

An Analytical Study of Risk of Depression in Adult Population With Hearing Impairment

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ABSTRACT

Background: According to the National Institute of Clinical Excellence (NICE), adults with hearing loss to the extent that it affects their ability to communicate and hear should be offered hearing aids with proper counseling.

Objective: The aim of the current study was conducted with the primary aim of evaluating the frequency of depression and associated factors among hearing loss patients. The secondary aim of the study was to determine the impact of usage of hearing aids on depression.

Methods: This quasi-experimental study was performed at Qureshi ENT and Medical Center located in Karachi, Pakistan. The study was conducted from January to November 2022. The speech therapist performed the pure tone audiometry test to assess hearing ability. Depression was assessed using a PHQ-9 questionnaire and a score of 10 and higher was labeled as positive for depression. All of the patients were advised to use hearing aids regularly. Baseline depression level was assessed and patients were scheduled with a follow-up appointment after three months for assessment of depression level after usage of hearing aids.

Results: A total of 251 patients with a median age of 22 years (IQR=22-35) were enrolled in the research. Median disease duration was 2.5 (IQR=2-3.5) years. The majority had disease of a mild nature (n=176, 70.1%) whereas 38 (15.1%) had moderate and 37 (14.7%) had severe disease. At baseline, depression was prevalent among 111 (n=44.2%) patients. On the multivariable regression model, younger age (aOR=0.41, 95% CI: 0.17-0.93, p=0.039), being unemployed (aOR=0.51, 95% CI: 0.26-0.98, p=0.046) and mild disease (aOR=0.06, 95% CI: 0.03-0.14, p<0.001) were significantly associated with lower odds of depression. Depression after using a hearing aid was prevalent among 76 (30.3%) patients. There was a significant decrease in the proportion of people having depression after three months of follow-up (p<0.001).

Conclusion: The baseline depression in hearing loss was higher, particularly in older patients, employed and having moderate to severe disease. Three months usage of hearing aid improved depression among hearing loss patients.

Keywords: Depression, hearing loss, hearing impairment, psychological well-being, mental health, severity of hearing impairment.

INTRODUCTION

In the world, hearing impairment (HI) is one of the more common conditions, which is defined as the partial or complete loss of hearing in one or both ears [1]. It is affecting almost 80% of the individuals belonging to low and middle-income nations [2]. World Health Organization (WHO) estimated that by the end of 2050, one in ten people, or approximately 700 million people, will have hearing loss [2]. In 2018, among South Asian countries including Bangladesh, India, Bhutan, Nepal, Afghanistan, and Pakistan, the prevalence of hearing loss was reported as 28.2% [3]. The known causes of hearing impairment in these countries are lack of healthcare accessibility and exposure to ototoxic drugs and childhood infections [4].

Hearing loss (HL) is positively associated with age and third most common chronic illness among people of age more than 60 years [1, 2]. HI is also found to be associated

with emotional vitality, anxiety, depression, loneliness, self-esteem, life satisfaction, cognitive impairment and autonomy [4-7]. Evidence showed that sudden hearing loss had 2.17 times higher risk of developing depression in contrast to people with standard hearing [8]. Another recent research showed that 11% of the adults suffering hearing impairment had moderate to severe depression [9]. Research also revealed that older people suffering from hearing impairment had severe depression and anxiety issues, which negatively impacted their quality of life [10]. Whereas, in another study, it was observed that younger patients with hearing impairment had a higher risk of depression than older patients [8].

The intervention of hearing aid is the first treatment of choice until and unless other medical treatments are required as well. According to the National Institute of Clinical Excellence (NICE), adults with hearing loss to the extent that it affects their ability to communicate and hear should be offered hearing aids with proper counseling regarding warning sounds and listening to music [11]. Hearing aid devices do not restore the damage that causes hearing. However, they are useful in detecting sound and understanding speech thereby

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enhancing a person's ability to perform better in daily life activities [12]. There are pieces of evidence that the use of hearing aid improves cognition abilities, social engagement, quality of life and depressive symptoms [13]. However, there is a dearth of literature in Pakistan on this topic. A recent research in Pakistan found that social stigma caused 70% of the study subjects to reject the hearing aid and that 61.5% also said they did not like the way hearing aids looked [14].

HI severely hinder day to day activities of individuals as they are unable to communicate clearly and effectively. As a result of this, these individuals feel isolated from their near and dear ones. Overall, the psychological, social and functional health of individuals is compromised. Different researchers have evaluated the causal effect of severe hearing impairment on depression but limited Pakistani data is available in this regard. Therefore, the aim of the current study was conducted with the primary aim of evaluating frequency of depression and associated factors among HL patients. The secondary aim of the study was to determine the impact of usage of hearing aids on depression.

METHODS

This quasi-experimental was performed at Qureshi ENT and Medical Center which is located in Karachi, Pakistan. The study was conducted from January to November 2022. Patients of age 18 years and above of any gender, having confirmed diagnosis of sensorineural hearing loss, and those who never used hearing aids were included in this study. Patients having hearing loss due to trauma, congenital hearing impairment, and having comorbidities like visual impairment and other major comorbid such as kidney and liver diseases, malignancies, diabetes, cardiovascular disease, prior diagnosis of depression and taking anti-depressants, having neurological disorders and cognitive impairment were excluded from this study. Patients having hearing loss because of any ear problems were also excluded from this study.

A sample size of 251 was calculated at a 95% confidence interval and 6% margin of error by taking 37.8% depression prevalence from previous literature [15]. Open-Epi, an online available calculator opted to perform sample size estimation. The method of non-probability consecutive sampling was used to enlist research participants.

Pure tone audiometry (PTA) test for assessing hearing ability. We calculated the hearing cutoff values at 0.5, 1, 2, 3, 4, and 6 kHz. The PTA of speech frequency (0.5, 1, 2, and 4 kHz) was divided into normal hearing (25 dB), mild loss (25 dB 40), moderate loss (40 dB 70), and severe loss (>70 dB) according to the American Speech-Language Hearing Association standards [16]. Depression was assessed using a PHQ-9 questionnaire and a score of 10 and higher was labeled as positive for depression. For the assessment of depression, a

PHQ-9 score of 10 has been demonstrated to have 88% sensitivity and 88% specificity [17]. The data regarding age, gender, education, occupation, marital status and disease duration was collected using pre-designed proforma by the researcher herself.

All of the patients were advised to use hearing aids regularly. Brief education was given to all patients regarding the proper use of hearing aids. Further, they were informed to visit the center if they found any problem with their hearing aid device. Baseline depression level was assessed and patients were scheduled with a follow-up appointment after three months for assessment of depression level after usage of hearing aids. Reminders were sent to patients through calls and text messages to visit the center after three months on a pre-booked day.

IBM SPSS version 26 was used to input and analyze the data. Categorical variables were summarized as frequency and percentage. Numerical variables were tested for assumption of normality through the Shapiro-Wilk test. Non-normal variables were expressed as median with inter-quartile range (IQR). Binary logistic regression was applied to calculate the odds ratio and their 95% confidence for assessing the association of study variables with baseline depression. Variables with $p < 0.25$ were put in the multivariable regression model. MacNemar's test was applied to determine the difference in proportion of depression at baseline and after three months. Statistical significance for the final regression model was specified as a two-tailed p -value less than or equal to 0.05.

RESULTS

Socio-Demographic Profile of Included Patients

A total of 267 patients were enrolled in the study. 16 patients were dropped out later as they were lost to

Table 1: Socio-demographic profile of study participants.

Socio-demographic variables	Frequency	Percentage
Age groups		
<40 years	213	84.9
≥40 years	38	15.1
Gender		
Male	175	69.7
Female	76	30.3
Employment status		
Employed	86	34.3
Unemployed	165	65.7
Marital status		
Married	104	41.4
Unmarried	147	58.6
Education		
Matric	29	11.6
Intermediate	42	16.7
Graduate	128	51
Post-graduate	52	20.7
Disease duration		
<3 years	91	36.3
≥3 years	160	63.7

Table 2: Comparison of study variables among depressed and non-depressed groups and univariate association of variables with baseline depression.

Study Variables	Groups	Depressed n(%)	Non-depressed n(%)	OR (95% CI)	p-value
Age groups	<40 years	89(41.8)	124(58.2)	0.52 (0.25-1.05)	0.068
	≥40 years	22(57.9)	16(42.1)	Reference category	
Gender	Male	82(46.9)	93(53.1)	1.43 (0.83-2.48)	0.203
	Female	29(38.2)	47(61.8)	Reference category	
Occupation	Unemployed	65(39.4)	100(60.6)	1.76 (1.04-2.99)	*0.034
	Employed	46(53.5)	40(46.5)	Reference category	
Marital Status	Married	48(46.2)	56(53.8)	1.14 (0.69-1.89)	0.605
	Unmarried	63(42.9)	84(57.1)	Reference category	
Education	Matric	10(34.5)	19(65.5)	0.72 (0.28-1.84)	0.490
	Intermediate	25(59.5)	17(40.5)	2.01 (0.88-4.58)	0.099
	Graduate	54(42.2)	74(57.8)	0.99 (0.52-1.91)	0.988
	Post Graduate	22(42.3)	30(57.7)	Reference category	
Monthly income	<25K PKR	23(43.4)	30(56.6)	0.94 (0.46-1.93)	0.866
	25-50K PKR	33(48.5)	35(51.5)	1.15 (0.59-2.26)	0.673
	51-100k PKR	24(39.3)	37(60.7)	0.80 (0.40-1.60)	0.520
	>100K PKR	31(44.9)	38(55.1)	Reference category	
Disease severity	Mild	49(27.8)	127(72.2)	0.08 (0.04-0.16)	**<0.001
	Moderate to Severe	62(82.7)	13(17.3)	Reference category	
Disease duration	<3 years	34(37.4)	57(62.6)	0.64 (0.38-1.08)	0.100
	≥3 years	77(48.1)	83(51.9)	Reference category	

CI: Confidence interval, OR: Odds ratio, *Significant at $p < 0.05$, **Significant at $p < 0.01$.

follow-up and hence data of 251 patients was analyzed. For 251 patients, the median age of 22 (IQR=22-35) years. The age range was 18-50 years. Median disease duration was 2.5 (IQR=2-3.5) years. The range of disease duration was 1-6.5 years. The majority had disease of a mild nature ($n=176$, 70.1%) whereas 38 (15.1%) had moderate and 37 (14.7%) had severe disease. Table 1 displays the socio-demographic features of study participants.

Depression Prevalence at Baseline and Associated Factors

At baseline, depression was prevalent among 111 ($n=44.2\%$) patients. In univariate analysis, the odds of

Table 3: Multivariable analysis of factors associated with depression at baseline.

Study Variables	Groups	aOR	95% CI	p-value
Age groups	<40 years	0.41	0.17-0.93	*0.039
	≥40 years	Reference category		
Gender	Male	1.19	0.61-2.34	0.600
	Female	Reference category		
Occupation	Unemployed	0.51	0.26-0.98	*0.046
	Employed	Reference category		
Education	Matric	0.78	0.25-2.43	0.680
	Intermediate	2.97	1.04-8.43	*0.040
	Graduate	1.36	0.61-3.06	0.448
	Post Graduate	Reference category		
Disease severity	Mild	0.06	0.03-0.14	**<0.001
	Moderate to Severe	Reference category		
Disease duration	<3 years	1.23	0.65-2.34	0.529
	≥3 years	Reference category		

CI: Confidence interval, aOR: Adjusted odds ratio, *Significant at $p < 0.05$, **Significant at $p < 0.01$.

depression were significantly lower among unemployed patients than employed patients. Patients with mild disease were likely to have lower depression risk than those who had moderate to severe disease. Age, gender, marital status, education, monthly income and disease duration were not found to be significantly associated with depression (Table 2).

Table 3 displays the multivariable association of study variables with depression. After adjusting the model with gender, marital status, monthly income, disease severity and duration, and employment status, age was found to be associated with depression with significantly lower depression risk in younger patients than older patients. Disease severity and employment status remained associated with depression even after adjusting the model with other covariates.

Depression after using a hearing aid was prevalent among 76 (30.3%) patients. Table 4 shows the frequency of depression before and after hearing aid use. The proportion of depressed patients at baseline was significantly decreased after 3 months usage of hearing aids ($p < 0.001$).

Table 4: Frequency of depression at baseline and after three months usage of hearing aids.

Baseline depression status	Three months depression status		Total Count (%)
	Depressed Count (%)	Non-depressed Count (%)	
Depressed	76(30.3)	35(13.9)	111(44.2)
Non-depressed	0(0)	140(55.8)	140(55.8)
Total	76(30.3)	175(69.7)	251(100)

DISCUSSION

The present study analyzed a baseline depression prevalence of 44.2% among patients before using hearing aids. A previously conducted study in Pakistan evaluated depression in tinnitus patients having hearing loss. A higher frequency of 46.2% was reported in this study [18]. A study from Turkey reported that mild to moderate depression was seen in 55.6% of patients having sudden one-sided hearing loss [19]. A study was conducted in Nepal to evaluate the impact of hearing loss in older adults. Hearing Handicap Inventory for the Elderly questionnaire was used in this study. This study analyzed that nearly half of the participants fell in the significant handicap category (47.1%) whereas 45.7% were mild to moderate handicap and the remaining 7.1% had normal HHIE scores [20]. Unfortunately, the literature is lacking for parallel comparison.

The prevalence of HI has been on the rise in all age groups across the world [21]. HL affects nearly one-third of older adults, and the likelihood of hearing loss rises with age [22]. Contrary to this, the majority of our study subjects were younger than 40 years. However, we found a significant association of depression with age on multivariable analysis with significantly lower depression at baseline among younger patients. In agreement with these findings, many studies report depression is common in elderly population having hearing problems. Huang Chang *et al.* also found that depression was correlated with loss of hearing in old age individuals [23]. A study by Bamini *et al.* found hearing impaired females of age less than 70 years have five times higher odds of depression [24]. According to research carried out by Hajek *et al.* older people having both hearing and visual impairment suffer from the worst type of depression and anxiety issues.

We further studied the gender differences in baseline depression prevalence in this study. However, there was no discernible difference between the two sexes in terms of the probability of depression. Whereas, according to Mehboob *et al.*, male subjects with HL had considerably more psychological distress than female subjects [25]. Sei *et al.* conducted a similar type of study to determine if gender has an impact on depression levels or whether individuals regardless of their gender, respond similarly to depression. They also found that males with hearing loss suffered more from depression than females [26]. Although the majority of patients were male in this study but most plausible cause of finding a non-significant association with gender could be that HL is a significant problem either for male or female. In Pakistani environment majority of families live in a joint family system where males are engaged in outdoor responsibilities whereas females are busy in their home with their kids and relatives and interacting with them due to which both genders are equally exposed to the people around them identifying and highlighting problems in their hearing ability.

In this study, it was analyzed that patients who were employed were more likely to suffer from depression at baseline than those who were unemployed. Generally unemployed people are more likely to have depression. However, HI is more highlighted when the affected individuals are surrounded by more people which may lead to depressive symptoms in HL patients. That may be the reason for the higher risk of depression in employed patients than unemployed as employed people are engaged in business-related interactions which makes them embarrassed because of their HI issue.

In the current research, participants with moderate to severe HI had a substantially higher proportion of depression. Our results are in line with previous research. Li *et al.* showed moderate to severe depression was present in 11% of the participants with HL problems [9]. Dona *et al.* revealed significantly higher odds of depression for patients with moderate to severe HL (OR=27.51, 95% CI=3.25 to 232.95) [27]. Cetin *et al.* observed a higher proportion of depression in patients with hearing loss as compared to controls [28]. After adjusting for age, gender, previous medical histories, region, low and high-income groups, and other factors, Kim *et al.* discovered that patients with severe HI had a greater risk of depression [29].

In this study, after three months there was a significant decrease in depression prevalence from 44.2% to 30.3%. This result is consistent with findings from related research that are reporting improved symptoms of depression after hearing aid use [30, 31]. It is quite surprising to find that a higher proportion (30.3%) in our study reported depression even after the usage of hearing aids. However, there are conflicting results regarding hearing aids, and a new meta-analysis found no connection between hearing aid use and its impact on depression [32]. The fact that many owners do not actively use their aids could be a factor in our study's greater depression rates. Additionally, not every user controls their aids or makes use of the most recent and suitable corrections. This negligent behavior and non-compliance is highly prevalent among Pakistani patients. A dedicated involvement of a family member in the treatment process and stringent surveillance of their patients may result in better compliance improved mental health and disease status.

This is a single-center study from Pakistan which included only bilateral hearing impairment cases. Moreover, in this study, we did not evaluate the hearing handicap score and frequency of using hearing aids. Because of these limitations, the findings could not be generalized for the whole Pakistani cohort. In future more research should be done while considering the limitations of the current study.

CONCLUSION

The baseline depression in hearing loss was higher, particularly in older patients, employed and having

moderate to severe disease. Three months usage of hearing aid improved depression among hearing loss patients.

ETHICAL APPROVAL

The present study was performed after acquiring formal permission from the ethical committee of Qureshi ENT and Medical Centre. All procedures performed in studies involving human participants were following the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Patients were enrolled in the study with their written informed consent.

AVAILABILITY OF DATA

The data would be available from the principal investigator based on reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

SA conceptualized the study. SA and TAQ designed the study protocol. SA collected the data. SA and YA drafted the initial version of the manuscript. SS analyzed the data and interpreted results. TAQ critically revised the initial draft of the manuscript.

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