

## Association Between Hearing Loss and Mild Cognitive Impairment: A Search Still Open

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Presbycusis, an age-related hearing loss, is a common disorder in elderly. It is a progressive disorder affecting hearing functions. It is usually characterized by progressive hearing loss at high frequencies, which are particularly important for speech recognition [1,2]. Similar to this problem, there are an age-related losses in cognitive processing including speed of information processing, memory and attention. Recent advances in research and clinical practice have been driven by questions hearing loss and cognitive processing, with an increase with the age of the prevalence and incidence of the mild cognitive impairment (MCI). This term is used to describe older subjects with demonstrable cognitive impairment who have not crossed the threshold for dementia [3]. In medical literature there are epidemiological studies that have identified an association between hearing loss and dementia although are not clear the mechanisms underlying this association [4].

In our clinical practice we observed a correlation between hearing loss in over 65 age patients and cognitive impairment. For example, from January 2017 to December 2017 we valued 81 patient (49 men and 32 women) more than 65 years old (mean age  $76 \pm 7.51$ ) that had hearing loss. They had no cause of their hearing loss could be found other than Presbycusis. They all had the typical moderately sloping pure tone audiogram configuration. The pure tone average hearing loss (pure tone audiometry PTA, average of 0.5, 1 and 2 kHz) ranged from 11 to 70 decibels Hearing Level (dBHL) with a median of 40. This patients came at because of presented a history of progressive memory problems that affected his life performance. We did them neurologic examination: Montreal Cognitive Assessment (MoCA), Geriatric Depression Score (GDS) activities of daily living (ADLs) and instrumental activities of daily living (IADLs). The results of these test are: in normal IADLs ( $7/8 \pm 1$ ) and normal ADLs ( $5/6 \pm 1$ ). The 82% of patients (40 man and 26 woman) demonstrated a MOCA score between 17 and 19 (mean  $17,5 \pm 0,5$ )

We also measured GDS score and it resulted that the 67% of patients (33 man and 22 woman) are slightly depressed ( $8 \pm 1$ ). We did not operate other statistical approaches (correlations, regressions), also given the limited time frame at our disposal, but we limited ourselves

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to a strictly observational analysis. So we observed that in this group of patients there is an association between MCI and hearing loss and also that there is a correlation between a depressed profile and hearing loss. Other authors in papers published in the medical literature have depth on these issues from the perspective of a greater methodological and statistical rigor [5]. Therefore, our results appear to be in agreement to other data that are in literature. In fact Ren., *et al.* demonstrated that cognitive function is significantly associated with pure tone average in older adults in a chinese cohort [6].

Previous studies of older American [7] and Australian adults [8] have reported significant relationships between peripheral hearing loss and global cognitive status, executive function and psychomotor speed [9, 10]. Both the central and the peripheral auditory system were studied, both in animal models and in humans, the changes of these two systems due to age, the altered metabolism of the involved neuronal systems, the anatomical and functional consequences and the relapses on the cognitiveness of the individual in old age. Certainly age-related hearing loss has a multifactorial pathogenesis so that it is difficult to study both the risk factors and any preventive treatments. A recent study, still in progress, will investigate, in this regard, the importance of comorbidities and the positive role played by aspirin in the possible prevention of hearing loss (secondary outcomes consist of changes in retinal microvascular indicators, and changes in cognitive function) [11]. It has been shown that the risk of developing dementia is higher in individuals affected by hearing loss because, according to an explanation perhaps quite simplistic, the hearing loss leads to cognitive decline because of degradation of inputs to the brain [12].

Alongside these hypotheses has made its way the conception of a true anatomical damage, caused by hearing loss. Hearing loss in older adults correlates with tissue volume loss in auditory cortex and whole brain and is associated with functional reorganization and a reduced cognitive reserve [13]. The strong connection between hearing loss and cognitive decline has been explained by a hypothesis of Chang, *et al.*; these authors demonstrated that hearing loss might act as a risk factor for cognitive impairment in Alzheimer disease's patients and that hearing loss may cause hippocampal synapses to be more vulnerable to brain pathology. So the authors said that there are connections between the central auditory pathway and the hippocampus [14]. The central auditory deficit would be a silent impairment because it does not have an immediate impact on daily functions and the subject is usually not aware of his/her deficits and tends to minimize the handicap. This predisposes patients to a social isolation that has been shown to have an important effect on cognitive status [15]. Given these data certainly interesting, it is difficult to find the scientific work they are uniform in examining this association. In fact, the reviews highlight several studies characterized by different limits and bias.

There is no standardization of the evaluation methods of the studied cohorts and the comparison of the various trials and studies is difficult [4,16-19]. According to a more recent vision, a more recent vision, hearing loss and loss of cognition would not be one the cause of the other, or vice versa, but a common expression of aging and brain degeneration. Very recently, Uchida et al. have tried to trace the most accredited etiopathogenetic hypotheses, to explain this link between hearing loss and cognitive impairment [20]: a hypothesis would put at the center of all the oxidative damage as a common genesis of both hearing loss and cognitive degeneration, without a causality between the two pathological conditions.

On the contrary, a cascade hypothesis would describe an aggravated peripheral hearing affects brain structure directly via impoverished sensory input, with verbal communication failure, severely limit social integration a decrease in socialization and social isolation, loneliness, apathy, depression, all risk factors for a decline in cognitive abilities. At this regard, some studies (the Aging and Cognitive Health Evaluation in Elders – ACHIEVE – ; the Epidemiology of Hearing Loss Study – EHLS – ; the SENSE-Cog) investigated, rather than pharmacological remedies (like aspirin from the already mentioned ASPREE-HEARING trial), the benefits produced by interventions aimed at improving the hearing ability of subjects with cognitive impairment, such as cochlear implants [21-23]. The benefit derived from these interventions, to date, appears however to be modest. Anyway, the question of whether hearing intervention has the potential to delay the development of dementia requires further investigation.

Hearing loss and cognitive decline are due to pathological entities with a multifactorial aetiology that undoubtedly influence each other. Although the association between the two conditions has been observed in terms of both clinical, epidemiological and

instrumental studies, there are still doubts about the (pathogenetic) relationship between them. The same thing can be said for a therapy directed toward the presbycusis that have healing results or even estimates on cognitive impairment. Pending further investigations that highlight new scientific evidence on the link between presbycusis and cognitive decline, it seems useful to underline take home message on the importance of cultivate a need to listen to screening among patients at risk of definite cognitive decline and people with MCI .

## Conflict of Interest

All authors declare no conflict of interest.

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