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REVIEW ARTICLE

Assessment of auditory conditions in misophonia treatment research: a scoping review

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ABSTRACT

Objective: To identify treatment research that used a behavioural approach to treat misophonia as the primary focus of treatment, and the audiological testing included in the research.

Design: Scoping literature review completed in February 2023 and updated in March 2024.

Study Sample: Included studies that provided a behavioural or audiological intervention for misophonia, were peer-reviewed, and published in English before February 29, 2024. Studies were excluded if a pharmacological treatment was provided, if misophonia was not the primary treatment target, or if the assessment of misophonia severity was not a treatment outcome.

Results: Fifteen articles met the inclusion criteria. Six studies had paediatric participants and nine had adult participants. Three studies included the identification of audiological comorbidities including hearing ability, hyperacusis, and/or tinnitus in their assessment process. Nine of the studies included assessment for psychological comorbidities. For the different psychological treatment approaches, misophonia severity scores decreased from baseline from 19% to 83%.

Conclusions: There is a need for misophonia research to identify audiological comorbidities and to provide evidence-based guidance for addressing them within treatment. Symptoms often appear during childhood and individuals with misophonia would benefit from timely assessment and interdisciplinary coordination to address broader patient impacts in the treatment process.

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Adult; hearing; misophonia; paediatric; treatment

Introduction

Misophonia is a sound tolerance disorder characterised by an intense emotional reaction (e.g. anger, irritation, disgust) to specific sounds that trigger their reaction, including repetitive sounds such as eating, breathing, and tapping (Swedo et al. 2022). This condition was first described by audiologist Marsha Johnson in 1990 (Bernstein, Angell, and Dehle 2013), and in 2001 the term misophonia was introduced (Jastreboff and Jastreboff 2002). Research on underlying mechanisms influencing misophonia is evolving, and early models are emerging to explain the pathway for activation of the distressing emotional response. Recently a social cognitive model was proposed based on neuroimaging studies and the social context of the perceived sound source and the role this plays in the strength of the response to the trigger (Berger, Gander, and Kumar 2024). Notably, individuals with misophonia often have hearing thresholds within normal limits (Jager et al. 2020a) and objective tests of the auditory system have been found to exhibit no differences between individuals with and without misophonia (e.g. Aryal and Prabhu 2023a; Suraj, Venkateswaran, and Prabhu 2024). Current and future research on the neurophysiological mechanisms involved and how they are similar or different among people suffering from misophonia will inform and refine future approaches to treatment. A recent consensus definition of misophonia (Swedo et al. 2022) recognised that misophonia can co-

exist with other conditions, including auditory, neurological or psychiatric conditions, and for individuals with misophonia, their symptoms of misophonia should not be better explained by a co-morbid condition.

Identification of co-morbid conditions represents an important step in providing individuals seeking treatment with coordinated and comprehensive care, suggesting a need for an interdisciplinary approach for assessment and treatment planning. Psychological comorbidities include disorders such as depression, anxiety, (Ferrer-Torres and Giménez-Llort 2022) attention-deficit hyperactivity disorder (Rouw and Erfanian 2018), as well as other psychiatric disorders. Auditory comorbidities have been found with tinnitus and hyperacusis (Jastreboff and Jastreboff 2015); however, findings vary among studies, raising questions about the prevalence of auditory co-morbidities and how they impact an individual's experience with misophonia, that are not yet clearly defined. For example, hyperacusis can be measured by self-report questionnaires and by measurement of loudness discomfort level (LDL) for discrete tones. A recent study that compared LDLs among three groups (i.e. misophonia, auditory over-responsivity, and health controls) found no statistically significant differences in LDLs among the groups (Siepsiak et al. 2022). Yet in another study of individuals with misophonia, 71% self-reported hyperacusis (Enzler et al. 2021).

Currently, there are no universally accepted diagnostic criteria for misophonia; however, it is commonly assessed using

questionnaires and/or a structured interview process developed to determine severity of and response to trigger sounds. People seeking help for coping with their symptoms typically seek out services from audiology, psychology, and psychiatry. The prevalence of clinically significant misophonia is unclear for children and adults. A recent study found 20% of college students experienced distress from misophonia (Brennan et al. 2024) and a population-based sample in Germany aged 16 and older found 34% reported misophonic sound sensitivities (Pfeiffer, Allroggen, and Sachser 2025). Misophonia typically emerges in childhood and impairment often continues in adulthood (Jager et al. 2020a). While the cause of misophonia is not yet known, the impact on daily life is significant and can lead to maladaptive ways of coping including social isolation (Brout et al. 2018).

To address the impacts of misophonia and help people manage their response to trigger sounds different approaches have been used, including psychological and pharmacological interventions (Mattson et al. 2023), tinnitus retraining therapy (Jastreboff and Jastreboff 2015), and technology to mask trigger sounds (Bernstein, Angell, and Dehle 2013; Zitelli 2021). In a recent systematic review with misophonia as the primary or secondary focus of psychological and/or pharmacological treatment (Mattson et al. 2023) the authors concluded that while the interventions showed potential, there currently is no clear treatment recommendation for misophonia. Furthermore, the authors established that there was a lack of rigour and comparative studies in the research, as well as limitations with sample size and replication. One of the treatment studies used tinnitus retraining therapy and identified 28% of their sample with hyperacusis (Jastreboff and Jastreboff 2014). Research does not yet have a clear answer for how co-morbid auditory disorders influence the treatment process. The current scoping review extends on the Mattson et al. (2023) study by identifying the status of assessment of auditory conditions in misophonia treatment research to provide additional context.

Therefore, the purpose of this scoping review was to identify and describe treatment research that used a behavioural approach to treat misophonia as the primary focus of treatment, and the auditory conditions assessed for in the research. This scoping review contributes to the literature by providing information on gaps that exist in assessing for co-morbid auditory conditions in misophonia treatment research for paediatric and adult populations. This information can help guide interdisciplinary collaboration between behavioural/psychological and audio-logical fields.

Methods

The design for this study was a scoping literature review. Scoping reviews identify key concepts and research gaps using a systematic process.

Eligibility criteria

A scoping literature review was completed in February 2023 and updated in March 2024 following guidance from the Joanna Briggs Institute (Peters et al. 2022). To be included, the studies were in peer-reviewed publications, provided behavioural or audiological intervention for misophonia, and were published in English before February 29, 2024. Studies were excluded if a pharmacological treatment was provided, if misophonia was not the primary treatment target, or if insufficient data were provided on misophonia treatment outcomes (e.g. outcomes were

not measured post-treatment, a misophonia severity measure was not used).

Search strategy

To identify potentially relevant articles, three databases were searched (MEDLINE, CINAHAL Complete and PsycINFO all via EBSCOhost) using the following keywords: 1. (misophonia OR sound-tolerance); 2. (intervention OR treatment OR hearing OR audiol*). An overarching search string was created that incorporated the keywords for the database (see Appendix A for search queries).

Data extraction

Three authors (DV, MH, and DO) developed a data charting form prior to completing the literature search. The articles were screened for inclusion independently by two authors (DV, MH). First, a title and abstract screening was conducted. The authors met to discuss and resolve any discrepancies in selected articles. In the event of disagreement over inclusion, a third author (DO) reviewed the article in question. Second, a full text screening was completed (DV, MH), and reference lists of included articles were reviewed (DV, MH) to identify additional articles for consideration. Third, two authors (KM, DV) independently reviewed articles using Joanna Briggs methodological quality checklists that were available for the study designs (Gagnier et al. 2013; Munn et al. 2020; Barker et al. 2023).

Analysis

Study details were extracted and entered in an Excel spreadsheet (i.e. publication date, first author, study design, participant information, outcome measure(s), treatment information, and audio-logical tests). The articles were divided into two groups to show the status of assessing for auditory conditions based on participant age (i.e. paediatric [under 18 years] and adult [18 years and older]) and narratively synthesised.

Results

The database search identified 934 articles after duplicates were removed. Title and abstract screening excluded 885, one article could not be accessed, and 34 were excluded during full-text screening. One article was identified from the reference list review; a total of 15 articles met the eligibility criteria for inclusion (see Figure 1 for the PRISMA [Preferred Reporting Items for Systematic reviews and Meta-Analyses] flowsheet). Six studies had paediatric participants (Table 1) and nine had adult participants (Table 2).

Paediatric

The six studies with paediatric participants were case reports. The children and adolescents ranged in age from 10 to 17 years. Misophonia onset reported in five of the studies was from approximately age 5 to 11 years. The Amsterdam Misophonia Scale (AMISO-S) and/or the Misophonia Questionnaire (MQ) were used to measure severity. All the studies provided psychological interventions and decreases in severity were found post-treatment. Psychological comorbidities were assessed for in all

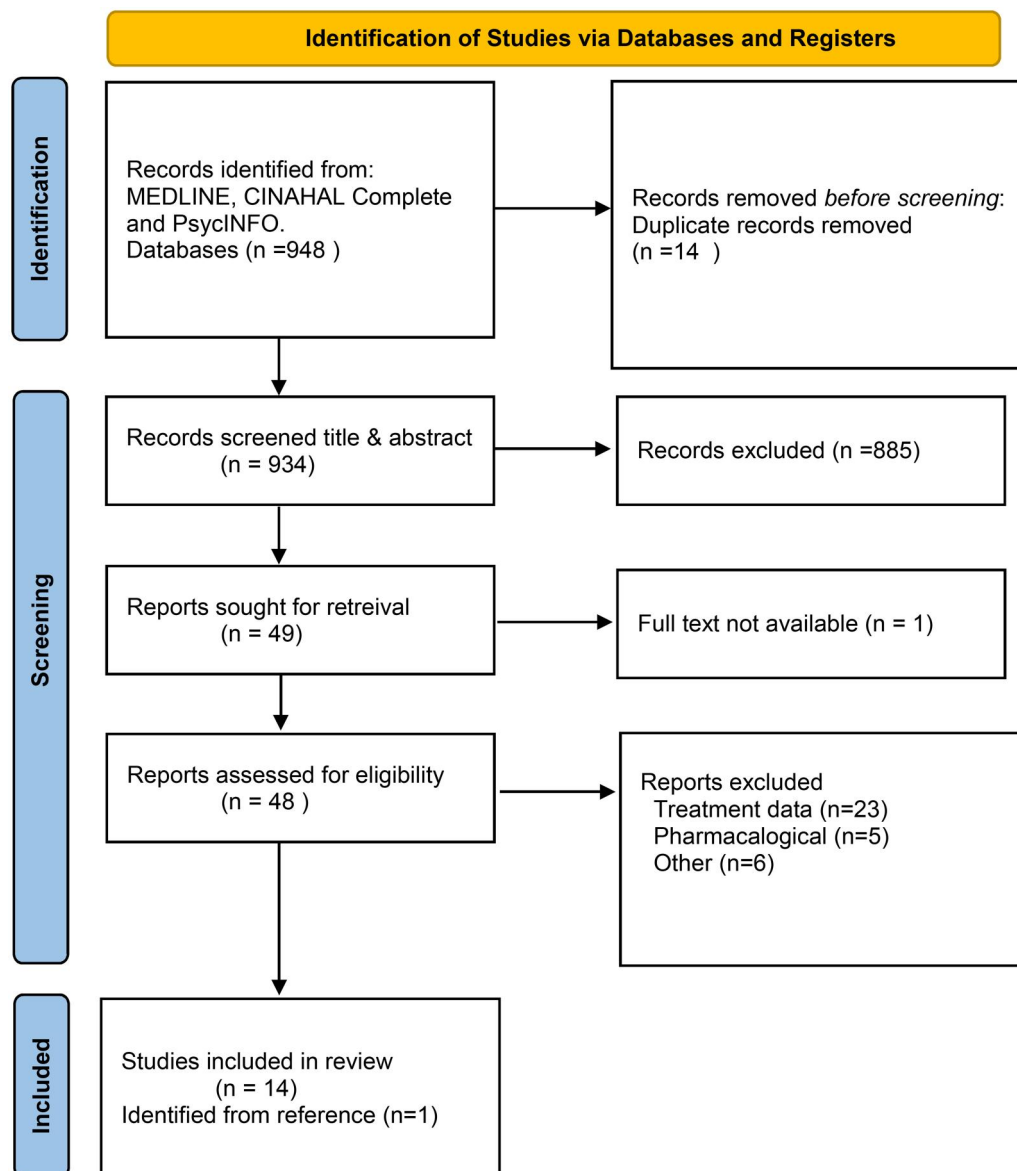


Figure 1. PRISMA flowchart for article inclusion.

Table 1. Paediatric misophonia treatment studies.

Author Year	Design	Sample size + gender + age	Misophonia measures	Misophonia change*	Treatment approach	Sessions
Petersen 2023	Case report	1 F 12 years	AMISO-S	50%	ACT	16
Zarotti 2022	Case report	1 F 16 years	AMISO-S	41%	DBT, ACT,	15
Cecilione 2022	Case report	1 F 12 years	MQ	42%	CBT	24
Dover 2023	Case report	1 F 10 years	AMISO-S MQ	70% (AMISO-S) 78% (MQ)	CBT	23
Schneider 2017	Case report	1 M 17 years	AMISO-S	57%	ACT, DBT	10
McGuire 2015	Case report	2 F 17 / 11 years	MQ	33% (case 1) 19% (case 2)	CBT	10-18

F: female; M: male; AMISO-S: Amsterdam Misophonia Scale; MQ: Misophonia Questionnaire; CBT: Cognitive Behavioural Therapy; DBT: Dialectical Behaviour Therapy; ACT: Acceptance and Commitment Therapy

*Misophonia change refers to the percent decrease in the misophonia severity from pre-treatment to post-treatment.

six of the studies. Only one study assessed for audiological comorbidities; hyperacusis was included using the Hyperacusis Questionnaire (Khalfa et al. 2002) and no evidence of hyperacusis was identified (Cecilione, Hitti, and Vrana 2022).

Three case studies used a mindfulness and acceptance-based approach, Acceptance and Commitment Therapy (ACT) and Dialectical Behavioural Therapy (DBT) (Schneider and Arch 2017; Zarotti, Tuthill, and Fisher 2022; Petersen and Twohig

Table 2. Adult misophonia treatment studies.

Author Year	Design	Sample size + gender + age	Misophonia Measures	Misophonia Change	Treatment approach	Sessions
Gregory 2024	Case series	19 F/M 17.6–51 years	MQ AMISO-S	38% (MQ) 40% (AMISO-S)	CBT	5–19
Gregory 2023	Case report	1 F 24 years	SFive	83%	CBT	5
Jager 2021	Case series	7 F/M 18–56 years	AMISOS-R CGI-I	28% had \geq 25% (AMISO-S) and CGI-I < 3	EMDR	1–4
Jager 2020 _b	RCT	54 F/M 18–70 years	AMISOS-R CGI-I	9.7 mean decrease (AMISO-S) 37% CBT, 0% wait list (CGI-I)	CBT	7
Vanaja 2020	Case report	1 F 26 years	AMISO-S	65%	Retraining	28
Altınöz 2018	Case report	1 F 18 years	AMISO-S	64%	CBT	6
Schröder 2017	Open trial	90 F/M 18–64 years	AMISO-S CGI-I	48% had \geq 30% (AMISO-S) and CGI-I < 3	CBT	8
Dozier _a 2015	SSD	1 F 48 years	MAQ	93%	Counter-conditioning	14
Dozier _b 2015	Case report	1 F 21 years	MAQ	75%	NRT	4–6

RCT: randomised controlled trial; SSD: single subject design; F: female; M: male; AMISO-S: Amsterdam Misophonia Scale; MQ: Misophonia Questionnaire; AMISOS-R: Revised Amsterdam Misophonia Scale; CGI-I: Clinical Global Impressions Improvement; MAQ: Misophonia Assessment Questionnaire; CBT: Cognitive Behavioural Therapy; EMDR: Eye Movement Desensitisation & Reprocessing Therapy; NRT: Neural Repatterning Technique.

2023). Two studies provided online treatment (Zarotti, Tuthill, and Fisher 2022; Petersen and Twohig 2023). Three case studies used Cognitive Behavioural Therapy (CBT) (McGuire, Wu and Storch 2015; Cecilione, Hitti, and Vrana 2022; Dover and McGuire 2023). One study used a family-based approach and found family accommodations decreased by 75% from a high level of accommodation at pre-treatment (Dover and McGuire 2023). One study measured treatment gains beyond post-treatment and improvements were maintained at six months (Schneider and Arch 2017).

Adult

The nine studies with adult participants used various research designs and different measures were used to assess severity, including AMISO-S, MQ, Amsterdam Misophonia Scale – Revised (AMISO-R), Misophonia Assessment Questionnaire (MAQ), and/or Selective Sound Sensitivity Syndrome Study (SFive), and some also used Clinical Global Impressions Improvement (CGI-I). Psychological comorbidities were assessed for in three studies and other medical comorbidities (i.e. migraine, irritable bowel, hyperthyroidism) were reported in one study. Two studies assessed for audiological comorbidities. Vanaja and Abigail (2020) used a retraining treatment and assessed hearing ability and findings were within normal limits with no evidence of hyperacusis based on measurement of loudness discomfort levels, although there was a previous diagnosis of hyperacusis by another clinic. Jager et al. (2020b) used a CBT treatment and self-report to assess hearing ability, tinnitus, and hyperacusis; three participants had previously been diagnosed with tinnitus and no other hearing problems were reported.

Open trial and randomized controlled trial (RCT)

The open trial (Schröder et al. 2017) and the RCT (Jager et al. 2020b) excluded individuals with significant comorbid conditions. The age of misophonia onset was 12.5 years (SD = 4.8) in the open trial, and was not reported in the RCT. At the end of treatment for the open trial, 48% met the criteria for response to treatment, defined as a 30% or greater reduction on the AMISO-S and a score of 1 or 2 (very much improved; much improved)

on the Clinical Global Impressions Improvement (CGI-I); no follow-up assessment was completed. For the RCT, the AMISO-R showed a large effect size ($d = 1.97$) in the treatment group compared to the wait list for the decrease in misophonia severity, and on the CGI-I, 37% of the treatment showed a clinical response for misophonia, compared to 0% in the wait list group, and these improvements maintained at the one-year follow-up.

Single subject design

This study used a multiple baseline design across trigger stimuli (Dozier 2015a). The participant experienced triggers from both auditory and visual stimuli for their misophonia and reported misophonia onset at age seven. The treatment was behavioural counterconditioning, a technique used for Post-Traumatic Stress Disorder (PTSD) and was delivered remotely. Misophonia severity decreased from a moderate to a mild level for auditory triggers based on the Misophonia Assessment Questionnaire (MAQ). This case treated single triggers in one context, and it is not clear if the treatment would be as effective if multiple triggers were present or if they occurred in different contexts.

Case series

In the study conducted by Jager et al. (2021), seven participants completed the treatment. The mean age of onset was 13 years (SD = 9.75), and individuals with significant comorbid conditions were excluded from participation. Participants received Eye Movement Desensitisation & Reprocessing Therapy (EMDR), which focused on misophonia memories that were emotionally disturbing. Number of sessions varied by the number of target memories for the person and ranged from one to four sessions. Two participants (28%) met the criteria for a full response to treatment, defined as a 25% or more reduction measured by the AMISOS-R and a CGI-I score of less than three. In the case series conducted by Gregory, Graham, and Hayes (2024) 19 consecutive cases were retrospectively reviewed for patients who completed CBT treatment. Session length and treatment components varied, and age of onset was not reported. The MQ and AMISO-S both had a large effect size for pre-treatment to follow-up changes, with Cohen's d of 1.63 and 1.55 respectively. Reliable improvement on the MQ was found for 78% of the

participants, and 61% were deemed to have clinically significant changes.

Case reports

Three different approaches to treatment were used, including retraining therapy with desensitisation and habituation (Vanaja and Abigail 2020), CBT (Altınöz, Ünal, and Tosun Altınöz 2018; Gregory and Foster 2023), and counterconditioning (Neural Repatterning Technique [NRT]) with treatments conducted independently using a smart phone app plus four sessions with the therapist (Dozier 2015b). The smart phone app treatment was developed based on a previous study by the same author (Dozier 2015a). Age of onset ranged from approximately six to 24 years. All cases reported decreased misophonia severity after treatment. One decreased from a severe to a mild level on the AMISO-S with results that maintained at three months follow-up (Vanaja and Abigail 2020). Another decreased from a moderate to a sub-clinical level at post-treatment (no follow-up assessment completed) on the AMISO-S (Altınöz, Ünal, and Tosun Altınöz 2018). In another, auditory triggers decreased from a severe to a mild level (visual triggers remained) on the MAQ and gains were maintained at the 12-month follow-up (Dozier 2015b). Gregory and Foster (2023) used the SFive to measure outcomes and described meaningful changes from one session to the next, and found scores decreased 83% from “significantly burdensome symptoms” at pre-treatment.

Discussion

The purpose of this scoping review was to identify and describe treatment research that used a behavioural approach to treat misophonia as the primary focus of treatment, and the audiological testing included in the research. Only three studies assessed for auditory conditions. One case report with an adult participant completed an audiological test battery finding pure tone thresholds within normal limits, excellent word recognition in quiet, and a determination of no hyperacusis (Vanaja and Abigail 2020). One case report with a paediatric participant assessed for hyperacusis with a negative finding (Cecilione, Hitti, and Vrana 2022). One randomized clinical trial (Jager et al. 2020b) completed auditory assessments but did not incorporate the auditory findings in the treatment process. How auditory comorbid conditions should be considered within misophonia treatment research is unknown. The gap in research represents an opportunity to expand the understanding of auditory co-morbidities in future misophonia treatment research.

The misophonia treatment research to date is limited. Two-thirds of the studies in this review were case reports. The retrospective nature of describing a single case has risk of bias from focusing on a single unusual case or outcome. It is not possible to determine a cause-effect relationship from the treatment and the results cannot be generalised to others. There was one RCT and outcomes were compared to individuals on a waiting list (no treatment) and evaluator bias may have influenced the clinical interview because they were aware of the treatment condition. Future studies are needed that include (a) independent evaluators, (b) an active control group to identify treatment factors associated with symptom reduction, including treatment type, duration, and delivery considerations, (c) identification of comorbid conditions (e.g. psychological and audiological), (d) inclusion of audiological testing and description of parameters used to define and characterise auditory considerations, and (e)

and more research with children and adolescents to inform practice protocols given gaps in protocol guidance for hyperacusis and tinnitus assessment.

Researchers have identified the need for comprehensive assessment that involves a team of professionals (Schröder et al. 2017; Palumbo et al. 2018; Ferrer-Torres and Giménez-Llort 2022), including audiologists (Aryal and Prabhu 2023b). Identification of comorbid conditions is needed to understand the issues influencing an individual's experience with misophonia and to inform treatment planning. Aryal and Prabhu (2023b) recommended including objective hearing assessment measures to support the evaluation and treatment process along with the subjective measures used to determine misophonia severity. Studies have reported co-occurrence of tinnitus and hyperacusis with misophonia (Siepsiak and Dragan 2019; Brennan et al. 2024), and Jastreboff and Jastreboff (2015) recommend treating hyperacusis first when it is present. There is a need to understand the complex relationships among auditory conditions and misophonia and to determine how they influence treatment. For example, in a sample of children with auditory processing disorders, 13% also had misophonia and these children were more likely to also have hyperacusis and/or tinnitus (Ahmmed and Vijayakumar 2024). There are critical practice implications related to the age of misophonia onset, timely initiation of treatment, and the need for interdisciplinary collaboration.

Although there is limited treatment research, the studies to date support the importance of timely assessment and management of misophonia. Most of the participants in this review reported childhood onset, as young as five years (e.g. Petersen and Twohig 2023), underscoring the need for validated assessment tools for the paediatric population. Importantly, studies described symptoms worsening and having additional triggers over time (e.g. Dozier 2015a), increasing risk for negative consequences such as isolation and emotional distress. These trends of childhood onset and increasing symptoms over time were also found in a large study of misophonia ($N=575$; onset age $M=13.17$ [$SD=7.37$]; Jager et al. 2020b). Family engagement in management can provide an important source of support as individuals learn effective coping strategies. One study with a paediatric patient used a family-based approach and family members learned to be adaptive rather than reactive, such as implementing catchphrases to help the child use coping strategies in daily life (Dover and McGuire 2023). In another study with a paediatric patient, the mother participated in the last ten minutes of each session to support homework engagement between sessions (Petersen and Twohig 2023), and one group treatment study included family and friends in one psychoeducation session (Jager et al. 2020b).

There are important clinical implications for promoting an interdisciplinary approach within practice. When audiology is the point of entry for care, there is the risk that consideration for psychological comorbid conditions may be overlooked, and treatment may not adequately take into consideration the influence of behavioural coping mechanisms on quality of life. For example, a narrow focus on sound attenuation (e.g. use of ear-plugs) to help an individual eat dinner with their family would limit sound tolerance and emotional adjustment to the distress by reinforcing avoidance of the trigger sounds (Lewin et al. 2021). Determining the balance for when and how to use strategies is important for longer-term management. Individuals suffering from misophonia seek services from audiologists. There is a need for clinical protocols in audiology to guide practice. Furthermore, comprehensive assessment and interdisciplinary

collaboration allow for an approach to treatment that can target the needs of each individual.

There are limitations to consider for the study, including the search focused on behaviour interventions provided for misophonia as the primary concern. Other research that treated misophonia as a secondary concern with another condition was not reviewed. This could have limited our understanding of how auditory co-morbidities have been considered in treatment research. Furthermore, only studies published in English were reviewed.

Conclusion

Misophonia treatment research is limited; however, the early research is promising and demonstrates people suffering from misophonia can experience improvement with treatment. There is an urgent need for research to identify treatment factors associated with symptom reduction to provide evidence-based guidance for evaluating and treating misophonia. Individuals with misophonia can have co-occurring conditions that would benefit from interdisciplinary coordination to address broader patient impacts in the treatment process.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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