Neuropsychiatric Disease and Treatment

Dovepress
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ORIGINAL RESEARCH

Cognitive Disorders In Acquired Sensorineural Hearing Loss, At The Ent Department Of The "Village Bondeko" Center, In Kinshasa

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Context: Several data from the literature have focused on the relationship between congenital sensorineural hearing loss, as well as acquired hearing loss, and their impact on cognition and the risk of dementia. However, few studies have been conducted on this subject in countries where access to hearing rehabilitation measures is limited. Thus, the objective of the present study was to investigate the relationship between sensorineural hearing loss and cognitive disorders in a correlational approach.

Methods: This is a cross-sectional and analytical study conducted in the ENT department of the Center for the Disabled (visual, auditory, and mental) "Village Bondeko", from June to September 2023, involving 150 adults (≥20 years) with acquired sensorineural hearing loss; without a history of neuropsychic disorders. Sensorineural hearing loss was confirmed by tonal threshold audiometry and characterized according to WHO criteria; cognitive disorders were defined according to the MoCA scale.

Results: In total, 150 adults, including 78 men and 72 women, were collected in the present study. The average age was 54.11 ± 20 years, with extremes ranging from 20 to 87 years. In univariate analysis, there was a significant association ($p<0.0001$) between the degree of hearing loss and cognitive disorders. The analysis of variance (ANOVA) comparing the means demonstrated a very significant correlation ($p < 0.0001$) between the decline in cognitive functions and the severity of hearing impairment. The low level of education, marital status, and cardiovascular risk factors were associated with cognitive disorders; however, no association was demonstrated between advancing age, gender, socioeconomic status, and cognitive disorders in the study population.

Conclusion: The present study has demonstrated the existence of an association between sensorineural hearing loss and cognitive disorders, involving a multidisciplinary and early management of sensorineural hearing loss.

Keywords: sensorineural hearing loss, cognition, Kinshasa, Village Bondeko

Introduction

Sensorineural hearing loss (SNHL) currently constitutes the third leading cause of disability in the world, affecting 1.57 million people,[1] 80% of whom live in developing countries.[2] Compared to high-income countries, where prevalences around 4 to 6.4% are observed in adults, the SSA reports prevalence rates of hearing loss three times higher.[3]

In addition to the negative economic impact of SNHL, SNHL is responsible for communication difficulties with the surrounding environment. In children, it is responsible for delayed language acquisition and decreased academic

Received: 14 May 2024
Accepted: 24 December 2024
Published: 7 January 2025

performance.[4] In adults, the consequences are rather social isolation, depression, and cognitive decline with a risk of dementia.[5] Cognitive functions are essential elements for maintaining autonomy and quality of life; they refer to the mental processes involved in attention, language, reasoning, memory, problem-solving ability, and visuospatial capacity, which can be accompanied by behavioral disorders at certain stages of the disease.[6]

The natural history of cognitive impairments, especially severe ones, is still poorly understood, but it is increasingly suspected that a silent period of around 15 to 20 years often precedes the clinical diagnosis of Alzheimer's-type cognitive disorders. This reality reinforces the importance of thoroughly understanding the factors that can influence cognitive disorders such as low education level, marital status, hypertension, diabetes, alcohol and tobacco use, aging, and socioeconomic status; thus enabling the implementation of targeted interventions, especially among middle-aged and elderly adults.[7]

According to the Lancet Commission report in 2020, sensorineural hearing loss has been identified as the main target in strategies for preventing cognitive disorders such as dementia. Thus, eliminating hearing loss in midlife could reduce the risk of developing dementia by 9%.[8]

Several systematic reviews and meta-analyses have highlighted an association between both congenital and acquired sensorineural hearing loss and a decline in cognitive performance.[9–11]

Recent studies on the association (correlation) between cognitive disorders and sensorineural hearing loss stipulate that the risk of developing cognitive disorders is increased by 24% in the case of deafness (average threshold at 39 dB) and that there is a linear association between the risk of occurrence of cognitive disorders, their severity, and the severity of hearing impairment.[12]

However, the majority of previous studies demonstrating the association between hearing loss and cognitive decline are based on data from Western countries.[13] Indeed, in Sub-Saharan Africa, the knowledge of this association remains very poorly documented; however, the high prevalence of disabling hearing loss, as well as the harmful societal impacts of sensorineural deafness in developing countries, should constitute a public health priority,[14] particularly in the D.R. Congo, where access to hearing rehabilitation measures is limited by the lack of effective healthcare coverage.

The advent of the COVID-19 pandemic in 2019 from China[15] and after 2020 in the rest of the world,[16] including the DRC,[17] general deafness,[18] and cognitive disorders/dementia are compelling evidence (Evidence Based Medicine) of an anxiety-depressive and pro-dementia state.[19]

The hypothesis is proposed that the prolonged exposure to military conflicts, inter-ethnic crises, auditory trauma, and the widespread poverty of Congolese people contribute to an epidemic-like prevalence of sensorineural hearing loss and cognitive disorders in Kinshasa.

Thus, the objective of the present study was to investigate the association between sensorineural hearing loss and cognitive disorders using a correlational approach; among patients followed at the ENT department of the "Village Bondeko" center in Kinshasa.

Methods

Nature and Period of the Study

The present cross-sectional and analytical study was conducted from June 4 to September 30, 2023, at the ENT department of the diocesan organization "Village Bondeko" located in the Kinshasa commune,[20] whose choice was justified by its expertise in the care of patients living with disabilities (mental, auditory, and visual).[21]

Study Population

The study population consisted of patients aged 20 years or older, with acquired sensorineural hearing loss, who consulted the ENT department during the study period.

Sampling

The sample size calculation was performed using the Raosoft software: Approximately 150 patients were consulted each day from Monday to Friday during the study period. Included in the study were all consenting, literate patients aged

≥ 20 years; who had normal otoscopic and tympanometric examinations; who presented with hearing loss on pure tone audiometry (PTA); and who had no history of neuropsychological disorders. Patients with a history of visual disorders, chronic pain, vestibulopathy, head trauma, and HIV infections, as well as those who did not participate in all stages of the study, were excluded.

Data Collection

The collected data came from the otoscopic examination, tympanogram, PTA, and the pre-established questionnaire to gather sociodemographic information, clinical history, as well as cognitive functions.

Variables D'intérêt

The parameters of interest in the study were age, sex, education level, socio-economic status, marital status; complaints at admission, notions of alcohol and tobacco, diabetes mellitus, and hypertension.

The pure tone audiometric test (PTA) was conducted using an automated screening audiometer from the brand SHOEBOX Ottawa, Canada, equipped with a soundproof headset from the brand Radio Ear DD450 minnesota, USA. The frequency measurements from 500 to 8000 hz and intensities from −10 to 130 dB, validated according to Canadian expert guidelines, were used.[22] The audiogram allowed for the quantification of hearing loss in each ear in decibels, for the frequencies 500Hz, 1000Hz, 2000Hz, 4000Hz, and 8000Hz in air conduction.[23] The audiometric test was conducted in a quiet room, with the examiner positioned behind the patient, who was seated and equipped with headphones, the earpiece applied to the ear centered on the concha; the red earpiece placed on the right and the blue on the left ear. The instruction given by the examiner was to respond immediately by raising the hand each time a sound was perceived by the patient in either ear, even if the sound was faint, and to lower the hand when the sound was not heard. The results of the audiometric test were automatically presented in the form of a graph (audiogram) on which the different hearing thresholds obtained were recorded, with frequencies (Hz) on the x-axis and intensities (dB) on the y-axis directed downwards.

The evaluation of the patients' cognitive functions was carried out using a questionnaire from the Montreal Cognitive Assessment (MoCA) scale.[24–27] French Version 7.1. The MoCA scale was designed to evaluate eight sub-tasks or cognitive domains, which included immediate memory (unmarked sub-domain),[28] and the seven other cognitive domains visuospatial and executive scores rated out of 5 points, language abilities (fluency) (3 points), attention (6 points), temporal-spatial orientation (6 points), delayed memory (5 points), naming (3 points), and abstraction ability (2 points); the scoring was out of a maximum of 30 points.[29] During the cognitive assessment, the patient was provided with a pencil, a scratch paper, and the questionnaire to be filled out after receiving instructions from the examiner both orally and in writing. The scoring was done directly on the answer sheet by the examiner, with 1 point for a correct answer and 0 points for an incorrect answer.

Operational Definitions

The hearing levels were defined according to the WHO recommendations:[30]

- Normal hearing, defined by an average hearing threshold ≤ 25 dB
- Mild hearing loss, defined as any hearing loss of 26–40 dB
- Moderate hearing loss, any hearing loss of 41–60 dB
- Severe hearing loss, considered any hearing loss of 61–80 dB
- Deep hearing loss, represented any hearing loss > 80 dB.
- Hearing loss was considered bilateral when the initial auditory threshold in the better ear was > 25dB.

Cognitive impairment was defined by a global score on the MoCA scale < 26 out of 30 points.[29] The scoring was interpreted as follows:[31]

- ≥ 26/30: no cognitive impairment;

- 18–25/30: mild cognitive impairment;
- 10–17/30: moderate cognitive impairment;
- <10/30: severe cognitive impairment.

Statistical Analysis of the Data

The data were initially entered using Microsoft Excel 2019, processed, and analyzed using IBM SPSS Statistics 26.0 software. The qualitative variables were presented in terms of frequencies and proportions in percentage. The quantitative data were summarized in means and standard deviations (SD). The univariate analysis allowed for the comparison of proportions between two study groups using Pearson's chi-square test. The odds ratio and the bivariate correlation (Spearman coefficient: r) between the explanatory/independent variables such as age advancement/immunosenescence, sex, marital status, education level, socioeconomic status, hypertension, diabetes, tinnitus/hyperacusis, the notion of alcohol, tobacco, and the severity of hearing loss (r=9.288) with cognitive disorders (dependent variable) were calculated.

As for the means between the groups, they were compared using the ANOVA test. Univariate and multivariate associations and odds ratio (OR) estimates were calculated with a 95% confidence interval (CI). The multivariate logistic regression model was used with OR, 95% CI after adjusting for confounding factors to identify the independent and significant determinants of cognitive disorders in the study population. The p-value of < 0.05 was considered statistically significant. Regarding potential information biases, these were eliminated, firstly by using appropriate scales as guided by Evidence Based Medicine, secondly by utilizing literature data from PubMed and Google Scholar, and thirdly through the statistical analyses conducted in this study, particularly the use of logistic regression (multivariate analysis) which excluded confounding variables.

Results

General Characteristics of the Patients

Out of a total of 150 patients, there was no overrepresentation of males or females with a sex ratio of 1 man: 1 woman. The average age of the study participants was 54.11 ± 20 years, ranging from 20 to 87 years. The advancement in age (≥60 years) represented 40.7% of the patients (n=61). The majority of patients who participated in the study were single, followed by widows with 34.7% and 27.3%, respectively. The secondary education level was more represented with 41.3%, and the socioeconomic level of the patients was relatively low for 72% of them. The majority of patients' complaints were hearing loss at 89% (n=134), followed by tinnitus at 80% (n=120). (Table 1). A good number of patients

Table 1 General Characteristics of Patients

Variables	Total (n=150)	Percentage (%)
Years		
< 60 years	89	59.3
≥ 60 years	61	40.7
Sex		
Female	72	48
Male	78	52
Marital status		
Widow(er)	41	27.3
Divorced	24	16
Married in a couple	33	22
Single	52	34.7
Education level		
Primary	22	14.7
Secondary	62	41.3
University	34	22.7
Postgraduate	32	21.3

(*Continued*)

Table 1 (Continued).

Variables	Total (n=150)	Percentage (%)
Socio-economic level		
Low	108	72
High	42	28
History		
Tobacco	67	44.7
Alcohol	102	68
Diabetes	101	67.3
Hypertension	104	69.3
Complaints upon admission		
Hearing loss	134	89
Tinnitus	120	80
Duration without worsening of self-reported hearing loss		
≤ 5 years	23	15
> 5 years	127	85

reported a worsening of their hearing loss in less than 5 years, specifically 85%; the average duration without worsening of hearing loss was estimated at 2.3 ±1.4 years, within a range of a minimum of 1 month and a maximum of 48 months.

Audiometric Characteristics

SNHL Predominated in Bilateral Hearing Impairments with 80% (n=120)

Patients with mild, moderate, severe, and profound hearing loss at PTA represented 19.3% (n=29), 14.6% (n=22), 32.6% (n=49), and 33.3% (n=50), respectively (Figure 1).

Characteristics of Cognitive Assessment

In the study population, the overall mean score on the MoCA cognitive assessment scale was 16.5±6.7 points; the median and mode being 15 and 12 points, respectively; on a range from 10 to 30 points. The different cognitive domains assessed are listed in Table 2. The majority of patients, 81% (n=122), presented with a comorbidity of cognitive disorders and sensorineural hearing loss (Figure 2) according to the following biological gradient: 18% (n=22) of patients with mild

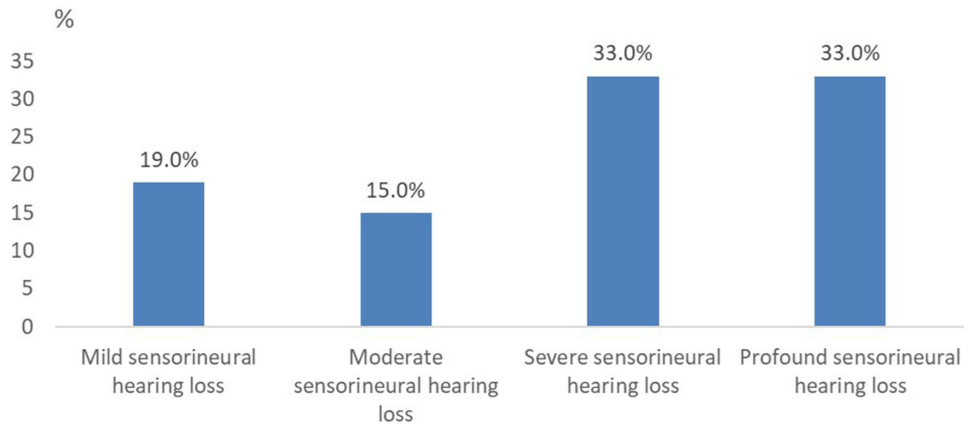

Figure 1 Distribution of patients according to the degree of sensorineural hearing loss.

https://doi.org/10.2147/NDT.S478277

Table 2 Scores of the Different Cognitive Domains of Patients Obtained Using the MoCA Scale

Variables	Mean ± SD
Visuospatial ability	4±1
Naming	2.7±0.4
Memory	4±0.9
Attention	3.8±1.2
Language	2.5±0.7
Abstraction	1.7±0.6
Temporal-spatial orientation	5±0.6

cognitive disorders, 29% (n=35) of patients with moderate cognitive disorders, and 53% (n=65) of patients with severe cognitive disorders. Thus, severe cognitive disorders were overrepresented (Figure 3).

Univariate Analysis of Factors Associated with Cognitive Disorders and SNHL

Socio-Demographic and Clinical Factors Associated with Cognitive Disorders

In univariate analysis, as presented in Table 3, excluding age, sex, and socio-economic status, all other socio-demographic and clinical parameters were significantly associated with cognitive disorders in the study population (p

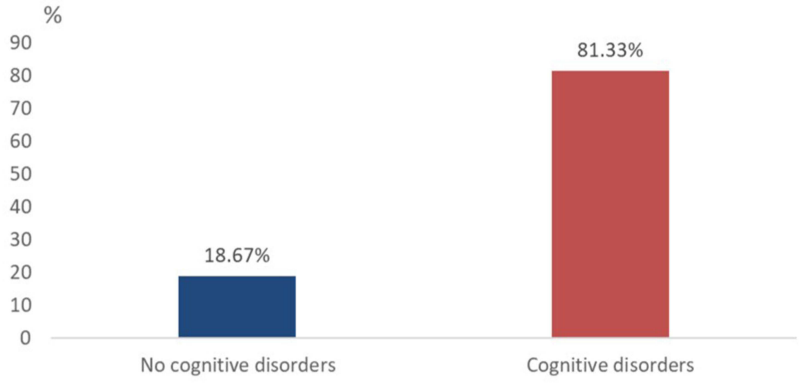

Figure 2 Frequency of cognitive disorders in the study population.

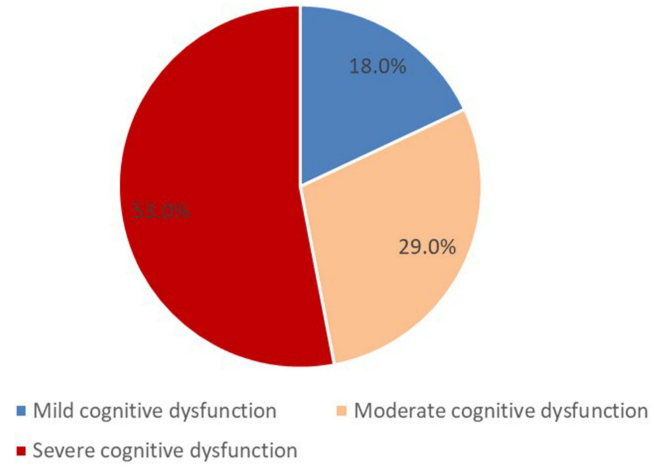

Figure 3 Distribution of patients according to the degree of cognitive dysfunction.

Table 3 Socio-Demographic and Clinical Parameters Associated with Cognitive Disorders

Variables	Cognitive disorders		Risk	IC 95%	p
	Yes	No			
Years					
• ≥60years	51(84)	10(16)	0.7	(0.3–1.8)	0.356
• <60years	71(80)	18(20)			
Sex					
• Female	55(76)	17(24)	0.5	(0.2–1.2)	0.1
• Male	67(86)	11(14)			
Civil status					
• Maried	88 (90)	10 (10)	5	(2–11)	<0.0001
• Singles	34(65)	18(35)			
Education level					
Primary/Secondary	62(74)	22 (26)	3.5	(1.3–9.3)	0.006
University/Postgraduate	60(91)	6(9)			
Socio-economic level					
• Poor	84(78)	24(22)	2,7	(0.8–8.3)	0.055
• Rich	38(90)	4(10)			
Alcohol					
• Yes	97(95)	5(5)	18	(6–52)	<0.0001
• No	25 (52)	23(48)			
Smoking					
• Yes	66 (99)	1(1)	32	(4–242)	<0.0001
• No	56(67)	27(33)			
Diabetes					
• Yes	95(94)	6(6)	2	(1.6–3)	<0.0001
• No	21(43)	28(57)			
Hypertension					
• Yes	97(93)	7(7)	0.08	(0.03–0.23)	<0.0001
• No	25(54)	21(46)			
Tinnitus					
• Yes	92(77)	28(23)	0.7	(0.6–0.8)	0.001
• No	30(100)	0(0)			

< 0.05). These include marital status, education level, smoking and alcohol consumption, patients with a history of diabetes and hypertension, as well as tinnitus (Table 3).

Site, Duration, and Degree of Hearing Loss Associated with Cognitive Disorders

In the present study, cognitive disorders were more localized bilaterally at 93% than unilaterally at 33%, with statistical significance being very significant (P<0.0001); the risk of developing cognitive disorders was 28 times higher in patients with bilateral hearing loss than in those with unilateral hearing loss (Table 4). Cognitive disorders were more noted in severe and profound sensorineural hearing loss than in mild and moderate sensorineural hearing loss, with a very significant statistical difference ($p < 0.0001$) (Table 4). The univariate ANOVA analysis demonstrated a very significant correlation ($p < 0.0001$) between the decrease in cognitive functions on the MoCA cognitive assessment scale and the severity of auditory impairment on the PTA (Figure 4). The comparison of the mean cognitive scores on the MoCA scale between the SNHL groups showed a very significant difference ($p<0.0001$) between the SNHL groups of mild (24.5 ±7.2), moderate (19.4±8.2), severe (14.6±3.2), and profound (12.5±2.8).

Table 4 Site, Duration, and Degree of Hearing Loss Associated with Cognitive Disorders

Characteristics	Cognitive disorders		Risque	IC 95%	p
	yes	No			
Anatomical localization of auditory impairment	112	8(7)	28	(10–80)	<0.0001
• Bilateral	(93)	20			
• Unilateral	10 (33)	(67)			
Duration without worsening of self-reported hearing loss≤ 5	23(100)	0(0)	1.2	(1.1–1.4)	0.006
years	99(78)	28(22)			
• > 5 years					
Degree of sensorineural hearing loss at		20(69)			<0.0001
PTA	9 (31)	8(36)			
• Mild	14(64)	0 (0)			
• Moderate	49	0(0)			
• Severe	(100)				
• Profound	50				
	(100)				

As illustrated in Figure 5, all patients whose SNHL worsened in no more than 5 years developed cognitive disorders, and according to the ANOVA analysis, patients whose hearing loss worsened suddenly developed moderate to severe cognitive disorders (Figure 5).

In bivariate analysis, the correlation between the different cognitive domains constituting the MoCA cognitive scale and SNHL, there was a significant correlation ($p<0.05$) between temporospatial orientation ($r = 0.975$), visuospatial ability ($r=0.902$), memory ($r=0.882$), attention ($r=0.804$), language ($r=0.795$), abstraction ability ($r=0.777$) and SNHL. Table 5, comparing the degree of hearing loss at PTA and the different cognitive domains on the MoCA scale, demonstrates a more pronounced deterioration in visuospatial ability as well as temporospatial orientation with the increase in hearing loss ($p<0.05$) (Table 5).

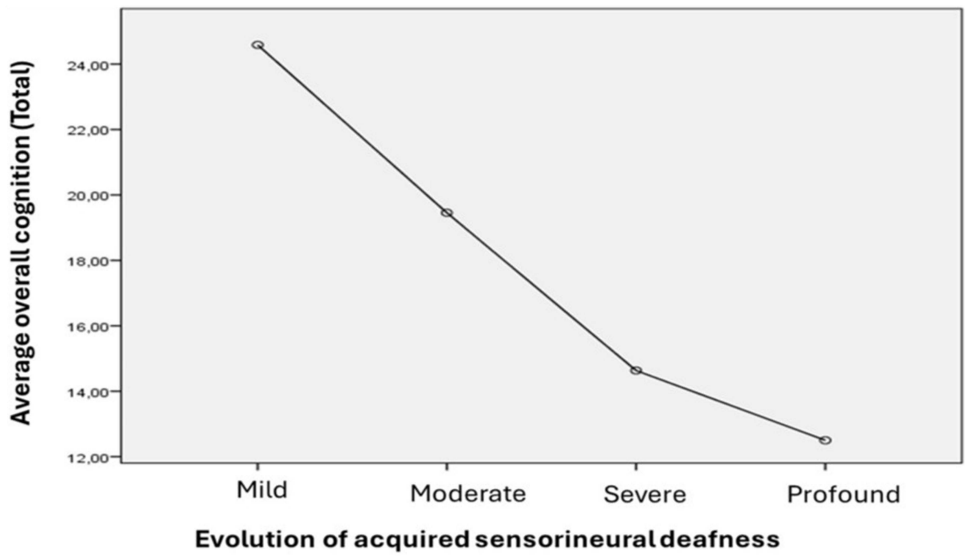

Figure 4 Correlation between the average score on the cognitive scale (MoCA) and the severity of sensorineural hearing loss.

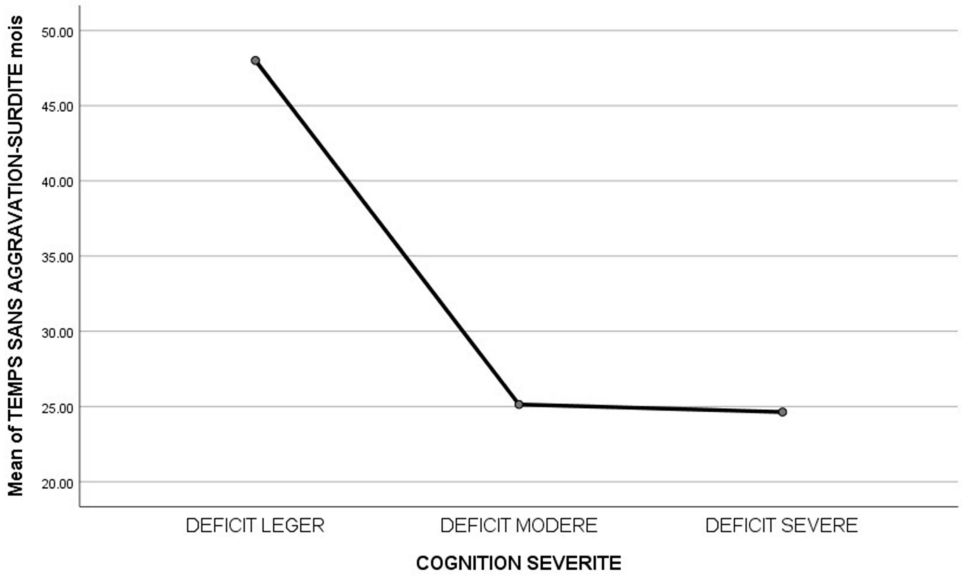

Figure 5 Correlation between the duration without worsening of sensorineural hearing loss and the severity of cognitive impairment.

Multivariate Analysis

Determinants of Cognitive Disorders

After excluding confounding factors such as marital status, education level, and diabetes; the multivariate analysis using binary logistic regression identified alcohol, tobacco, and hypertension as independent and significant determinants ($p<0.05$) associated with cognitive disorders in the study population (Table 6).

Table 5 Correlation Between the Degree of Hearing Loss at PTA and the Different Cognitive Domains on the MoCA Scale

Variables	Degrees of sensorineural hearing loss				p
	Mild	Moderate	Severe	Profound	
Visuospatial ability	4.2±0.8	4.6±0.5	4.2±1	3.8±1.1	0.009
Denomination	2.7±0.5	2.8±12	2.8±0.4	2.7±0.4	0.047
Memory	4.3±0.7	4.3±0.8	4.2±0.9	4.3±1.0	0.010
Attention	3.8±1.1	4.3±1.1	3.8±1.3	3.6±1.2	0.019
Language	2.6±0.5	2.5±0.7	2.6±0.8	2.4±0.9	0.036
Abstraction	1.7±0.4	2.0±0.7	1.6±0.5	1.6±0.7	0.011
Temporal-spatial orientation	5.2±0.8	5.2±1.1	5.2±0.9	4.7±1.3	0.003

Table 6 Independent Determinants of Cognitive Disorders in the Study Population

Variables	A	E.S	Wald	ddl	Exp (OR)	IC (95%)	p
Alcohol	2.508	0.621	16.328	1	12.286	(4–41)	<0.0001
Tobacco	3.131	1.096	8.167	1	22.906	(3–196)	0.004
High blood pressure	1.658	0.611	7.352	1	5.246	(1.5–17)	0.007
Constant	−0.874	0.717	1.488	1	0.417		0.223

https://doi.org/10.2147/NDT.S478277

Discussion

This article recalled the main objective of the present study, namely to establish the correlation between cognitive disorders and SNHL at the "Village Bondeko" center.

Thus, the most important results were discussed according to different mathematical models and pathophysiological bases after confronting them with the results of the literature, confirming or refuting the study's findings.

The results of the present study corroborate (confirm) the data from the scientific literature within the framework of the exposome (set of exposures), and the influence of advancing age, gender, education level, and socio-economic status, marital status, hypertension, diabetes, tinnitus, the concept of alcohol and tobacco.[32]

Descriptive Approach

Age and Sex

The descriptive approach highlighted the gender neutrality in the study population of the present study. This neutrality has also been observed in other studies, notably in Iran[33] and Sweden.[34] However, the predominance of one sex over the other has been observed both in Africa and the rest of the world.[35–37] If the small sample size (n=150), the profession of the patients, as well as the acquired origin of the SNHL in the study population, can explain the gender neutrality in the present study (men do more work related to noise exposure), it should nevertheless be noted that connexin 26 associated with the Y chromosome is linked to the onset of congenital SNHL. The presence of this protein could explain the predominance of the male sex in most studies conducted worldwide.[38] Indeed, in these studies, the SNHL was mostly of congenital origin.

The selection criterion for the study population, based on the feasibility of auditory and cognitive tests, included patients with an average age of 54.11 years ±20 years. This choice is reinforced by the fact that the entire study population had acquired SNHL with various etiologies, most of which are characteristic of advanced age (immunosenescence, degenerative diseases), or are due to the patients' professions.[39,40]

Education and Socio-Economic Level

The education level of the population in this study was more primary/secondary (56%) than university/post-university (44%) and explains the different professions practiced by this population (vendeurs, ouviers, taximans). The level of education can also explain why ¾ of the patients in this study (n=108) were characterized by a low socio-economic status. This economic precariousness can be explained by disabilities and early retirements caused by SNHL.[41,42]

Univariate Analysis

Cognitive Dysfunction and SNHL

SNHL, the third leading cause of disability in the world, the main modifiable risk factor for cognitive disorders and dementia, has been the subject of several studies worldwide, highlighting the impact of SNHL on the occurrence of cognitive disorders, especially in severe stages but also in cases of mild hearing loss, albeit to a lesser degree.[43]

Low cognitive scores on the MoCA cognitive assessment in patients with SNHL have been described by several recent studies, such as those by Moradi et al in Norway, in 2024, and by Hui-Fu et al in China, in 2023.[44,45]

The correlational and comparative approach of the present study demonstrating the significant association between the deterioration of cognitive functions on the MoCA scale and the increase in hearing loss aligns with the findings by Tongxiang et al. In China, in 2021, highlighting a linear trend between the increase in hearing thresholds at PTA and the increased risk of dementia.[46]

In a longitudinal study conducted in Baltimore, USA, involving adults aged 36 to 90 years, it was demonstrated that hearing loss was predictive of the risk of developing dementia, with an incidence multiplied by 2 in the case of mild hearing loss (25 to 40 dB), by 3 in the case of moderate hearing loss (41 dB to 70 dB), and by 5 in the case of severe hearing loss (>70 dB).[47] This reinforces the links established by the literature indicating that SNHL can contribute to cognitive decline. Indeed, different mechanisms are involved in the case of SNHL. The absence of prolonged auditory stimulation is responsible for a structural and functional alteration of the brain, resulting in global brain atrophy, particularly a decrease in gray matter in the temporal lobe, prefrontal auditory areas, frontal areas, and the

hippocampus.[48] These changes occur in brain regions essential for cognitive processing (memory, language comprehension). Furthermore, the excessive use of cognitive resources to improve listening abilities makes them unavailable for other aspects of higher cognition during the listening effort; this results in an exhaustion of cognitive reserves.[49]

However, some results contrary to previous studies have rather demonstrated that there is no association between SNHL and cognitive disorders.[50] This difference could be explained by the variability in the choice of cognitive tests, the types of audiometry used, and probably also the quality of the human resources involved in the analysis of these results, which were not better equipped.

The significant percentage of cognitive disorders found in the present study could also be explained by the fact that the majority of patients did not wear hearing aids. However, it is established in the literature that the use of hearing aids reduces the incidence of dementia in people with hearing loss.[51,52] A recent study demonstrated that unilateral cochlear implantation in an adult population with severe to profound bilateral sensorineural hearing loss had a positive effect on cognitive functioning and quality of life one year after activation.[53]

In the present study, patients whose hearing loss worsened suddenly were at a higher risk of developing moderate to severe cognitive disorders. The current results corroborate those of a cohort study in China, which revealed that over a 7-year follow-up period, patients with sudden SNHL had a higher risk of dementia.[54] In addition to the various characteristics of SNHL in the study population, such as the severity of SNHL, its bilateral nature, and especially associated symptoms like tinnitus, which according to some studies are responsible for an increased risk of early-onset dementia in young and middle-aged adults.[55,56] These characteristics could exacerbate chronic stress, social isolation, loss of productivity, and significantly influence cognitive performance.[57]

Exposome and Cognitive Disorders

Various factors, including sociodemographic factors, lifestyle-related factors, environmental factors, and cardiometabolic factors, have been identified as potential contributors to the onset of part of SNHL[58] and cognitive disorders.[59]

In the present study, patients who were married in couples and had been married (divorced and widowed) had a fivefold increased risk of developing cognitive disorders compared to singles. It is established by several longitudinal studies and meta-analyses that loneliness significantly contributes to cognitive disorders and dementia.[60,61] In the D.R. Congo, divorce, and especially widowhood, constitute permanent psychological stress factors for young adults due to relatively low income and generally higher number of children.[62] The overpopulation of the city of Kinshasa linked to industrialization also explains the different types of pollution, atmospheric[63,64] and noise, which significantly influence SNHL and cognition.[65]

If the level of education as well as the socio-economic status of the population in this study could partly explain the possibility of cognitive disorders due to a feeling of incapacity; cardiovascular risk factors such as a history of diabetes, hypertension, and the notion of alcohol and tobacco highlight the important role of metabolic syndrome in SNHL and cognitive decline. The results of the present study, which state that the risk of developing cognitive disorders was twice as high in patients with diabetes, align with research conducted on the association between diabetes on one hand and SNHL and cognitive decline on the other.[66,67]

Numerous studies, such as the one conducted by Babarinde et al in 2021 in a Cardiology department in Nigeria, have highlighted a significant association between hypertension and SNHL ($p < 0.01$). Hypertension-related SNHL increased with age, severity, and duration of the disease.[68] Indeed, the stria vascularis, being supplied by labyrinthine arteries without collateral circulation, is very sensitive to the impact of ischemic lesions that can lead to the death of hair cells and, ultimately, to hearing loss caused by hypoxia resulting in progressive or sudden hearing loss.[69–71] However, these same microvascular causes found in cardiovascular diseases affect both cerebral vascularization in addition to that of the cochlea; they can thus be responsible for hearing loss and cognitive impairment.[72] These so-called atherogenic diseases, whose incidence is increasing due to urbanization, lifestyle changes, and the nutritional transition towards a Western-type diet, also constitute a major health problem in less developed countries.[73–76]

The finding of an increased risk of dementia in people who drink alcohol was also demonstrated by Fitzpatrick et al in England, in 2023.[77] Yet some studies continue to show results consistent with the protective effects of low to moderate alcohol consumption on dementia and cognitive functions.[78] A cohort study found that abstaining from alcohol and

consuming more than 14 units of alcohol per week are associated with an increased risk of dementia. However, the risk of dementia among abstainers could be partly attributable to cardiometabolic disease.[79]

Multivariate Analysis

Independent Determinants of Cognitive Disorders in Multivariate Analysis

In the present study, multivariate logistic regression identified alcohol, tobacco, and hypertension as independent and significant determinants of cognitive disorders. In addition to the studies by Gareth-Hagger et al in the United Kingdom in 2013[80] and by H. Hendriks et al in the Netherlands in 2020,[81] several other studies have been conducted to establish the deleterious effects of chronic alcohol and tobacco consumption on cognitive functions. Indeed, chronic alcohol consumption would increase the risk of dementia by causing structural and functional brain damage, responsible for a decline in cognitive functions, particularly a decrease in learning abilities, memory, attention, and problem-solving capacity.[82,83] Regarding smoking and hypertension, their influences on the decline in cognitive performance and the occurrence of SNHL are well established.[84–88]

Strengths and Limitations of the Study

The present study was limited to a certain extent. The small sample size, the lack of genetic information from patients which did not allow for the consideration of all types of sensorineural hearing loss, as well as the unavailability of certain equipment for the assessment of hearing loss in very high-frequency auditory impairments. Indeed, only tonal audiometry was used in the present study. This study only used the MoCA cognitive assessment test, allowing for the evaluation of overall cognition; however, there are other tests that are much more specific for evaluating each cognitive domain separately. Therefore, it is difficult to accurately demonstrate which specific cognitive domain is most affected by SNHL. In addition, the absence of a control group without SNHL also constitutes a limitation of the study. Furthermore, although the "Bondeko Village" Center serves as a tertiary reference in the organization of primary care within the Catholic network, the results of this study cannot be generalized.

However, this study has the merit of being the first to have investigated the association between cognitive disorders and SNHL in the DRC. In addition to this, the use of odds ratios measured with confidence intervals (CI) for univariate and multivariate analyses has strengthened the credibility of our results. The relevance of the obtained results remains a major asset in the development of subsequent research projects.

Conclusion and Perspectives

This study confirmed, based on a very significant association, the link between cognitive disorders and SNHL. The present study also emphasized the risk factors significantly associated with cognitive disorders such as low education level, marital status, hypertension, diabetes, tinnitus, alcohol consumption, and tobacco use, but could not demonstrate an association between aging, gender, and socioeconomic status with cognitive disorders. Other studies, such as cohort studies and meta-analyses, would be necessary in order to contribute, within this multidisciplinary approach, to the improvement of the management of sensorineural hearing loss by integrating the neuropsychological aspect.

The negative impact of SNHL on cognitive aspects should be a public health priority for policymakers and public health leaders, with the aim of improving the availability and quality of care for individuals with SNHL, especially in developing countries where audiology and otorhinolaryngology care are limited, and where the lack of effective health coverage reduces access to hearing rehabilitation services (hearing aids, cochlear implants). Moreover, patients with SNHL should benefit from cognitive support and psychological counseling. In the absence of effective interventions on hearing health in SSA, and in particular in DRC, disabling SNHL and its consequences on cognition would further increase unproductivity, and thus the economic burden on health systems.

Abbréviations

SSA, Sub-Saharan Africa; PTA, PTA: Pur tone audiometrydB, Decibel; MoCA, Montreal cognitive assessment; MMSE, Mini-Mental State Exam; WHO, World Health Organization; ENT, Otolaryngology; DRC, Democratic Republic of Congo; SNHL, Sensorineural hearing loss; SPSS, Statistical Package for the social sciences; US, United States.

Ethical Considerations

The protocol of this study had obtained approval from the National Ethics Committee under the number 446/CNES/BN/PMMF/2023. All participants were informed of the objective of the study, in accordance with the Declaration of Helsinki.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflict of interest.

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