

Self-reported hearing difficulty, subjective well-being and social relationships among older adults in Ghana

Alfred E Yawson^{1*}, John Tetteh¹, Isaac Adomako¹, Phaedra Yamson¹, Kafui Searyoh²,
George Mensah¹, Richard K Biritwum¹

¹Department of Community Health, University of Ghana Medical School, College of Health Sciences, University of Ghana, Accra, Ghana; ²Department of Surgery, Korle Bu Teaching Hospital, Korle-Bu, Accra, Ghana.

Received November 2019; Revised December 2019; Accepted January 2020

Abstract

Background: Hearing difficulty negatively impacts individual relationships with family and friends and other social relationships

Objective: This research was conducted to determine the factors significantly influencing self-reported hearing difficulty (SHD) and further to assess the influence of SHD on social relationship among older adults in Ghana.

Methods: World Health Organization's Study on Global AGEing and Adult Health Ghana dataset for older adults 50 yr. and above was used for this study. Social relationship and hearing difficulty were the primary and secondary outcomes respectively. A modified Poisson with Mahalanobis distance matching within propensity caliper was employed to determine the different influences on social relationships by SHD. All analysis was performed using the statistical software Stata Version 15 and with a confidence interval (CI) of 95%.

Results: The prevalence of SHD among older adults in Ghana was 19.5% (95% CI = 16.9-22.3). Rao-Scott test of association showed that all covariates (demographic characteristics, self-rated health, quality of life, life satisfaction and unhealthy lifestyle) were significantly associated with SHD ($p < 0.05$). Sensitivity analysis showed that, SHD predicted a significantly decreased probability count of social relationship among older adults with SHD [adjusted prevalence ratio (95% CI) = -0.08 (-0.15-0.02)]. Binary and ordinal outcomes showed that among the older adults with SHD, only 35% and 70% respectively were likely to have a good social relationship [adjusted odds ratio (aOR) (95% CI) = 0.65 (0.46-0.90) and aOR (95% CI) = 0.70 (0.51-0.96) respectively].

Conclusion: Overall, the prevalence of hearing loss in older adults in Ghana was 19.5%, and was higher among older adult females. This high prevalence of SHD had significant negative effect on social relationships among the older adults. In line with global efforts to reduce effect of hearing loss, it is imperative that, clinical assessment of hearing loss should always consider the social characteristics of the older adult.

Keywords: Older adults, self-reported hearing difficulty, social relationships

INTRODUCTION

Hearing difficulty, one of the four major conditions associated with disability globally, affects over 6.1% of the world's population. In all 432 million of these are adults and a greater proportion are 65 yr. and above [1-3]. It is projected that, by 2050, over 900 million people will have hearing difficulties and that approximately one-third of people aged 65 yr. and above would have hearing difficulty [3,4]. Unfortunately, the prevalence in this age group is highest in South Asia, Asia Pacific and sub-Saharan Africa [2,3]. Epidemiological surveys are scarce, particularly in low-income countries as a result of difficulty in performing field audiometric testing of hearing levels, as well as poor diagnosis and reporting. In addition, lack

of awareness of the condition and limited funds for population level surveys, compound the problem [5]. Multiple causes of hearing impairment have been identified to generally include congenital abnormalities and infections during the perinatal period, childhood infections, exposure to excessive or prolonged noise, head/neck injuries, and use of ototoxic medications, industrial solvents, certain nutritional deficiencies, genetic disorders and ageing [6,7]. Different methods are used to define and assess hearing impairment in surveys aimed at estimating the prevalence and consequences of hearing loss at the population level [2]. Usually, surveys use either subjective self-reported data on hearing and hearing problems, or objectively, through clinical audiometric testing; or a combination of these methods. Persons with hearing difficulty are more at risk of experiencing depression, anxiety, poor interpersonal and social relationships with reduced social networks scores, and hostility compared to individuals with no hearing difficulty [8,9]. Other pieces of evidence indicate that, hearing difficulty if untreated can

* Corresponding author

Email: aeyawson@ug.edu.gh, aeyawson@gmail.com

negatively impact individual relationships with family and friends and particularly with closest relations-spouses, children and caregivers [9–11]. Kamil et al., further suggested that, the association of demographic characteristics with self-reported hearing difficulty (SHD) should be considered by clinicians for optimal outcomes [12]. This research was conducted to determine the factors significantly influencing SHD and further assess the effect of SHD on social relationships and well-being among older adults in Ghana.

MATERIALS AND METHODS

The Ghana World Health Organization (WHO) Study on Global Ageing and Adult Health (SAGE) wave 2 data was used in this study. The study was conducted between 2014/2015 and executed in six lower-to-middle income countries including China, Ghana, India, Mexico, Russian Federation, and South Africa [13]. SAGE round of surveys covers a wide range of health indicators and used questionnaire-based surveys, anthropometric and clinical measurements as well as used of biomarkers [14,15]. The study involved a multistage cluster sampling design of 250 Primary Sample Units and 20 strata with sampling weights for each participant [13]. Details about the study design and procedures for data collection have been published elsewhere [16].

Study participants

Two study cohorts were involved in SAGE study; a nationally representative sample of adults aged 50 yr. and older, and a smaller comparative sample of persons aged 18–49 years. However, this analysis, involved only older adults aged 50 yr. and above. A total sample of 4735 respondents were involved for Ghana SAGE wave 2, however, 3575 older adults were used for this analysis, which was large enough to provide precise estimates for the population level outcomes).

Dependent variables

The secondary outcome of interest in this study involved Self-reported Hearing Difficulty (SHD). SAGE study asked participants whether in the last 30 days, how much difficulty did the participants have in “*hearing someone talking on the other side of the room in a normal voice?*” or “*how much difficulty did you have in hearing what is said in a conversation with one other person in a quiet room (even with your hearing aid on if you use one)?*” An index variable was generated by scoring a participant as Yes (answering yes for either of the two hearing questions) and 0 (otherwise). The primary outcome of interest involved in this study was social networking. In SAGE wave 2 study, respondents were asked how often in the last 12 mos they have engaged in social activities in 10 Likert scale questions with a recorded score ranging from 0–4. An index score ranging from 0–40 was generated for all participants with a weighted Mean \pm standard deviation (SD) of 18.4 ± 8.9 . Per the study objective, raw scores were further reclassified into binary and ordinal secondary outcomes. To improve reliability and internal consistency, the Jann Stata module was used to compute Cronbach's alpha for weighted data due to the design nature of SAGE 17. The overall test of reliability for social networking was very high and of good quality ($\alpha = 0.89$). The items all tapped into the same concept of measurement.

Independent variables

Covariates analyzed in this study included demographic characteristics such as sex, age group, educational level, marital status, religion, place of residence, place where born (same locality or different locality), geographical location/region as well as work status. Other covariates included self-rated health (SRH) (good, moderate and bad), difficulty in work activity (none, mild, moderate, severe, extreme), quality of life (QoL) (good, moderate, bad), life satisfaction (LS) (satisfied, neutral and dissatisfied) and unhealthy lifestyle. In this analysis, unhealthy lifestyle were estimated using achievement of recommended behaviors for (1) currently smoking or tobacco use, (2) currently drinking any alcoholic beverage, (3) eating less fruits and vegetables (4) physical inactivity (less than 150 min moderate-intensity activities on a typical day) [15] and (5) body mass index were coded as none, one, two, and three or more. Detailed variable definition, type of variable, measurement and scale of measurement used in this study has been clearly defined in Supplementary Table 1 as an annex.

Statistical analysis

Due to the complex nature of the SAGE data and to prevent biased estimation, three approaches to data analysis were conducted: Bivariate descriptive statistics with Rao-Scott chi-square for testing association (for complex survey) between covariate variables and the outcome variable SHD; Covariate factors influencing SHD were estimated by adopting three statistical models individually involving Poisson, Logistic and Probit models; and effect or impact of SHD on the primary outcome (social networking) was quantified by adopting Mahalanobis distance matching within propensity score caliper. Many studies have established that, matching on the linear propensity score reduces bias estimations [18–20]. The Mahalanobis distance matching within propensity score caliper (1:1) was adopted in this study to obtain a credible counterfactual estimate on the study outcome [18–20]. The probability of older adult experiencing SHD using propensity score given the observed covariates was defined as $e_i(X_i) = P(SHD_i|X_i)$. The model defines $e_i(X_i)$ as the estimated scores, X_i as including older adults age, marital status, region, currently working status, SRH, difficulty in work/house-hold related (HH), quality of life and life satisfaction. Upon pre-processing the data with Mahalanobis distance matching within propensity score caliper, quantification of the effect of SHD on social networking was performed by adopting three statistical models separately involving; Modified Negative Binomial (MNB), Modified Logistic (ML) regression and Modified Ordinal Logistic regression respectively [24].

RESULTS

The prevalence of SHD among older adults in Ghana was 19.5% [95% confidence interval (CI) = 16.9–22.3], with a preponderance among females [21.9% (432) vs 16.8% (307)]. Increasing age depicted increasing prevalence of SHD. Interestingly, older adults with higher educational level had relatively lower prevalence of SHD and older adults who were widowed were found to experience relatively higher prevalence of SHD (24.8%, 253). Rural-urban differential in SHD existed such that the prevalence was relatively higher among rural-dwelling older adults [23.7% (498) vs 15.0% (241)].

Table 1: Demographic characteristics and prevalence of Self-reported hearing difficulty among older adults in Ghana, SAGE Wave 2, 2014-2015

Demographics	Total	Prevalence (95% CI)		Rao-Scott <i>p</i> value
		Non-SHD 80.5 (77.6-83.1)	SHD 19.5 (16.9-22.3)	
	<i>n</i>	Weighted %	Weighted %	
Sex				0.002
Male	1472	83.2	16.8	
Female	2103	78.1	21.9	
Age group				0.000
50-59	1295	85.4	14.6	
60-69	1105	81.3	18.7	
70-79	771	73.4	26.6	
80+	404	62.3	37.9	
Educational level				0.000
None	1784	73.2	26.8	
Primary	860	84.5	15.5	
Secondary	811	86.7	13.3	
Tertiary	120	89.4	10.6	
Marital status				0.001
Never married	115	87.1	12.9	
Married	2002	80.7	19.3	
Separated/ Divorced	427	88.3	11.7	
Widowed	1031	75.2	24.8	
Religion				0.000
None	114	72.9	27.1	
Christian	2563	83.2	16.8	
Islam	665	78.6	21.4	
Primal indigenous	222	55.1	44.9	
Place of residence				0.002
Urban	1403	85.0	15.0	
Rural	2172	76.3	23.7	
Region				0.000
Ashanti	586	86.7	13.3	
Brong Ahafo	380	85.2	14.8	
Central	461	90.6	9.4	
Eastern	288	76.1	23.9	
GT Accra	339	91.4	8.6	
Northern	360	90.9	9.1	
Upper East	197	35.8	61.2	
Upper West	185	27.1	72.9	
Volta	330	73.7	26.3	
Western	449	84.2	15.8	
Currently working				0.000
No	1282	71.9	28.1	
Yes	2293	84.6	15.4	
SRH				0.000
Good	2150	83.5	16.5	
Moderate	1039	73.7	26.3	
Bad	359	79.0	21.0	
Difficulty in work/HH activity				0.000
None	1356	95.1	4.9	
Mild	932	69.2	30.8	
Moderate	960	71.8	28.2	
Severe	328	68.5	31.5	
Place of born				0.002
Same locality	2479	78.1	21.9	
Different locality	1096	85.6	14.4	
Quality of life (QoL)				0.000
Good	1576	85.5	14.5	
Moderate	1615	76.5	23.5	
Bad	384	73.6	26.4	
Life satisfaction (LS)				0.021
Satisfied	2628	79.4	20.6	
Neutral	692	86.4	13.6	
Dissatisfied	255	75.6	24.4	
Unhealthy lifestyle				0.000
None	957	71.5	28.5	
One	1497	80.2	19.8	
Two	873	86.6	13.4	
Three and more	248	88.9	11.1	

*SHD, self-reported hearing difficulty; CI, confidence interval.

Table 2: Demographic factors influencing self-reported hearing difficulty among older adults in Ghana, SAGE Wave 2, 2014-2015

Covariates	Poisson aPR [95% CI]	Logistic aOR [95% CI]	Probit β [95% CI]
Sex			
Male	Ref	Ref	Ref
Female	1.16[0.99-1.36]	1.33[1.02-1.72]*	0.17[0.03-0.31]*
Age group			
50-59	Ref	Ref	Ref
60-69	1.13[0.92-1.37]	1.20[0.87-1.64]	0.12[-0.05-0.28]
70-79	1.29[1.02-1.63]*	1.56[1.07-2.26]*	0.26[0.06-0.47]*
80+	1.60[1.22-2.07]***	2.29[1.46-3.60]***	0.50[0.25-0.75]***
Educational level			
Tertiary	Ref	Ref	Ref
None	1.11[0.59-2.09]	1.11[0.47-2.62]	0.06[-0.38-0.50]
Primary	1.14[0.58-2.26]	1.19[0.47-2.96]	0.10[-0.37-0.56]
Secondary	1.06[0.55-2.05]	1.09[0.45-2.63]	0.04[-0.41-0.49]
Marital status			
Married	Ref	Ref	Ref
Never married	0.78[0.43-1.42]	0.67[0.30-1.48]	-0.24[-0.67-0.19]
Separated/ Divorced	0.64[0.45-0.90]*	0.53[0.33-0.84]**	-0.34[-0.58-- 0.09]**
Widowed	0.82[0.68-0.98]*	0.72[0.53-0.98]*	-0.18[-0.36--0.01]*
Religion			
Christian	Ref	Ref	Ref
None	1.12[0.75-1.67]	1.25[0.63-2.47]	0.11[-0.25-0.49]
Islam	1.07[0.81-1.42]	1.14[0.71-1.84]	0.06[-0.19-0.31]
Primal indigenous	1.00[0.79-1.28]	1.11[0.64-1.90]	0.04[-0.25-0.35]
Place of residence			
Rural	Ref	Ref	Ref
Urban	0.99[0.77-1.28]	0.97[0.67-1.42]	-0.01[-0.22-0.19]
Region			
Greater Accra	Ref	Ref	Ref
Ashanti	1.51[0.80-2.84]	1.64[0.77-3.46]	0.30[-0.06-0.67]
Brong Ahafo	1.46[0.70-2.85]	1.50[0.61-3.70]	0.22[-0.25-0.69]
Central	1.09[0.51-2.34]	1.07[0.43-2.65]	0.04[-0.41-0.50]
Eastern	2.20[1.03-4.69]	2.72[1.03-7.18]*	0.57[0.04-1.09]*
Northern	0.87[0.30-2.54]	0.78[0.21-2.86]	-0.14[-0.78-0.52]
Upper East	4.45[2.32-8.52]***	13.05[5.29-32.15]***	1.53[1.05-2.00]***
Upper West	4.12[2.15-7.91]***	13.32[5.59-31.71]***	1.56[1.10-2.02]***
Volta	2.57[1.34-4.93]**	3.41[1.52-31.71]**	0.69[0.27-1.11]***
Western	1.68[0.89-3.16]	1.84[0.87-3.89]	0.36[-0.02-0.73]
Currently working			
Yes	Ref	Ref	Ref
No	1.21[1.01-1.46]*	1.39[1.01-1.90]*	0.18[0.01-0.35]*
SRH			
Good	Ref	Ref	Ref
Moderate	1.08[0.86-1.34]	1.10[0.77-1.57]	0.07[-0.13-0.26]
Bad	0.69[0.50-0.96]*	0.57[0.034-0.94]*	-0.32[-0.60-0.04]
Difficulty in work/HH activity			
None	Ref	Ref	Ref
Mild	4.24[3.09-5.83]***	6.13[4.20-8.94]***	0.98[0.78-1.17]***
Moderate	4.23[2.94-6.09]***	6.05[3.88-9.41]***	0.95[0.72-1.19]***
Severe	4.65[2.97-7.25]***	6.79[3.79-12.16]***	1.03[0.72-1.34]***
Place of born			
Same locality	Ref	Ref	Ref
Different locality	0.89[0.68-1.17]	0.84[0.57-1.25]	-0.08[-0.29-0.13]
Quality of life			
Good	Ref	Ref	Ref
Moderate	1.20[1.01-1.43]*	1.40[1.06-1.84]*	0.20[0.05-0.35]*
Bad	1.28[0.91-1.78]	1.43[0.83-2.45]	0.20[-0.09-0.50]
Life satisfaction			
Satisfied	Ref	Ref	Ref
Neutral	0.70[0.55-0.88]**	0.57[0.40-0.79]***	-0.30[-0.49-- 0.11]**
Dissatisfied	1.03[0.67-1.58]	1.03[0.55-1.93]	0.05[-0.30-0.39]
Unhealthy lifestyle			
None	Ref	Ref	Ref
One	0.99[0.81-1.22]	0.98[0.68-1.41]	-0.03[-0.22-0.18]
Two	0.78[0.60-1.00]	0.67[0.45-1.00]	-0.21[-0.42-0.01]
≥Three	0.76[0.51-1.15]	0.69[0.38-1.25]	-0.21[-0.53-0.11]

*aOR, adjusted odds ratio; aPR, adjusted prevalence ratio; * *p* value < 0.05; ** *p* value < 0.01; *** *p* value < 0.001.

Another interesting observation was the relatively higher prevalence of SHD in the Northern regions of the Country [Upper East (61.2%, 115) and Upper West (72%, 133)]. In all,

older adults with severe difficulty in work/HH activities experienced relatively higher prevalence of SHD (31.5%, 102). Expectedly, older adults with poor self-rated health status (bad

SRH) and poor life satisfaction index had relatively high prevalence of SHD [26.4% (880) and 24.4% (410) respectively]. It was observed that, the higher the number of unhealthy lifestyle (with health risk), the lesser the prevalence of SHD. In all, as in Table 1, Rao-Scott test of association showed that all covariates under study were significantly associated with SHD ($p < 0.05$). As demonstrated in Table 2, factors influencing SHD was assessed by performing Poisson, Logistic and Probit statistical models separately. Age group, marital status, region, currently working, SRH, difficulty in work/HH activity, QoL and LS significantly influenced SHD (see Table 2).

The analysis showed that the higher the age, the higher the likelihood to experience SHD, that older adults currently working were more likely to experience SHD compared with those not working and that older adults residing in the (Upper East and Upper West regions) were more likely to have SHD compared with residents of Greater Accra. Poisson regression with adjusted prevalence ratio (aPR) predicted higher prevalence ratio among Upper East residents [aPR (95% CI) = 4.45 (2.32-8.52)] while Logistic predicted higher odds among Upper West residents [adjusted odds ratio (aOR) (95% CI) = 13.32 (5.59-31.71)]. In addition, Poisson regression shows that, older adults who were working are 21% more likely to experience SHD [aPR (95% CI) = 1.21 (1.01-1.46)] and that older adults with severe difficulty in work/HH activity had over 4 folds increased likelihood to experience SHD [aPR (95% CI) = 4.65 (2.97-7.25)]. The probability log count for older adults with severe difficulty in work/HH activity increased by 1.03 compared with older adults with no difficulty [aPR (95% CI) = 1.03 (0.72-1.34)]. Furthermore, older adults with moderate QoL were 20% and 40% more likely to experience SHD compared to those with good QoL as predicted by Poisson regression [aPR (95% CI) = 1.20 (1.01-1.43)] and Logistic regression [aOR (95% CI) = 1.40 (1.06-1.84)], respectively, as in Table 2. Descriptive assessments of older adults with hearing difficulty (Table 3) indicated that 53.6% (2011) of these never attending any public meeting in which there was discussion of local or school affairs; 43.0% (1521) never met personally with someone considered to be a community leader and 39.9% (1502) never attended any group,

club, society, union or organizational meeting. In all, only 26.8% (978) older adults had friends come over to their home daily while few (10.1%, 326) socialized with coworkers outside their work daily. A pairwise correlation conducted showed that a significant negative relationship existed between SHD and social relationship among the older adults. In addition, a test of mean difference for social relationship of the raw scores indicated a significant mean difference [older adults without SHD had relatively higher mean score compared with older adults with SHD (F-test = 22.7)].

To improve the precision of estimates from the data, testing for common assumption in the analysis, indicated that there is an overlap of the propensity scores matching of older adults with SHD and those without, which thus fulfilled the key assumptions, as in Figure 1. In addition, the adoption of the Mahalanobis distance matching within propensity caliper (1:1) reduced bias among significant covariates influencing SHD extremely to 0% after matching as in Figure 2. A further analysis as in Table 4, illustrated that, older adults with SHD were at a disadvantage in social relationships, in that the focus model (raw scores) predicted a significant decreased probability count of 0.08 social relationship among older adults with SHD compared to those without [aPR (95% CI) = -0.08 (-0.15-0.02)]. It further showed in model 2 (binary outcome) that, older adults with SHD were significantly 35% less likely to have good social relationships compared with those without [aOR (95% CI) = 0.65 (0.46-0.90)], and Model 3 (ordinal outcome) depicted a significant odds of 0.70 for older adults with SHD to be at the highest level of social relationship compared with middle and low social relationship [aOR (95% CI) = 0.70 (0.51-0.96)] (Table 4). Table 4 showed that older adults born at different place were found to be less likely to have high level of social relationship in all models [Model 1: [aPR (95% CI) = -0.11 (-0.19-0.02); Model 2: aOR (95% CI) = 0.63 (0.42-0.93) and Model 3: aOR (95% CI) = 0.57 (0.38-0.86)]. Another key observation was that older adults with three or more unhealthy lifestyles had significant increased social relationship probability count of 0.40 from MNB [aPR (95% CI) = 0.40 (0.27-0.52)]. Meanwhile, from logistic regression, prevalence of social relationship among

Table 3: Descriptive statistics of social relationship among older adults in Ghana, SAGE Wave 2, 2014-2015

Variable	Responses					Total
	Never	Once or twice per year	Once or twice per month	Once or twice per week	Daily	
How often in the last 12 months have you ...	%	%	%	%	%	n
...attended any public meeting in which there was discussion of local or school affairs?	53.6	27.1	10.9	4.8	3.5	3508
...met personally with someone you consider to be a community leader?	43.0	21.6	17.6	11.8	5.9	3505
...attended any group, club, society, union or organizational meeting?	39.9	19.5	23.7	12.6	4.3	3503
...worked with other people in your neighborhood to fix or improve something?	48.7	23.4	16.7	5.5	5.7	3513
...had friends over to your home?	13.2	7.6	14.5	38.0	26.8	3507
...been in the home of someone who lives in a different neighborhood than you do or had them in your home?	20.6	13.0	24.7	24.4	17.3	3494
...socialized with coworkers outside of work?	40.8	14.3	17.0	17.8	10.1	3487
...attended religious services (not including weddings and funerals)?	13.9	8.5	22.0	41.1	14.5	3499
...gotten out of the house/your dwelling to attend social meetings, activities, programs or events or to visit friends or relatives?	18.2	14.9	30.6	22.5	13.7	3505
...communicated with your closest friends?	11.8	3.9	12.2	27.3	44.8	3492

* NOTE: % were weighted

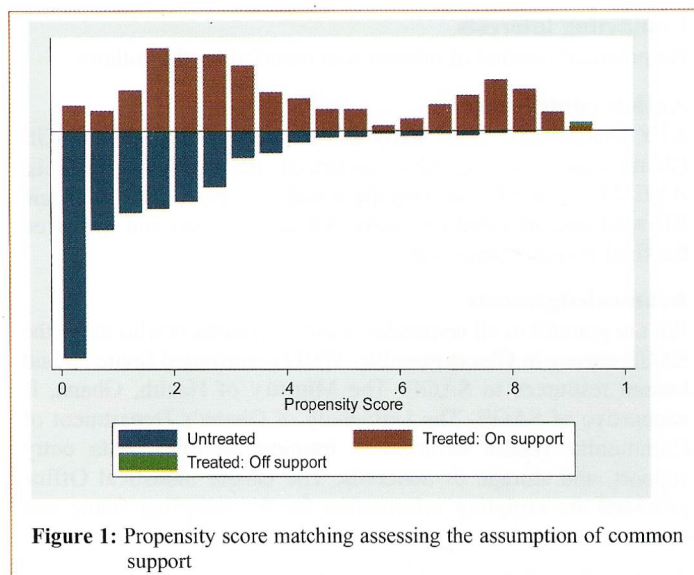


Figure 1: Propensity score matching assessing the assumption of common support

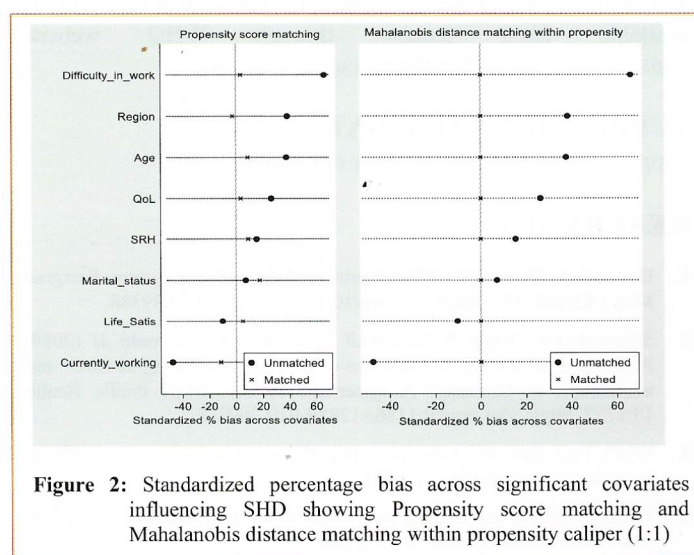


Figure 2: Standardized percentage bias across significant covariates influencing SHD showing Propensity score matching and Mahalanobis distance matching within propensity caliper (1:1)

Table 4: Impact of self-reported hearing difficulty social relationship among older adults in Ghana, SAGE Wave 2, 2014-2015

Demographic variable	Model 1: Focus aPR [95% CI]	Model 2: Binary aOR [95% CI]	Model 1: Ordinal aOR [95% CI]
Hearing difficulty			
No	Ref	Ref	Ref
Yes	-0.08[-0.15-0.02]**	0.65[0.46-0.90]**	0.70[0.51-0.96]*
Religion			
None	Ref	Ref	Ref
Christian	-0.07[-0.39-0.24]	0.43[0.12-1.56]	0.48[0.09-2.29]
Islam	0.01[-0.06-0.08]	1.40[0.89-2.20]	0.80[0.56-1.16]
Primal indigenous	-0.003[-0.11-0.11]	1.04[0.55-1.98]	1.16[0.66-2.03]
Place of residence			
Rural	Ref	Ref	Ref
Urban	-0.06[-0.14-0.02]	0.99[0.69-1.44]	0.95[0.66-1.35]
Place of born			
Same locality	Ref	Ref	Ref
Different locality	-0.11[-0.19-0.02]*	0.63[0.42-0.93]*	0.57[0.38-0.86]**
Unhealthy lifestyle			
None	Ref	Ref	Ref
One	0.03[-0.04-0.11]	2.12[1.45-3.08]***	1.91[1.35-2.70]***
Two	0.03[-0.06-0.12]	2.36[1.46-3.83]***	1.42[0.91-2.22]
Three and more	0.40[0.27-0.52]***	6.05[2.53-14.47]**	6.69[2.71-16.48]**

*aOR, adjusted odds ratio; aPR, adjusted prevalence ratio * p value < 0.05 , ** p value < 0.01 , *** p value < 0.001

participants with three or more unhealthy lifestyle was over 6-fold as compared to those with no unhealthy lifestyle risks [aOR (95% CI) = 6.05 (2.53-14.47)].

DISCUSSION

The prevalence of SHD among the aged as reported in this analysis was 19.5%, with a female preponderance. This finding is generally in consonance with other studies [21,22 23–25]. The prevalence is, however, relatively lower than the estimated global figure of about a third among persons aged 65 yr. and above, potentially because the SAGE used a relatively lower aged limit of 50 years. In addition, this analysis is based on subjected reporting of hearing difficulty, which is argued to be less accurate and often underestimates the prevalence [6,7], as opposed to more objective clinical-based assessments. The recognition of hearing impairment by the individual may be challenging due to the insidious nature – occurring over a long period, sometimes more than a decade, while audiometric changes take a relatively shorter time. Even more so, some SHD studies have also argued that, older people underestimate their hearing difficulties compared to the younger adults [26].

The female preponderance identified in this analysis is consistent with other studies on SHD [30]. Torres et al. found SHD was more reliable among women than men; and postulated this may be due to women being more conscious about their health and having more opportunities in the life-time to visit the health facility, and therefore having a better health seeking behavior than their male counterparts [27]. This observation is in sync with the generally observed male health seeking behaviours – failure to seek help promptly (hegemonic masculinity). This point is further buttressed by Kamil et al. who found that more women than men between the ages of 50 and 69 over-estimated their hearing loss [12,27]. A different trend is, however, observed when clinical assessment via audiometry is used; males then generally tend to have a higher prevalence of hearing difficulty [26]. Besides these, other demographic variables have been identified to be a major factor affecting SHD. A Taiwanese study found that perceptions of hearing loss were affected by marital status and general health status while another study in the USA found that, in addition to age and gender, ethnicity and level of education affected differences between self-reported and measured hearing ability [12,28,29]. Generally, observations from the current analysis is in conformity with the findings of these other studies. The observation that SHD was relatively higher in those with lower educational levels could potentially be that the more educated one is, the better the health seeking behavior and improved access to health care. Which potentially could explain the observed rural-urban differentials as well. Most of the rural dwelling older people are likely to be less educated and may have worked as factory hands in noise-polluted occupational settings with little personal protection.

Interestingly, the northern areas of the country had higher prevalence of hearing loss, which could potentially be due to the accumulation of ear wax because of the dry dusty environment in that ecological zone. This technically, could be mistaken for presbycusis; otoscopic evaluation may be needed to confirm or refute this observation. Cultural and linguistic variations in SHD, have been shown to exist and was confirmed in this study as well [22,26,27]. Primal indigenous religions had a higher SHD than

the other religions. Religion plays a role in ones perceived health status, whereas some religions expect all people to live a healthy successful life in old age, other religions recognize health challenges associated with ageing and therefore proffer help for the older adult.

A Taiwanese study suggested that, many elderly Chinese do not regard themselves as disabled by hearing impairment, in part owing to the respect they are accorded and a lack of stigma in being old in that cultural setting [28]. Another observation of note was that those with unhealthy lifestyle had a higher prevalence of SHD although unhealthy lifestyle such as smoking, intake of excessive alcohol is a known risk factor for hearing impairment. Intriguing as it may, it is unsurprising as these older folks may belong to some social groups which engender, promote and encourage indulgence in such lifestyles as smoking and drinking. In line with the above explanation, this analysis found unequivocally, that SHD had a negative effect on the social relationships of the older adult and severely affected their social engagements- public meetings, meeting with community leaders or group, club, society, union or organization. Thus, the more outgoing ones are likely to be those with no SHD and are the ones who will meet, fraternize, socialize and share common behaviours including smoking and drinking. In addition, these socializations may disinherit stigma associated with hearing disability as these individuals may be linked to friends who also engage in similar social behaviours. A call for further interrogation into the type of persons with which these older people interact socially may be worth interrogating. Overall, this nationwide survey indicated that older adults with SHD have a worsened social relationship and well-being than those without, which is in congruence with the suggestion that hearing loss is 'a killer of relationships' [30].

Conclusion

Overall, the prevalence of hearing loss in older adults in Ghana was 19.5%, and was higher among older adult females. This high prevalence of SHD had significant negative effect on social relationships among the older adults. In line with global efforts to reduce effect of hearing loss on social functioning, appropriate and timely interventions can facilitate access to education, employment and ensure healthy living and well-being. It is imperative that, clinical assessment of hearing loss in the older adult should always consider the social characteristics.

DECLARATIONS

Ethical considerations

SAGE wave 2 study was approved by World Health Organization's Ethical Review Board with reference number RPC149 and also, the Ethical and Protocol Review Committee, College of Health Sciences, University of Ghana, Accra, Ghana. Written informed consent was obtained from all study participants.

Funding

Financial support was provided by the US National Institute on Aging through Interagency Agreements (OGHA 04034785; YA1323-08-CN-0020; Y1-AG-1005-01) with the World Health Organization and a Research Project Grant (R01 AG034479-64401A1).

Competing interests

No potential conflict of interest was reported by the authors

Author contributions

AEY conceptualized the study as a member of the WHO SAGE Ghana Team. JT and AEY undertook the statistical analysis. AYE, JT, IA and PY drafted the initial manuscript. KS, GM and RB read and provided revisions. All authors read and approved the final review manuscript.

Acknowledgements

We are grateful to all respondents and interviewers who made the SAGE survey in Ghana possible. WHO contributed financial and human resources to SAGE. The Ministry of Health, Ghana, is supportive of SAGE. The University of Ghana's Department of Community Health contributed training facilities, data entry support, and storage of materials. The Ghana Statistical Office provided the sampling information for the sampling frame and updates.

Availability of data and materials

The minimal dataset used to support the findings of this study is available upon request through WHO website <https://www.who.int/healthinfo/sage/cohorts/en/>

SUPPLEMENTARY DATA

Supplementary Table 1: Variable definitions

REFERENCES

- Howarth A, Shone GR (2006) Ageing and the auditory system. *Postgrad Med J* 82:166–171. <https://doi.org/10.1136/pgmj.2005.039388>
- Schmucker C, Kapp P, Motschall E, Loehler J, Meerpohl JJ (2019) Prevalence of hearing loss and use of hearing aids among children and adolescents in Germany: A systematic review. *BMC Public Health* 19:1277. <https://doi.org/10.1186/s12889-019-7602-7>
- WHO. Fact sheet about deafness. <https://www.who.int/news-room/facts-in-pictures/detail/deafness> (2018).
- WHO. Deafness and hearing loss. <https://www.who.int/news-room/facts-sheets/detail/deafness-and-hearing-loss> (2019)
- Duthey B, Kaplan W, Wirtz VJ, Mental-Teeuwisse A, Stolk P, Laing R (2013) Priority Medicines for Europe and the World - 2013. *Prior. Med. Eur. World - 2013 Updat.* 165–168
- Davis A, Smith P, Ferguson M, Stephens D, Gianopoulos I (2007) Acceptability, benefit and costs of early screening for hearing disability: A study of potential screening tests and models. *Health Technol Assess (Rockv)* 11:1–294. <https://doi.org/10.3310/hta11420>
- Shield B (2012) Evaluation of the social and economic costs of hearing impairment. A report for Hear-it. Hear-it 159
- Monzani D, Galeazzi GM, Genovese E, Marrara A, Martini A (2008) Psychological profile and social behaviour of working adults with mild or moderate hearing loss. *Acta Otorhinolaryngol Ital* 28:61–66
- Ogawa T, Uchida Y, Nishita Y, Tange C, Sugiura S, Ueda H, Nakada T, Suzuki H, Otsuka R, Ando F, Shimokata H (2019) Hearing-impaired elderly people have smaller social networks: A population-based aging study. *Arch Gerontol Geriatr* 83:75–80. <https://doi.org/10.1016/j.archger.2019.03.004>
- Packer L (2016) How hearing loss impacts relationships. *Healthy Hearing*. Available: <https://www.healthyhearing.com/report/52619-The-impact-of-hearing-loss-on-relationships>. Accessed 11 August 2019
- Wallhagen MI, Strawbridge WJ, Shema SJ, Kaplan GA (2004) Impact of Self-Assessed Hearing Loss on a Spouse: A Longitudinal Analysis of

- Couples. *Journals Gerontol - Ser B Psychol Sci Soc Sci* 59:S190–S196. <https://doi.org/10.1093/geronb/59.3.S190>
12. Kamil RJ, Genther DJ, Lin FR (2015) Factors associated with the accuracy of subjective assessments of hearing impairment. *Ear Hear* 36:164–167. <https://doi.org/10.1097/AUD.0000000000000075>
 13. Chatterji S (2013) World Health Organisation's (WHO) Study on Global Ageing and Adult Health (SAGE). *BMC Proc* 7:S1. <https://doi.org/10.1186/1753-6561-7-s4-s1>
 14. Agrawal G, Patel SK, Agarwal AK (2016) Lifestyle health risk factors and multiple non-communicable diseases among the adult population in India: a cross-sectional study. *J Public Heal* 24:317–324. <https://doi.org/10.1007/s10389-016-0727-6>
 15. Minicuci N, Biritwum RB, Mensah G, Yawson AE, Naidoo N, Chatterji S, Kowal P (2014) Sociodemographic and socioeconomic patterns of chronic non-communicable disease among the older adult population in Ghana. *Glob Health Action* 7:10–15. <https://doi.org/10.3402/gha.v7.21292>
 16. Kowal P, Chatterji S, Naidoo N, Biritwum R, Fan W, Ridaura RL, Maximova T, Arokiasamy P, Phaswana-Mafuya N, Williams S, Josh Snodgrass J, Minicuci N, D'Este C, Peltzer K, Ties Boerma J, Yawson A, Mensah G, Yong J, Guo Y, Zheng Y, Parasuraman P, Lungdim H, Sekher T V., Rosa R, Belov VB, Lushkina NP, Peltzer K, Makiwane M, Zuma K, Ramlagan S, Davids A, Mbelle N, Matseke G, Schneider M, Tabane C, Tollman S, Kahn K, Ng N, Juvekar S, Sankoh O, Debpuur CY, Chuc NTK, Gomez-Olive FX, Hakimi M, Hirve S, Abdullah S, Hodgson A, Kyobutungi C, Egondi T, Mayombana C, Minh H V., Mwanyangala MA, Razzaque A, Wilopo S, Streatfield PK, Byass P, Wall S, Scholten F, Mugisha J, Seeley J, Kinyanda E, Nyirenda M, Mutevedzi P, Newell ML (2012) Data resource profile: The world health organization study on global ageing and adult health (SAGE). *Int J Epidemiol* 41:1639–1649. <https://doi.org/10.1093/ije/dys210>
 17. Jann, B. ALPHAWGT: Stata module to compute Cronbach's alpha for weighted data. (Boston College Department of Economics, 2004).
 18. Rubin DB, Thomas N (2000) Combining propensity score matching with additional adjustments for prognostic covariates. *J Am Stat Assoc* 95:573–585. <https://doi.org/10.1080/01621459.2000.10474233>
 19. Rubin DB (1973) Matching to Remove Bias in Observational Studies. *Biometrics* 29:159. <https://doi.org/10.2307/2529684>
 20. Rosenbaum PR, Rubin DB (1983) The central role of the propensity score in observational studies for causal effects. *Biometrika* 70:41–55. <https://doi.org/10.1093/biomet/70.1.41>
 21. Choi JE, Moon IJ, Baek SY, Kim SW, Cho YS (2019) Discrepancies between self-reported hearing difficulty and hearing loss diagnosed by audiometry: Prevalence and associated factors in a national survey. *BMJ Open* 9:e02244. <https://doi.org/10.1136/bmjopen-2018-022440>
 22. Soares MO, Oenning NSX, Ziegelmann PK, Goulart BNG (2018) Association between self-reported hearing impairment and diabetes: A Brazilian population-based study. *Arch Public Heal* 76:62. <https://doi.org/10.1186/s13690-018-0300-6>
 23. Marrone N, Ingram M, Bischoff K, Burgen E, Carvajal SC, Bell ML (2019) Self-reported hearing difficulty and its association with general, cognitive, and psychosocial health in the state of Arizona, 2015. *BMC Public Health* 19:875. <https://doi.org/10.1186/s12889-019-7175-5>
 24. Sindhusake D, Mitchell P, Smith W, Golding M, Newall P, Hartley D, Rubin G (2001) Validation of self-reported hearing loss. The blue mountains hearing study. *Int J Epidemiol* 30:1371–1378. <https://doi.org/10.1093/ije/30.6.1371>
 25. Gomez MI, Hwang SA, Sobotova L, Stark AD, May JJ (2001) A comparison of self-reported hearing loss and audiometry in a cohort of New York farmers. *J Speech, Lang Hear Res* 44:1201–1208. [https://doi.org/10.1044/1092-4388\(2001/093\)](https://doi.org/10.1044/1092-4388(2001/093))
 26. Davis A, Smith P (2013) Adult hearing screening: Health policy issues—what happens next? *Am J Audiol* 22:167–170. [https://doi.org/10.1044/1059-0889\(2013/12-0062\)](https://doi.org/10.1044/1059-0889(2013/12-0062))
 27. Nondahl DM, Cruickshanks KJ, Wiley TL, Tweed TS, Klein R, Klein BEK (1998) Accuracy of self-reported hearing loss. *Int J Audiol* 37:295–301. <https://doi.org/10.3109/00206099809072983>
 28. Chang HP, Ho CY, Chou P (2009) The factors associated with a self-perceived hearing handicap in elderly people with hearing impairment—results from a community-based study. *Ear Hear* 30:576–583. <https://doi.org/10.1097/AUD.0b013e3181ac127a>
 29. Torre P, Moyer CJ, Haro NR (2006) The accuracy of self-reported hearing loss in older Latino-American adults. *Int J Audiol* 45:559–562. <https://doi.org/10.1080/14992020600860935>
 30. Peracino A, Pecorelli S (2016) The Epidemiology of Cognitive Impairment in the Aging Population: Implications for Hearing Loss. *Audiol Neurotol* 21:3–9. <https://doi.org/10.1159/000448346>

Thank you for publishing with



HSI Health Sciences
Investigations Journal

Supplementary Table 1: Variable definitions

Variable	Type of variable	Description	Measurement	Scale of measurement
Hearing difficulty	Secondary outcome variable	Whether in the last 30 days, how much difficulty did the participants have in: hearing someone talking on the other side of the room in a normal voice? OR In the last 30 days, how much difficulty did you have in hearing what is said in a conversation with one other person in a quiet room (even with your hearing aid on if you use one)?	None and Difficulty (mild, moderate, severe and extreme/Cannot do)	Binary
Social networking	Primary outcome variable	WHO 10 standard and validated social network questionnaire	Never, once or twice per year, once or twice per month, once or twice per week and daily	Ordinal Discrete Binary
Sex of participant	Explanatory variable	Sex definition of the participant	Male or Female	Binary
Age	Explanatory variable	Age of participant as at data collection	Raw ages recoded into 50-59, 60-69, 70-79 and 80+	Discrete Categorical
Educational level	Explanatory variable	Highest educational level of participants	Recoded into None, primary, secondary and tertiary	Categorical
Marital status	Explanatory variable	Current marital status of participants	Recoded as never married, married, separated/divorced and widowed	Categorical
Religion	Explanatory variable	Religious affiliation of participants	Recoded as none, Christian, Islam and Primal indigenous (traditionalist)	Categorical
Place of residence	Explanatory variable	Place where participants resides	Urban and rural	Binary
Region	Explanatory variable	The then region where participant lives	Ashanti, Brong Ahafo, Central, Eastern, GT Accra, Northern, Upper East, Upper West, Volta and Western	Categorical
Currently working	Explanatory variable	Whether participant is engaging in any work for pay or income	No and Yes	Binary
Self-rated health	Explanatory variable	Respondents were asked to rate their health	Good, moderate and bad	Ordinal
Difficulty in work/HH activity	Explanatory variable	Overall in the last 30 days, how much difficulty did participant have with work or household activities	None, mild, moderate and severe/extreme	Ordinal
Place of where	Explanatory variable	Place where were participant was born	Recoded as same locality and different locality	Binary
Quality of life	Explanatory variable	Participants were asked to rate their overall quality of life	Recoded as Good, moderate, bad	Ordinal
Life satisfaction	Explanatory variable	Taking all things together, participant was asked to rate how they're satisfied with their life's as a whole	Recoded as Satisfied, neutral and dissatisfied	Ordinal
Unhealthy lifestyle	Explanatory variable	Unhealthy lifestyle were estimated and a score of 1 were classified for not achieving the recommended behavior for (1) currently smoking or tobacco use, (2) currently drinking any alcoholic beverage, (3) eating less fruits and vegetables as part of diet (less than 3 servings per day), (4) physical inactivity (less than 150 minutes moderate-intensity activities on a typical day [15] and (5) BMI (low or high) and 0 "otherwise" if recommended behavior achieved	Index variable recoded as none, one, two and three and more	Ordinal