Recurrent sudden sensorineural hearing loss—A literature review

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Abstract

Objective: Sudden sensorineural hearing loss (SSNHL) is one of the few emergent otologic conditions. Although more than half of all patients would benefit from timely treatment, recurrence occasionally develops unexpectedly. The aim of our study is to evaluate the recurrence rate after SSNHL, and present the prognosis after first-episode and recurrent SSNHL.

Methods: A literature search was conducted of the PubMed and Embase electronic databases.

Results: Seven studies with a total of 3781 patients were included, and 96 patients experienced recurrence. The recurrence rate ranged between 1.4% and 17%. The average time to recurrence was about 2 years in most studies. The majority of the studies reported using systemic steroids for treating first-episode SSNHL, and one study used a plasma expander in patients with recurrent SSNHL. The recovery rate for first-episode patients was 58%–79%, while that for recurrent SSNHL ranged widely, from 21% to 86%. There were no common risk factors for SSNHL recurrence among the studies, although low-frequency hearing loss, the presence of tinnitus during follow-up, and an increased neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio have been proposed.

Conclusion: Understanding the recurrence rate, risk factors, and prognosis after recurrence of SSNHL is crucial for comprehensive medical care; in this respect, further prospective studies with long-term follow-up may be instructive.

Level of Evidence: 4

KEYWORDS
recurrence, recurrent, SSNHL, sudden hearing loss, sudden sensorineural hearing loss

1 INTRODUCTION

Sudden sensorineural hearing loss (SSNHL) is commonly defined as a sudden loss of 30 dB over three consecutive frequencies within 3 days.1 SSNHL affects 5–27 of every 100,000 people2 and is likely to have multiple etiologies rather than a single cause. The cause of most SSNHL remains unknown despite great efforts to elucidate it; a vascular origin, autoimmune disease, membrane rupture, and viral infection have all been implicated.3 Systemic steroids, intratympanic or otherwise, are the mainstay of treatment although their mechanism of action has not yet been clarified.4

Short-term (less than 3 months) outcomes after treatment are well-documented in the literature, and many studies have reported the long-term hearing outcomes after SSNHL. Pecorari et al.5 reported no
significant deterioration of hearing over time after an SSHNL episode in the affected ear. Härkönen et al.\(^6\) reported that hearing deteriorated as a function of age in both affected and healthy ears, but hearing did not seem to deteriorate faster after the SSHNL episode.

Compared to other audiovestibular disorders, such as Ménière’s disease, the recurrence rate of SSHNL is low and thus often overlooked. However, some reports of recurrence have appeared in the literature. Wu et al.\(^7\) described one of the largest cohorts of patients with idiopathic SSHNL (ISSNHL); relapse of ISSNHL occurred in 2281 patients (incidence = 4.99%). In that study, comorbid diabetes mellitus and hypercholesterolemia were more prevalent in patients with than without ISSNHL recurrence, suggesting that insufficient cochlear perfusion is an important risk factor for the recurrence of sudden deafness; however, coronary artery disease, hypertension, chronic renal disease, diabetes mellitus, and hypercholesterolemia were not associated with a higher incidence of ISSNHL. A literature review of recurrent hearing loss after SSHNL is needed. Thus, we reviewed the literature to clarify the risk and prognostic factors for recurrent SSHNL.

2  |  MATERIALS AND METHODS

2.1  |  Literature search

A review of the literature on the recurrence of SSHNL was performed. The articles were identified through searches of the PubMed and Embase electronic databases performed on October 14, 2021. Using the keywords “sudden deafness,” “sudden sensorineural hearing loss” “sudden hearing loss,” “recurrence,” and “recurrences,” 562 articles were found. The title and abstract of each article were screened by the first author and reviewed by the second author. Discrepancies between the authors were eliminated through discussion. The Newcastle–Ottawa Scale was used to assess the quality of the included cohort and case–control studies.

2.2  |  Eligibility, inclusion, and exclusion criteria for study selection

The eligibility criteria for study inclusion in the analysis were as follows:

- Retrospective or prospective study on the recurrence of SSHNL;
- SSHNL diagnosed according to clinical practice guidelines (sudden loss of 30 dB over three consecutive frequencies within 72 h);
- Assessment of the associations of demographic factors (sex and age) with recurrent SSHNL patients and the potential risk factors for SSHNL recurrence;
- Articles published in English.

The exclusion criteria were as follows:

- Diagnosis of SSHNL not based on clinical practice guidelines;
- Diagnosis of SSHNL recurrence not based on audiological examination.

2.3  |  Data extraction

The titles and abstracts were reviewed first to determine study eligibility. For articles that appeared eligible for inclusion, the full texts were retrieved and reviewed. For studies meeting all of the inclusion criteria, the following data were extracted and analyzed: first author, year of publication, total number of patients, number of recurrent patients, inclusion criteria, exclusion criteria, mean age, gender, treatment, recovery rate, time to recurrence, risk factors for recurrence, rate of progression to Ménière’s disease, and side of recurrence.

3  |  RESULTS

3.1  |  Study selection

Articles were selected according to the PRISMA guidelines (Figure 1). A total of 562 articles were identified through searching the PubMed and Embase databases, and 165 duplicate records were removed before screening. A further 350 studies were excluded based on their titles and abstracts, and 4 reports could not be retrieved despite extensive efforts. Of the remaining 43 articles, 13 were excluded because they were not in English, 7 due to being case reports, and 16 due to not defining the diagnostic criteria or using criteria differing from the clinical practice guidelines. Ultimately, seven articles met the inclusion criteria and were analyzed. The quality assessment results of the included studies are provided in Tables 1 and 2.

3.2  |  Findings

A total of 3781 patients with SSHNL were included in the seven eligible studies, 96 of whom had recurrence (Table 3). All studies were retrospective. Four\(^6,8\)–\(^{10}\) of the seven studies reported the gender of all SSHNL patients (Table 4); 312 (45.3%) of 688 patients were male. Four\(^9,11\)–\(^{13}\) of the studies reported the gender of the recurrent SSHNL patients; 38 (52.1%) of the 73 recurrent patients were male.

Four studies\(^6,8\)–\(^{10}\) reported the mean age of the patients at the time of their first episode of SSHNL, which was 48.8 years. Four studies\(^5,11\)–\(^{13}\) reported the mean age of patients with recurrent SSHNL, which was 44.3 years. Only one study\(^7\) compared the recurrent and non-recurrent groups in terms of age; the recurrent group was significantly younger.

3.2.1  |  SSHNL recurrence rate

The SSHNL recurrence rate ranged widely among the studies, from 1.4% to 17%. Despite applying different inclusion criteria, all studies used the most common definition of SSHNL. Most studies excluded
patients with fluctuating hearing loss, and some excluded patients with recurrent hearing loss in whom other diseases were also diagnosed, such as vestibular schwannoma or Ménière’s disease. One study reported 3 (4.1%) cases of a third episode of SSNHL and none of them was diagnosed of Ménière’s disease.

3.2.2 | Follow-up time and time to recurrence

Time to recurrence was reported in four studies; most reported that the average time to recurrence was 2 years. One study reported 2- and 5-year cumulative recurrence rates of 5% and 10%, respectively. Härkönen et al. had the longest follow-up and reported a recurrence rate of 3.5%.

3.2.3 | Risk factors for SSHNL recurrence

Three studies reported risk factors for SSHNL recurrence. Pecorari et al. concluded that the presence of tinnitus during follow-up was associated with a higher rate of recurrence; however, more than half of the patients had tinnitus during follow-up so it was not a particularly useful predictor. Psillas et al. compared low- with high-tone SSNHL and concluded that the recurrence rate was higher in the low-tone group. Seo et al. reported increased neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios in patients with recurrent SSNHL compared to controls.

3.2.4 | Progression to Ménière's disease after first SSNHL episode

Two studies reported a 4% rate of progression to Ménière's disease, while another reported that no patients experienced progression. Another two studies excluded patients who progressed to Ménière's disease.

3.2.5 | Treatment and recovery rates after the first and second SSHNL episodes

Most studies used systemic corticosteroids with/without intratympanic corticosteroids for treating SSNHL. Three studies used the same...
### Table 1: Newcastle-Ottawa Scale of the included cohort studies of recurrent SSNHL

| Study       | Selection | Outcome |
|-------------|-----------|---------|
|             | Representativeness of cohort | Selection of non-exposed cohort | Ascertainment of exposure | Outcome of interest | Comparability of cohorts | Assessment of outcome | Adequate duration of follow-up | Adequate follow-up of cohort | Total |
| Härkönen K⁶ | 1         | 1       | 1 | 1 | 0 | 1 | 1 | 1 | 7 |
| Pecorari⁸    | 1         | 1       | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| Park¹¹      | 1         | 1       | 1 | 1 | 0 | 1 | 1 | 0 | 6 |
| Wu¹²        | 1         | 1       | 1 | 1 | 0 | 1 | 0 | 1 | 6 |
| Kuo¹³       | 1         | 1       | 1 | 1 | 0 | 1 | 0 | 0 | 5 |

### Table 2: Newcastle-Ottawa Scale of the included case control studies of recurrent SSNHL

| Study       | Selection | Outcome |
|-------------|-----------|---------|
|             | Is the case definition adequate | Representativeness of the cases | Selection of controls | Definition of controls | Comparability of cases and controls | Ascertainment of exposure | Same method of ascertainment for cases and controls | Non-Response rate | Total |
| Seo⁹        | 1         | 1       | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Psillas¹⁰   | 1         | 1       | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Author       | Year | Patients | Inclusion criteria                                                                 | Exclusion criteria                                                                 | Group                        |
|--------------|------|----------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------|
| Pecorari     | 2020 | 73       | 30 dB, 3 frequencies, 3 days                                                        | Ménière’s disease, vestibular neuritis, traumatic hearing loss, bilateral SSNHL, vestibular schwannoma, and previous episodes of SSNHL | Nil                          |
| Härkönen     | 2017 | 172      | 30 dB, 3 frequencies, 3 days                                                        | Not fulfill AAO–HNO criteria, Ménière’s disease                                      | Recovery to normal or not    |
| Park         | 2013 | 809      | 30 dB, 3 frequencies, 3 days                                                        | Perilymphatic fistulas, acoustic trauma, Ménière’s disease, labyrinthitis, autoimmune hearing loss or acute low-tone hearing loss that showed fluctuating hearing loss | Nil                          |
| Seo          | 2015 | 20 patients with recurrent ISSNHL 348 patients with non-recurrent ISSNHL            | 30 dB, 3 frequencies, 3 days                                                        | Acute inflammation, infection, diabetes mellitus, systemic hypertension, hyperlipidemia, coronary artery disease, acute or chronic renal failure, chronic liver disease, chronic obstructive pulmonary disease, connective tissue disease, inflammatory bowel disease, and any otologic disease such as chronic otitis media, otosclerosis, acoustic trauma history, or Ménière’s disease | Recurrent, non-recurrent, normal control |
| Psillas      | 2019 | Low-tone SSNHL group (27 patients, 10 males, 17 females), and the high-tone SSNHL group (20 patients, 8 males, 12 females). | Low-tone type SSNHL: hearing loss for which the average from 3 low frequencies (125, 250, and 500 Hz) was ≥30 dB, and the average from 3 high frequencies (2000, 4000 and 8000 Hz) was ≤20 dB. High-tone SSNHL: at least a 15-dB difference in hearing level at high frequencies (4000 and/or 8000 Hz) in comparison with that of the healthy side | Retrocochlear disease, otologic surgery, acoustic trauma (or barotrauma), acute or chronic otitis media and Ménière disease | Low tone, high tone |
| Wu           | 2021 | 1156     | 30 dB, 3 frequencies, 3 days                                                        | Infection, systemic autoimmune disease, trauma, cerebrovascular disorder, or neoplasm that can lead to sudden hearing loss, received ototoxic agents, received chemotherapy before, chronic otitis media, cholesteatoma, perilymphatic fistula, acoustic trauma, or Ménière’s disease, autoimmune hearing loss or acute low-tone hearing loss that fluctuated for more than 3 weeks, history of previous ear surgery, endolymphatic hydrops visualized by magnetic resonance imaging | First episode and second episode |
| Kuo          | 2012 | 1156     | 30 dB, 3 frequencies, 3 days                                                        | Posterior fossa tumor, stroke, Ménière’s disease, perilymph fistula, autoimmune inner ear disorders or congenital anomaly (e.g. enlarged vestibular aqueduct) | Ipsilateral vs contralateral types |
therapy during episodes of recurrence. One study\textsuperscript{13} reported using a plasma expander during the first recurrence of SSNHL but did not mention the treatment strategy.

Recovery rates after SSNHL episodes are difficult to calculate due to diversity in the definitions of improvement after treatment (Table 5). Two studies\textsuperscript{9,11} used Siegel's criteria, but the others used different definitions. In Siegel's criteria, a hearing gain of less than 15-dB is used as the cutoff for distinguishing improvement and non-improvement. Other studies\textsuperscript{8,10,12,13} used 10 dB as the cutoff.

Four studies\textsuperscript{6,8–10} reported the improvement rate in patients with their first episode of SSNHL to be 58%–79%. Two studies\textsuperscript{11,12} only calculated the improvement rate of recurrent SSNHL patients with their first attack, and it ranged from 73% to 91%. As for the improvement rate of the recurrent SSNHL episode, five studies\textsuperscript{8,9,11–13} from 21% to 86%. However, the data were not suitable for meta-analysis due to the different definitions of improvement among these studies.

### 3.2.6 Ipsilateral versus bilateral recurrence

Four studies\textsuperscript{8,11–13} reported the side of recurrence. Interestingly, more than half of the recurrences occurred on the contralateral side in three of those studies,\textsuperscript{8,12,13} while the other one\textsuperscript{11} reported a rate of ipsilateral recurrence of 91%. Pecorari et al.\textsuperscript{8} reported one case with bilateral recurrence, but details of the condition of this patient were lacking (i.e., whether the autoimmune profile was checked, among other potential etiologies). In summary, the side of recurrence was reported in 64 patients, in 31 of whom the recurrence was ipsilateral; 32 patients had recurrence on the contralateral side, and one patient had bilateral recurrence.

### 4 DISCUSSION

#### 4.1 Definition of SSNHL

SSNHL is most commonly defined as sensorineural hearing loss of 30 dB or more over three contiguous frequencies within 72 h.\textsuperscript{14} Despite recently published and updated clinical practice guidelines,\textsuperscript{1} one study\textsuperscript{15} did not clearly define the diagnostic criteria and was thus excluded from our review. Two other studies\textsuperscript{16,17} adopted different diagnostic criteria and were excluded to avoid heterogeneity.

#### 4.2 Fluctuating hearing loss

Although there is a commonly accepted definition of SSNHL, a definition of recurrent SSNHL is lacking. Similarly, there is no definition of fluctuating hearing loss, making differentiation of these two conditions difficult. For example, cases exhibiting a short time to recurrence are sometimes classified as fluctuating or progressive hearing loss; both of these hearing loss types were excluded from this review. In fact, one\textsuperscript{8} of the seven included studies reported three cases of a third
| Author | Patients | Recurred patients | Treatment of 1st SSNHL | Recovery rate of 1st SSNHL | Treatment of 2nd SSNHL | Recovery rate of 2nd SSNHL | Recovery criteria | Ipsilateral recurrent SSNHL |
|--------|----------|-------------------|------------------------|---------------------------|------------------------|---------------------------|---------------------|--------------------------|
| Pecorari | 73 | 9 (12%) | Intravenous corticosteroids and mannitol | 46 of 73 (63%) | NA | 6 of 7 (86%) | Stachler et al., 2012 (OTOHNS) | 3 of 7 (43%) |
| Härkönen | 172 | 6 (3.5%) | Systemic steroids, beta-histidine, and carbogen inhalation separately or in different combinations | 58% | NA | NA | NA | NA |
| Park | 809 | 11 (1.4%) | A systemic steroid or intratympanic dexamethasone injection and vasodilators | N/A (the recovery rate of 11 patients with their first episode is 91%) | Same as first episode | 73% | Siegel's criteria | 10 of 11 (91%) |
| Seo | 364 | 16 (4.4%) | Systematic prednisone and intratympanic dexamethasone | 79% | Same as first episode | 21% | Siegel's criteria | NA |
| Psillas | 47 | 8 (1.7%) | Intravenous steroids | 70% | NA | NA | Complete, partial, unchanged (improvement < 10 dB) | NA |
| Wu | 1156 | 30 (2.6%) | Intravenous and/or intratympanic steroid and/or Hyperbaric oxygen therapy | NA (the recovery rate of 30 patients with their first episode is 73%) | Same as first episode | 73% | Sudden Deafness Research Group criteria | 11 of 30 (36%) |
| Kuo | 1156 | 16 (1.4%) | NA | NA | Plasma expander | 50% | Complete recovery, improvement, unchanged | 7 of 16 (44%) |
episode of SSNHL, and all three patients experienced partial recovery. Multiple recurrence may be extremely rare, and it is regarded as fluctuating hearing loss in most situations.

The recurrence rate of SSNHL varied widely among the studies included in this review, because of different inclusion criteria and diagnostic criteria for recurrent hearing loss. Some studies defined second hearing loss episode as hearing loss of 30-dB over three consecutive-frequencies within 3 days, while others recorded any recurrent hearing loss as second-episode SSNHL. In this review, we only included studies using strict definitions, to exclude patients with fluctuating hearing loss rather than recurrent SSNHL.

As well as the differences in diagnostic and inclusion criteria among studies, patients with recurrence may be lost to follow-up at their primary medical institution, leading to underestimation of SSNHL recurrence. A prospective cohort study may be needed to determine the true recurrence rate of SSNHL.

### 4.3 | Acute low-tone hearing loss versus SSNHL

First described by Abe in 1982, acute low-tone sensorineural hearing loss (ALHL) is regarded as a variant of SSNHL. It is defined as hearing impairment at low frequencies (125, 250, and 500 Hz) summing to ≥70 dB and hearing impairment at high frequencies (2, 4, and 8 kHz) summing to ≤60 dB, by the Study Group for Acute Profound Deafness Research Committee of the Ministry of Health, Labor, and Welfare of Japan.

The relationship between ALHL and SSNHL is subject to debate, and no consensus has yet been reached. Junicho reported higher recurrence and progression rates for Ménière’s disease in patients with ALHL who had spontaneous nystagmus, as recorded by electronystagmography. On the other hand, Fushiki found no difference in recurrence rate between patients with ALHL and those with another form of sudden low-tone hearing loss.

Shimono et al. reported a 92% prevalence rate of cochlear endolymphatic hydrops in patients with ALHL based on 3-Tesla magnetic resonance imaging (MRI). The improvement and recurrence rates of cochlear endolymphatic hydrops suggest that it is a variant of SSNHL. Furthermore, patients with ALHL may not conform to the diagnosis of SSNHL, which may lead to selection bias and heterogeneity. Therefore, studies focusing on ALHL were excluded from our review.

### 4.4 | Differential diagnosis of recurrent SSNHL

Different conditions may cause recurrent hearing loss after SSNHL. A fluctuating hearing level with vertigo may lead to the diagnosis of Ménière’s disease or perilymph fistula. Progressive hearing loss implies an autoimmune inner ear disorder or central lesion. Recurrent hearing loss in patients with an underlying autoimmune disease is sometimes considered as autoimmune hearing loss.

A thorough investigation may be needed when patients suffer from recurrent sudden hearing loss after their first SSNHL episode. A complete workup may include, but is not limited to, autoimmune blood tests, testing for syphilis, viral titers against the herpes family, and gene testing if a congenital anomaly is suspected. MRI for detecting retrocochlear lesions and stroke is also indispensable. Furthermore, a vestibular function test, including vestibular evoked myogenic potential and electronystagmography, may provide information on the function of the entire inner ear.

### 4.5 | Possible mechanism for recurrent SSNHL

To date, no universal etiology has been identified for SSNHL; the multiple etiologies mean that the presentation and prognosis are inconsistent among patients. Although some hypotheses have been proposed regarding the causes of SSNHL, such as vascular insufficiency, virus infection, and immune dysfunction, none of these can explain SSNHL in all patients. The cause of recurrence is also unknown. Only a small proportion of patients progressed to Ménière’s disease. Therefore, recurrent SSNHL should be regarded as a different disease.

The side of recurrence was reported in 64 of 96 patients, and about half of these patients had contralateral recurrence during the second episode. Kuo et al. directly compared 16 patients (7 with ipsilateral recurrence and 9 with contralateral recurrence) and found no significant difference in the side of recurrence according to age, inter-episode interval, gender, presence of vertigo, or abnormal caloric results. However, questions remain regarding whether a second episode in the contralateral ear should be regarded as independent from the first episode or recurrence.

### 4.6 | Treatment and recovery rate for recurrent SSNHL

Systemic steroids remain the main therapy for SSNHL, but little is known about the mechanism of action. The treatment for recurrent SSNHL is empirical, and the reported improvement rate varies widely among studies. Most of the studies in this review applied systemic steroids, except for one study using a plasma expander. Kuo et al. reported a higher rate of recovery from the second episode in patients with normal cervical vestibular evoked myogenic potential, but the number of cases was small. Other studies did not analyze prognostic factors for recurrent SSNHL.

### 5 | LIMITATION

There were several limitations to this study. First, we searched PubMed and Embase only, and restricted our review to studies published in English. Thus, relevant research published in other languages and databases may have been missed. Second, all of the included
studies were retrospective, so may have been affected by selection bias and other confounding factors. Third, although all of the included studies used the same diagnostic criteria, the inclusion and exclusion criteria were not consistent among the studies. In addition, the side effect of recurrence, treatment choice, definition of hearing improvement, and mean hearing gain were not reported in some studies. Therefore, the mean recurrence and improvement rates could not be calculated. A multiple-center cohort study with long-term follow-up and strict inclusion and exclusion criteria may allow for a more accurate SSNHL recurrence rate estimation.

6 CONCLUSION

Recurrence of SSNHL is rare but should be treated as a discrete disease entity. Thorough examinations should be performed before treating these patients for disease differentiation. A large cohort study with long-term follow-up and strict diagnostic criteria may be needed to clarify the true recurrence and improvement rates of SSNHL, and the risk factors for its recurrence.

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CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

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