



## Review

# Increased risk of psychosis in patients with hearing impairment: Review and meta-analyses



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## ABSTRACT

Several studies suggest hearing impairment as a risk factor for psychosis. Hearing impairment is highly prevalent and potentially reversible, as it can be easily diagnosed and sometimes improved. Insight in the association between hearing impairment and psychosis can therefore contribute to prevention of psychosis. This paper provides meta-analyses of all epidemiologic evidence on the association between hearing impairment and psychosis and summarizes mechanisms that potentially underlie this relationship.

Meta-analyses showed an increased risk of hearing impairment on all psychosis outcomes, such as hallucinations (OR 1.40(95%CI 1.18–1.65;  $n = 227,005$ )), delusions (OR 1.55(95%CI 1.36–1.78;  $n = 250,470$ )), psychotic symptoms (OR 2.23(95%CI 1.83–2.72;  $n = 229,647$ ) and delirium (OR 2.67(95%CI 2.05–3.48;  $n = 12,432$ )). Early exposure to hearing impairment elevated the risk of later development of schizophrenia (OR 3.15(95%CI 1.25–7.95;  $n = 50,490$ )).

Potential mechanisms underlying this association include loneliness, diminished theory of mind, disturbances of source monitoring and top-down processing and deafferentiation. Early assessment and treatment of hearing impairment in patients with (high risk of) psychosis may be essential in psychosis treatment and prevention.

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## 1. Introduction

For many decades, the potential effect of hearing impairment on the development and severity of psychosis, in particular of auditory hallucinations, has been a topic of discussion. The first descriptions of auditory hallucinations in patients with peripheral auditory sensory deficits originate from the mid-19th century (Baillarger, 1846; Esquirol, 1838). Kraepelin (1915) was the first to describe the presence of paranoia and persecutory delusions in patients with impaired hearing. Ever since these case reports emerged, the question has risen to what extent hearing impairment impacts the presence of psychotic symptoms and -disease.

This question has become even more relevant, as the exposure to hearing impairment nowadays is high: the worldwide prevalence of hearing impairment of at least a moderate severity is estimated at 299 million men, 238 million women and 16 million children (Stevens et al., 2013). In this manuscript, the term 'hearing impairment' is used to define any deterioration of hearing function, both congenital and acquired. Insight into the mechanisms underlying the associations between hearing impairment and psychosis may contribute to the search of more adequate psychosis treatment. Furthermore, current techniques to significantly improve hearing impairment have expanded rapidly. The use of cochlear implants can improve hearing capacity dramatically and several reports underscore the potential of improved hearing to reduce psychotic symptoms (Coebergh et al., 2015; Sommer et al., 2014). Finally, if hearing impairment is indeed a risk factor for psychotic symptoms and psychosis-related disorders, better understanding of this risk factor can guide preventive strategies to reduce incident psychosis. For all these reasons, further understanding of the relationship between hearing impairment and psychosis is crucial to improve insight in the pathophysiological processes that underlie psychosis and with that, to the search of specific preventive and interventional options.

Several mechanisms have been proposed to account for the increased prevalence of psychosis in people with hearing impairment. Recent studies suggest that hearing impairment may increase the risk of schizophrenia development through social defeat and an accompanying sensitization of the dopaminergic system (Gevonden et al., 2014; Selten et al., 2013). Alternatively, hearing impairment may disrupt several neurocognitive processes that are supposedly involved in the occurrence of positive psychotic symptoms. Examples include disruptions of metacognitive

processes that are necessary for source monitoring, top-down perception, Bayesian inference or the construct of theory of mind, which may result in hallucinations, delusions or a paranoid way of thinking (Stefanis et al., 2006; van der Werf et al., 2011). Recent neurobiological evidence indicates that mechanisms of auditory deafferentiation might contribute to the supposed relation between hearing impairment and auditory hallucinations (ffytche and Wible, 2014; Vanneste et al., 2013).

The goal of the current study is to provide insight into the relationship between hearing impairment and psychosis in three ways:

1. Calculating the strength of the association between hearing impairment and different presentations of psychotic symptoms by providing a systematic overview and meta-analyses of all current epidemiological evidence. Although the type, origin, and severity of hearing impairment may very well influence the risk for psychosis, we have chosen to include the entire scope of hearing impairment in order to be as comprehensive as possible. We have therefore included studies regardless of the type, origin, or severity of hearing impairment.
2. Providing a summary of the evidence on mechanisms that may underlie a relationship between hearing impairment and psychosis, thus providing a theoretical framework that includes different neuroscientific and psychosocial perspectives and creates a context for the meta-analytic findings.
3. Discussing the practical consequences of the observed relationship between hearing impairment and psychosis for diagnosis, treatment and prevention.

## 2. Epidemiological studies: Review and meta-analyses

### 2.1. Methods

#### 2.1.1. Methodological difficulties

When addressing the association between hearing impairment and psychosis, difficulties arise due to the broad and complex definition of both terms. Hearing impairment can occur at any age and can be a result of many etiologic processes. It can be acquired or congenital. Its severity can range from mild to severe and can be measured and defined in various ways. Similarly, the term 'psychosis' may apply to both psychotic disorders as well as the occurrence of psychotic symptoms, either in psychotic disorders, other

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