



# Hearing Loss Prevalence, Years Lived with Disability, in South Asia from 1990 to 2021: an analysis from the Global Burden of Disease Study 2021

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## Evidence in Context

- Analyzes trends in hearing loss prevalence across South Asia from 1990 to 2021.
- Evaluates the years lived with disability (YLDs) due to hearing loss in the region.
- Assesses regional variations in the burden of hearing loss.
- Investigates risk factors contributing to hearing impairment.
- Offers policy recommendations to address hearing loss as a public health issue.

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## Abstract

**Background:** Age-related hearing loss (ARHL) is an increasing health concern in South Asia, driven by an aging population. This study forecasts trends in prevalence and Years Lived with Disability (YLD) for ARHL in South Asia from 2022 to 2031 using Global Burden of Disease (GBD) data.

**Methods:** We used ARIMA models (Auto Regressive Integrated Moving Average) to project age-standardized prevalence rates (ASPR) and YLD from 1990 to 2021, with projections for 2022–2031. We analyzed trends across age groups, gender, and countries including India, Bangladesh, Pakistan, and Sri Lanka. Empirical Annual Percentage Changes (EAPC) were calculated to understand long-term shifts in prevalence and disability.

**Results:** By 2031, age-standardized prevalence rates for ARHL are projected to decrease slightly from 19,017 per 100,000 in 2021 to 18,606 per 100,000. However, the total number of prevalent cases will increase significantly from 322.9 million to 409 million. Prevalence in males will rise from 171 million to 222 million, and in females from 151 million to 200 million. The total YLD will increase from 9.29 million to 11.33 million. Significant increases in prevalent cases are observed in India, Bangladesh, and Pakistan, with India contributing the largest burden, rising from 253 million in 2021 to 321 million by 2031.

**Conclusion:** While age-standardized rates for ARHL slightly decline, the total burden will grow significantly, especially in India and Pakistan, emphasizing the urgent need for targeted public health interventions, particularly for older age groups.

**Keywords:** Age-related hearing loss, prevalence, YLD, age groups, ARIMA, South Asia

## Introduction

In 2019, approximately 1.57 billion individuals globally were affected by hearing loss, representing roughly one in every five people [1]. Hearing loss, a condition that affects millions globally, goes beyond a simple reduction in auditory ability. Age-related hearing loss, also known as presbycusis, is a gradual decline in hearing ability that typically occurs as people age. This condition primarily affects the inner ear or auditory nerve, leading to sensorineural hearing loss [2]. The gradual decline in hearing sensitivity due to presbycusis is closely linked to challenges in speech comprehension.



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Individuals with presbycusis initially experience hearing loss at higher frequencies, which significantly hampers communication, particularly in environments with background noise or echo. As the condition advances and hearing loss extends to the 2–4 kHz frequency range, the ability to accurately perceive words, consonants, and even vowels becomes more difficult, leading to increased thresholds for auditory recognition [3]. ARHL can lead to emotional challenges such as feelings of loneliness, social withdrawal, depression, and heightened anxiety [4-6]. ARHL can vary in severity, often affecting both ears symmetrically, and may lead to challenges in communication, social interaction, and overall quality of life [7]. While the progression of this condition is generally permanent, early detection and appropriate interventions, such as hearing aids or assistive devices, can help manage the impact on daily life [8]. In 2020, the global economic losses due to untreated hearing loss amounted to nearly 1 trillion international dollars [9]. Effective and cost-efficient approaches for the identification and rehabilitation of hearing loss are already benefiting millions of individuals across various age groups. By combining these interventions with public health strategies, it is possible to extend their reach to all those in need [10]. The global burden of hearing loss, measured in YLDs, has increased significantly over the past decades, with a linear increase of 18.7% in the past ten years [11]. Most existing studies focus on the prevalence of hearing loss within specific countries. There is limited research addressing the South Asia region. The region faces unique challenges due to its large population, diverse socio-economic conditions, and varying levels of healthcare infrastructure. ARHL in South Asia is not only a medical concern but also a socio-economic one, affecting individuals' quality of life and productivity [12, 13]. In South Asia, this issue represents a formidable challenge, compounded by a lack of trained healthcare professionals, limited human resources, and inadequate diagnostic facilities, which together hinder effective management and intervention [14]. This study aims to analyze the prevalence and disability burden of ARHL in South Asia from 1990 to 2021, using data from the Global Burden of Disease Study 2021. It examines temporal trends in ARHL prevalence and YLD, while providing projections for 2031 to guide future public health strategies to address this public health challenge.

## Methods

### Data sources

The GBD 2021 study provides an extensive assessment of health loss associated with 369 diseases, injuries, and impairments, and 88 risk factors across 204 countries and territories, using latest epidemiological data and refined standardized methods. All results are available via the GBD Compare website [15], and all input data is identified via the Global Health Data Exchange website [16]. This study utilizes data from the GBD 2021 to assess the prevalence and disability burden (YLDs) of age related hearing loss in South Asia, covering the years 1990 to 2021. The analysis incorporates ASPR and age-standardized YLD rates (ASYR) and its numbers across eight countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The data was disaggregated by age and sex to examine differences in the impact of hearing loss across various demographic groups. Prevalence and YLD numbers were analyzed across different age categories, revealing trends in ARHL and its associated disability burden over time.

### Statistical analysis

#### Joinpoint regression analysis

Joinpoint regression analysis was used to identify significant changes or "joinpoints" in the trends of age-standardized prevalence and YLD rates for ARHL in South Asia. The analysis was conducted to detect periods of accelerated or decelerated trends in the rates from 1990 to 2021. This method allowed for the segmentation of the trend into distinct periods, each with its own slope, thereby providing insights into the temporal dynamics of ARHL prevalence and disability burden. The annual percentage change (APC) in each segment was calculated with 95% confidence intervals, helping to determine the significance and direction of trends over different time intervals.

#### ARIMA forecasting

To forecast the age-standardized prevalence and YLD rates of ARHL in South Asia from 2022 to 2031, we applied the ARIMA model. This time series forecasting method was chosen for its ability to capture temporal dependencies and underlying trends in the historical data. Initially, differencing

Was performed to achieve stationarity, ensuring that the series were free of trends and seasonality. Residual analysis was then conducted to evaluate the model's fit, ensuring that the error terms were random and normally distributed, with no autocorrelation. Once the model assumptions were satisfied, we generated forecasts for prevalence and YLD rates, along with prediction intervals to estimate uncertainty in the projections [17].

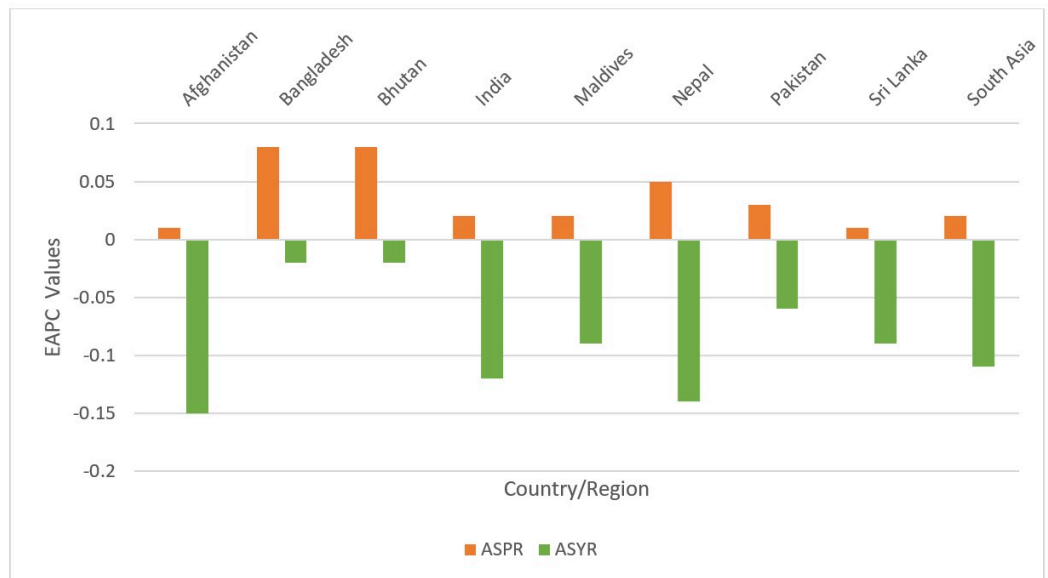
**Estimated Annual Percentage Change (EAPC) analysis**

EAPC analysis was conducted to estimate the overall average annual percentage change in age-standardized prevalence and YLD rates for ARHL over the entire study period (1990-2021). This method provides a summary measure of the annual change in rates, accounting for the cumulative effect of multiple trends identified through the joinpoint regression. EAPC is a useful metric for understanding the long-term directional trends and was calculated for both prevalence and YLDs, enabling comparison across regions and age-sex groups. The results of this analysis were reported with 95% confidence intervals to assess the statistical significance of the trends over time. These methodologies provided a comprehensive understanding of the historical trends and future projections of ARHL prevalence and associated disability in South Asia, contributing to evidence-based public health strategies for mitigating the burden of ARHL in the region.

**Results**

**Prevalence of ARHL**

The data on the prevalence of ARHL in South Asia from 1990 to 2021 shows an increase in both the number of cases and the rates of hearing loss across the region, with notable variations across individual countries. The total number of cases in South Asia rose from approximately 136.6 million in 1990 to 322.9 million in 2021, with the rate increasing slightly from 18,520 to 19,017 per 100,000 individuals (Table 1).



**Figure 1: EAPC of ASPR and ASYR of age-related hearing loss**

The overall EAPC for the region was 0.02% (95% CI: 0 to 0.05), reflecting a modest rise in the prevalence of hearing loss over this period. In terms of gender, males exhibited a larger increase in both the number of cases (from 76 million to 171 million) and the rate (from 13,075 to 17,690 per 100,000). The EAPC for males was 0.04% (95% CI: 0.01 to 0.06), indicating a slightly higher annual increase compared to females, who experienced a rise in cases from 60 million to 152 million, with the rate increasing from 11,239 to 16,263 per 100,000, and an EAPC of 0.03% (95% CI: 0.01 to 0.05). Country-specific trends show Figure 1 that Bangladesh and Bhutan had notably higher EAPCs, both at 0.08%.

In contrast, Afghanistan saw a much lower EAPC of 0.01% (95% CI: -0.01 to 0.04), with a slight

Increase in cases from approximately 973,000 to 1.97 million. Sri Lanka also exhibited a low EAPC of 0.01% (95% CI: -0.01 to 0.04), with a modest increase in cases from 2.65 million to 5.52 million. Countries like India and Pakistan showed moderate increases in both the number of cases and the rate of hearing loss, with EAPCs of 0.02% and 0.03%, respectively. The Maldives and Nepal demonstrated relatively stable trends with slight increases in rates and cases, with EAPCs of 0.02% and 0.05%, respectively.

**Table 1: Prevalence of in age-related hearing loss in South Asia in 1990 and 2021, with the EAPC from 1990 to 2021**

Region	Case no. in 1990 (95% UI)	Rate in 1990 (95% UI)	Case no. in 2021 (95% UI)	Rate in 2021 (95% UI)	EAPC (95% CI) (%)
South Asia	136643364.5	18520.70361	322906755.24 (308318001.41 to 338119599.9)	19016.8612	0.02 (0 to 0.05)
Male	76082158.24 (71798700.62 to 80368799.74)	13075.16 (12339.02 to 13811.84)	171238675.94 (163897912.48 to 179577418.24)	17689.98 (16931.64 to 18551.42)	0.04 (0.01 to 0.06)
Female	60561206.22 (57166589.83 to 64070246.66)	11239.47 (10609.47 to 11890.71)	151668079.3 (144269929.16 to 158949766.95)	16263.23 (15469.93 to 17044.04)	0.03 (0.01 to 0.05)
Afghanistan	973267.9626	13868.51158	1965649.12 (1813176.81 to 2121533.94)	13786.58729	0.01 (-0.01 to 0.04)
Bangladesh	10935062.1	18090.94496	27910254.06 (26677050.2 to 29321955.94)	18498.43583	0.08 (0.06 to 0.09)
Bhutan	61877.53653	18159.76199	128688.5 (122906.65 to 134782.48)	18648.59843	0.08 (0.08 to 0.09)
India	107667759.7	18640.055	253239804.93 (241693864.27 to 265148395.21)	19214.01136	0.02 (-0.01 to 0.05)
Maldives	24780.41735	20732.07406	98461.93 (93926.97 to 104038.74)	21237.10429	0.02 (0 to 0.04)
Nepal	2091698.602	17729.91803	4711725.09 (4481950.56 to 4976325.08)	18065.44735	0.05 (0.05 to 0.06)
Pakistan	12235326.06	18156.13615	29335976.15 (27872485.69 to 30979032.58)	18335.04863	0.03 (0.02 to 0.03)
Sri Lanka	2653592.093	20512.34562	5516195.47 (5233822.06 to 5831519.54)	20983.62098	0.01 (-0.01 to 0.04)

**YLD of ARHL**

The data on the YLD due to ARHL in South Asia from 1990 to 2021 shows a substantial increase in the total number of cases, but a slight decline in the rate of disability. The total number of YLD cases in South Asia rose from approximately 4.09 million in 1990 to about 9.29 million in 2021 (Table 2). However, the rate of YLD decreased marginally from 576.94 to 568.98 per 100,000 individuals.

The overall EAPC for the region was -0.11% (95% CI: -0.14 to -0.09), indicating a slight annual reduction in the rate of YLD despite the increase in the number of cases. By gender, both males and females experienced a similar trend. For males, the number of YLD cases increased from 2.2 million in 1990 to 4.75 million in 2021, while the rate decreased slightly from 593.65 to 586.67 per 100,000 individuals, with an EAPC of -0.11% (95% CI: -0.13 to -0.08). Similarly, for females, the number of YLD cases rose from 1.89 million to 4.54 million, with the rate declining from 558.88 to 551.75 per 100,000 individuals, and an EAPC of -0.11% (95% CI: -0.14 to -0.08).

Region-specific trends varied, with Afghanistan showing the most pronounced decline in the rate of YLD, with an EAPC of -0.15% (95% CI: -0.16 to -0.14). Countries like Bangladesh and India exhibited moderate reductions in the rate of YLD, with EAPCs of -0.02% and -0.12%, respectively. Bhutan and Sri Lanka showed minimal decreases in the rate, with EAPCs of -0.02% and -0.09%, respectively. Maldives and Pakistan also demonstrated slight reductions in rates, with EAPCs of -0.09% and -0.06%, respectively (Figure 1). Nepal experienced a relatively higher decrease in the rate of YLD at -0.14% (95% CI: -0.18 to -0.11), while Sri Lanka had a more moderate decrease.

**Distribution of ARHL in South Asia**

The regional analysis of age-standardized prevalence and YLD for ARHL in South Asia in 2021 revealed varying trends across countries, as detailed in Figure 2. Afghanistan experienced a decrease in both prevalence and YLD rates, with a -0.59% change in prevalence and a significant -5.43% reduction in YLD rate. Conversely, countries such as Bangladesh, Bhutan, and India saw increases in age-standardized prevalence rates, with Bangladesh showing the highest growth at 2.25%, followed by Bhutan at 2.69%, and India at 3.08%. Despite the rise in prevalence, these countries also exhibited declines in age-standardized YLD rates, with India showing the largest reduction at -1.12%. The Maldives, Nepal, Pakistan, and Sri Lanka also experienced modest increases in prevalence, ranging from 0.99% in Pakistan to 2.44% in the Maldives. However, all these regions showed decreases in YLD rates, with Nepal seeing a notable decline of -4.23%.

**Table 2: Years lived with disability(YLD) of in age-related hearing loss in South Asia in 1990 and 2021, with the EAPC from 1990 to 2021**

Region	Case no. in 1990 (95% UI)	Rate in 1990 (95% UI)	Case no. in 2021 (95% UI)	Rate in 2021 (95% UI)	EAPC (95% CI) (%)
South Asia	4086951.81 (2825744.98 to 5651969.66)	576.94 (407.04 to 789.77)	9291007.46 (6480951.79 to 12912608.71)	568.98 (399.08 to 783.72)	-0.11 (-0.14 to -0.09)
Male	2199385.51 (1506947.66 to 3057296.01)	593.65 (414.94 to 816.76)	4748682.09 (3264692.48 to 6611538.76)	586.67 (407.97 to 810.76)	-0.11 (-0.13 to -0.08)
Female	1887566.3 (1318797.32 to 2608764.36)	558.88 (398.04 to 764.46)	4542325.37 (3200491.44 to 6262631.65)	551.75 (390.42 to 757.62)	-0.11 (-0.14 to -0.08)
Afghanistan	34706.2 (24215.37 to 48215.37)	499.84 (351.32 to 688.46)	66594.62 (45319.1 to 92614.7)	472.7 (331.97 to 644.29)	-0.15 (-0.16 to -0.14)
Bangladesh	328188.71 (224311.34 to 454433.93)	548.18 (383.57 to 753.44)	794234.61 (553597.46 to 1096823.97)	544.11 (379.52 to 751.45)	-0.02 (-0.04 to -0.01)
Bhutan	1823.86 (1239.99 to 2513.59)	557.06 (390.35 to 767.56)	3674.99 (2546.65 to 5135.44)	553.14 (385.37 to 770.36)	-0.02 (-0.02 to -0.02)
India	3218086.32 (2231221.86 to 4458052.48)	584.49 (413.12 to 800.33)	7329777.23 (5115437.92 to 10169403.4)	577.95 (405.44 to 795.93)	-0.12 (-0.16 to -0.09)
Maldives	776.19 (527.22 to 1077.48)	642.4 (449.15 to 892.44)	2716.01 (1840.02 to 3814.94)	632.98 (437.73 to 885.22)	-0.09 (-0.11 to -0.08)
Nepal	67770.65 (46951.82 to 91452.95)	582.71 (407.36 to 783.88)	140712.08 (99315.72 to 194087.54)	558.07 (396.02 to 762.19)	-0.14 (-0.18 to -0.11)
Pakistan	355808.87 (242557.19 to 491941.03)	535.82 (374.52 to 739.79)	793959.81 (539679.08 to 1102879.08)	525.62 (365.24 to 724.46)	-0.06 (-0.06 to -0.05)
Sri Lanka	79791.01 (54388.24 to 111993.64)	627.1 (436.87 to 872.6)	159338.11 (110201.96 to 221618.31)	621.48 (430.94 to 855.83)	-0.09 (-0.13 to -0.05)

**ARHL trend in South Asia**

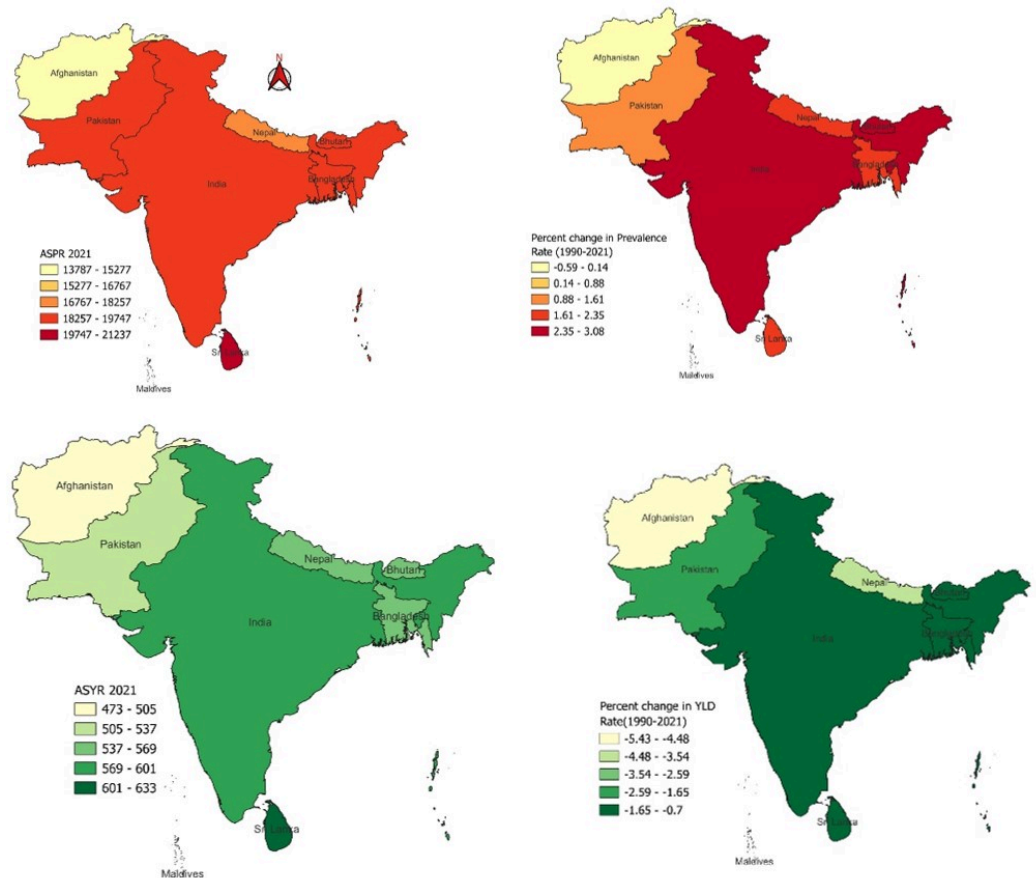
The Joinpoint analysis revealed significant trends in the prevalence and Years Lived with Disability (YLD) due to hearing loss in South Asia from 1990 to 2021. For prevalence, the number of cases showed an overall increasing trend, with an Average Annual Percentage Change (AAPC) of 2.82% (95% CI: 2.81 to 2.83). This growth was marked by substantial increases during four segments: 1990-1993 (APC: 2.96%), 1993-2009 (APC: 2.71%), 2009-2014 (APC: 3.07%), and 2014-2021 (APC: 2.82%). The age-standardized prevalence rate also exhibited a gradual increase, with an AAPC of 0.09% (95% CI: 0.08 to 0.10) (Figure 3 and supplementary Table 1).

For YLD, the total number of cases increased at an AAPC of 2.70% (95% CI: 2.68 to 2.71). The number of YLD cases showed steady growth in each segment, particularly from 1990 to 1993 (APC: 3.14%) and 1993 to 2000 (APC: 2.68%). However, the age-standardized YLD rate decreased slightly over the entire period, with an AAPC of -0.04% (95% CI: -0.05 to -0.04), despite an increase in the total number of YLD cases. These findings indicate that while the burden of hearing loss in terms of cases and disability has risen, improvements in age-standardized disability rates suggest potential progress in healthcare outcomes over time.

**ARHL trend by sex and age in South Asia**

Among the total number of prevalent cases, the highest figures are seen in the 50-54 years age group, with approximately 16.86 million males and 14.66 million females. The 45-49 years group follows closely, with 15.74 million males and 13.34 million females. In contrast, the <5 years

Age group has the lowest total number of prevalent cases, with 387,373 males and 343,095 females. Prevalence rates per 100,000 individuals also show a similar age-related increase, with the highest rates in the 90+ years group (83,233 males and 81,723 females) and the 85-89 years group (82,218 males and 79,321 females) (Figure 4). Conversely, younger age groups, such as <5 years and 5-9 years, exhibit much lower prevalence rates, with 448.74 per 100,000 males and 432.40 per 100,000 females in the <5 years group, and 1,450.35 per 100,000 males and 1,215.60 per 100,000 females in the 5-9 years group. Gender-wise, males generally have a higher number of prevalent cases across most age groups, although the prevalence rate per 100,000 individuals is slightly higher in females for older age groups, particularly those aged 80-84 years and 85-89 years.



**Figure 2: Distribution of ASPR and ASYR and the corresponding Percent change in age-related hearing loss in South Asia.**

**Projections in South Asia of ARHL**

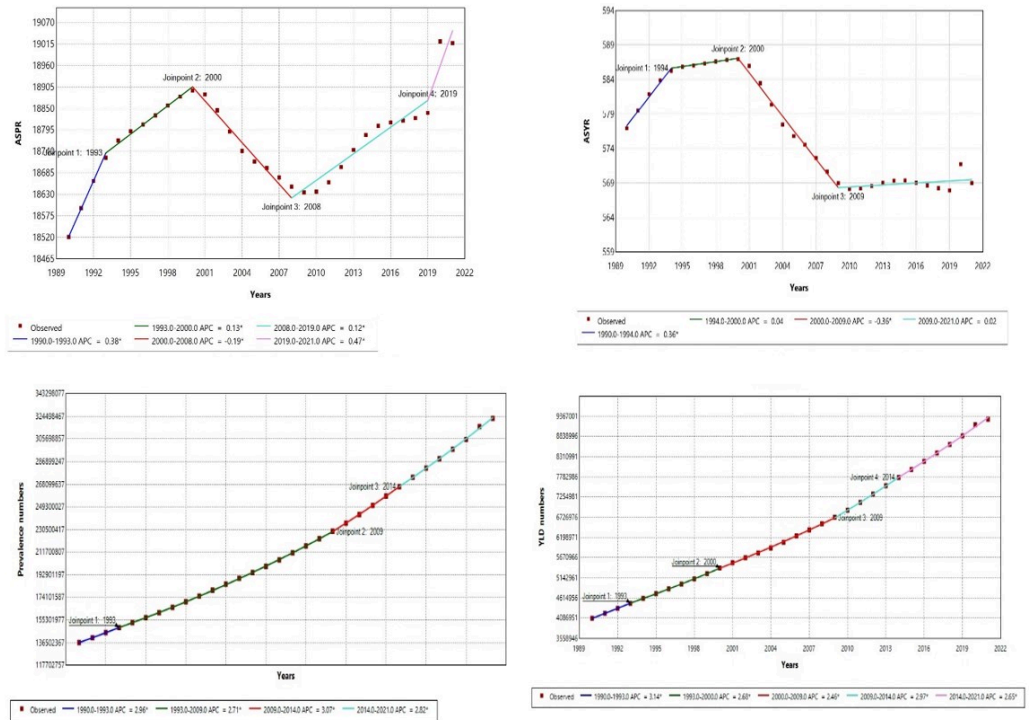
The forecasting of ASPR for hearing loss in South Asia indicates a gradual decline, from 19,016.86 in 2021 to 18,605.68 by 2031. Despite this slight decrease in ASPR, the total number of prevalent cases is expected to rise significantly, from 322.9 million in 2021 to 409 million by 2031 (Figure 5 and Table 3). ASYR show minor fluctuations during the period but remain largely stable. However, the total YLD numbers are projected to increase consistently, from 9.29 million in 2021 to 11.33 million by 2031.

**Discussion**

The findings from the analysis of ARHL prevalence and the associated disability burden in South Asia provide critical insights into both the trends and the significant implications for public health. The prevalence of ARHL in South Asia has significantly increased from 1990 to 2021. The number of cases rose from approximately 136.6 million in 1990 to 322.9 million in 2021. This reflects a modest yet consistent rise in both the total burden and the prevalence of ARHL across the region over this



Period which aligns with global trends where older populations exhibit the highest rates of hearing impairment [18, 19]. ARHL is a common sensory disorder among older adults, with a notable effect on both cognitive abilities and everyday functioning. As the global population continues to age, the incidence of ARHL is rising, mirroring worldwide patterns where hearing loss is most prevalent in elderly populations [20]. Elderly are disproportionately affected by hearing loss, with age-standardized prevalence rates significantly higher in the 80+ years group. In the 85-89 years age group, the prevalence of hearing loss is significantly higher among the elderly. The lower prevalence in younger age groups suggests that while hearing loss is less common in these populations, early interventions could help reduce future burden.



**Figure 3: The jointpoint regression analysis of South Asia prevalence and YLDs (Years Lived with Disability) of age-related hearing loss from 1990 to 2021. (A) Age-Standardized Rates of Prevalence;(B) Age-Standardized Rates of YLDs (Years Lived with Disability) (C) Number of prevalence (D) Number of YLDs (Years Lived with Disability)**

For males, the age-standardized prevalence rate is 82,218 per 100,000, while for females, it is 79,321 per 100,000. These findings reinforce the growing concern of presbycusis, a condition characterized by age-related hearing degeneration. This increase in prevalence reflects the aging population in South Asia, where improvements in healthcare have led to increased life expectancy [18, 21]. Given the substantial rise in cases among the elderly, there is an urgent need to focus public health efforts on managing hearing loss as a significant cause of disability in older adults. This is crucial for improving their quality of life and preventing social isolation, a common consequence of untreated hearing impairment. Another significant finding is the gender disparity in hearing loss, where males generally exhibit higher total numbers of prevalent cases, especially in younger age groups. However, females show higher age-standardized prevalence rates in the older age groups, particularly in those aged 85-89 years. This suggests that although more elderly men experience hearing loss due to the larger male population, females face a higher relative burden of disability as they live longer, thus contributing to a higher rate of hearing impairment later in life. In south Asia, conventional gender roles frequently place greater emphasis on men's health needs, resulting in delayed healthcare-seeking behavior among women [22]. This gender-based variation may also be influenced by cultural and socio-economic factors that affect healthcare access and health outcomes in South Asia [23]. ARHL is linked to various molecular and cellular alterations, including the loss of auditory sensory cells and neurons. The dysregulation of critical biological pathways such as AMPK, mTOR, and the accumulation of oxidative stress are central to the development and progression of ARHL. These disruptions at the molecular level interfere with cellular functions, ultimately leading to hearing impairment in the aging population [18].

**Table 3: Prevalence and YLD forecasting of age-related hearing loss in South Asia from 2022 to 2031 based on GBD data from 1990 to 2021**

	Age standardized Prevalence Rate	Age standardized YLD Rate	Prevalence Number	YLD Number
Year	ARIMA(2,1,1)	ARIMA(2,1,0)	ARIMA(2,1,0)	ARIMA(2,1,0)
2022	19016.21 (18937.07 to 19095.36)	570.38 (567.77 to 573)	332815297.77 (331480990.01 to 334149605.54)	9495552.34 (9444278.13 to 9546826.55)
2023	18997.03 (18874.29 to 19119.78)	569.24 (565.12 to 573.35)	340225234.45 (338171586.56 to 342278882.34)	9700097.23 (9609973.37 to 9790221.08)
2024	18961.78 (18802.95 to 19120.61)	569.72 (563.49 to 575.96)	349709053.55 (346311077.94 to 353107029.15)	9904642.11 (9772266.36 to 10037017.86)
2025	18913.95 (18726.26 to 19101.63)	569.23 (561.04 to 577.42)	357471517.42 (352878500.5 to 362064534.35)	10109187 (9930649.38 to 10287724.62)
2026	18857.76 (18648.77 to 19066.75)	569.38 (559.08 to 579.67)	366662733.37 (360501571.91 to 372823894.83)	10313731.88 (10085208.62 to 10542255.14)
2027	18797.79 (18574.86 to 19020.72)	569.15 (556.83 to 581.47)	374668062.49 (366980724.57 to 382355400.42)	10518276.77 (10236127.02 to 10800426.52)
2028	18738.66 (18508.2 to 18969.11)	569.17 (554.82 to 583.53)	383657696.44 (374191270.59 to 393124122.29)	10722821.65 (10383593.07 to 11062050.24)
2029	18684.63 (18451.37 to 18917.88)	569.06 (552.73 to 585.39)	391830341.81 (380574610.17 to 403086073.46)	10927366.54 (10527780.4 to 11326952.67)
2030	18639.37 (18405.79 to 18872.94)	569.05 (550.78 to 587.32)	400681100.63 (387450131.13 to 413912070.13)	11131911.42 (10668844.29 to 11594978.55)
2031	18605.68 (18371.85 to 18839.52)	568.99 (548.84 to 589.13)	408969014.56 (393725237.17 to 424212791.94)	11336456.31 (10806922.7 to 11865989.91)

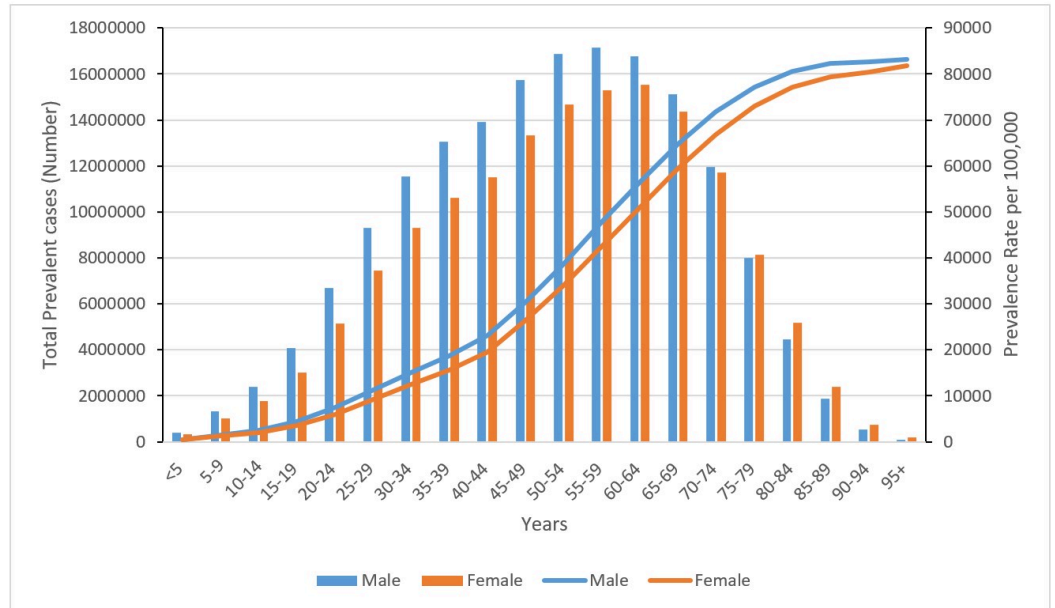
The YLDs provide further insights into the profound impact of hearing loss, particularly in older adults. The highest disability burden was found in the 80-84 years and 85-89 years groups, with females experiencing slightly higher YLDs than males in these brackets. This aligns with the overall higher age-standardized YLD rates among females in the elderly population, highlighting the significant disability associated with hearing loss. This highlights the need for comprehensive interventions that not only address the physical aspects of hearing loss but also consider its broader effects on individuals' daily activities, independence, and overall well-being. Hearing loss significantly impacts cognitive function as well, leading to potential difficulties in communication, memory, and social interaction, further emphasizing the importance of holistic care that encompasses both physical and cognitive dimensions [20]. In this study, the future projections indicated that while the ASPR of hearing loss is expected to decline slightly, the absolute number of cases and years lived with disability are both anticipated to rise. This trend can likely be attributed to population growth, aging demographics, and improved detection and reporting due to advancement in medical care. The steady increase in YLD highlights the growing burden of hearing loss as a chronic condition, especially in an aging population [24]. The increase in YLDs also suggests that the impact of hearing loss on individuals' daily functioning and quality of life may become more significant in the coming years, underlining the need for public health strategies that address the long-term management and prevention of hearing loss in South Asia.

The implications for public health policy are substantial. The results clearly suggest that as South Asia's population ages, the burden of hearing loss will increase, particularly among older adults. Policymakers should prioritize early screening and prevention efforts, especially in vulnerable populations such as the elderly, who face the greatest risks. This could involve expanding access to hearing health services, affordable hearing aids, and rehabilitation programs to mitigate the effects of hearing loss. For younger populations, while prevalence rates are lower, there is still a significant absolute number of cases. Early intervention in this age group is critical, as hearing loss in children can have long-term educational and social implications. Although some early detection services, including new-born hearing screenings and cochlear implant treatments, are available, their reach remains limited throughout South Asia [25]. The strengths of this study lie in its use of the GBD database, which provides a comprehensive and standardized approach to estimating the prevalence and disability burden of hearing loss across South Asia.

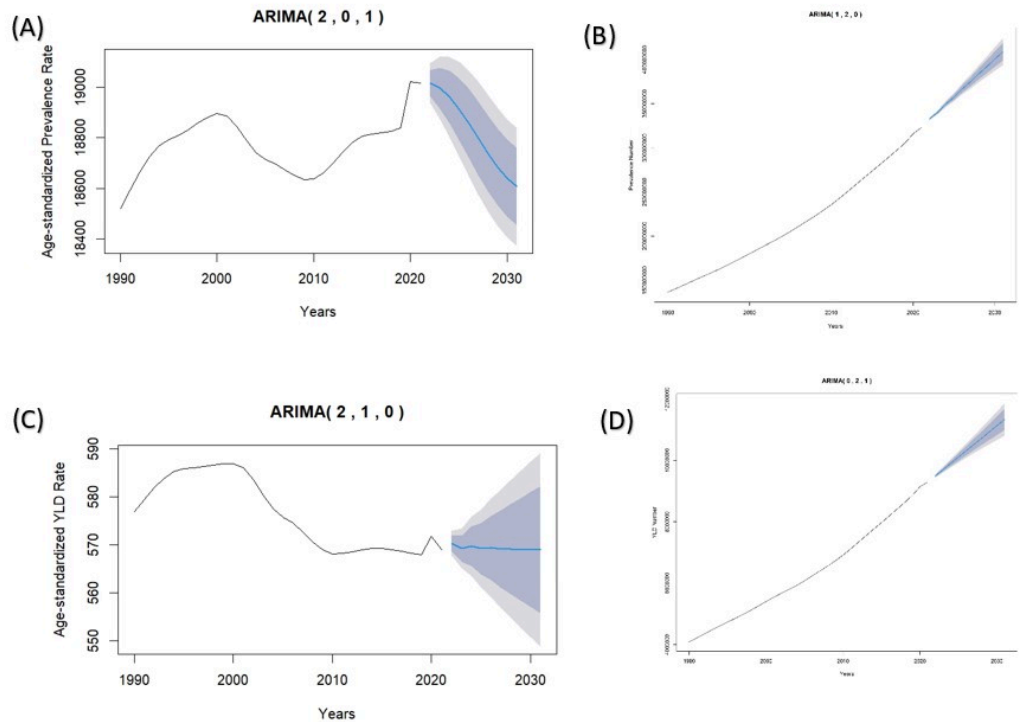
The large sample size and detailed age- and gender-specific data offer valuable insights



Into the demographic trends and allow for accurate projections of future trends. Additionally, the integration of YLDs provides a more holistic understanding of the impact of hearing loss on quality of life, making the study highly relevant for informing public health policies in the region.



**Figure 4: Age-specific numbers and rates of Prevalence of age-related hearing loss in 2021**



**Figure 5: Forecasted plot of age-related hearing loss (A) Prevalence Rate (B) and YLD Rate (C) Prevalence Number (D) YLD number for South Asia with 95% and 80% CI**

A key limitation of this study is the reliance on secondary data from the GBD database, which may involve inherent biases and inaccuracies due to data quality and reporting inconsistencies across regions. Additionally, the study does not account for regional variations in healthcare access, cultural factors, or environmental influences that could affect the prevalence and impact of hearing

Loss. Lastly, the use of projected estimates, while useful, introduces uncertainty as future trends are subject to changes in healthcare, demographic shifts, and unforeseen factors. Future research should continue to explore the socio-economic factors contributing to these trends and work towards innovative solutions to improve hearing health outcomes in South Asia.

## Conclusion

In conclusion, hearing loss in South Asia is a growing public health concern that requires targeted action to address the aging population's increasing needs. The significant age-related patterns of hearing loss and the higher disability burden in the elderly underscore the necessity for comprehensive hearing health programs. The gender disparities in prevalence and disability rates point to the need for tailored interventions that consider both the biological and socio-cultural factors influencing health outcomes. Future research and policy initiatives should aim at improving access to preventive care, early diagnosis, and assistive technologies, thereby reducing both the prevalence and impact of hearing loss across all age groups in the region.

### Abbreviations

ASPR: Age-standardized prevalence rates

ARHL: Age-related hearing loss

ARIMA: Auto Regressive Integrated Moving Average

EAPC: Estimated Annual Percentage Changes

YLD: Years Lived with Disability

**Supporting information:** Supplementary figures and table.

**Ethical Considerations:** Not applicable

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