



Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Review Article

A scoping review to catalogue tinnitus problems in children

Harriet Smith^{a,b,*}, Kathryn Fackrell^{a,b}, Veronica Kennedy^c, Johanna Barry^{b,d}, Lucy Partridge^e, Derek J. Hoare^{a,b}^a NIHR Nottingham Biomedical Research Centre, Ropewalk House, 113 the Ropewalk, Nottingham, NG1 5DU, UK^b Hearing Sciences, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, Nottingham, NG7 2UH, UK^c Bolton NHS Foundation Trust, Halliwell Health and Children's Centre, Bolton, BL1 3SQ, UK^d Nottingham University Hospitals NHS Trust, Queens Medical Centre, Derby Road, Nottingham, NG7 2UH, UK^e Nuffield Hearing and Speech Centre, Royal National Throat Nose and Ear Hospital, 330 Gray's Inn Rd, London, WC1X 8DA, UK

ARTICLE INFO

Keywords:
Tinnitus
Children
Paediatric
Problems

ABSTRACT

Background: The reported prevalence of tinnitus in children is similar to that in adults. However, unlike adults, there is relatively little understanding of the tinnitus-related problems children experience. Knowledge of the problems experienced by adults has led to the development of numerous clinical questionnaires used by health professionals in assessment and treatment practices; to date no child-specific questionnaire measure of tinnitus has been developed. To support development of a questionnaire measure of tinnitus in children, the aim of this scoping review was to catalogue the peer-reviewed and grey scientific literature according to 1) the methods used to identify problems experienced by children with tinnitus, 2) tinnitus-related problems observed in or reported by children, and 3) research recommendations suggested by investigators with regards to tinnitus in children.

Methods: A scoping review was conducted following an established methodological framework. Records were included where a tinnitus-related problem was reported in a child 18 years or younger, and tinnitus was reported as the primary complaint. Tinnitus problems were extracted and categorised into problem themes.

Results: Thirty-five records met the inclusion criteria for this review. Methods used to identify tinnitus-related problems in children, and the number and range of problems reported, varied across the records. Symptom impact was summarised according to six problem themes; Physical health, Cognitive health, Hearing and listening, Emotional health, Quality of life, and Feeling different/isolated. Identified research recommendations highlighted a demand for more standardised approaches.

Conclusions: The findings evidence the detrimental impact tinnitus can have on a child's quality of life and emotional wellbeing. The current British Society of Audiology Tinnitus in Children Practice Guidance recommends management practices to address the most broadly reported problems identified in this review; sleep difficulties, emotional difficulties, and concentration and hearing problems at school. Given the finding of this review, we suggest problems relating to the impact of tinnitus on quality of life and feelings of isolation are also important problem domains to consider when managing a child who has tinnitus. Current variability in the approach to identifying children's tinnitus problems underlines the importance of developing a standardised and dedicated measure of tinnitus in children.

1. Introduction

Tinnitus is the perception of sound in the ears or head without any external source. It is a symptom rather than a condition, and is associated with hearing loss, otological problems, neurological disorders, cardiovascular disease, and head and neck trauma [1]. It affects both adults and children and can have a significant impact on quality of life

and wellbeing [2,3]. To date, most tinnitus research has addressed symptom manifestation in adults with the goal of developing treatments for affected adults. The field has produced multiple systematic reviews of treatment efficacy [4–8] and both national and international guidance regarding assessment and treatment [9,10]. Understanding the tinnitus-related problems experienced by adults has led to the development of numerous clinical questionnaire measures to support

* Corresponding author. NIHR Nottingham Biomedical Research Centre, Ropewalk House, 113 The Ropewalk, Nottingham, NG1 5DU, UK.

E-mail addresses: harriet.smith@nottingham.ac.uk (H. Smith), kathryn.fackrell@nottingham.ac.uk (K. Fackrell), veronica.kennedy@boltonft.nhs.uk (V. Kennedy), johanna.barry@nottingham.ac.uk (J. Barry), lucypartridge@nhs.net (L. Partridge), derek.hoare@nottingham.ac.uk (D.J. Hoare).

<https://doi.org/10.1016/j.ijporl.2019.04.006>

Received 9 October 2018; Accepted 9 April 2019

Available online 11 April 2019

0165-5876/ © 2019 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

clinicians in the assessment of tinnitus severity and measurement of treatment-related change [11–13]. By contrast, there has been relatively little research on how tinnitus manifests in children, or on how it affects a child's day-to-day life.

Most studies in children have aimed to measure tinnitus prevalence. A systematic review by Rosing et al. [14] reported prevalence estimates to range from 4.7% to 46% in the general paediatric population, and from 23.5% to 62.2% in children with hearing loss. A study by Humphris et al. [15] reported the prevalence of “clinically significant” tinnitus to be 3.1%. Prevalence data in children shows similarities to figures reported in adults. A large study by Davis & El Refaie [16] reported at least 2.8% of adults to experience tinnitus described as moderately annoying or worse. To date, prevalence studies in both adults and children have reported inconsistent results, owing to differences in study design, study population, how tinnitus is defined, and the question used to determine tinnitus presence [1,14].

Various strategies are used to treat children with bothersome tinnitus, depending on the needs of the child. Approaches include explanation, advice and information giving, hearing aids, wearable sound generators, non-wearable sound enrichment, sleep hygiene, relaxation techniques, mindfulness techniques, cognitive behaviour therapy (CBT), and narrative therapy. Whilst these approaches have found their way into clinical practice, there has been little research to evaluate their effectiveness [17].

The need for improved understanding of tinnitus in children was highlighted by a priority setting partnership where the question, “*What is the optimal set of guidelines for assessing children with tinnitus?*” emerged as one of the top 10 priority tinnitus research questions that needed to be addressed [18]. In response to this need, the British Society of Audiology (BSA) Tinnitus in Children: Practice Guidance was developed [17]. Kentish and colleagues based this practice guidance on the scientific evidence available for tinnitus in children, as well as relevant evidence from other literature (e.g. anxiety, pain), in addition to their own clinical experience. However, throughout their recommendations, the authors highlight the lack of a robust research in tinnitus in children and state the urgent need for further studies to help determine the most effective assessment and treatment approaches. Slow advances in the field of tinnitus in children are attributed to a lack of awareness, in addition to a limited understanding of the problems faced by children and how their daily lives are affected.

The BSA practice guidance highlights the lack of a standardised child-specific questionnaire measure of tinnitus and states the urgent need for one to be developed. In its absence, the guidance recommends use of single-item scales (e.g. Likert scales, visual analogue scales) as tools to understand tinnitus distress. The guidance also suggests several other child questionnaires, which are not specific to tinnitus, for use when assessing a child's psychological wellbeing or educational performance. They advise that adult tinnitus questionnaires could be used with older children to help gather qualitative information, but caution that they are not appropriate for diagnostic use. Adult questionnaires are not appropriate for use with children because they have been developed from knowledge of tinnitus-related problems experienced by adults and not based on the problems experienced by children. It is therefore unlikely that adult tinnitus questionnaires can detect specific issues that are important to children with tinnitus. Furthermore, adult questionnaires are likely to be overly complex and burdensome for the child to complete in terms of length, reading level, and response scales [19]. As children's language development and understanding differs across age groups, the reliability of children's responses to certain questions and response formats can be age-dependent [20,21]. It is therefore important for measures of paediatric health conditions to use age-appropriate language and suitable response scales. A recent evaluation of UK NHS paediatric tinnitus services found variability in the assessment tools used in practice. Whilst there was some use of single-item scales and self-devised questionnaires, 37% of services did not report the use of any measurement tools. Furthermore, 11% percent of

services reported using adult tinnitus questionnaires when assessing children [22].

A robust evidence-base on the tinnitus problems experienced by children will facilitate the development of a child-specific measure of tinnitus. The measure will support clinicians in assessing the impact of tinnitus on the child's life, and data can be used to inform treatment decisions. The child-specific measure could be applied as an outcome measure to support clinicians in understanding treatment-related change. The measure could also be used in trials evaluating tinnitus treatments for children, supporting evidence-based care, and facilitating the validation of novel treatments. Furthermore, data generated by the instrument could inform the organisation of services. The use of well-established instruments in paediatric pain is a successful example of how child-specific instruments can be used in management of subjective paediatric symptoms [23].

The aim of this scoping review was to catalogue the scientific and grey literature according to 1) the methods used to identify problems experienced by children with tinnitus, 2) tinnitus-related problems observed in or reported by children, and 3) research recommendations suggested by investigators with regards to tinnitus in children.

2. Material and methods

2.1. Scoping review method

This scoping review followed a six-step methodological framework involving (1) identification of the research question and target population, (2) identification of relevant studies, (3) selection of relevant studies via an iterative approach of title, abstract, and full-text screening, (4) extraction and charting of the data, (5) collation, summary, and reporting of results, and (6) consultation with expert clinicians to gain a clinical perspective on the findings and interpretation [24].

2.2. Identification of the target population

2.2.1. Inclusion criteria

Records were included where tinnitus was reported as the primary complaint in children 18 years or younger and tinnitus-related problems were reported. Tinnitus-related problems were defined as a difficulty or symptom experienced by a child because of their tinnitus. Records reporting both subjective and objective tinnitus were included. Subjective tinnitus being where the sound is perceived exclusively by the child with no clinically identifiable source, and objective tinnitus being where the sound can be detected by another individual (e.g. a clinician) via objective assessment. Eligible records reported randomised controlled trials, non-randomised controlled trials, cohort studies, case series, case studies, epidemiology articles, and sources reporting personal/expert opinions that included reference to actual cases. Records were included from all countries, providing they were available in English language.

2.2.2. Exclusion criteria

Records were excluded where tinnitus or tinnitus-related problems were not reported, where tinnitus was reported as part of a symptom set, where tinnitus was secondary to another condition, where the study included adults (over 18 years old), or where tinnitus was reported as a treatment-related adverse event (e.g. due to chemotherapy or surgical trauma). Studies that focussed on noise-induced or transient tinnitus were also excluded. Review articles were not eligible. Where multiple eligible records pertaining to a single data set were identified, the record that was most comprehensive in terms of tinnitus problems reported was selected for inclusion.

Table 1
An example of database search strategy terms.

Medline via OvidSP	
1	exp TINNITUS/
2	tinnit*.ti,ab,kw.
3	phantom sound.ti,ab,kw.
4	1 or 2 or 3
5	exp Child, Preschool/ or exp Pediatrics/ or exp Child/ or exp Adolescent/ or exp Infant, Newborn/ or exp Infant/
6	child*.ti,ab,kw
7	young people.ti,ab,kw.
8	adolescent*.ti,ab,kw.
9	paediatric*.ti,ab,kw.
10	infant*.ti,ab,kw.
11	teenage*.ti,ab,kw.
12	5 or 6 or 7 or 8 or 9 or 10 or 11
13	4 and 12

2.3. Identification of relevant studies

The search strategy involved (1) searches of electronic databases of peer-reviewed journals using defined search terms, (2) searches of the grey literature, and (3) searches of the reference lists of the six records reporting the most tinnitus-related problems. Electronic databases were searched for records containing key terms “tinnitus” AND “child”. The searches were expanded to capture alternative words and phrasing for each of the key terms (see Table 1 for Medline search strategy). Search terms were tested and refined to ensure relevant and comprehensive results were retrieved. The online search interface OvidSP was used to search Medline, EMBASE, and PsycINFO databases and the search interface EBSCOhost was used to search the Cumulative Index to Nursing and Allied Health Literature (CINAHL). OvidSP was also used to search articles from the magazine ‘The Hearing Journal’. For searches of Google Scholar and Google, a stopping rule was applied when three consecutive search pages retrieved no further relevant records. These were searched via EThoS and ProQuest online archives. No limitations on study date were applied as all records relating to this topic were of interest. Initial searches were carried out in February 2018 and a search update was conducted via Google Scholar in July 2018.

2.4. Selection of relevant studies

Records identified from the electronic database and manual search were downloaded with citations, title and abstract, and imported to Mendeley reference manager. Duplicate records were removed, and records were divided into three equal groups for title and abstract screening. Each group of records was screened independently by two researchers (HS, KF, JB, DJH). When disagreements arose between the two reviewers regarding the decision to include or exclude, the record was revisited and discussed until an agreement to include or exclude was reached. If agreement could not be reached, a third researcher was consulted to arbitrate. Full texts were retrieved for those records agreed to include for full text screening. Two researchers (HS, KF, DJH) independently screened each full text. If agreement to include or exclude was not reached, the third researcher was consulted to arbitrate.

2.5. Extraction and charting of the data

A data extraction form was created and piloted using three records. Following team discussions, the form was revised before formal data extraction began. Two researchers (HS, KF) extracted the data from each record. Extraction fields included: type of tinnitus, country where study was conducted, study design, total sample size, number of children with tinnitus, number of children with bothersome tinnitus, how bothersome tinnitus was defined, study population, study setting, general methods, method/question used to identify the presence of

tinnitus, method/question used to identify the presence of bothersome tinnitus, method/question used to identify tinnitus-related problems, age (range and mean), tinnitus-related problems reported directly, problems indicated by outcome, associated problems, age-specific problems, exacerbating factors, whether problems were direct or indirect, whether problems were qualitative or quantitative, whether problems were inductive or deductive, clinical recommendations, research recommendations, and conclusions. The tinnitus-related problems extracted were analysed thematically. An inductive, ‘bottom-up’ approach based on Braun & Clarke [25] was used to review, analyse and code the problem domains. Similar problem domains were grouped in order to identify and develop key problem themes. Themes were identified where problem domain groups were judged as sufficiently different from one another.

2.6. Consultation with an expert clinician

VK and LP reviewed charted data and researcher interpretation to check for clinical validity.

3. Results

Fig. 1 details the record screening process including numbers and rationale for exclusions. The literature search received a total of 3024 hits across the peer-reviewed and grey literature searches. Five-hundred and twenty-one duplicate records were removed, leaving 2503 records that were screened by title and abstract. Based on study criteria, 2416 records were excluded. Following full text screening of the remaining 87 records, a further 52 records were excluded. Thirty-five records remained for inclusion in this scoping review.

Of the 35 included records (Table 2), 11 were case reports, 12 were prospective population studies, six were retrospective case reviews, three were mixed method studies with elements of both retrospective case review and prospective investigation, and three were case series. The earliest record was published in 1974 and the most recent was published in 2018. Records originated from a wide range of countries including, Australia, Brazil, Denmark, Canada, Finland, India, Israel, Italy, the Netherlands, Nigeria Poland, South Korea, Sweden, Turkey, the UK, and the USA. Study populations included children presenting in clinic, populations of children with hearing loss, or general populations in schools. Children described in these records ranged from 3 to 18 years old.

3.1. Methods used to identify problems experienced by children with tinnitus

Table 3 summarises the methods used in each of the 35 included records. Eighteen records identified problems via clinician interview in a clinical appointment setting, 14 records reported use of structured questions regarding tinnitus problems, and one record used both clinician interview and structured questions. Where structured approaches were used, few records reported the actual question wording used. Two records reported the use of adult tinnitus questionnaires, the Tinnitus Handicap Inventory (THI) [12] and the Tinnitus Functional Index (TFI) [11], to assess tinnitus in children. One record reported using the Hospital Anxiety and Depression Scale (HADS) [26] to assess depression or anxiety-related symptoms. Via these data collection methods, tinnitus-related problems were reported both directly and indirectly. Reports of problems included: direct, spontaneous reports from the child following open questioning; direct, prompted reports in response to questions that assessed the presence or severity of particular problems; indirect reports from clinicians, parents or teachers; and inferred problems, indicated by the reported therapeutic approach. No study used clinical questionnaire measures specifically designed for children. The use of questionnaires (THI, TFI, and HADS) was restricted to older children, aged 8 and above, whereas the use of structured questioning approaches did not vary by population age.

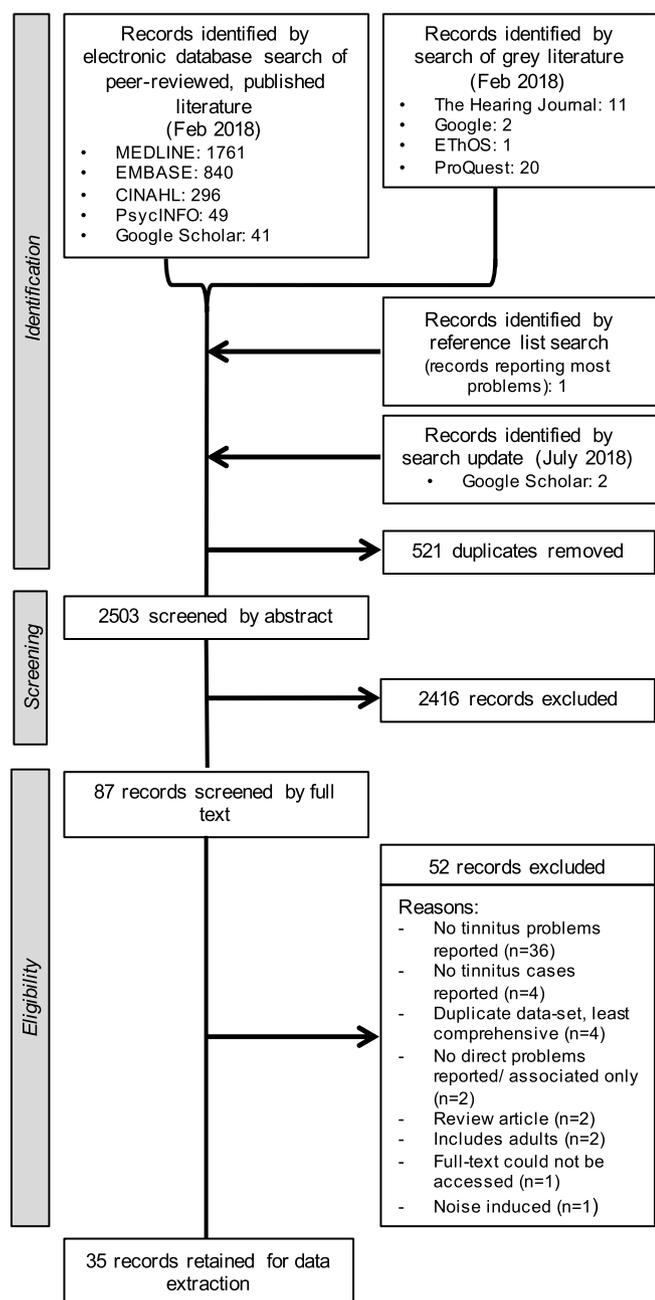


Fig. 1. Flow chart of the study selection process.

3.2. Tinnitus-related problems observed in or reported by children

Tinnitus-related problems observed in or reported by children were catalogued to understand the range of issues experienced and thus provide a source of candidate domains to be assessed by a novel questionnaire measure. The level of detail, number and range of tinnitus problems reported varied widely across the 35 records. Five records reported just one tinnitus-related problem in a child, 16 reported two or three problems, ten reported four to 10 problems, and four reported more than 10 problems. Problems identified were catalogued as relating to (1) Physical health, (2) Cognitive Health, (3) Hearing and Listening, (4) Emotional Health, (5) Quality of life, or (6) Feeling of different/isolated. Although problem domains grouped under the theme “Feeling different/isolated” may constitute problems relating to “emotional health”, they were judged as distinct in this review.

3.2.1. Physical health

A range of problems was identified under the theme of physical health, i.e. issues relating to physical symptoms and bodily functions. General sleep problems were commonly reported [27–40]. For example, Baguley [27] described a child that “wasn't sleeping” because of their tinnitus, and Rosing et al. [40] reported children with “issues related to sleep”. Eight records reported children whose tinnitus prevented them from getting to sleep [17,29,36,38,39,41–43] and three records reported tinnitus causing children to wake at night [27,29,38]. Some records described the child's emotional response to tinnitus-related sleep difficulty. Fox et al. [42] reported tinnitus “irritated the patient as she tried to fall asleep”, Jero [44] described the child's tinnitus was “annoying during sleep at night”, and Ben-David et al. [43] described a child who was “irritated and nervous when he lay in his bed at night”. Kentish et al. [17] described a child whose tinnitus-related anxiety caused his lack of sleep and, as a result, he had begun to miss school in order to sleep throughout the day. Baguley et al. [39] applied a tinnitus severity framework [45] whereby levels of sleep difficulty provided indicators of tinnitus severity. Tinnitus that “can disturb going to sleep, but not sleep in general” was taken to indicate that the child's tinnitus was a moderate problem, whereas tinnitus that “disturbs going to sleep and can disturb sleep in general” was taken to indicate that the child's tinnitus was severe. Tinnitus-related fatigue was reported in four records [17,27,46,47]. Other physical symptoms included headache [29,35,36,47], dizziness/vertigo [29,47], ear pain [35], physical discomfort [30], tension in the neck and jaw [40], a feeling of blocked ears [41], and changes in appetite [27]. Many records described physical health problems to be attributed directly to the tinnitus as opposed to co-occurring issues in the presence of tinnitus. For example, Graham [47] reported a child who said tinnitus “makes me feel sleepy” and Kentish [41] described a girl with tinnitus that “made her ears feel blocked”.

3.2.2. Cognitive health

General concentration and attention issues were reported in eleven records [17,28–30,32–35,37,48,49]. For example, Szibor et al. [28] observed “concentration disorders” in children presenting in clinic with bothersome tinnitus and Adegbiyi et al. [48] observed attention problems. Often records reported concentration difficulties specifically, in association with negative effects on school performance [27,29,32,35,41,47,50]. For example, Phillipps et al. [50] described a child whose tinnitus was “affecting her ability to concentrate at school”, and Graham [47] reported perspectives from school teachers who associated tinnitus with “disturbances in concentration or behaviour”.

3.2.3. Hearing and listening

General hearing and listening difficulties were reported in six records [29,30,35,47,49,51]. Kentish et al. [29] reported children with listening difficulties “in background noise” and “at home”. Difficulties at home were described as difficulties “listening to television, music and conversations”. Both Drukier [51] and Graham [47] reported children with tinnitus that “makes it difficult to hear people's voices”. Gabriels [32] reported a child whose tinnitus made her radio sound distorted. Graham [47] and Kentish et al. [17] reported tinnitus making it difficult for children to hear audiogram test tones. Similar to concentration issues, hearing and listening problems were also reported as problems affecting the child at school [17,29,32,33,41,52]. Kentish [41] reported a case of a child whose tinnitus caused her to miss information from the teacher, which subsequently resulted in her being “told off for not paying attention”. Kentish et al. [17] reported a child whose tinnitus often masked his teacher's voice during spelling tests, causing him to make mistakes.

3.2.4. Emotional health

Children's emotional responses to tinnitus, such as being annoyed, bothered, or disturbed were often reported [29–31,34,36,37,47,49,53–56],

Table 2
Article demographics.

Record #	Reference #	Year	Author(s)	Title	Country	Study Population	Total Sample (with tinnitus)	Age
1	[46]	1974	Keller	An otological study of an objective tinnitus.	USA	Patients in clinic	1(1)	7
2	[47]	1981	Graham	Tinnitus in children with hearing loss.	UK	School children with hearing loss	158(78)	12–18
3	[36]	1984	Mills	Subjective tinnitus in children with otological disorders.	UK	Patients in clinic and school children with hearing loss	Unknown(79)	4–17
4	[50]	1989	Phillipps et al.	Objective tinnitus and tympanic membrane displacement.	UK	Patients in clinic	1(1)	10
5	[51]	1989	Drukker	The prevalence and characteristics of tinnitus with profound sensori-neural hearing impairment.	USA	School children with hearing loss	331(96)	6–18
6	[42]	1991	Fox & Baer	Palatal myoclonus and tinnitus in children.	USA	Patients in clinic	1(1)	8
7	[34]	1994	Martin et al.	Children presenting with tinnitus: A retrospective study.	UK	Patients in clinic	67(67)	<18
8	[43]	1995	Ben-David et al.	Tinnitus in Children - Still a Neglected Problem.	Israel	Patient in clinic	1(1)	4
9	[32]	1995	Gabriels	Children with Tinnitus	Australia	Patients in clinic	21(21)	<18
10	[44]	2000	Jero	Palatal myoclonus and clicking tinnitus in a 12-year-old girl - Case report.	Finland	Patients in clinic	1(1)	12
11	[29]	2000	Kentish et al.	Children's experience of tinnitus: a preliminary survey of children presenting to a psychology department.	UK	Patients in clinic	24(24)	7–17
12	[49]	2001	Fritsch et al.	Objective Tinnitus in Children.	USA	Patients in clinic	5(5)	7–14
13	[60]	2003	Ensink et al.	Treatment for severe palatoclonus by occlusion of the eustachian tube.	Netherlands	Patients in clinic	1(1)	11
14	[59]	2005	Howsam et al.	Bilateral objective tinnitus secondary to congenital middle-ear myoclonus.	UK	Patients in clinic	1(1)	11
15	[56]	2007	Savastano	Characteristics of tinnitus in childhood.	Italy	Patients in clinic	1100(374)	6–16
16	[37]	2007	Aksoy et al.	The extent and levels of tinnitus in children of central Ankara.	Turkey	General population in school	1039(154)	6–16
17	[30]	2007	Coelho et al.	Tinnitus in children and associated risk factors.	Brazil	General population in school	506(190)	5–12
18	[38]	2009	Chadha et al.	Tinnitus is prevalent in children with cochlear implants.	Canada	Children with cochlear implants	40(15)	3–15
19	[61]	2012	Alicandri-Giuffelli et al.	A Clockwork Ear.	Italy	Patients in clinic	1(1)	11
20	[58]	2013	Juul	Hearing symptoms in children and adolescents Tinnitus and temporary threshold shift. Paper 3.	Sweden	General population in school	1105(409)	16–17
21	[27]	2013	Baguley	'Moments of Being So Very Upset'	Unknown	Patients in clinic	2(2)	7 and 14
22	[39]	2013	Baguley et al.	Troublesome tinnitus in childhood and adolescence: Data from expert centres.	UK	Patients in clinic	88(88)	6–17
23	[53]	2014	Bae et al.	Childhood tinnitus: Clinical characteristics and treatment.	South Korea	Patients in clinic	108(108)	5–18
24	[41]	2014	Kentish	Drawing pictures and telling stories: treating tinnitus in childhood.	UK	Patients in clinic	1(1)	9
25	[52]	2015	Eryilmaz et al.	Successful Treatment of Essential Palatal Tremor Lasting Over a Long Term with a Rare Application of Botulinum Toxin in a Child.	Turkey	Patients in clinic	1(1)	12
26	[17]	2015	Kentish et al.	Tinnitus in Children Practice Guidance	UK	Patients in clinic	7(7)	5–16
27	[33]	2016	Kentish	Scary Monsters and Waterfalls: Tinnitus Narrative Therapy for Children.	UK	Patients in clinic	5(5)	9–11
28	[57]	2016	Nisha et al.	Essential palatal myoclonus: A rare cause of objective tinnitus.	India	Patients in clinic	1(1)	12
29	[40]	2016	Rosing et al.	Demographic data, referral patterns and interventions used for children and adolescents with tinnitus and hyperacusis in Denmark.	Denmark	Patients in clinic and primary non-medical care setting	81 (81)	5–18
30	[55]	2017	Kim et al.	Characteristics of tinnitus in adolescents and association with psychoemotional factors.	South Korea	General population	962(311)	12–17
31	[54]	2017	Kedzierawska et al.	A sense of disability in children with tinnitus.	Poland	Patients in clinic	30(30)	8–16
32	[28]	2017	Szibor et al.	Clinical Characteristics of Troublesome Paediatric Tinnitus.	Finland	Patients in clinic	112(112)	6–18
33	[35]	2017	Chan et al.	Paediatric tinnitus: A clinical perspective.	USA	Patients in clinic	180(180)	3–17
34	[31]	2018	Lee & Kim	Urine Cotinine Should Be Involved in Initial Evaluation of Tinnitus in Adolescents	South Korea	General population	2782(486)	12–18
35	[48]	2018	Adegboji et al.	Characteristics and Management of Childhood Tinnitus in a Developing Country	Nigeria	Patients in clinic	132(132)	6–18

Table 3
Methods used to identify problems.

Record #	Reference #	Year	Author(s)	Study Design	Method used to identify problems	Question used to identify problems (actual wording or as described in article)
1	[46]	1974	Keller	Case report	Clinician interview	When you hear the noise does it make your hearing worse?
2	[47]	1981	Graham	Prospective population study	Question	Does it make it difficult for you to hear people's voices? Degrees of annoyance (not at all/slightly/sometimes/always). The children were asked to say whether the tinnitus occurred at any regular time or in any particular situation. They were also asked to add their own comments. Children were asked whether or not it bothered them.
3	[36]	1984	Mills	Prospective population study	Question	Does the tinnitus worry you? (not at all/slightly/very much).
4	[50]	1989	Phillipps et al.	Case report	Clinician interview	When you hear the noise, does it make it difficult to hear people's voices? (yes/no/sometimes).
5	[51]	1989	Drukker	Prospective population study	Structured questions	Question wording unknown.
6	[42]	1991	Fox & Baer	Case report	Clinician interview	Children asked to record annoyance level in morning and evening (scale of just noticeable to severe). Children also encouraged to write comments.
7	[34]	1994	Martin et al.	Retrospective case review and prospective questionnaire study	Questionnaire sent to the child and the parents or guardians about the child's tinnitus and associated symptoms.	
8	[43]	1995	Ben-David et al.	Case report	Clinician interview	
9	[32]	1995	Gabriels	Children with Tinnitus	Clinician interview and annoyance level chart	
10	[44]	2000	Jero	Case report	Clinician interview	
11	[29]	2000	Kentish et al.	Retrospective case notes review	Clinician interview (with structured discussion)	
12	[49]	2001	Fritsch et al.	Retrospective case review	Clinician interview	
13	[60]	2003	Ensink et al.	Case report	Clinician interview	
14	[59]	2005	Howsam et al.	Case report	Clinician interview	
15	[56]	2007	Savastano	Prospective population study	Structured questions	The annoyance degree (always annoyed/seldom annoyed, very annoyed/little annoyed). The severity of tinnitus in regards to causing worry (not at all/slightly/sometimes/more severely). Describe these noises: Bothersome? (yes/no). Do these noises effect your sleep and concentration? (yes/no). Does it bother or annoy you? In what situations does it bother or annoy you?
16	[37]	2007	Aksoy et al.	Prospective population study	Structured questions	The children, together with their parents were asked about any impact these sounds had on their quality-of-life.
17	[30]	2007	Coelho et al.	Prospective population study	Structured questions	
18	[38]	2009	Chadha et al.	Prospective population study	Structured interview	
19	[61]	2012	Alicandri-Ciuffelli et al.	Case report	Clinician interview	
20	[58]	2013	Juul	Prospective population study	Hospital Anxiety and Depression Scale (HADS)	
21	[27]	2013	Baguley	Case series	Clinician interview	
22	[39]	2013	Baguley et al.	Retrospective case review	Clinician interview	
23	[53]	2014	Bae et al.	Retrospective case review	Structured question	To evaluate the tinnitus severity and annoyance, we asked the children how often tinnitus bothered them or disturbed their daily activities. "Seldom", "sometimes" or "only when in a quiet place" was considered as mild tinnitus; "always", "usually" or "often", as severe or troublesome tinnitus.
24	[41]	2014	Kentish	Case report	Clinician interview	
25	[52]	2015	Eryilmaz et al.	Case report	Clinician interview	
26	[17]	2015	Kentish et al.	Case series	Clinician interview	
27	[33]	2016	Kentish	Case series	Clinician interview	
28	[57]	2016	Nisha et al.	Case report	Clinician interview	
29	[40]	2016	Rosing et al.	Prospective and retrospective case notes analysis	<i>Unknown: Problems extracted from this article were based on the descriptions of the therapy received by the child.</i>	
30	[55]	2017	Kim et al.	Prospective population study	Tinnitus Handicap Inventory (THI). Questionnaire items and visual analogue scale (VAS) pertaining to various aspects of tinnitus.	Question wording unknown.

(continued on next page)

Table 3 (continued)

Record #	Reference #	Year	Author(s)	Study Design	Method used to identify problems	Question used to identify problems (actual wording or as described in article)
31	[54]	2017	Kedzierawska et al.	Prospective population study	Tinnitus Handicap Inventory (THI), Tinnitus Functional Index (TFI), and a questionnaire to assess the symptoms and characteristics of tinnitus. Clinician interview	
32	[28]	2017	Szibor et al.	Retrospective case review	Structured telephone questionnaire	The questionnaire aimed to assess change in tinnitus and quantify potential alterations in quality of life using multiple-choice questions (3 or 4-point Likert scales when appropriate).
33	[35]	2017	Chan et al.	Retrospective case notes review and prospective questionnaire	Structured questions	Do these sounds bother you? (no/a little annoying/very annoying and disrupting sleep).
34	[31]	2018	Lee & Kim	Prospective population study	Interviewer assisted questionnaire (questions covered nature, relieving and aggravating factors)	Question wording unknown.
35	[48]	2018	Adegbiyi et al.	Prospective population study		

with descriptors being used interchangeably within the same study record. Frequently, the presence or absence of negative feelings towards tinnitus was used to estimate tinnitus severity [31,36,37,47,53,56]. For example, Bae et al. [53] evaluated tinnitus severity by asking children how often tinnitus bothered them or disturbed their daily activities. Children answering “seldom”, “sometimes” or “only when in a quiet place” were considered to have mild tinnitus whereas children answering “always”, “usually” or “often” were defined as having severe or troublesome tinnitus.

Children were also reported to be anxious [17,29,33,35,40,48,57,58], worried [29,48,51,56], distressed [32,33,35,44], frightened [17,29,33,41], depressed [32,40,48], upset [27,46,47], frustrated [27], irritated [59], overwhelmed [17], troubled [33], unable to relax [17], or tense [33] because of their tinnitus. Gabriels [32] described a child whose family's initial lack of understanding and belief about her tinnitus caused her considerable distress at home. In a general school population investigated by Juul [58], children with tinnitus were found to score significantly higher on both sections of the HADS than children without tinnitus. Kentish et al. [29] reported a group of children presenting with “anxiety symptoms” which included “panic attacks, hyperventilation, fear of being alone, dizziness, and pre-occupation with tinnitus symptoms”. Some records reported children with behavioural changes, which were attributed to their tinnitus. These included, disruptive behaviour (tantrums or aggression) [27,29,35,47], reluctance to wear a hearing aid [32,47], or internalising feelings [29]. A case study authored by Ensink et al. [60] reported an 11 year old child who was so severely affected by his objective tinnitus that he expressed suicidal ideation.

Four records described children with fears or concerns about their tinnitus [17,29,33,41]. Kentish [41] described a child who was “worried that she would go deaf” because of her tinnitus. Kentish et al. [17] described both a child who was “worried that she might have noise damage” and another child whose tinnitus sounded like “creaking stairs” and associated this with “fears of someone breaking into the house at night”. Kentish & Crocker [33] reported a child who believed her tinnitus was caused by “having a monster in her head”, and another child who feared that her tinnitus would never change and “wanted to know if it would go away when she got older”. Parents' fears about their child's tinnitus were also reported. For example, concerns that tinnitus may be reflecting or causing deterioration of their child's hearing [29,33], concerns that tinnitus may be a sign of mental health problems [29], or worries that the noises may be a sign of brain tumours or other neurological conditions [29].

3.2.5. Quality of life

Four records reported problems relating to the impact of tinnitus on children's general quality of life and daily activities [30,39,53,55]. One of these, Coelho et al. [30], described the activities affected being “leisure” activities and “physical activities”. Two records reported how tinnitus had a negative impact on children's social life [33,61]. Kentish & Crocker [33] described a child who specifically attributed her lack of friends to her tinnitus, while Alicandri-Ciuffelli et al. [61] described a girl with “problems in her social life”.

Seven records described how tinnitus disrupted school or learning-related activities [17,33,36,40,48,55,61]. General issues were reported, such as “learning disturbances” [55], “literacy difficulties” [33], “reduced scholastic performance” [61], and observations of children with tinnitus being “education backward” [48]. Kentish & Crocker [33] described a child with “difficulties keeping up with school work” and Mills et al. [36] described a child who was disturbed by tinnitus when trying to study. Both Kentish et al. [17] and Kentish & Crocker [33] described children who missed or stopped attending school because of tinnitus, and Kentish & Crocker [33] described a child who was “finding school quite stressful”.

3.2.6. Feeling different/isolated

Four records described children who experienced feeling different or isolated because of their tinnitus. Baguley [27] and Kentish &

Crocker [33] noted how children felt their tinnitus made them feel different from everybody else, while Adegbiyi et al. [48] observed children to experience social isolation. Kentish [41] described a child who did not feel able to talk to her teacher about her tinnitus, or to ask for help when needed.

3.3. Research recommendations suggested in included records

Several records made recommendations about the future investigation of tinnitus in children. These recommendations were catalogued as relating to tinnitus aetiology, assessment, impact, and treatment.

3.3.1. Aetiology

Three records made recommendations relating to the investigation of tinnitus aetiology in children. Kim et al. [55] called for further investigation into the underlying mechanism(s) of tinnitus, Lee & Kim [31] suggested more research to investigate “the correlation between tinnitus and passive smoking”, and Eryilmaz et al. [52] suggested further investigation into the aetiology and pathophysiology of essential palatal tremor.

3.3.2. Assessment

Three records suggested the need for more standardisation when investigating tinnitus in children. Kentish et al. [29] recommended that “future research should include more standardised material”. Coelho et al. [30] stated the need for a definition of tinnitus in children in order to standardise the approach of future epidemiological studies. They also reported the need for validated instruments to assess and classify tinnitus distress in children, to assess maturation of tinnitus and to measure treatment-related change. Chadha et al. [38] also highlighted the lack of a validated instrument to assess tinnitus in children. They proposed that the effect of tinnitus on quality of life in children with cochlear implants could be further explored using a “matched case–control methodology with a validated paediatric quality-of-life instrument”.

3.3.3. Impact

Two records suggested investigation into the link between tinnitus in children and psychological health. Kim et al. [55] highlighted the need for further studies to determine the relationship between tinnitus and tinnitus-related psycho-emotional disorders in adolescents, whereas Kentish et al. [29] called for investigation into the causal relationship between stress and anxiety in children with troublesome tinnitus. Kentish et al. [29] also suggested investigation into the differences between children with tinnitus and hearing loss and children with tinnitus and normal hearing, because their study suggested higher levels of difficulty experienced by children with tinnitus and normal hearing. Szibor et al. [28] reported the scientific community need to be encouraged to recognise the problem of tinnitus in children; improving understanding of how it occurs and how children communicate it. Ben-David et al. [43] proposed controlled studies to investigate paediatric tinnitus and head trauma induced tinnitus, in order to further understand the issue and enable clinicians to identify, treat and minimise its damage. Druker [51] suggested an in-depth study regarding the effect of tinnitus on children's behaviour and performance in school. He also suggested further investigation into the effect of tinnitus on audiologic testing, aural rehabilitation, cochlear implantation and hearing aid success. To characterise the onset, variability, and impact of tinnitus in children with cochlear implants, Chadha et al. [38] suggested future large-scale prospective cohort studies, with samples that include bilaterally implanted children with different inter-implant delays.

3.3.4. Treatment

Regarding future research into tinnitus treatments for children, Coelho et al. [30] suggested that basic and clinical research should

focus on developing innovative treatment options, and Eryilmaz et al. [52] recommended studies with larger numbers of patients to investigate the therapeutic effect of botulinum toxin for children with essential palatal tremor.

4. Discussion

This scoping review addressed three key aims. Firstly, the review found high variability in the methods used to identify tinnitus-related problems in children. Secondly, the review identified a broad range of tinnitus-related problems experienced by children, across six broad themes; physical health; cognitive health; hearing and listening; emotional health; quality of life; and feeling different/isolated. These findings evidence the detrimental impact of tinnitus on children's quality of life and emotional wellbeing that risk long-term impairments in learning and development. Finally, the review identified a range of research recommendations relating to the investigation of tinnitus in children. Specifically, recommendations highlighted a demand for more standardised approaches and the need to understand the psychological problems associated with tinnitus in children; objectives that remain highly relevant today.

4.1. Identification of tinnitus problems in children

Amongst the 35 records included in this review, 21 records reported three problems or fewer, whereas four records reported more than 10 problems. The records reported different approaches to identify the problems experienced by the child, with the majority identifying problems via open questioning during the clinical interview. Where structured questions or measures were applied, approaches used were inconsistent. Problems were reported both directly (using the child's verbatim) and indirectly via the interpretation of other stakeholders (clinicians, parents, and teachers). Some problems were raised spontaneously and others were identified following prompts from the investigator. This variability suggests a lack of uniformity in the current approach to assessing and reporting the impact of tinnitus in children, limiting our overall understanding of how children are affected. Going forward, it will be important for research to measure and report tinnitus problems experienced by children more systematically and comprehensively. The identification of research recommendations calling for “standardised materials” [29] and “validated instruments” [30,38] to assess tinnitus in children further supports the need for standardised approaches.

4.1.1. Sleep

This review found sleep difficulty to be a broadly reported problem for children with tinnitus. To assess the child's sleep problems, the BSA practice guidance advises clinicians to ask in detail about the child's tinnitus at night, in order to understand experiences and associated worries. Treatment approaches suggested are the introduction of quiet environmental sound and encouraging a good bedtime routine [17]. Likewise, tinnitus-related sleep difficulty is a known problem experienced by adults [2,62] and some studies have shown sound enrichment at night as an effective therapeutic approach [63,64]. Whilst no large scale studies have demonstrated the efficacy of sleep management approaches for children with tinnitus, the successful use of environmental sound at night has been reported in several cases [27,43]. Bartnik et al. [65] also reported the successful use of bedside sound generators as part of Tinnitus Retraining Therapy for children. Furthermore, Smith et al. [22] found non-wearable sound enrichment and sleep hygiene techniques to be used by the majority of UK paediatric tinnitus services.

4.1.2. Hearing and listening

This review found tinnitus-related hearing and listening difficulties to be commonly reported in children. The BSA practice guidance advises clinicians to establish the impact of tinnitus on the child's hearing

and listening through discussion with the child and their supporting network. Medical and audiological assessments are recommended to understand the child's tinnitus in the context of their hearing ability. The guidance also suggests the adapted use of existing paediatric questionnaires such as the Children's Auditory Performance Questionnaire (CHAPS) [66], Listening Inventory For Education (LIFE) [67], and Screening Instrument For Targeting Educational Risk (SIFTER) [68] to gather qualitative information regarding listening difficulties. Hearing aids are recommended as a first line of treatment for any child with tinnitus and hearing loss. Studies have shown hearing aids to be beneficial in adults with tinnitus and hearing loss [69]. However, as of yet, no studies have demonstrated the utility of hearing aids for children with tinnitus [17].

4.1.3. Concentration

This review also found tinnitus-related concentration issues to be commonly reported. The BSA practice guidance advises clinicians to establish the impact of tinnitus on the child's concentration through discussion. The guidance also suggests the adapted use of existing questionnaires such as the CHAPS [66] to assess the child's cognitive performance in different listening conditions. The detrimental impact of tinnitus on cognition has been demonstrated in several adult population studies [70,71]. Whilst no therapeutic options specifically target tinnitus-related concentration problems, a reduction in tinnitus severity via other therapeutic routes may help to alleviate concentration issues.

4.1.4. School

Difficulties at school, typically relating to concentration, hearing and listening problems, were reported by many records included in this review. The BSA guidance state that when assessing a child, it is important to gather information about the impact of tinnitus on all aspects of life, including specific investigation into how the child is coping at school. Furthermore, the guidance recommends the use of measures, such as single-item scales or existing paediatric questionnaires (CHAPS [66], LIFE [67], and SIFTER [68]), to qualitatively assess difficulty relating to listening, concentration and school performance. For the specific management of tinnitus in the classroom, the guidance advises a pragmatic and personalised approach, incorporating planned self-help strategies and teacher-led techniques, discussed and agreed formally with the child's school [17].

4.1.5. Emotional health

The emotional impact of tinnitus was identified as a key problem theme in this review. Problematic emotional responses to tinnitus were broadly reported, as were symptoms of anxiety and depression. The BSA practice guidance recommends health professionals gain an understanding of the psychological impact of the child's tinnitus, as part of the clinical assessment procedure and highlight the complex relationship between tinnitus, emotional wellbeing, stress and the context of the child's life. In the absence of a child-specific questionnaire measure of tinnitus distress, the guidance suggests the use of existing paediatric questionnaires to screen for general psychological difficulties. For example, the Paediatric Index of Emotional Distress Questionnaire (PI-ED) [72], Strengths and Difficulties Questionnaire (SDQ) [73], or Revised Children's Anxiety and Depression Scale (RCADS) [74]. Single-item scales are also recommended to help children describe their level of tinnitus distress. Single-item measures can be performed in the context of different situations to assess various areas of the child's life (e.g. home, or school). They can also be used over multiple time points to measure changes in distress over time. The BSA practice guidance recommends several psychological approaches that can be used to address children's tinnitus-related emotional difficulties. These include CBT, relaxation techniques, mindfulness techniques, and Narrative Therapy. Tinnitus-related psychological distress has been well documented in adults [3]. Furthermore, several studies have suggested an association between psychological factors, such as anxiety and

depression, and severe tinnitus [75]. A systematic review found sufficient evidence to support the efficacy of therapist-delivered CBT for adults with tinnitus [4]. Whilst there is no evidence to support the efficacy of CBT for children with tinnitus, there is promising evidence to support its effect in reducing anxiety in children [76]. In UK paediatric tinnitus services, psychological approaches were found to be the least used treatment approach across services [22]. Similarly, in UK adult tinnitus services, access to psychological therapy or support is highly variable [77].

Fears and concerns about the tinnitus were also identified as problems relating to emotional health. The BSA practice guidance advises health professionals to assess and discuss any fears or beliefs the child has about their tinnitus [17]. Information giving and therapeutic approaches such as psychological techniques are recommended to address and alleviate tinnitus-related fear in both adults and children.

4.1.6. Quality of life/feeling different/isolated

Other themes identified were problems relating to the impact of tinnitus on the child's quality of life and activities and feeling different/isolated. Whilst withdrawal from activities and social problems are highlighted by the BSA practice guidance as potential indicators of tinnitus and associated difficulty, the guidance does not discuss the assessment of these problem areas in detail, nor does it advise on treatment approaches to specifically rehabilitate these areas of the child's life. In adults, the detrimental impact of tinnitus on quality of life, self-perception, and social activities has also been documented [3]. For children, it may be particularly important to detect and address social problems, given that research has linked childhood social difficulties to poor mental wellbeing [78,79].

4.2. Limitations

A possible limitation to this study is the accuracy and reliability of problem data reported. Much of the problem data are reported in the voice of the adult (clinician, parent, researcher) with little verbatim description from the child. The problems voiced by adults may not be those considered important to the child. Furthermore, there may be issues identified by a parent or teacher that are relevant to the overall care of the child as opposed to the child's own personal experiences. Whilst all reported issues may be important, further investigation is required to understand the relative importance of child versus stakeholder-reported issues.

Different methods of collecting problem data may also influence the accuracy and consistency of problem data reported. Rosing et al. [14] systematically reviewed the methods used in epidemiology studies of tinnitus in children and found that it was typical for investigators to use different definitions of tinnitus, variable phrasing in the questions used to identify the presence of tinnitus, and variable efforts to ensure that the children in the study provided reliable answers. These differences were believed to account for variability in the prevalence data reported across studies. Likewise, the problem questions identified in the records in this review varied.

Even direct reports from the child may lack accuracy. There are recognised challenges involved in interviewing children regarding their tinnitus, such as children's reluctance to discuss their tinnitus with adults, or their lack of linguistic ability to communicate their difficulties [80]. When interviewing children about their tinnitus there is a risk they do not understand the question asked, wish to please the interviewer, or are influenced by leading or poorly worded questions. For example, children's answers are unlikely to be accurate where questions contain multiple elements, or where not all elements are relevant or understood by the child. In these instances, it is typical for a child to give a blanket yes or no response. In the records included in this review, some of the questions could be considered too complex and burdensome for a child to respond accurately. One example was the question used by Aksoy et al. [37] where children were asked, "Do these noises

effect your sleep and concentration?” with the response options “Yes” or “No”. Hence, how should the child respond if tinnitus negatively affects their concentration but has no effect on sleep?

5. Conclusions

This scoping review found children with tinnitus to experience a wide range of problems that have a detrimental impact on life and wellbeing. At this critical period of life, the importance of addressing these issues is vital, since these problems have the potential to contribute long-term impairments in learning and development. Evidence from this review therefore supports the clear clinical need for the provision of high quality, effective care for children with bothersome tinnitus. The current BSA practice guidance recommends management practices to address the most broadly reported problems, including sleep difficulties, concentration and hearing problems at school, and emotional difficulties. Given the finding of this review, we suggest problems relating to the impact of tinnitus on quality of life (i.e. general activities, school activities, and social activities) and feeling different/isolation are also important problem domains to consider when assessing and planning treatment with a child who has tinnitus. The development of a validated, child-specific questionnaire measure of tinnitus would provide an effective method of performing a systematic assessment and could provide a means of stratifying tinnitus severity in children. Given the challenges associated with interviewing children about their tinnitus, it will be particularly important for a child-specific measure to include questions at a level of language accessible and familiar to the child [19,80].

Declarations of interest

None.

Funding

HS is funded by the British Tinnitus Association. DJH is funded by the National Institute for Health Research (NIHR) Biomedical Research Centre programme, however the views expressed are those of the authors and not necessarily those of the NIHR, the NHS, or the Department of Health and Social Care.

References

- [1] D. Baguley, D. McFerran, D. Hall, Tinnitus, *Lancet* 382 (2013) 1600–1607, [https://doi.org/10.1016/S0140-6736\(13\)60142-7](https://doi.org/10.1016/S0140-6736(13)60142-7).
- [2] R. Tyler, L.J. Baker, Difficulties experienced by tinnitus sufferers, *J. Speech Hear. Disord.* 48 (1983) 150, <https://doi.org/10.1044/jshd.4802.150>.
- [3] D. Hall, K. Fackrell, A.B. Li, R. Thavayogan, S. Smith, V. Kennedy, C. Tinoco, E.D. Rodrigues, P. Campelo, T.D. Martins, V.M. Lourenço, D. Ribeiro, H. Haider, A. Beatrice Li, V. Martins Lourenço, A narrative synthesis of research evidence for tinnitus-related complaints as reported by patients and their significant others, *Health Qual. Life Outcomes* 16 (2018) 61, <https://doi.org/10.1186/s12955-018-0888-9>.
- [4] D.J. Hoare, V.L. Kowalkowski, S. Kang, D. Hall, Systematic review and meta-analysis of randomized controlled trials examining tinnitus management, *Laryngoscope* 121 (2011) 1555–1564, <https://doi.org/10.1002/lary.21825>.
- [5] P. Baldo, C. Doree, P. Molin, D. McFerran, S. Cecco, Antidepressants for patients with tinnitus, *Cochrane Database Syst. Rev.* (2012), <https://doi.org/10.1002/14651858.CD003853.pub3>.
- [6] H. Hesser, C. Weise, V.Z. Westin, G. Andersson, A systematic review and meta-analysis of randomized controlled trials of cognitive-behavioral therapy for tinnitus distress, *Clin. Psychol. Rev.* (2011), <https://doi.org/10.1016/j.cpr.2010.12.006>.
- [7] D.J. Hoare, M. Edmondson-Jones, M. Sereda, M.A. Akeroyd, D. Hall, Amplification with hearing aids for patients with tinnitus and co-existing hearing loss, *Cochrane Database Syst. Rev.* (2014), <https://doi.org/10.1002/14651858.CD010151.pub2>.
- [8] O.C. Person, M.E. Puga, E.M. da Silva, M.R. Torloni, Zinc supplementation for tinnitus, *Cochrane Database Syst. Rev.* (2016), <https://doi.org/10.1002/14651858.CD009832.pub2>.
- [9] T.E. Fuller, H. Haider, D. Kikidis, A. Lapira, B. Mazurek, A. Norena, S. Rabau, R. Lardinois, C.R. Cederroth, N.K. Edvall, P.G. Brueggemann, S. Rosing, A. Kapandais, D. Lungaard, D.J. Hoare, R.F.F. Cima, Different teams, same conclusions? A systematic review of existing clinical guidelines for the assessment and treatment of tinnitus in adults, *Front. Psychol.* 8 (2017) 206, <https://doi.org/10.3389/fpsyg.2017.00206>.
- [10] R.F.F. Cima, B. Mazurek, H. Haider, D. Kikidis, A. Lapira, A. Noreña, D.J. Hoare, A multidisciplinary European guideline for tinnitus: diagnostics, assessment, and treatment, *HNO* (2019) 1–33.
- [11] M. Meikle, J. Henry, S.E. Griest, B.J. Stewart, H.B. Abrams, R. McArdle, P.J. Myers, C.W. Newman, S. Sandridge, D.C. Turk, R.L. Folmer, E.J. Frederick, J.W. House, G.P. Jacobson, S.E. Kinney, W.H. Martin, S.M. Nagler, G.E. Reich, G. Searchfield, R. Sweetow, J. a Vernon, The tinnitus functional index: development of a new clinical measure for chronic, intrusive tinnitus, *Ear Hear.* 33 (2012) 153–176 <https://doi.org/10.1097/AUD.0b013e31822f67c0>.
- [12] C.W. Newman, G.P. Jacobson, J.B. Spitzer, Development of the tinnitus Handicap inventory, *Arch. Otolaryngol. Head Neck Surg.* 122 (1996) 143–148, <https://doi.org/10.1001/archotol.1996.01890140029007>.
- [13] F.K. Kuk, R. Tyler, D. Russell, H. Jordan, The psychometric properties of a tinnitus Handicap questionn...: Ear and Hearing, *Ear Hear.* 11 (1990) 434–445, <https://doi.org/10.1097/00003446-199012000-00005>.
- [14] S. Rosing, J.H. Schmidt, N. Wedderkopp, D. Baguley, Prevalence of tinnitus and hyperacusis in children and adolescents: a systematic review, *BMJ Open* 6 (2016) e010596, <https://doi.org/10.1136/bmjopen-2015-010596>.
- [15] R. Humphris, A. Hall, D. Baguley, Prevalence and characteristics of spontaneous tinnitus in 11-year-old children, *Int. J. Audiol.* 55 (2016) 142–148, <https://doi.org/10.3109/14992027.2015.1120890>.
- [16] A. Davis, A. El Refaie, Epidemiology of tinnitus, in: R. Tyler (Ed.), *Handb. Tinnitus, Singular*, 2000, pp. 1–23.
- [17] R. Kentish, C. Benton, V. Kennedy, C. Munro, J. Philips, C. Rogers, J. Rosenberg, S. Salvage, Tinnitus in Children Practice Guidance, 8 (2015), pp. 20–26.
- [18] D. Hall, N. Mohamad, L. Firkins, M. Fenton, D. Stockdale, Identifying and prioritizing unmet research questions for people with tinnitus: the James Lind alliance tinnitus priority setting partnership, *Clin. Investig. (Lond.)* 3 (2013) 21–28, <https://doi.org/10.4155/cli.12.129>.
- [19] C. Eiser, R. Morse, Quality of life measures in chronic diseases of childhood, *Health Technol. Assess. (Rockv.)* 5 (2001) 609–610, <https://doi.org/10.3310/hta5040>.
- [20] D. Mellor, K.A. Moore, The use of likert scales with children, *J. Pediatr. Psychol.* 39 (2014) 369–379, <https://doi.org/10.1093/jpepsy/jst079>.
- [21] C.T. Chambers, C. Johnston, Developmental differences in children's use of rating scales, *J. Pediatr. Psychol.* 27 (2002) 27–36, <https://doi.org/10.1093/jpepsy/27.1.27>.
- [22] H. Smith, K. Fackrell, J.G. Barry, V. Kennedy, E. Broomhead, D.J. Hoare, An Evaluation of Paediatric Tinnitus Services in the UK, (2018).
- [23] L.L. Cohen, K. Lemanek, R.L. Blount, L.M. Dahlquist, C.S. Lim, T.M. Palermo, K.D. McKenna, K.E. Weiss, Evidence-based assessment of pediatric pain, *J. Pediatr. Psychol.* (2008), <https://doi.org/10.1093/jpepsy/jsm103>.
- [24] H. Arksey, L. O'Malley, Scoping studies: towards a methodological framework, *Int. J. Soc. Res. Methodol. Theory Pract.* 8 (2005) 19–32, <https://doi.org/10.1080/1364557032000119616>.
- [25] V. Braun, V. Clarke, Using thematic analysis in psychology, *Qual. Res. Psychol.* 3 (2006) 77–101.
- [26] A.S. Zigmond, R.P. Snaith, The hospital anxiety and depression scale, *Acta Psychiatr. Scand.* 67 (1983) 361–370, <https://doi.org/10.1111/j.1600-0447.1983.tb09716.x>.
- [27] D. Baguley, Moments of being so very upset, *Hear. Heal.* 29 (2013) 12–14 <http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=107957532&site=ehost-live>.
- [28] A. Szibor, T. Jutila, A. Makitie, A. Aarnisalo, A. Mäkitie, A. Aarnisalo, Clinical characteristics of troublesome pediatric tinnitus, *Clin. Med. Insights Ear, Nose Throat* 10 (2017), <https://doi.org/10.1177/1179550617736521>
- [29] R. Kentish, S. Crocker, L. McKenna, Children's experience of tinnitus: a preliminary survey of children presenting to a psychology department, *Br. J. Audiol.* 34 (2000) 335–340, <https://doi.org/10.3109/03005364000000149>.
- [30] C. Coelho, T. Sanchez, R. Tyler, Tinnitus in children and associated risk factors, *Prog. Brain Res.* 166 (2007) 179–191, [https://doi.org/10.1016/S0079-6123\(07\)66016-6](https://doi.org/10.1016/S0079-6123(07)66016-6).
- [31] D.Y. Lee, Y.H. Kim, Urine Cotinine Should Be Involved in Initial Evaluation of Tinnitus in Adolescents, (2018), <https://doi.org/10.21053/ceo.2017.01641>.
- [32] P. Gabriels, Children with tinnitus, in: G. Reich, J. Vernon (Eds.), *Proc. 5th Int. Tinnitus Semin. American Tinnitus Association, Portland, Oregon*, 1996, pp. 270–274.
- [33] R. Kentish, S. Crocker, Scary Monsters and Waterfalls: Tinnitus Narrative Therapy for Children | Ento Key, (2016) <https://entokey.com/scary-monsters-and-waterfalls-tinnitus-narrative-therapy-for-children/>.
- [34] K. Martin, S. Snashall, Children presenting with tinnitus: a retrospective study, *Br. J. Audiol.* 28 (1994) 111–115 <http://www.ncbi.nlm.nih.gov/pubmed/7841888> , Accessed date: 12 December 2017.
- [35] K.H. Chan, E.L. Jensen, D. Gao, Pediatric tinnitus: a clinical perspective, *Laryngoscope* (2017), <https://dx.doi.org/10.1002/lary.26851>.
- [36] R. Mills, J. Cherry, Subjective tinnitus in children with otological disorders, *Int. J. Pediatr. Otorhinolaryngol.* 7 (1984) 21–27, [https://doi.org/10.1016/S0165-5876\(84\)80050-6](https://doi.org/10.1016/S0165-5876(84)80050-6).
- [37] S. Aksoy, Ö. Akdogan, Y. Gedikli, E. Belgin, The extent and levels of tinnitus in children of central Ankara, *Int. J. Pediatr. Otorhinolaryngol.* 71 (2007) 263–268, <https://doi.org/10.1016/j.ijporl.2006.10.008>.
- [38] N.K. Chadha, K.A. Gordon, A.L. James, B.C. Papsin, Tinnitus is prevalent in children with cochlear implants, *Int. J. Pediatr. Otorhinolaryngol.* 73 (2009) 671–675 <https://dx.doi.org/10.1016/j.ijporl.2008.12.032>.

- [39] D. Baguley, G. Bartnik, T. Kleinjung, M. Savastano, E. Hough, Troublesome tinnitus in childhood and adolescence: data from expert centres, *Int. J. Pediatr.*
- [40] S. Rosing, A. Kapandais, J. Schmidt, D. Baguley, Demographic data, referral patterns and interventions used for children and adolescents with tinnitus and hyperacusis in Denmark, *Int. J. Pediatr. Otorhinolaryngol.* 89 (2016) 112–120, <https://doi.org/10.1016/j.ijporl.2016.07.036>.
- [41] R. Kentish, Drawing Pictures and Telling Stories: Treating Tinnitus in Childhood, *Entandaudiologynews.com*, 2014, <https://www.entandaudiologynews.com/media/3087/entjfl4-audiology-kentish-new.pdf>.
- [42] G. Fox, M. Baer, Palatal myoclonus and tinnitus in children, *West. J. Med.* 154 (1991) 98–102 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed5&NEWS=N&AN=21084316>.
- [43] Ben-David, Fradis Podoshin, Tinnitus in children - still a neglected problem, *Int. Tinnitus J.* 1 (1995) 155–157 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=medp&NEWS=N&AN=10753337>.
- [44] J. Jero, T. Salmi, Palatal myoclonus and clicking tinnitus in a 12-year-old girl - case report, *Acta Oto-Laryngol. - Suppl.* 543 (2000) 61–62 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=10908979>.
- [45] I. Klockhoff, U. Lindblom, Menière's disease and hydrochlorothiazide (di-chloride)mdash;a critical analysis of symptoms and therapeutic effects, *Acta Otolaryngol.* (1967), <https://doi.org/10.3109/00016486709128769>.
- [46] A.P. Keller, An oscillographic study of an objective tinnitus, *Laryngoscope* 84 (1974) 998–1003 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med1&NEWS=N&AN=4832381>.
- [47] J.M. Graham, Tinnitus in children with hearing loss, *Ciba Found. Symp.* 85 (1981) 172–192 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed2&NEWS=N&AN=12604129>.
- [48] W.A. Adegbiji, G.T. Olajide, O. Olubi, A.A. Aluko, A.O. Olajuyin, P.A. Eletta, A.I. Yahya, Characteristics and management of childhood tinnitus in a developing country, *Int. Tinnitus J.* 22 (2018) 66–71, <https://doi.org/10.5935/0946-5448.20180011>.
- [49] M.H. Fritsch, M.K. Wynne, B.H. Matt, W.L. Smith, C.M. Smith, Objective tinnitus in children, *Otol. Neurotol.* 22 (2001) 644–649, <https://doi.org/10.1097/00129492-200109000-00015>.
- [50] J.J. Philipps, A. Reid, R.J. Marchbanks, R.F. Jarrar, Objective tinnitus and tympanic membrane displacement, *J. Laryngol. Otol.* 103 (1989) 872–873 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med3&NEWS=N&AN=2584880>.
- [51] G.S. Drukier, The prevalence and characteristics of tinnitus with profound sensorineural hearing impairment, *Am. Ann. Deaf* 134 (1989) 260–264 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med3&NEWS=N&AN=2589143>.
- [52] A. Eryilmaz, Y. Basal, C. Gunel, A. Ozkul, A. Tosun, Successful treatment of essential palatal tremor lasting over a long term with a rare application of botulinum toxin in a child., *Iran. J. Child Neurol.* 9 (2015) 75–77 <http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=110847943&site=ehost-live>.
- [53] S.-C. Bae, S.-N. Park, J.-M. Park, M. Kim, S.-W. Yeo, S.-Y. Park, Childhood tinnitus: clinical characteristics and treatment, *Am. J. Otolaryngol. - Head Neck Med. Surg.* 35 (2014) 207–210, <https://doi.org/10.1016/j.amjoto.2013.10.003>.
- [54] S. Kedzierawska, A. Niedzielski, A. Al-Jazani, G. Mielnik-Niedzielska, A sense of disability in children with tinnitus, *J. Hear. Sci.* 7 (2017) 106–107 <http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=127380291&site=ehost-live>.
- [55] S.Y. Kim, Y.J. Jeon, J.-Y.Y. Lee, Y.H. Kim, Characteristics of tinnitus in adolescents and association with psychoemotional factors, *Laryngoscope* 127 (2017) 2113–2119 <https://doi.org/10.1002/lary.26334>.
- [56] M. Savastano, Characteristics of tinnitus in childhood, *Eur. J. Pediatr.* 166 (2007) 797–801, <https://doi.org/10.1007/s00431-006-0320-z>.
- [57] T. Nisha, A. Vinayakumar, Essential palatal myoclonus: a rare cause of objective tinnitus, *Int. J. Adv. Med. Health Res.* 3 (2016) 91, <https://doi.org/10.4103/2349-4220.195936>.
- [58] J. Juul, Hearing Symptoms in Children and Adolescents Tinnitus and Temporary Threshold Shift, (2013) <http://hdl.handle.net/2077/32376>.
- [59] G.D. Howsam, A. Sharma, S.P. Lambden, J. Fitzgerald, P.R. Prinsley, Bilateral objective tinnitus secondary to congenital middle-ear myoclonus, *J. Laryngol. Otol.* 119 (2005) 489–491 <https://doi.org/10.1258/0022215054273223>.
- [60] R.H. Ensink, H.M. Vingerhoets, C.W.T.H. Schmidt, C.W.R.J. Cremers, Treatment for severe palatoclonus by occlusion of the eustachian tube, *Otol. Neurotol.* 24 (2003) 714–716 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=14501444>.
- [61] M. Alicandri-Ciuffelli, D. Soloperto, S. Palma, A. Marrara, E. Genovese, A clockwork ear, *Neuropediatrics* 43 (2012) 146–148 <https://dx.doi.org/10.1055/s-0032-1307452>.
- [62] G. Andersson, L. Lyttkens, H.C. Larsen, Distinguishing levels of tinnitus distress, *Clin. Otolaryngol. Allied Sci.* 24 (1999) 404–410 <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=10542919>.
- [63] L. Handscomb, Use of bedside sound generators by patients with tinnitus-related sleeping difficulty: which sounds are preferred and why? VIIIth International Tinnitus Seminar. Held in Pau, France, 6–10 September, 2005, *Acta Otolaryngologica*, vol. 126, 2006, pp. 59–63 <http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=106134245&site=ehost-live>.
- [64] S. Benton, Bedside sound generators as a tool for tinnitus management, *Hear. J.* 69 (2016) 31–34, <https://doi.org/10.1097/01.HJ.0000483272.44396.24>.
- [65] G. Bartnik, A. Stepien, D. Raj-Kozia, A. Fabijańska, I. Niedzialek, H. Skarzyński, Troublesome tinnitus in children: epidemiology, audiological profile, and preliminary results of treatment, *Int. J. Pediatr.* 2012 (2012) 1–5, <https://doi.org/10.1155/2012/945356>.
- [66] W.J. Smoski, M.A. Brunt, J.C. Tannahill, Children's Auditory Performance Scale (CHAPS), n.d, https://www.phonakpro.com/content/dam/phonakpro/gc_hq/en/resources/counseling_tools/documents/child_hearing_assessment_childrens_auditory_performance_scale_chaps_2017.pdf, Accessed date: 28 September 2018.
- [67] K.L. Anderson, J.J. Smaldino, Listening inventories for education: a classroom measurement tool, *Hear. J.* 52 (1999) 74–76.
- [68] K.L. Anderson, Screening Identification for Targeting Educational Risk, *Successforkidswithhearingloss.com/wp-content/uploads/2017/09/SIFTER_Manual.pdf*, Accessed date: 28 September 2018.
- [69] M.I. Trotter, I. Donaldson, Hearing aids and tinnitus therapy: a 25-year experience, *J. Laryngol. Otol.* 122 (2008) 1052–1056, <https://doi.org/10.1017/S002221510800203X>.
- [70] S. Tegg-Quinn, R.J. Bennett, R.H. Eikelboom, D.M. Baguley, The impact of tinnitus upon cognition in adults: a systematic review, *Int. J. Audiol.* (2016), <https://doi.org/10.1080/14992027.2016.1185168>.
- [71] Y. Wang, J.-N. Zhang, W. Hu, J.-J. Li, J.-X. Zhou, J.-P. Zhang, G.-F. Shi, P. He, Z.-W. Li, M. Li, The characteristics of cognitive impairment in subjective chronic tinnitus, *Brain Behav.* 8 (2018) e00918, <https://doi.org/10.1002/brb3.918>.
- [72] S. O'Connor, E. Ferguson, T. Carney, E. House, R.C. O'Connor, The development and evaluation of the paediatric index of emotional distress (PI-ED), *Soc. Psychiatr. Psychiatr. Epidemiol.* 51 (2016) 15–26, <https://doi.org/10.1007/s00127-015-1134-y>.
- [73] R. Goodman, The Strengths and difficulties questionnaire: a research note, *JCPP (J. Child Psychol. Psychiatry)* (1997), <https://doi.org/10.1111/j.1469-7610.1997.tb01545.x>.
- [74] B.F. Chorpita, B.F. Chorpita, L. Yim, L. Yim, C. Moffitt, C. Moffitt, L.A. Umemoto, L.A. Umemoto, S.E. Francis, S.E. Francis, Assessment of DSM-IV anxiety and depression in children: a revised child anxiety and depression scale, *Behav. Res. Ther.* 38 (2000) 835–855.
- [75] G. Andersson, Psychological aspects of tinnitus and the application of cognitive-behavioral therapy, *Clin. Psychol. Rev.* (2002), [https://doi.org/10.1016/S0272-7358\(01\)00124-6](https://doi.org/10.1016/S0272-7358(01)00124-6).
- [76] A.C. James, G. James, F.A. Cowdrey, A. Soler, A. Choke, Cognitive behavioural therapy for anxiety disorders in children and adolescents, in: A.C. James (Ed.), *Cochrane Database Syst. Rev.*, John Wiley & Sons, Ltd, Chichester, UK, 2013, p. CD004690, <https://doi.org/10.1002/14651858.CD004690.pub3>.
- [77] D.J. Hoare, E. Broomhead, D. Stockdale, V. Kennedy, Equity and person-centeredness in the provision of tinnitus services in UK National Health Service audiology departments, *Eur. J. Pers. Centered Healthc.* 3 (2015) 318–326, <https://doi.org/10.5750/EJPCH.V3I1>.
- [78] M. Boivin, S. Hymel, W.M. Bukowski, The roles of social withdrawal, peer rejection, and victimization by peers in predicting loneliness and depressed mood in childhood, *Dev. Psychopathol.* (1995), <https://doi.org/10.1017/S0954579400006830>.
- [79] H. Gazelle, G.W. Ladd, Anxious solitude and peer exclusion: a diathesis-stress model of internalizing trajectories in childhood, *Child Dev.* (2003), <https://doi.org/10.1111/1467-8624.00534>.
- [80] R. Kentish, Talking about tinnitus (What can young children tell us?), (n.d.).