

Frequency of tinnitus following non-blast related traumatic brain injury: A systematic review of literature

Project Team Leader: Michelle Le (Audiologist – University Hospital Geelong)

Project Team Members: Dr Bojana Sarkic (La Trobe University), Dr Richard Anderson (La Trobe University)

Barwon Health

DEAKIN UNIVERSITY

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INTRODUCTION

Traumatic brain injury (TBI) is the leading cause of death and disability worldwide with an estimated annual incidence of 150-300 people per 100,000.¹ Non-blast related post-traumatic deficits encompass the physical (e.g., loss of coordination, fatigue, speech production, headache), neurocognitive (e.g., attention, memory, executive function), and sensory (e.g., vision, hearing, olfaction) systems.^{2,3,4,5} There is strong evidence of auditory deficits including hearing loss and tinnitus (the perception of sound in the absence of an external source) following TBI with prevalence rates up to 66%.^{6,7} While this evidence exists for post-traumatic tinnitus secondary to blast-related TBI, tinnitus in non-blast related injury is poorly characterised.



OBJECTIVES

1. To establish the frequency of occurrence of tinnitus in adults following non-blast related TBI reported using standardised and non-standardised measures
2. To establish the frequency of occurrence of tinnitus in adults following non-blast related TBI in the absence of measurable hearing loss

METHOD

A systematic search was carried out using MEDLINE, EMBASE, PsychINFO, CINAHL from January 1st 1990 to August 14th 2023. TBI, tinnitus and auditory findings were extracted from all eligible studies, and a descriptive synthesis performed. Studies were evaluated in accordance with the Oxford Centre of Evidenced-Based Medicine (OCEBM) levels of evidence.

INCLUSION CRITERIA

- Publication date between January 1st 1990 to August 14th 2023
- Participants ≥ 18 years old
- Published in English and peer-reviewed
- Full text articles available

EXCLUSION CRITERIA

- Focused exclusively on blast-related TBI
- Participants < 18 years old
- Participants from a military population
- Primary focus outside realm of tinnitus dysfunction
- Tinnitus secondary to concussion or whiplash
- Focal brain injury was the root of tinnitus onset
- Participants minimally conscious at time of testing
- Open head injury

RESULTS

Following the removal of duplicates, abstract screening and full text review, a total of 19 articles were retained for systematic review.

Quality appraisal

Of the 19 studies included in this review, only three met the criteria for Level 2b evidence. The remainder fell under Level 3b, Level 4, or Level 5, cumulating in a Grade C recommendation.

Tinnitus findings

Tinnitus was identified using standardised tinnitus questionnaires, non-standardised questionnaires or were participant (e.g., single item) self-reported. A total of 2080 participants across 19 studies were assessed for tinnitus, with 687 participants (33.0%) reporting tinnitus following TBI. The most common method of identifying tinnitus was through participant (e.g., single item) self-reported measures, which was used by 11 studies on 455 participants, with 150 participants (33.0%) reporting tinnitus following TBI.

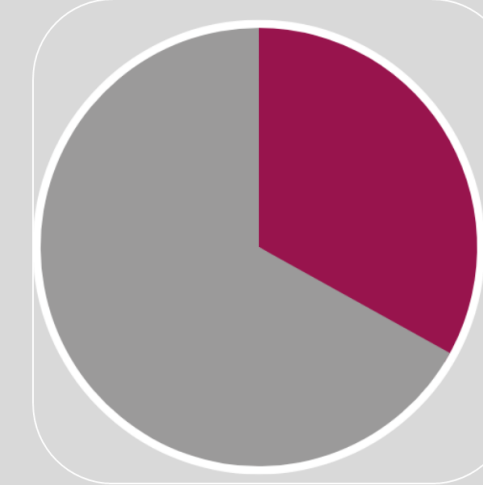
Tinnitus and audiological findings

Normal pure-tone audiometry results were reported in three studies on 56 participants, with 49 participants (87.5%) having normal audiological findings and tinnitus following TBI.

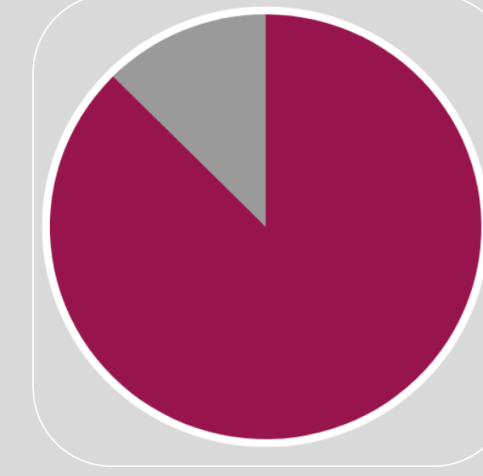
Abnormal pure-tone audiometry results were reported in three studies on 18 participants, of whom 9 (50.0%) had abnormal audiological findings and tinnitus following TBI.



Quality Appraisal
• 3 of 19 studies met 2b criteria



Tinnitus Findings
• 687 out of 2080 participants (33.0%) reporting tinnitus following TBI.



Tinnitus and Audiological findings
• Three studies on 56 participants found 49 participants (87.5%) having normal audiological findings and tinnitus following TBI.

DISCUSSION

This systematic review identified methodological gaps in studies on tinnitus post non-blast related TBI. The prevalence of lower-tier evidence, combined with considerable heterogeneity in study designs, rendered a meta-analysis unfeasible.

More than half of the studies included in this review relied on participant (e.g., single item) self-reports of tinnitus. The reliance on participant self-reporting of tinnitus, often through the use of a single question, oversimplifies the complex nature of tinnitus and neglects its multi-faceted dimensions.

Our findings showed that one-third of participants reported post-traumatic tinnitus, which differs from previous studies where frequencies of 61.5-66% were observed. The variability in these frequencies could be attributed to a combination of factors including study design heterogeneity and varied tinnitus reporting methodologies.

We found that the majority of participants with post-traumatic tinnitus had normal audiological findings, which is considerably higher than that reported within the general population. We also found that up to half of the participants with post-traumatic tinnitus displayed abnormal audiological findings.

Notably, the existing literature offers varied views on the co-occurrence of tinnitus and hearing loss following non-blast related TBI. These variations might be attributed to differences in assessment tools, the criteria for defining hearing loss, tinnitus assessment tools and individual factors such as the severity and cause of the TBI, as well as the time of assessment post injury.

CONCLUSION

A substantial need for prospective, longitudinal research investigating tinnitus following non-blast related TBI exists. This review also underscores the importance of standardizing methodologies in future investigations.

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