing difficulty in all three countries, a finding observed in other literature (Besser et al., 2018; Deal et al., 2019). This similarity across our sample strengthens support for the relationship between hearing loss and mortality among older adults (Genther et al., 2015). Prior studies have investigated the association between individual health conditions and hearing loss among older adults (Besser et al., 2018; Deal et al., 2019). Future research in this area would benefit from a similar approach to help globally inform preventative and curative measures related to hearing loss, particularly as it relates to men's hearing difficulty disadvantage.

This study is unique due to its investigation of men's hearing difficulty disadvantage among older adults from a culturally and economically diverse group of countries with nationally representative data. Our emphasis on country differences speaks to the disablement process by considering the intra- and extra-individual factors that inform functional limitations (Verbrugge & Jette, 1994). However, this study has some limitations that are largely due to the nature of conducting research with different surveys. First, respondent interpretation of the self-reported hearing difficulty variable likely varied at the country-level. For example, the English meaning of "fair", which translates to "*regular*" in Spanish, has different contextual interpretations (Viruell-Fuentes et al., 2011); therefore, given the response options, Mexican respondents were subject to reporting poorer hearing than those in the other three countries. Relatedly, pure-tone audiometry is viewed as the gold standard for assessing hearing sensitivity (West et al., 2020), but only self-reported measures of hearing difficulty were available in these datasets. This is not necessarily a major limitation, as research has also suggested that pure-tone audiometry may be less adept at capturing the lived experience of hearing difficulty (National Guideline Centre, 2018). Moreover, auditory tests require trained technicians, expensive equipment, and strict controls on background noise (Bagai et al., 2006), which makes them less accessible for assessing hearing in community-based settings. Second, we removed any respondent from our analysis who reported using a hearing aid. We did this to avoid reports of hearing difficulty being facilitated by assistive devices as well as due to the hearing difficulty questions asking respondents to include hearing aid usage in their self-reports. This particularly affected our U.S. sample, as 66.1% of those dropped from our sample due to hearing aid usage derived from this country and decreased the country's sample size by 11.6%. Third, previous research indicates that occupational stressors inform men's hearing difficulty disadvantage (Lie et al., 2016; Themann & Masterson, 2019); however, we did not have a harmonizable lifetime occupation variable with a low rate of missingness that could be used for this study. Finally, our sample from Mexico was limited due to a non-random skip pattern for proxy respondents; therefore, our findings from Mexico might be slightly biased.

We recommend that future research in this area could build on our findings using different approaches. First, since subjective versus objective reports of hearing loss may differ (Tsimpida et al., 2020), usage of an objective measure, such as pure tone audiometry (Haile et al., 2021), would provide a more precise measurement of hearing loss. Second, incorporating a more diverse set of countries, particularly those that are rapidly aging (i.e., Europe; South America), would help delineate the factors that universally and nationally contribute to men's hearing difficulty disadvantage. Finally, longitudinal research that focuses on men's hearing difficulty disadvantage by country would improve our understanding of cohort effects on hearing loss and illustrate if this gender disparity has changed over time.

CONCLUSION

We found heterogeneity in the health and social factors that influence older men's hearing difficulty disadvantage in three culturally and economically distinct countries. In Mexico, men's hearing difficulty disadvantage was explained by the interactive effect of gender and age group. In Korea, men's hearing difficulty disadvantage was not observed until

accounting for health factors. In the U.S., men's hearing difficulty disadvantage was consistently observed. Our study illustrates the utility of studying how various factors (i.e., age group; health) help explain older men's hearing difficulty disadvantage among different countries in a rapidly aging world.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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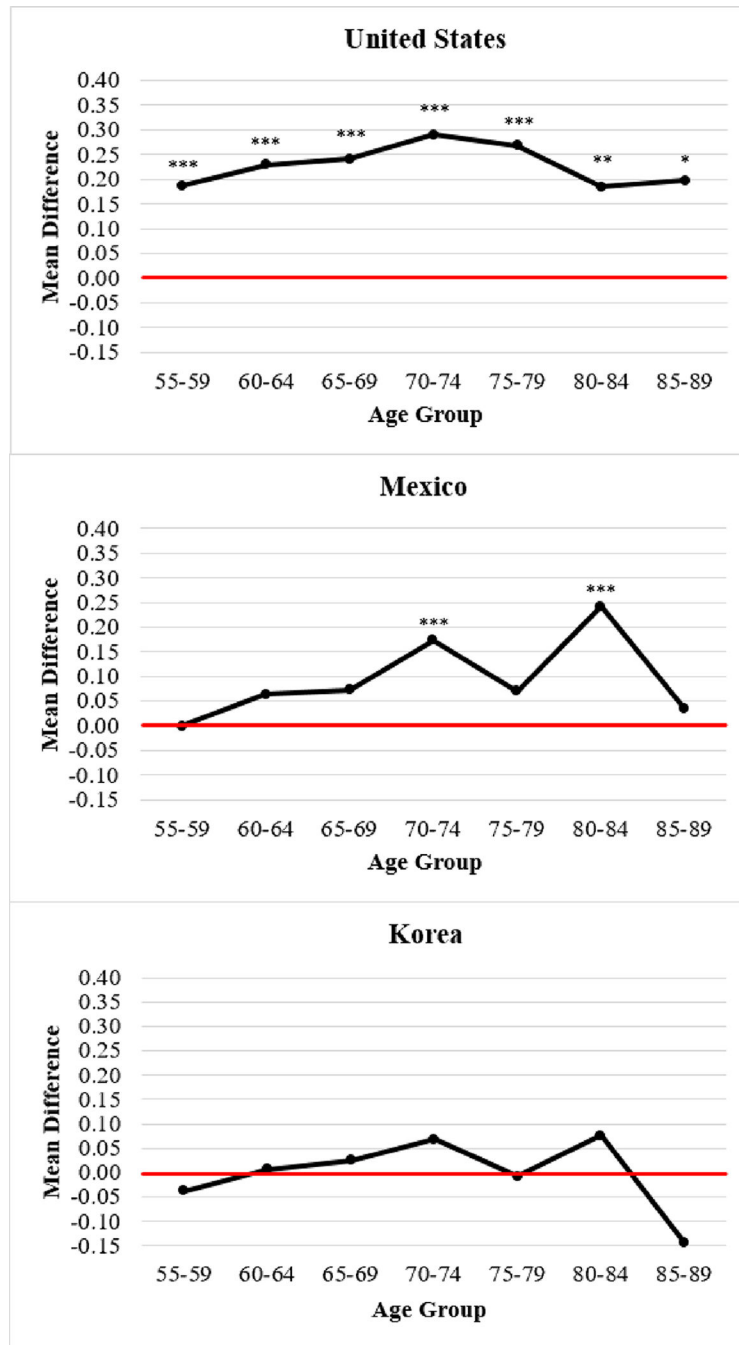


Figure 1. Gender Differences in Reports of Hearing Difficulty by Country and Age Group.
Note: Gender difference by age group = * p<0.05, ** p<0.01, *** p<0.001; Red line = gender equity

Table 1.

Prevalence of Sample Characteristics by Country and Gender (N=29,480)

	United States			Mexico			Korea		
	Men %/Mean(SD)	Women %/Mean(SD)	<i>P</i>	Men %/Mean(SD)	Women %/Mean(SD)	<i>P</i>	Men %/Mean(SD)	Women %/Mean(SD)	<i>P</i>
Hearing Difficulty [†]	2.73(1.03)	2.52(1.00)	0.000	3.24(0.93)	3.16(0.88)	0.000	2.48(0.76)	2.51(0.73)	0.006
Age [†]	66.77(8.94)	67.85(9.22)	0.000	68.15(8.61)	67.92(8.44)	0.000	68.1(8.87)	68.75(9.49)	0.000
<Upper Secondary Education	17.25%	16.99%	0.000	79.79%	89.20%	0.000	37.09%	63.77%	0.000
Upper Secondary/Vocational Training	55.51%	60.58%	0.000	4.68%	2.32%	0.000	42.56%	30.61%	0.000
Tertiary Education	27.24%	22.43%	0.000	15.53%	8.48%	0.000	20.35%	5.62%	0.000
Married/Partnered	73.75%	50.95%	0.000	81.65%	55.28%	0.000	90.44%	67.73%	0.000
Divorced/Separated/Never Married	19.52%	26.61%	0.000	8.21%	15.28%	0.000	4.82%	3.26%	0.019
Widowed	6.74%	22.44%	0.000	10.14%	29.44%	0.000	4.74%	29.01%	0.000
Rural	22.34%	23.52%	0.000	32.50%	28.58%	0.000	23.75%	24.85%	0.000
Household Size [†]	2.42(1.34)	2.24(1.31)	0.000	2.34(1.65)	2.36(1.71)	0.000	3.17(1.25)	2.95(1.34)	0.000
Household Wealth [§]	170,000	130,250	0.016	36,648	33,776	0.000	201,144	145,296	0.000
Comorbidities [†]	1.92(1.33)	2.04(1.32)	0.000	1.27(1.14)	1.72(1.19)	0.000	0.88(1.00)	1.14(1.12)	0.000
n=	5,062	7,504		4,726	6,036		2,594	3,558	

Note:

[†] = Mean

[§] = Median in United States dollars (USD)

P= Gender difference by country

Table 2. Adjusted Ordinal Logistic Regression Odds Ratios of Hearing Difficulty in the United States

	M1: Age Group		M2: Interaction		M3: Social		M4: Comorbidities	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Men	1.51	1.41-1.61	1.41	1.24-1.61	1.42	1.25-1.62	1.46	1.28-1.66
Age Group [55-59]								
60-64	1.24	1.13-1.37	1.21	1.06-1.37	1.20	1.06-1.36	1.16	1.02-1.31
65-69	1.35	1.23-1.49	1.31	1.15-1.49	1.35	1.18-1.53	1.22	1.07-1.39
70-74	1.37	1.22-1.53	1.27	1.10-1.47	1.31	1.13-1.53	1.14	0.98-1.33
75-79	1.69	1.51-1.89	1.59	1.38-1.84	1.57	1.35-1.82	1.32	1.14-1.54
80-84	2.17	1.92-2.46	2.17	1.85-2.55	2.07	1.75-2.45	1.76	1.48-2.09
85-89	2.57	2.17-3.03	2.55	2.08-3.12	2.34	1.89-2.89	2.00	1.61-2.48
Gender* Age Group [Women *55-59]								
Men *60-64			1.08	0.89-1.30	1.12	0.92-1.35	1.09	0.90-1.32
Men *65-69			1.08	0.88-1.32	1.13	0.92-1.38	1.11	0.91-1.35
Men *70-74			1.20	0.95-1.52	1.28	1.01-1.62	1.26	0.99-1.59
Men *75-79			1.16	0.92-1.45	1.27	1.01-1.60	1.25	0.99-1.57
Men *80-84			0.99	0.77-1.28	1.08	0.84-1.40	1.02	0.79-1.32
Men *85-89			1.00	0.70-1.42	1.17	0.82-1.67	1.09	0.76-1.55
Education [<Lower Secondary]								
Upper Secondary/Vocational Training			0.55	0.50-0.60	0.55	0.50-0.60	0.56	0.51-0.62
Tertiary Education			0.39	0.35-0.43	0.39	0.35-0.43	0.42	0.37-0.46
Marital Status [Married/Partnered]								
Divorced/Separated/Never Married			1.00	0.92-1.09	1.00	0.92-1.09	0.98	0.90-1.07
Widowed			1.13	1.02-1.25	1.13	1.02-1.25	1.09	0.99-1.21
Rural			1.19	1.10-1.28	1.19	1.10-1.28	1.17	1.08-1.26
Household Size			1.06	1.03-1.09	1.06	1.03-1.09	1.06	1.03-1.09
Household Wealth			0.98	0.97-0.98	0.98	0.97-0.98	0.98	0.98-0.99
Comorbidities							1.20	1.16-1.23

N=12,566

Note: OR = Odds Ratio; CI = Confidence Interval;

1000>d

1000>d
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5000>d
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Table 3. Adjusted Ordinal Logistic Regression Odds Ratios of Hearing Difficulty in Mexico

	M1: Age Group		M2: Interaction		M3: Social		M4: Comorbidities	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Men	1.25	*** 1.16 1.34	1.02	0.87 1.19	1.10	0.94 1.29	1.18	* 1.01 1.39
Age Group [55–59]								
60–64	1.25	*** 1.11 1.39	1.16	1.00 1.34	1.13	0.97 1.31	1.08	0.93 1.26
65–69	1.58	*** 1.41 1.77	1.47	*** 1.26 1.70	1.40	*** 1.20 1.63	1.29	** 1.11 1.50
70–74	1.74	*** 1.55 1.94	1.45	*** 1.24 1.69	1.37	*** 1.17 1.60	1.23	* 1.05 1.44
75–79	2.16	*** 1.90 2.45	1.95	*** 1.64 2.32	1.82	*** 1.53 2.17	1.61	*** 1.34 1.92
80–84	3.24	*** 2.78 3.79	2.57	*** 2.10 3.16	2.35	*** 1.90 2.91	2.07	*** 1.67 2.57
85–89	3.91	*** 3.16 4.84	3.88	*** 2.92 5.17	3.50	*** 2.61 4.69	3.15	*** 2.35 4.23
Gender* Age Group [Women *55–59]								
Men *60–64			1.17	0.93 1.47	1.15	0.92 1.45	1.17	0.93 1.47
Men *65–69			1.18	0.94 1.48	1.18	0.93 1.48	1.19	0.94 1.49
Men *70–74			1.49	*** 1.19 1.87	1.45	** 1.16 1.82	1.46	** 1.17 1.84
Men *75–79			1.25	0.97 1.61	1.21	0.94 1.56	1.20	0.93 1.56
Men *80–84			1.70	*** 1.24 2.31	1.61	** 1.18 2.20	1.59	** 1.16 2.17
Men *85–89			1.01	0.66 1.55	0.96	0.63 1.48	0.89	0.58 1.36
Education [<Lower Secondary]								
Upper Secondary/Vocational Training					0.67	*** 0.55 0.81	0.68	*** 0.56 0.83
Tertiary Education					0.54	*** 0.48 0.61	0.56	*** 0.50 0.63
Marital Status [Married/Partnered]								
Divorced/Separated/Never Married					0.87	* 0.78 0.98	0.90	0.80 1.01
Widowed					1.01	0.91 1.11	1.00	0.91 1.11
Rural					1.14	** 1.05 1.23	1.16	*** 1.07 1.26
Household Size					1.02	1.00 1.04	1.02	0.99 1.04
Household Wealth					0.98	*** 0.97 0.99	0.98	*** 0.97 0.99
Comorbidities							1.19	*** 1.16 1.23

N=10,762

Note: OR = Odds Ratio; CI = Confidence Interval;

1000>d

1000>d
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5000>d
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Table 4.
Adjusted Ordinal Logistic Regression Odds Ratios of Hearing Difficulty in Korea

	M1: Age Group		M2: Interaction		M3: Social		M4: Comorbidities	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Men	0.95	0.86 1.04	1.12	0.90 1.40	1.17	0.94 1.46	1.16	0.93 1.46
Age Group [55–59]								
60–64	1.21 *	1.03 1.42	1.31 *	1.06 1.62	1.23	0.99 1.53	1.17	0.94 1.45
65–69	1.88 ***	1.60 2.21	2.10 ***	1.69 2.61	1.87 ***	1.49 2.34	1.70 ***	1.36 2.13
70–74	2.71 ***	2.30 3.20	3.16 ***	2.53 3.94	2.76 ***	2.18 3.50	2.39 ***	1.88 3.05
75–79	4.52 ***	3.82 5.34	4.74 ***	3.82 5.88	4.07 ***	3.21 5.15	3.45 ***	2.71 4.40
80–84	7.09 ***	5.86 8.58	8.24 ***	6.45 10.54	7.15 ***	5.44 9.40	5.90 ***	4.45 7.82
85–89	11.68 ***	8.99 15.18	10.95 ***	7.97 15.05	9.44 ***	6.68 13.34	7.85 ***	5.52 11.15
Gender*Age Group [Women*55–59]								
Men*60–64			0.84	0.61 1.16	0.87	0.63 1.20	0.89	0.64 1.23
Men*65–69			0.77	0.55 1.07	0.80	0.57 1.11	0.82	0.59 1.14
Men*70–74			0.71 *	0.51 0.99	0.72	0.52 1.01	0.75	0.53 1.05
Men*75–79			0.90	0.64 1.27	0.91	0.64 1.28	0.95	0.67 1.34
Men*80–84			0.69	0.48 1.01	0.70	0.47 1.02	0.74	0.50 1.08
Men*85–89			1.31	0.76 2.24	1.28	0.74 2.21	1.33	0.77 2.29
Education [<Lower Secondary]								
Upper Secondary/Vocational Training					0.78 ***	0.69 0.89	0.81 ***	0.71 0.91
Tertiary Education					0.71 ***	0.59 0.85	0.74 ***	0.62 0.88
Marital Status [Married/Partnered]								
Divorced/Separated/Never Married					1.05	0.81 1.36	1.03	0.79 1.34
Widowed					0.84 *	0.72 0.98	0.83 *	0.72 0.96
Rural					1.07	0.95 1.20	1.09	0.97 1.22
Household Size					0.97	0.93 1.00	0.97	0.93 1.01
Household Wealth					0.99 *	0.98 1.00	0.99 *	0.98 1.00
Comorbidities							1.16 ***	1.10 1.22

N=6,152

Note: OR = Odds Ratio; CI = Confidence Interval;

1000>d

1000>d
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5000>d
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