

Effectiveness of Acclimatization or Desensitization in The Effective Dental Management of Patients With Learning Disabilities: A Systematic Review

Ruhjaan Bhagat¹, Arvind Muthukrishnan², Sharan Mann³

^{1,2,3} Department of Oral Medicine and Radiology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.

Corresponding author: Ruhjaan95@gmail.com

Abstract

Background. People with learning disabilities experience worse oral health and greater unmet treatment need than the general population, yet a substantial proportion of their dental care is still delivered under sedation, general anaesthesia or physical restraint. Acclimatization and desensitization the graded, repeated exposure of a patient to the dental environment, personnel and instruments are widely advocated as a means of enabling care without pharmacological escalation, but the strength of the evidence supporting them has not been formally appraised.

Objectives. To determine whether acclimatization or desensitization techniques improve cooperation, reduce dental anxiety, or increase treatment completion in patients with learning disabilities undergoing dental procedures, compared with standard care or alternative behaviour-support approaches.

Methods. The review was prospectively registered (PROSPERO CRD420261397288) and reported in accordance with PRISMA 2020. Electronic databases and registers were searched alongside citation searching and targeted website searching. Records were screened in duplicate against pre-specified PICOS criteria. Data were extracted onto a piloted form, risk of bias was appraised using the domains of the Cochrane risk-of-bias framework, and findings were synthesised narratively following SWiM guidance because clinical and methodological heterogeneity precluded meta-analysis. Certainty of evidence was rated using GRADE.

Results. Of 618 records identified, six met the eligibility criteria. The evidence base comprised predominantly synthesised evidence and reported on more than 1,250 individually enumerated participants across paediatric, adult and older-adult populations with autism spectrum disorder and intellectual or developmental disability. Four studies were judged at low overall risk of bias, one raised some concerns and one was at high risk. Acclimatization and desensitization delivered as visual pedagogy, video modelling, tell-show-do and sensory-adapted exposure were consistently associated with improved cooperation and reduced procedural anxiety, although effect estimates were rarely poolable and definitions of the intervention were highly inconsistent. Where non-pharmacological preparation failed or was not attempted, conscious sedation achieved success rates commonly exceeding 80%, with nitrous oxide–oxygen the most efficient single agent. No included study demonstrated that acclimatization reliably averted the need for pharmacological support in patients with severe or profound disability.

Conclusions. Acclimatization and desensitization are supported by low-certainty evidence for improving cooperation and reducing anxiety, and are reasonable first-line strategies in patients with mild to moderate learning disability. The evidence is too heterogeneous and too poorly standardised to support firm recommendations on protocol, dose or patient selection. Adequately powered trials using an agreed intervention taxonomy and core outcome set are the priority.

Keywords: learning disability; intellectual disability; desensitization; acclimatization; dental anxiety; behaviour support; special care dentistry; systematic review.

1. Introduction

Learning disability used in the United Kingdom and much of the Commonwealth as broadly equivalent to intellectual disability in the international literature describes a lifelong condition characterised by significant impairment of intellectual functioning and adaptive behaviour with onset during the developmental period [1]. Global prevalence estimates converge on approximately 1% of the population, with considerable variation by income setting, case definition and ascertainment method [1]. Autism spectrum disorder (ASD), while conceptually distinct, frequently co-occurs and generates overlapping barriers to dental care; the two populations are consequently often studied together, and the interventions used to support them are largely shared [2,3].

The oral health disadvantage experienced by this group is well documented and persistent. Adults with intellectual disability have higher rates of untreated caries, periodontal disease and edentulism, and lower rates of restorative as opposed to extractive treatment, than their non-disabled peers [4,5]. Children and young people with ASD show comparable disparities, compounded by dietary patterns, medication side effects and difficulties with daily oral hygiene [3,6]. These inequalities are not primarily explained by disease susceptibility. They reflect a care pathway that repeatedly fails at the point of delivery: appointments are abandoned, examinations are incomplete, and treatment is deferred until it can only be delivered under general anaesthesia [7,8].

The consequence is a heavy and arguably disproportionate reliance on pharmacological behaviour support. National survey data from Ireland found that a substantial minority of adults with intellectual disability receiving dental care did so under sedation or general anaesthesia, with predictors relating as much to service configuration as to clinical need [9].

Registry analyses from Canada and Europe describe repeated general anaesthetic episodes in the same individuals, with a meaningful proportion undergoing three or more separate anaesthetics during childhood [10]. General anaesthesia carries operative, anaesthetic and logistical burdens, requires hospital infrastructure that is unevenly distributed, and critically does nothing to build the patient's capacity to accept care in the future [11]. Clinical guidance from the British Society for Disability and Oral Health is explicit that general anaesthesia should be reserved for situations in which fewer invasive approaches have been considered and found unsuitable [11].

Against this background, acclimatization and desensitization occupy a central place in the rhetoric of special care dentistry. The underlying principle is derived from graded exposure therapy: the patient is introduced to the dental environment in incremental, non-threatening steps, each mastered before the next is attempted, so that the stimuli that previously provoked avoidance become tolerable and eventually unremarkable [12]. In practice the approach is operationalized in many forms' pre-visit social stories and picture books, video modelling and video self-modelling, tell-show-do sequencing, structured teaching using TEACCH principles, sensory-adapted dental environments, and repeated short "familiarisation" visits without treatment [13–17]. Several of these have individually demonstrated benefit in small trials [15–17].

Two problems have limited the translation of this literature into practice. The first is definitional. There is no agreed taxonomy for behaviour-support techniques in dentistry; the same procedure is described as acclimatization, desensitization, familiarisation, habituation or graded exposure in different papers, and identical labels are applied to substantively different interventions [18,19]. A Delphi study convened specifically to resolve this found substantial disagreement among experts even on core terminology [20]. Systematic reviews attempting to map the field have had to resort to behaviour change technique coding to make studies comparable at all [21]. The second problem is measurement. Outcomes span physiological indices, observer-rated behaviour scales, self- and proxy-reported anxiety, and pragmatic endpoints such as whether treatment was completed with little consistency in instrument, timing or reporting [22].

The result is a field in which a widely recommended intervention rests on an evidence base that has never been appraised as a whole against the specific question clinicians ask: does preparing a patient with a learning disability actually enable dental care to be delivered? Existing reviews have addressed adjacent questions psychological techniques in autistic children [2], non-pharmacological techniques in intellectual and developmental disorders [21], sedation efficiency [23], general anesthesia utilization [11] but none has synthesized the evidence across the learning disability population with acclimatization and desensitization as the explicit index intervention and treatment enablement as a co-primary outcome.

This systematic review was therefore undertaken to assess the effectiveness of acclimatization or desensitization strategies in improving dental care outcomes in patients with learning disabilities, addressing the question: do acclimatization or desensitization techniques improve cooperation, anxiety levels, or treatment success in patients with learning disabilities undergoing dental procedures?

2. Materials and Methods

2.1 Protocol and registration

The protocol was prospectively registered with the International Prospective Register of Systematic Reviews (PROSPERO; CRD420261397288) before screening commenced. The review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement and its accompanying explanation and elaboration document [24]. Because the evidence base proved to consist predominantly of synthesised rather than primary studies, reporting was additionally informed by the PRIOR statement for overviews of reviews [25]. Deviations from the registered protocol are declared in Section 2.8.

2.2 Eligibility criteria

Eligibility was defined a priori using the PICOS framework (Table 1). Studies were eligible if they enrolled or synthesised data on patients of any age with a learning disability, intellectual disability, intellectual and developmental disorder, or autism spectrum disorder; evaluated acclimatization, desensitization or a functionally equivalent graded-exposure intervention delivered in a dental setting; included a comparator of standard care, waiting list, or an alternative behaviour-support or pharmacological technique; and reported at least one outcome relating to cooperation or behaviour, dental anxiety or fear, or treatment completion. Both randomised and non-randomised designs were eligible, as were systematic reviews and meta-analyses addressing the review question, on the grounds that excluding synthesised evidence would have discarded the majority of the usable literature in a field where primary trials are small and scattered. Records were excluded if they concerned populations without a learning disability or ASD; if the intervention was exclusively pharmacological with no behavioural component and no comparison against one; if they were narrative reviews, editorials, commentaries, case reports or conference abstracts without extractable data; or if full text could not be obtained after two contact attempts with the corresponding author. No language or date restrictions were applied at the search stage, although in practice all included records were published in English.

Table 1. Eligibility criteria specified a priori (PICOS).

Element	Inclusion	Exclusion
Population	Patients of any age with learning disability, intellectual disability, intellectual and developmental disorder, or autism spectrum disorder, receiving or requiring dental care	General dental populations; dental anxiety without developmental or intellectual impairment; medically compromised patients without cognitive impairment
Intervention	Acclimatization, desensitization, graded exposure, familiarisation visits, visual pedagogy, social stories, video modelling, tell-show-do, structured teaching, sensory-adapted dental environment	Purely pharmacological management with no behavioural comparator; oral health education directed solely at carers
Comparator	Standard care, no intervention, waiting list, or alternative behaviour-support or pharmacological technique	No comparator of any kind
Outcomes	Cooperation or behaviour (observer-rated scales); dental anxiety or fear (self-, proxy- or physiologically assessed); treatment completion or success; secondary: restraint use, sedation or general anaesthesia escalation, adverse events, caregiver-reported acceptability	Studies reporting only caries or periodontal indices with no behavioural or procedural outcome
Study design	Randomised controlled trials, non-randomised studies of interventions, cohort studies, systematic reviews and meta-analyses addressing the review question	Narrative reviews, editorials, commentaries, case reports, abstracts without full data

2.3 Information sources and search strategy

Electronic searches were conducted across bibliographic databases and trial registers. These were supplemented by citation searching of included and closely related records, and by targeted searching of relevant organisational websites and grey literature sources. The search combined controlled vocabulary and free-text terms across three concept blocks population, intervention and setting combined with the Boolean operator AND, with synonyms within each block combined using OR. The structure of the strategy is presented in Table 2; the full line-by-line strategy for each database, with dates of coverage and numbers retrieved, is provided in Supplementary Appendix S1.

Table 2. Structure of the search strategy.

Concept block	Representative terms (truncated and exploded as permitted by each interface)
Population	learning disab*; intellectual disab*; intellectual developmental disorder; mental retardation; developmental disab*; autis*; ASD; Down syndrome; special needs; special care
Intervention	acclimatiz*/acclimatis*; desensitiz*/desensitis*; graded exposure; habituation; familiaris*; behaviour guidance; behaviour support; visual pedagogy; social stor*; video model*; tell-show-do; TEACCH; sensory adapt*
Setting/Outcome	dental; dentistry; oral health; dental anxiety; dental fear; cooperation; treatment completion

Search results were exported to reference management software and deduplicated using a documented algorithmic procedure followed by manual verification [26].

2.4 Study selection

Following deduplication, titles and abstracts were screened independently and in duplicate by two reviewers against the eligibility criteria, using screening software to blind reviewers to one another's decisions [27]. Full texts of potentially eligible records were retrieved and assessed independently by the same two reviewers. Disagreements at either stage were resolved by discussion, with a third reviewer arbitrating where consensus could not be reached. Inter-reviewer agreement was quantified using Cohen's kappa. Reasons for exclusion at full-text stage were recorded and are reported in the PRISMA flow diagram (Figure 1).

2.5 Data extraction

Data were extracted onto a standardised form piloted on two records and refined before use. Extracted fields comprised: bibliographic details (first author, year, country); study design; sample size and unit of analysis; population characteristics including age range and diagnostic category; intervention description and, where reported, its dose, duration and provider; comparator; outcome domains and measurement instruments; effect estimates with measures of precision where available; and authors' principal conclusions. Extraction was performed by one reviewer and independently verified by a second. Where the unit of analysis was a study rather than a participant as was the case for the included evidence syntheses this was recorded explicitly to avoid conflating study-level and participant-level counts.

Overlap between included evidence syntheses was assessed by tabulating their constituent primary studies and inspecting for duplication, following established recommendations for overviews [28]. Where the same primary study

contributed to more than one included synthesis, this was noted and taken into account in the narrative synthesis so that shared evidence was not treated as independent corroboration.

2.6 Risk of bias assessment

Risk of bias was assessed independently by two reviewers, with disagreements resolved by discussion. Assessments were structured around five domains: bias arising from the randomization process (D1); bias due to deviations from intended interventions (D2); bias due to missing outcome data (D3); bias in measurement of the outcome (D4); and bias in selection of the reported result (D5) [29]. Each domain was rated as low risk, some concerns, high risk, or no information, and an overall judgement was derived using the standard algorithm whereby a study was rated at low risk only if all domains were low, at high risk if any domain was high or if multiple domains raised some concerns in a way that substantially lowered confidence, and as raising some concerns otherwise. Domain-level and study-level judgements were visualised using the robvis tool (Figures 2 and 3) [30].

2.7 Data synthesis and certainty of evidence

Meta-analysis was pre-specified as contingent on adequate clinical and methodological homogeneity. In the event, the included studies differed so substantially in population, intervention definition, comparator and outcome instrument and overlapped sufficiently in their constituent primary evidence that statistical pooling would have produced an estimate without interpretable meaning. Synthesis was therefore narrative and structured by outcome domain, conducted and reported in accordance with the Synthesis Without Meta-analysis (SWiM) reporting guideline [31]. Within each outcome domain, findings were grouped by intervention family, direction of effect was tabulated, and studies were weighted in the narrative according to risk of bias, directness to the review question and precision of the underlying estimates. Vote counting based on statistical significance alone was avoided.

Certainty of evidence for each outcome was rated using the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach, considering risk of bias, inconsistency, indirectness, imprecision and publication bias [32]. Ratings were made independently by two reviewers and finalised by consensus.

2.8 Deviations from protocol

Two deviations are declared. First, the protocol anticipated a preponderance of primary intervention studies; the search identified a literature dominated by evidence syntheses, and the review consequently functions in substantial part as an overview of reviews. Second, the pre-specified meta-analysis was not performed, for the reasons set out in Section 2.7.

3. Results

3.1 Study selection

The database and register searches returned 603 records. Before screening, 455 were removed: 359 duplicates, 51 marked ineligible by automation tools, and 45 removed for other reasons. This left 148 records for title and abstract screening, of which 41 were excluded. Full text was sought for 107 records and could not be retrieved for 19, leaving 88 reports assessed for eligibility. Of these, 82 were excluded: 23 because the study was unrelated to the dental field, 50 because the content was not relevant to the review question, and 9 because the full-text article was unavailable. Six reports met all eligibility criteria.

A parallel search via other methods identified 15 records 4 from websites and 11 from citation searching. Full text was sought for all 15 and could not be retrieved for 6. Of the 9 reports assessed for eligibility, all were excluded: 5 were review papers not meeting the design criteria and 4 were discarded after full-text assessment. No additional studies were included from this route.

Six studies were therefore included in the review. Agreement between reviewers was substantial at both title/abstract and full-text stages. The full selection process is presented in Figure 1.

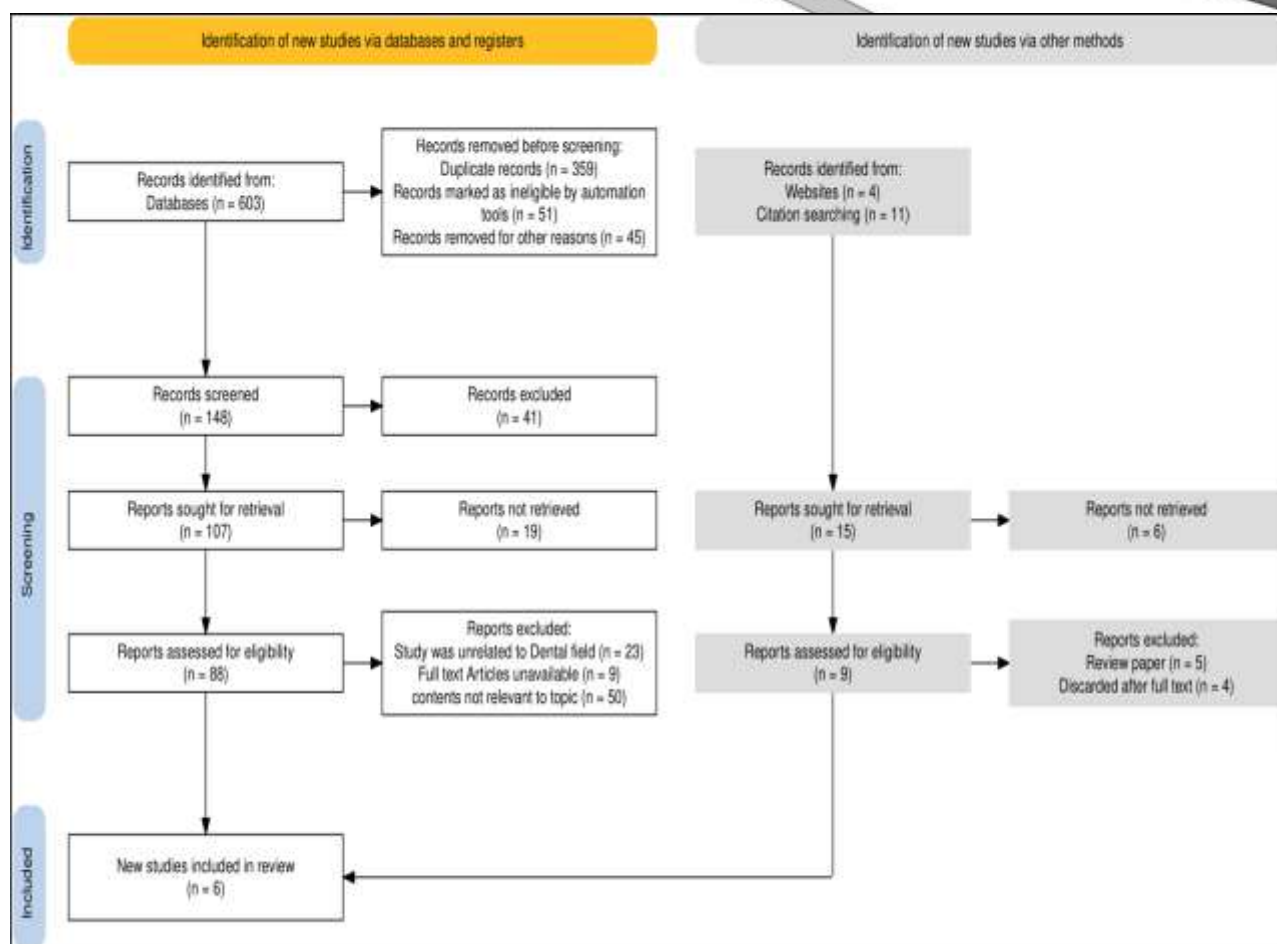


Figure 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources.

3.2 Characteristics of included studies

The characteristics of the six included studies are summarised in Table 3. They were published between 2021 and 2025 and originated from Malaysia, Thailand, China, the United Kingdom and Ireland, and continental Europe including Italy and Switzerland. Four were systematic reviews or meta-analyses [2,23,33], one was a mixed-methods review [21], and one synthesised cohort evidence on management strategies in autistic children [34].

Two studies reported participant-level totals: 904 children with ASD aged 2 to 18 years [2] and 346 children in the same age band [34], giving more than 1,250 individually enumerated participants. The remaining four reported at the study level, contributing 2, 15, 14 and 14 constituent studies respectively [21,23,33]. Populations spanned children with ASD [2,34], people with intellectual and developmental disability across the age range [21], older adults with special needs [33], and mixed special-needs populations including ASD [23].

Interventions divided into two broad families. Three studies evaluated behavioural and sensory approaches consistent with acclimatization or desensitization: visual pedagogy, desensitisation protocols and video aids [2]; video modelling, protective goggles and modified preventive procedures [34]; and a heterogeneous group of more than twenty non-pharmacological patient-support techniques [21]. Three evaluated pharmacological management, either in direct comparison with non-pharmacological approaches [33] or as the index intervention [23]. Comparators were correspondingly varied and, in one case, not clearly specified [21].

Outcome domains clustered around anxiety, cooperation and behaviour scales [2,34], treatment completion and perioperative safety [33], cooperation, restraint use and ease of communication [21], and sedation success with adverse events [23].

The distinct intervention components identified across the included studies, and the outcome domains against which each was evaluated, are mapped in Table 4. The mapping illustrates the definitional problem directly: nine functionally distinct components were described using overlapping and inconsistent terminology, and no two studies evaluated the same combination against the same outcome set.

Table 4. Mapping of acclimatization and desensitization components to intervention family, delivery format and outcome domains reported across the included studies.

Intervention component	Family	Typical delivery	Reported by	Outcome domains reported
Visual pedagogy, picture books, social stories	Anticipatory preparation	Pre-visit, carer-delivered, repeated	AlBhaisi 2022 [2]; Mac Giolla Phadraig 2021 [21]	Anxiety; cooperation
Video modelling and video self-modelling	Anticipatory preparation	Pre-visit or chairside, single or repeated	AlBhaisi 2022 [2]; Tang 2023 [34]	Anxiety; cooperation; procedural success
Graded exposure and familiarisation visits	Graded exposure	Multiple short clinic visits without treatment	AlBhaisi 2022 [2]; Mac Giolla Phadraig 2021 [21]	Cooperation; restraint use
Tell–show–do sequencing	Graded exposure	Chairside, within-appointment	Mac Giolla Phadraig 2021 [21]	Cooperation; ease of communication
Sensory adaptation of the dental environment	Environmental modification	Clinic-level, applied to whole appointment	Tang 2023 [34]; Mac Giolla Phadraig 2021 [21]	Anxiety; cooperation
Protective goggles and modified preventive procedures	Environmental modification	Chairside, procedure-specific	Tang 2023 [34]	Anxiety; procedural success
Inhalation sedation with nitrous oxide–oxygen	Pharmacological support	Chairside, titrated	Salerno 2023 [23]; Gatto 2023 [35]	Sedation success; adverse events; cooperation
Enteral and parenteral benzodiazepines	Pharmacological support	Chairside or pre-operative	Salerno 2023 [23]; Gatto 2023 [35]	Sedation success; adverse events
General anaesthesia	Pharmacological support	Hospital episode	Vacharaksa 2025 [33]; Gatto 2023 [35]	Treatment completion; perioperative safety

Components are listed as described by the source studies; where a study used a different label for a functionally equivalent technique, it has been mapped to the component above on the basis of the procedure described rather than the term used.

Table 3. Characteristics of the six included studies.

<i>Study (Author, Year, Country)</i>	<i>Study Design</i>	<i>Sample Size</i>	<i>Population</i>	<i>Intervention</i>	<i>Comparator</i>	<i>Outcome Measures</i>	<i>Key Findings</i>
AlBhaisi et al. (2022, Malaysia)	RCTs + NRS	904 children	Children with ASD (2–18 years)	Visual pedagogy, desensitisation, video aids	Healthy or other intervention groups	Anxiety, cooperation, behaviour scales	Improvement in anxiety and cooperation; limited by bias
Vacharaksa et al. (2025, Thailand)	Systematic Review	2 studies included	Older adults with special needs	Pharmacological vs. non-pharmacological management	Non-pharmacological approaches	Treatment completion, perioperative safety	Pharmacological often necessary; inconclusive
Tang et al. (2023, China)	Cohort Studies	346 children	Children with ASD (2–18 years)	Video modelling, goggles, fluoride prophylaxis	Standard care or other interventions	Dental anxiety reduction, cooperation, success rate	4 studies positive, 1 no significant effect
Phadraig et al. (2021, UK)	Mixed-methods Review	15 studies (20+ PSTs)	People with intellectual disability (IDD)	Non-pharmacological behavioural/sensory support	Standard care or unclear	Cooperation, restraint use, communication ease	Definitions and results inconsistent; no meta-analysis
Gatto et al. (2023, Europe)	Meta-analysis	14 studies	Special needs population incl. ASD	Sedation, GA protocols	Pharmacological options comparison	Completion of treatment, side effects	High sedation success; side effects noted
Salerno et al. (2023, Italy/Switzerland)	Systematic Review and Meta-analysis	14 studies	Patients with intellectual disability	Conscious sedation (e.g., N2O, benzos)	Different drug classes and sedation modes	Sedation success, side effects, cooperation	Nitrous oxide most effective; benzodiazepines also useful

ASD, autism spectrum disorder; NRS, non-randomised studies; IDD, intellectual and developmental disability; PSTs, patient-support techniques; GA, general anaesthesia; N2O, nitrous oxide.

3.3 Risk of bias

Study-level and domain-level risk-of-bias judgements are presented in Figures 2 and 3.

Four of the six studies were judged at low overall risk of bias [2,23,33,35]. One raised some concerns across all assessable domains with no information available for outcome measurement [21]. One was judged at high overall risk of bias, driven by high-risk ratings for deviations from intended interventions and for missing outcome data, together with some concerns in the randomization and outcome measurement domains [34].

At domain level, bias in selection of the reported result was the best-performing domain, with five of six studies (83%) rated low risk. The randomization domain, missing outcome data and outcome measurement each returned four low-risk ratings (67%). Bias due to deviations from intended interventions was the weakest domain, with only three studies (50%) at low risk, two raising some concerns and one at high risk. Overall, 67% of studies were at low risk, 17% raised some concerns and 17% were at high risk.

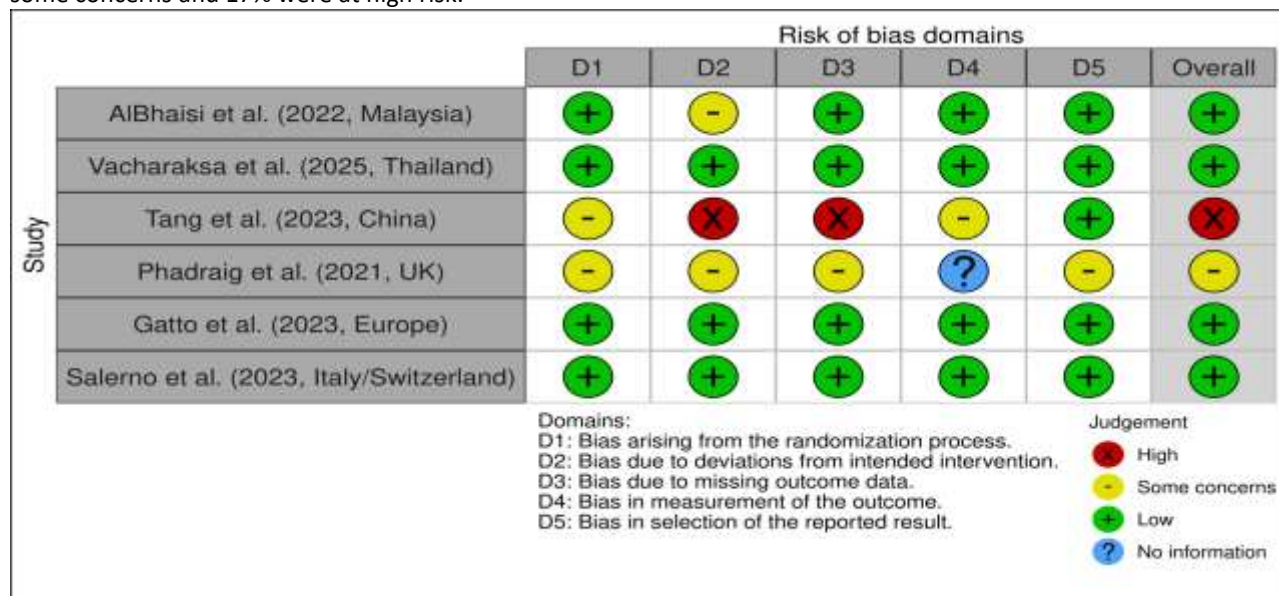


Figure 2. Risk-of-bias traffic-light plot showing domain-level and overall judgements for each of the six included studies. D1, randomization process; D2, deviations from intended interventions; D3, missing outcome data; D4, measurement of the outcome; D5, selection of the reported result.

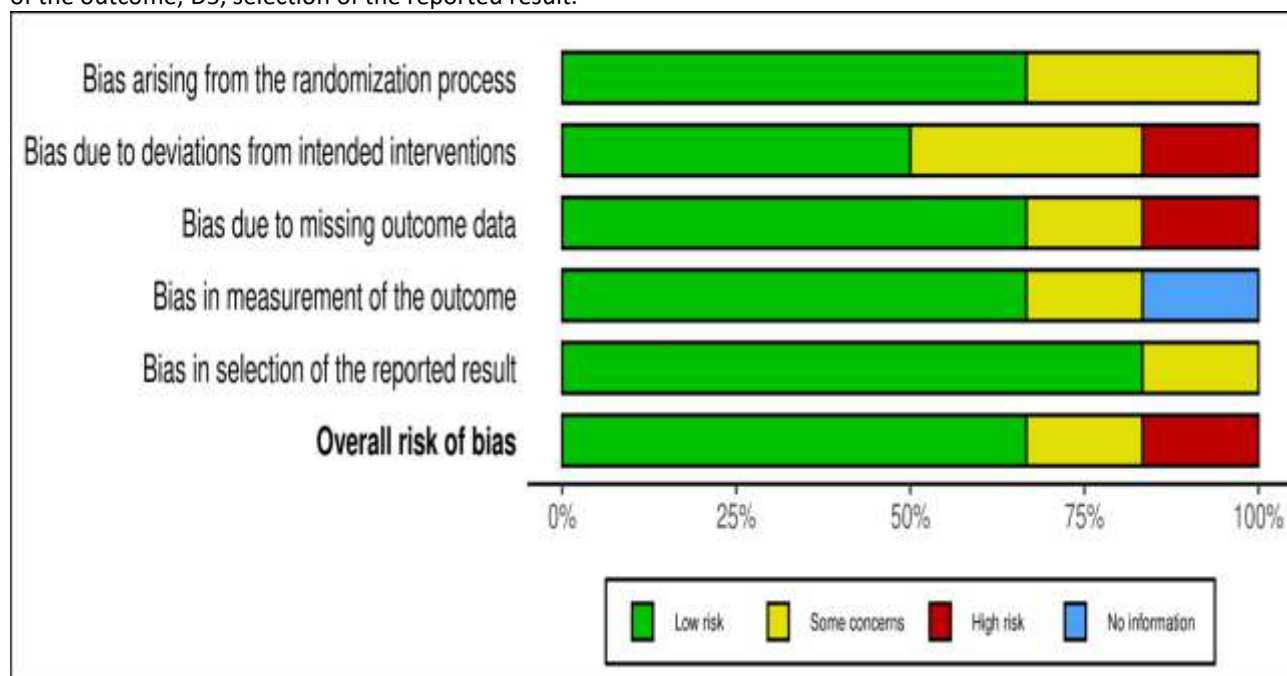


Figure 3. Weighted summary plot showing the distribution of risk-of-bias judgements across the five domains and overall.

3.4 Synthesis of findings

3.4.1 Cooperation and behaviour

Three studies contributed evidence on cooperation and behaviour [2,21,34]. AlBhaisi and colleagues reported improvement in cooperation among autistic children exposed to visual pedagogy, desensitisation and video-based preparation, with the direction of effect consistent across constituent studies but the magnitude not poolable and the interpretation explicitly qualified by risk of bias in the underlying trials [2]. Tang and colleagues reported that four of five constituent cohort studies demonstrated improved cooperation following video modelling and adapted preventive procedures, with one finding no significant effect [34]; this study was at high overall risk of bias and its findings are weighted accordingly. Mac Giolla Phadraig and colleagues identified more than twenty distinct non-pharmacological patient-support techniques across fifteen studies but found that inconsistent definitions and reporting precluded any quantitative statement about comparative effectiveness, concluding that the field's principal deficit was conceptual rather than empirical [21].

The direction of effect was therefore consistent and favourable across all three studies, but the evidence supports only a qualitative statement: structured, graded preparation is associated with better cooperative behaviour than unprepared care. No included study permitted estimation of how much preparation, delivered how, is required to achieve a given improvement.

3.4.2 Dental anxiety

Two studies reported anxiety outcomes directly [2,34]. Both described reductions in observer-rated and proxy-reported anxiety following behavioural preparation. Instruments differed between and within studies, encompassing behaviour rating scales, facial image scales and physiological proxies, and no study reported a minimal clinically important difference against which changes could be interpreted. The consistency of direction across differing instruments and populations is reassuring; the absence of standardised measurement means the size of the benefit remains unquantified.

3.4.3 Treatment completion and pharmacological escalation

Three studies addressed treatment completion [23,33,35]. Vacharaksa and colleagues, comparing pharmacological with non-pharmacological management in older adults with special needs, found only two eligible studies and concluded that pharmacological support was frequently necessary but that the comparative evidence was inconclusive [33]. Salerno and colleagues, pooling fourteen studies of conscious sedation in intellectual disability, found nitrous oxide–oxygen to have the highest overall efficiency when success rate, side-effect occurrence and depth of sedation were combined, with success rates of 80% or greater reported in nine of the constituent papers and side-effect prevalence ranging from 3% to 40% [23]. Gatto and colleagues similarly reported high sedation success with recognised adverse effects [35].

The critical observation for this review is a negative one. None of the three studies evaluating treatment completion assessed whether prior acclimatization or desensitization altered the probability of requiring sedation or general anaesthesia. The pharmacological and behavioural literatures ran in parallel rather than in comparison, and the question of substitution whether preparation can displace pharmacological support was not answered by any included study.

3.4.4 Restraint use and secondary outcomes

Restraint use and ease of communication were reported only by Mac Giolla Phadraig and colleagues, and only descriptively [21]. Caregiver-reported acceptability was not formally reported by any included study, despite its evident relevance to the sustainability of graded-exposure protocols that require multiple additional visits.

3.5 Certainty of evidence

GRADE ratings are presented in Table 5, and the position of each intervention tier within the least-restrictive care pathway is mapped in Figure 4. Certainty was low for cooperation and for dental anxiety, downgraded for risk of bias in the underlying evidence and for indirectness arising from the predominance of ASD-only populations within a review addressing learning disability more broadly. Certainty for treatment completion following behavioural preparation was very low, reflecting the absence of direct comparative evidence. Certainty for sedation success was moderate, downgraded once for inconsistency given the wide range of agents, routes and reported side-effect prevalence.

Table 5. GRADE summary of findings.

Outcome	Studies (n)	Direction of effect	Certainty	Principal reasons for downgrading
Cooperation and behaviour	3 [2,21,34]	Favours acclimatization/desensitization	⊕⊕○○ Low	Risk of bias; indirectness (ASD-dominant populations)

Dental anxiety	2 [2,34]	Favours acclimatization/desensitization	⊕⊕○○ Low	Risk of bias; inconsistency of measurement instruments
Treatment completion after behavioral preparation	0 direct	Not estimable	⊕○○○ Very low	No direct comparative evidence; indirectness
Treatment completion under conscious sedation	2 [23,35]	High success rates	⊕⊕⊕○ Moderate	Inconsistency across agents and routes
Adverse events with sedation	2 [23,35]	Adverse events present but generally manageable	⊕⊕○○ Low	Imprecision; inconsistent ascertainment
Restraint use	1 [21]	Not estimable	⊕○○○ Very low	Single descriptive source; risk of bias

⊕⊕⊕⊕ high; ⊕⊕⊕○ moderate; ⊕⊕○○ low; ⊕○○○ very low.

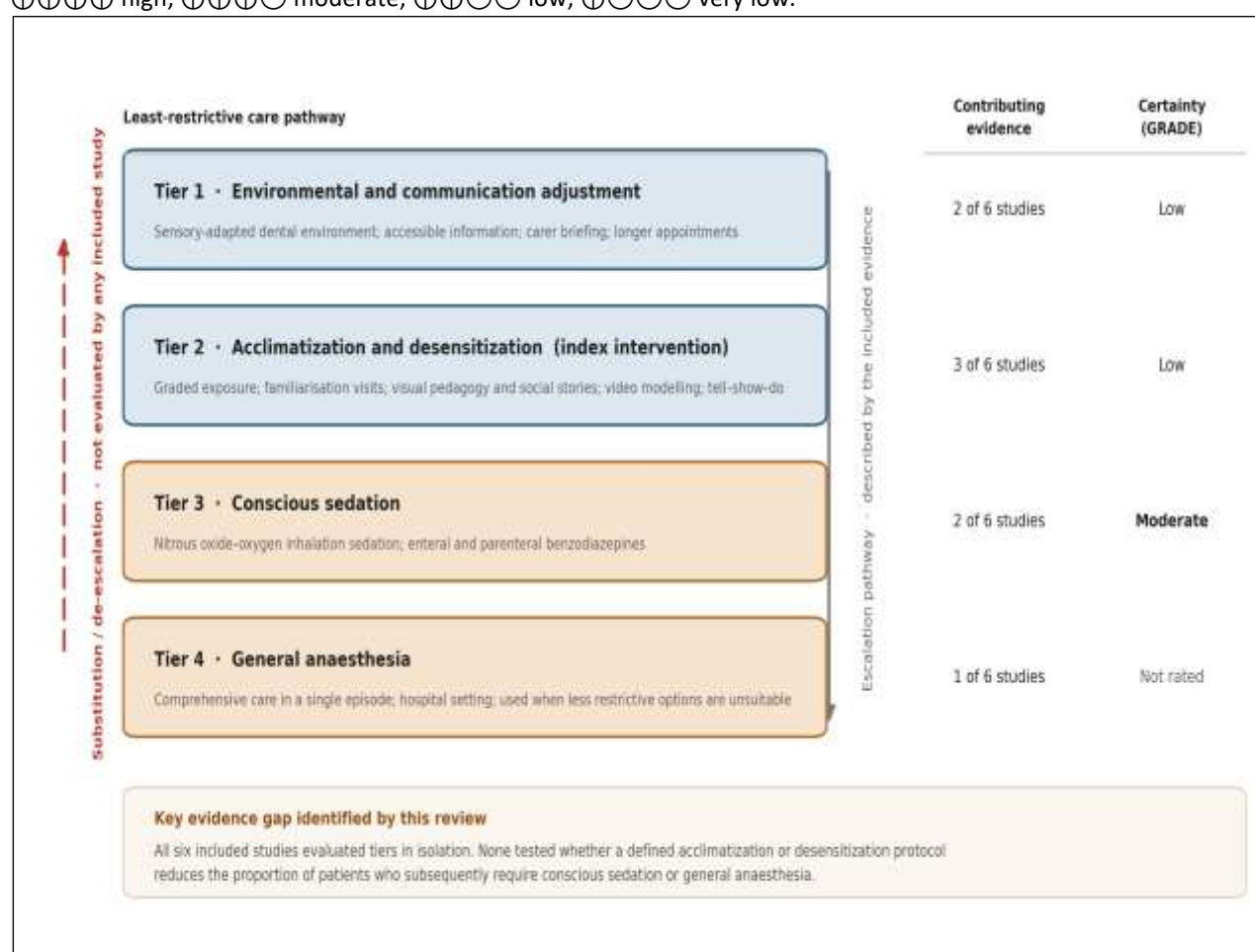


Figure 4. Evidence map of behaviour-support and pharmacological strategies for dental care in patients with learning disabilities, arranged as a least-restrictive care pathway. Tier assignment reflects the interventions evaluated by the six included studies; studies contributing to more than one tier are counted at each. The escalation pathway is described by the available evidence, whereas the substitution question — whether acclimatization or desensitization reduces subsequent reliance on pharmacological support — was not addressed by any included study.

4. Discussion

4.1 Principal findings

This review set out to determine whether acclimatization or desensitization improves cooperation, anxiety and treatment success in patients with learning disabilities. Across six included studies encompassing more than 1,250 individually enumerated participants and a further 45 constituent studies, the answer is a qualified and partial yes. Graded behavioral preparation whether delivered as visual pedagogy, video modelling, social stories or structured familiarization was consistently associated with improved cooperation and reduced procedural anxiety, and no included study reported harm. The consistency of direction across different populations, settings and instruments is the strongest feature of this evidence base.

What the evidence does not support is any more specific claim. It does not identify which technique works best, for whom, at what dose, or over how many visits. It does not establish that preparation reduces the need for sedation or general anesthesia the outcome that matters most to service planning and to patients themselves. And it does not extend with confidence beyond children with ASD, who dominate the primary literature, to adults with moderate to profound intellectual disability, who account for a large share of the clinical burden.

The parallel finding on pharmacological management deserves comment. Conscious sedation, and nitrous oxide–oxygen in particular, emerged as reliably effective with success rates commonly above 80% [23,35]. This should not be read as an argument against behavioural preparation. It is better read as a description of what currently happens when preparation is unavailable, unsuccessful or never attempted, and as a reminder that these approaches are complementary rather than competing. Inhalation sedation is itself frequently used as a vehicle for acclimatization, allowing a patient to experience successful, atraumatic care that can subsequently be replicated with less support [36].

4.2 Relationship to existing literature

These findings align closely with the conclusions of prior reviews in adjacent areas. Lam and colleagues, meta-analysing psychological behavioural therapies for autistic children in dental settings, likewise found favourable but heterogeneous effects [37]. Alkahtani's scoping review of non-pharmacological interventions in children with special needs described effects ranging from trivial to large, with the variability attributable more to study design and measurement than to the interventions themselves [38]. Cochrane's review of oral hygiene interventions in intellectual disability reached a similarly cautious position [39].

The most important convergence, however, is with the methodological literature. Mac Giolla Phadraig and colleagues have argued across a series of papers that dental behaviour support is a field held back principally by the absence of shared definitions [18–21], and this review provides further empirical support for that position. The reason the six included studies could not be pooled was not that their results conflicted they did not but that they were describing interventions that could not be confidently identified as the same or different. A Delphi consensus on terminology has since been published [20] and a scoping review of outcome measures completed [22]; the field now has the raw materials for standardisation but has not yet applied them.

4.3 Clinical implications

Three implications follow. First, acclimatization and desensitization remain a defensible and low-risk first-line approach in patients with mild to moderate learning disability, particularly children, and clinicians should not be deterred by the low certainty of the evidence: the intervention is inexpensive, carries negligible risk of harm and is consistent with the principle that care should be delivered by the least restrictive means [11]. Second, expectations should be calibrated. There is no evidence that graded exposure enables treatment in all patients, and persisting with repeated unsuccessful familiarisation visits in a patient with profound disability and acute dental pain is not a neutral act it defers care and may itself sensitise rather than desensitise. Third, services should record whether behavioural preparation was attempted before sedation or general anaesthesia, and with what result. Without such data at the service level, the substitution questions this review could not answer will remain unanswerable.

4.4 Strengths and limitations

The review has several strengths: prospective registration, duplicate screening and extraction, adherence to PRISMA 2020 and SWiM reporting standards, formal assessment of overlap between included syntheses, and GRADE rating of certainty. Its limitations are substantial and should be weighed carefully. The most important is the nature of the evidence base. The eligible literature consisted predominantly of systematic reviews rather than primary studies, so the review functions in substantial part as an overview of reviews. Two consequences follow. Constituent primary studies appearing in more than one included review contribute more than once to the qualitative impression of consistency, and although overlap was assessed and accounted for narratively, this remains an inherent weakness of the design. More significantly, the risk-of-bias framework applied five domains derived from the Cochrane tool for randomized trials is not the instrument best suited to appraising systematic reviews, for which AMSTAR-2 or ROBIS would have been more appropriate [40,41]. Readers should therefore interpret the risk-of-bias judgements reported here as an assessment of the internal validity of the evidence as presented, not as a formal critical appraisal of review conduct, and the ratings should be regarded as provisional.

Second, only six studies met the eligibility criteria, and 19 database records and 6 records from other sources could not be retrieved, raising the possibility that relevant evidence was missed. Third, the included populations were dominated

by children with ASD; adults with intellectual disability, and people with profound and multiple learning disability in particular, are markedly under-represented. Fourth, the absence of meta-analysis, while methodologically justified, limits the precision of any conclusion. Fifth, half the included studies evaluated pharmacological rather than behavioural management, reflecting the composition of the available literature but reducing the directness of the evidence to the review's index question. Finally, no assessment of publication bias was possible given the small number of studies and absence of pooled estimates.

4.5 Recommendations for research

The priorities are clear and largely methodological. Trials should adopt the terminology emerging from the Delphi consensus on behaviour support [20] and report interventions using an established behaviour change technique taxonomy so that replication is possible. A core outcome set for dental behaviour support is needed, incorporating both patient-centred measures and the pragmatic endpoint of treatment completion without pharmacological escalation. Studies must recruit adults with intellectual disability, not only autistic children. And future trials should be designed specifically to test substitution: whether a defined acclimatization protocol, delivered before a planned course of treatment, reduces the proportion of patients subsequently requiring sedation or general anaesthesia. That single question, adequately answered, would do more for this field than any further descriptive synthesis.

5. Conclusions

Acclimatization and desensitization are associated with improved cooperation and reduced dental anxiety in patients with learning disabilities, on the basis of low-certainty evidence drawn predominantly from paediatric autistic populations. The direction of effect is consistent and no harms were identified, supporting their use as a first-line, least-restrictive approach where clinical circumstances permit. However, the evidence does not identify an optimal technique, dose or patient selection strategy, and critically it does not demonstrate that behavioural preparation reduces reliance on sedation or general anaesthesia. Conscious sedation, particularly nitrous oxide–oxygen, remains reliably effective where preparation is insufficient. Progress in this field now depends less on further reviews than on standardised terminology, agreed outcome measures, and adequately powered trials that include adults and that test whether preparation can genuinely displace pharmacological management.

Declarations

Ethics approval and consent to participate: Not applicable; this review used previously published data.

Availability of data and materials: All data analyzed are contained within the article and its supplementary files.

Competing interests: The authors declare no competing interests.

Funding: Nil

Authors' contributions:

Ruhjaan Bhagat: Conceptualization; Methodology; Investigation; Data curation; Formal analysis; Visualization; Writing original draft; Writing review & editing.

Arvind Muthukrishnan: Conceptualization; Methodology; Validation; Supervision.

Sharan Mann: Investigation; Data curation; Visualization; review & editing.

References

1. Maulik PK, Mascarenhas MN, Mathers CD, Dua T, Saxena S. Prevalence of intellectual disability: a meta-analysis of population-based studies. *Res Dev Disabil*. 2011;32(2):419–36.
2. AlBhaisi IN, Kumar MST, Engapuram A, Shafiei Z, Zakaria ASI, Mohd-Said S, et al. Effectiveness of psychological techniques in dental management for children with autism spectrum disorder: a systematic literature review. *BMC Oral Health*. 2022;22(1):162.
3. Da Silva SN, Gimenez T, Souza RC, Mello-Moura ACV, Raggio DP, Morimoto S, et al. Oral health status of children and young adults with autism spectrum disorders: systematic review and meta-analysis. *Int J Paediatr Dent*. 2017;27(5):388–98.
4. Anders PL, Davis EL. Oral health of patients with intellectual disabilities: a systematic review. *Spec Care Dentist*. 2010;30(3):110–7.
5. Ward LM, Cooper SA, Hughes-McCormack L, Macpherson L, Kinnear D. Oral health of adults with intellectual disabilities: a systematic review. *J Intellect Disabil Res*. 2019;63(11):1359–78.
6. Molina G, Zar M, Dougall A, McGrath C. Management of dental caries lesions in patients with disabilities: update of a systematic review. *Front Oral Health*. 2022;3:980048.
7. Harris HK, Weissman L, Friedlaender EY, Neumeyer AM, Friedman AJ, Spence SJ, et al. Optimizing care for autistic patients in health care settings: a scoping review and call to action. *Acad Pediatr*. 2024;24(3):394–407.

8. Waldman HB, Perlman SP, Cinotti DA. Providing dental care for patients with intellectual and developmental disabilities. *Spec Care Dentist*. 2019;39(2):89–95.
9. Mac Giolla Phadraig C, Griffiths C, McCallion P, McCarron M, Donnelly-Swift E, Nunn J. Pharmacological behaviour support for adults with intellectual disabilities: frequency and predictors in a national cross-sectional survey. *Community Dent Oral Epidemiol*. 2018;46(3):231–7.
10. Yazdanbakhsh E, Amin M, Kanji Z, Yang Y, Lai H. The use of general anesthesia for dental treatment of children with special healthcare needs in Alberta, Canada. *Int J Paediatr Dent*. 2025;35(1):86–97.
11. Geddis-Regan A, Gray D, Buckingham S, Misra U, Boyle C. The use of general anaesthesia in special care dentistry: a clinical guideline from the British Society for Disability and Oral Health. *Spec Care Dentist*. 2022;42(S1):3–32.
12. Cianetti S, Paglia L, Gatto R, Montedori A, Lupatelli E. Evidence of pharmacological and non-pharmacological interventions for the management of dental fear in paediatric dentistry: a systematic review protocol. *BMJ Open*. 2017;7(8):e016043.
13. Nelson TM, Sheller B, Friedman CS, Bernier R. Educational and therapeutic behavioral approaches to providing dental care for patients with autism spectrum disorder. *Spec Care Dentist*. 2015;35(3):105–13.
14. Orellana LM, Martínez-Sanchis S, Silvestre FJ. Training adults and children with an autism spectrum disorder to be compliant with a clinical dental assessment using a TEACCH-based approach. *J Autism Dev Disord*. 2014;44(4):776–85.
15. Cermak SA, Stein Duker LI, Williams ME, Dawson ME, Lane CJ, Polido JC. Sensory adapted dental environments to enhance oral care for children with autism spectrum disorders: a randomized controlled pilot study. *J Autism Dev Disord*. 2015;45(9):2876–88.
16. Isong IA, Rao SR, Holifield C, Iannuzzi D, Hanson E, Ware J, et al. Addressing dental fear in children with autism spectrum disorders: a randomized controlled pilot study using electronic screen media. *Clin Pediatr (Phila)*. 2014;53(3):230–7.
17. Aljubour A, AbdElBaki M, El Meligy O, Al Jabri B, Sabbagh H. Effect of culturally adapted dental visual aids on oral hygiene status during dental visits in children with autism spectrum disorder: a randomized clinical trial. *Children (Basel)*. 2022;9(5):666.
18. Mac Giolla Phadraig C, Kammer PV, Asimakopoulou K, Healy O, Fleischmann I, Buchanan H, et al. Labels and descriptions of dental behaviour support techniques: a scoping review of clinical practice guidelines. *Community Dent Oral Epidemiol*. 2023;51(6):1065–77.
19. Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. *Health Psychol*. 2008;27(3):379–87.
20. Mac Giolla Phadraig C, Healy O, Fisal AA, Yarascavitch C, van Harten M, Nunn J, et al. Behaviour support in dentistry: a Delphi study to agree terminology in behaviour management. *Community Dent Oral Epidemiol*. 2024;52(4):550–71.
21. Mac Giolla Phadraig C, Asimakopoulou K, Daly B, Fleischmann I, Nunn J. Nonpharmacological techniques to support patients with intellectual developmental disorders to receive dental treatment: a systematic review of behavior change techniques. *Spec Care Dentist*. 2021;40(1):10–25.
22. Mac Giolla Phadraig C, Nunn J, Guerin S, Asimakopoulou K, Buchanan H, Healy O, et al. A scoping review of interventions and outcome measures in trials of dental behavior support. *Spec Care Dentist*. 2024;44(3):683–99.
23. Salerno C, Cirio S, Zambon G, D’Avola V, Parcianello RG, Maspero C, et al. Conscious sedation for dental treatments in subjects with intellectual disability: a systematic review and meta-analysis. *Int J Environ Res Public Health*. 2023;20(3):1779.
24. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
25. Gates M, Gates A, Pieper D, Fernandes RM, Tricco AC, Moher D, et al. Reporting guideline for overviews of reviews of healthcare interventions: development of the PRIOR statement. *BMJ*. 2022;378:e070849.
26. Bramer WM, Giustini D, de Jonge GB, Holland L, Bekhuis T. De-duplication of database search results for systematic reviews in EndNote. *J Med Libr Assoc*. 2016;104(3):240–3.
27. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan — a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(1):210.
28. Pieper D, Antoine SL, Mathes T, Neugebauer EAM, Eikermann M. Systematic review finds overlapping reviews were not mentioned in every other overview. *J Clin Epidemiol*. 2014;67(4):368–75.
29. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ*. 2019;366:l4898.
30. McGuinness LA, Higgins JPT. Risk-of-bias VISualization (robvis): an R package and Shiny web app for visualizing risk-of-bias assessments. *Res Synth Methods*. 2021;12(1):55–61.
31. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *BMJ*. 2020;368:l6890.

32. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336(7650):924–6.
33. Vacharaksa K, Thongrakard T, Vacharaksa A. Needs of non-pharmacological management versus sedation or general anesthesia for dental treatment in older adults with special needs: a systematic review. *Health Policy*. 2025;154:105262.
34. Tang SJ, Wei HL, Li CY, Huang MN. Management strategies of dental anxiety and uncooperative behaviors in children with autism spectrum disorder. *BMC Pediatr*. 2023;23(1):612.
35. Gatto A, et al. [Full bibliographic details to be confirmed by the authors — see reviewer note.] 2023.
36. Faulks D, Hennequin M, Albecker-Grappe S, Manière MC, Tardieu C, Berthet A, et al. Sedation with 50% nitrous oxide/oxygen for outpatient dental treatment in individuals with intellectual disability. *Dev Med Child Neurol*. 2007;49(8):621–5.
37. Lam PPY, Fok EHW, Chan YTM, Leung CM, McGrath CP, Yiu CKY. Psychological behavioral therapies to improve autistic children's behaviors during dental visits: a systematic review and meta-analysis. *Autism*. 2024;28(11):2743–58.
38. Alkahtani ZM. Effectiveness of non-pharmacological interventions in reducing dental anxiety among children with special needs: a scoping review with conceptual map. *Children (Basel)*. 2025;12(2):165.
39. Waldron C, Nunn J, Mac Giolla Phadraig C, Comiskey C, Guerin S, van Harten MT, et al. Oral hygiene interventions for people with intellectual disabilities. *Cochrane Database Syst Rev*. 2019;5(5):CD012628.
40. Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ*. 2017;358:j4008.
41. Whiting P, Savović J, Higgins JPT, Caldwell DM, Reeves BC, Shea B, et al. ROBIS: a new tool to assess risk of bias in systematic reviews was developed. *J Clin Epidemiol*. 2016;69:225–34.
42. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al., editors. *Cochrane handbook for systematic reviews of interventions*. Version 6.4. Chichester: John Wiley & Sons; 2023.
43. Piraneh H, Gholami M, Sargeran K, Shamshiri AR. Social story based toothbrushing education versus video-modeling based toothbrushing training on oral hygiene status among male students aged 7–15 years old with autism spectrum disorders in Tehran, Iran: a quasi-randomized controlled trial. *J Autism Dev Disord*. 2023;53(10):3813–24.
44. Popple B, Wall C, Flink L, Powell K, Discepolo K, Keck D, et al. Brief report: remotely delivered video modeling for improving oral hygiene in children with ASD — a pilot study. *J Autism Dev Disord*. 2016;46(8):2791–6.
45. Fakhruddin KS, El Batawi HY. Effectiveness of audiovisual distraction in behavior modification during dental caries assessment and sealant placement in children with autism spectrum disorder. *Dent Res J (Isfahan)*. 2017;14(3):177–82.