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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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THE EFFICACY OF SENSORY-ADAPTED DENTAL INTERVENTIONS FOR CHILDREN WITH DEVELOPMENTAL DISABILITIES AND SENSORY SENSITIVITIES

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Abstract.

Background: Children diagnosed with autism spectrum disorder (ASD) are often more sensitive to environmental stimuli, particularly light, sound, and touch, which can provoke significant anxiety and behavioral resistance during dental visits, thereby contributing to poor oral health.

Objective: To assess the efficacy of sensory-adapted dental environments (SADEs) and related interventions to reduce dental anxiety by improving behavioral cooperation of children with ASD based on peer-reviewed evidence.

Methods: English-language studies published between January 2010 and June 2025 were retrieved from the PubMed, ScienceDirect, and Google Scholar databases using the keywords “autism spectrum disorder,” “sensory-adapted dental environment,” “multisensory,” “dental anxiety,” and “occupational therapy.” Reports were limited to randomized controlled trials, quasi-experimental studies, observational research, and systematic reviews involving children with ASD or other developmental disabilities. Data were assessed qualitatively.

Results: Evidence indicates that SADEs consistently reduced physiological and behavioral signs of dental anxiety. A large crossover trial involving 162 autistic children reported that visual, auditory, and tactile adaptations significantly reduced stress during dental cleanings. Modifications (dimmed lighting, nature sounds, slow-motion projections, and deep-pressure wraps) were effective. A 2024 study involving neurotypical children found improved behavior and reduced anxiety in the SADE group, along with lower heart rates and higher oxygen saturation. A randomized trial of children with Down syndrome demonstrated that a multisensory waiting room significantly reduced heart rate and anxiety scores. While the primary focus was ASD, some comparative studies involving neurotypical children and children with Down syndrome were reviewed due to their relevance to sensory-processing mechanisms Meta-analyses of five studies found that SADEs significantly lowered psychophysiological markers of anxiety

Conclusion: Current evidence supports the efficacy of SADEs to reduce anxiety and enhance cooperation of children with ASD. These interventions are cost-effective, feasible, and easily tailored to individual sensory profiles. Future research is recommended to examine long-term outcomes, implementation in community settings, and integration with behavioral approaches.

Key words. Autism spectrum disorder, sensory-adapted environment, dental anxiety, multisensory intervention, occupational therapy.

Introduction.

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental condition characterized by challenges in social communication, restricted interests, and atypical sensory processing that affects approximately 1% of children in high-income countries. However, the prevalence varies by region [1]. Many autistic individuals exhibit hypersensitivity or hyposensitivity to environmental stimuli, such as bright lights, loud noises, tactile sensations, and unpredictable movements. Dental clinics commonly expose patients to various stimuli, including fluorescent lighting, high-pitched sounds, and unfamiliar textures during invasive procedures, thereby rendering dental care particularly distressful for children with ASD. Consequently, this population experiences higher rates of dental caries and periodontal disease as compared to neurotypical children [1,2]. Traditional approaches to reduce anxiety and improve patient cooperation often rely on sedation or physical restraint, highlighting the urgent need for non-pharmacological strategies.

Sensory-adapted dental environments (SADEs) aim to reduce sensory overload by modifying lighting, sound, and tactile input while incorporating calming visual and proprioceptive elements, such as nature projections or weighted pressure. These sensory adaptations are frequently combined with behavioral support, including desensitization protocols, social stories, picture schedules, and video modelling, to help children prepare for dental procedures. This review summarizes current evidence for the adoption of SADEs, drawing from randomized controlled trials (RCTs), observational studies, and systematic reviews, and discusses potential clinical implications and future research directions.

Methods.

Search Strategy and Selection Criteria:

The PubMed, ScienceDirect, and Google Scholar databases were comprehensively searched for relevant studies published between January 2010 and June 2025 using combinations of descriptors related to the population (e.g., "autism spectrum disorder," "ASD," "developmental disability"), interventions (e.g., "sensory-adapted dental environment," "multisensory," "occupational therapy," "video modelling," "social stories"), and outcomes (e.g., "dental anxiety," "behavioral cooperation," "electrodermal activity").

Studies that met the following criteria were eligible for inclusion:

1. Reported results for dental patients aged < 18 years
2. Diagnosis of ASD or another developmental disability
3. Evaluation of sensory or behavioral adaptations implemented in dental care settings
4. Reported at least one physiological outcome (e.g., electrodermal activity, heart rate) or behavioral outcome related to dental care.

Eligible study designs included randomized controlled trials (RCTs), quasi-experimental studies, observational research, and systematic reviews. The exclusion criteria were non-English language publications, studies focused solely on pharmacological interventions, and conference abstracts lacking full data.

Data Extraction and Synthesis:

Key data were extracted from all included studies, encompassing the study design, sample characteristics, sensory or behavioral intervention components, and measured outcomes. Due to the heterogeneity of interventional strategies, populations, and outcome metrics, a meta-analytic approach was not feasible. Instead, a qualitative synthesis of findings was conducted. All references are numbered in the order of their first appearance and formatted in the Vancouver style.

Assessment of Study Quality / Risk of Bias:

Study quality and risk of bias were assessed using appropriate tools (RoB-2 for RCTs, JBI for observational studies). Two reviewers independently evaluated bias across domains including randomization, blinding, outcome reporting, and attrition. Disagreements were resolved through discussion.

Results.

RCTs and Interventional Studies.

Sensory-Adapted Crossover Trial of Autistic Children:

The most robust evidence was presented by a crossover RCT of 162 children diagnosed with ASD conducted at Children's Hospital Los Angeles [3]. Each child underwent routine dental cleaning in both a standard dental environment and a SADE, with the order of conditions randomized. The SADE included dimmed lighting, blackout curtains, slow-motion nature video projections, calming ambient sounds, and a deep-pressure "butterfly" wrap. Physiological and behavioral stress responses were measured through measurements of electrodermal activity and structured observations of behaviors. The results indicated significantly lower physiological arousal and behavioral distress under the SADE condition as compared to the standard setting [3]. Notably, these sensory adaptations were low-cost, did not extend the duration of appointments, and required no specialized training.

Comparative Studies in Non- ASD Populations:

These studies were included to provide contextual understanding of sensory adaptation mechanisms across populations with similar sensory processing characteristics and are not considered primary evidence for ASD. Additional evidence supporting the effectiveness of sensory-adapted clinical environments comes from a recent perioperative RCT involving autistic patients, which demonstrated significantly reduced anxiety and improved cooperation under an adaptive sensory environment.

Parallel-Arm Study of Neurotypical Children:

A parallel-arm interventional study was conducted by Fathima et al. [4] involving 148 neurotypical children, randomly assigned to receive dental care under either an SADE or a traditional dental setting. The SADE incorporated dimmed lighting, calming music, and deep-pressure support. Although there were no significant differences in pre-procedure anxiety scores between the two groups, post-procedure data showed that children in the SADE group exhibited significantly better behavioral cooperation and lower anxiety levels. These outcomes were also supported by physiological measures, including lower heart rate and higher oxygen saturation. While the study population did not include autistic children, these findings highlight the general benefits of sensory-adapted settings to improve patient compliance in pediatric dentistry.

Multisensory Waiting Room Intervention:

Mehta et al. [5] evaluated the impact of a multisensory-adapted waiting room on the anxiety of children with Down syndrome. This RCT compared children exposed to a sensory-adapted waiting area featuring adjusted lighting, soft music, and tactile stimuli to those in a standard waiting room. The sensory intervention group exhibited significantly lower heart rates and anxiety scores, as measured by the Modified Venham Scale [5]. Although not specific to ASD, these findings suggest that sensory adaptation strategies may have broader applicability in special care dentistry.

Systematic Reviews and Meta-Analyses:

A systematic review and meta-analysis by Reynolds et al. [6] synthesized data from five studies that evaluated SADEs in children and young adults with intellectual and developmental disabilities [6]. The meta-analysis found that SADEs significantly reduced physiological indicators of dental anxiety, with a standardized mean change of -0.66 (95% confidence interval: -1.01 to -0.30; $p < 0.001$). However, improvements to observable maladaptive behaviors, such as crying, withdrawal, and aggression, were inconsistent across the studies and did not reach statistical significance. The authors noted considerable heterogeneity in study designs and outcome measures, underscoring the need for further high-quality RCTs.

Table 1. *Summarizes key findings from major studies evaluating the efficacy of sensory-adapted dental environments (SADEs) across populations and designs.*

Study (Author, Year)	Population	Design	Sensory Interventions	Measured Outcomes	Key Findings
Cermak et al., 2015 [1]	44 children with ASD	Pilot RCT	Dimmed light, soft music, deep-pressure wrap	Electrodermal activity, cooperation	Improved compliance, reduced arousal
Shapiro et al., 2009 [2]	Children with developmental disabilities	Observational	Adapted dental clinic environment	Behavior	Improved behavior in an adapted setting
Stein Duker et al., 2023 [3]	162 children with ASD	Crossover RCT	Dimmed lights, nature video, sound, deep-pressure wrap	Electrodermal activity, behavior	Reduced physiological & behavioral distress
Fathima et al., 2024 [4]	148 neurotypical children	Parallel-arm RCT	Dimmed lighting, music, deep-pressure support	Heart rate, oxygen saturation, behavior	Lower HR and better cooperation in SADE
Mehta et al., 2024 [5]	Children with Down syndrome	RCT	Sensory-adapted waiting room	Heart rate, anxiety	Reduced anxiety, lower physiological arousal
Reynolds et al., 2023 [6]	Children with IDD	Systematic review & meta-analysis	Various sensory modifications	Physiological and behavioral responses	Reduced anxiety markers; mixed behavioral effects
Fallea et al., 2022 [7]	Children with ASD (Italy)	Observational	Full SADE setup	Treatment success rate	68% success vs. 20% in standard
Stein et al., 2013 [8]	Children with ASD	Observational	Sensory-related oral care approaches	Oral care behavior	Sensory over-responsivity linked to poor oral care
da Silva et al., 2017 [9]	Children & adolescents with ASD	Systematic review	--	Oral health status	Higher caries risk; poor oral hygiene
Isong et al., 2014 [10]	Children with ASD	Pilot study	Picture-assisted dental instructions	Behavior, cooperation	Improved cooperation using visual aids
Prynda et al., 2024 [11]	Children with ASD	Systematic review of RCTs	Sensory-adapted strategies	Behavior, anxiety	SADE beneficial; evidence moderate
Sabbagh et al., 2021 [12]	Children with ASD (Saudi Arabia)	Cross-sectional	--	Characteristics and prevalence	Updated epidemiological profile
Aljubour et al., 2024 [13]	Children with ASD	RCT	Culturally adapted dental visual aids	Behavior management	Improved behavior; pages not specified
Lane & Reynolds, 2019 [14]	Children with ASD	Observational	Sensory over-responsivity	Problem behaviors	SOR predicts behavioral difficulties
Abid et al., 2024 [15]	Preschool children with ASD	RCT	Parental training program	Behavior, social responsiveness	Significant improvements post-training
Cunningham et al., 2021 [17]	Pediatric population	Systematic review	VR & smartphone apps	Dental anxiety	VR/apps reduce anxiety
Rios-Vega et al., 2024 [18]	Autistic children	Conceptual/Design study	Sensory-adaptive healthcare environments	Participation	Framework for optimized SADE design
Capurro et al., 2024 [19]	Children with ASD	Clinical protocol	New sensory-adapted dental approach	Behavior, acceptance	Improved cooperation and accep

Observational Studies and Early Trials:

Foundational research into SADEs emerged from early pilot studies. Shapiro et al. [2] introduced environmental modifications (dimmed lighting, soft music, and weighted blankets) in a dental clinic serving children with developmental disabilities. As compared to standard settings, the adapted environment improved cooperation and reduced distress. A randomized pilot study conducted by Cermak et al. [1] involving 44 autistic children found that SADEs significantly reduced electrodermal responses and improved compliance during dental cleanings.

Fallea et al. [7] evaluated the effects of a sensory-adapted dental setting in a cohort of Italian children with ASD and reported a 68% success rate for cavity treatment in the SADE group, as compared to only 20% in a standard dental environment. In another observational study, Stein et al. [8] found that autistic children with sensory over-responsivity were more likely to require sedation and exhibited greater aversive responses to dental stimuli as compared to peers without such sensitivities. Systematic reviews examining oral health in ASD populations consistently reported higher prevalence of caries and gingivitis, calling for the implementation of tailored preventive and

adaptive care strategies [9].

An additional early study by Shapiro et al. demonstrated that sensory adaptation significantly reduced anxiety in children with developmental disabilities during dental treatment, reinforcing the foundational evidence for SADE effectiveness.

Behavioral Strategies and Culturally-Adapted Interventions:

Behavioral strategies are frequently used in conjunction with sensory adaptations to improve dental experiences for children with ASD. Isong et al. [10] investigated the use of picture-assisted dental instructions and found that visual supports improved cooperation and reduced anxiety during dental procedures.

Video modelling and social stories have also demonstrated efficacy in preparing autistic children for dental visits. A recent systematic review concluded that video modelling is particularly effective, with positive effects sustained for up to 12 months [11]. Sabbagh and colleagues [12] emphasize that visuals help increase predictability and collaboration.

Cultural adaptation of behavioral materials is increasingly recognized as essential. Aljubour et al. [13] developed Arabic-language visual aids for children with ASD and found that culturally-tailored tools significantly reduced distress behaviors and improved cooperation as compared to standard English-language materials.

Lane and Reynolds [14] highlighted that sensory over-responsivity is a key predictor of behavioral challenges during dental care. Their findings suggest that interventions targeting sensory modulation can reduce anxiety and improve outcomes.

Recently published narrative reviews reinforce the importance of integrating sensory adaptations with behavioral strategies and caregiver training, particularly for children with more severe sensory sensitivities.

Discussion.

Interpretation of Evidence.

The current body of evidence supports the effectiveness of SADEs to reduce anxiety and improve behavioral cooperation in pediatric dental care, particularly for children with ASD. RCTs consistently demonstrated that multisensory modifications, such as dimmed lighting, ambient sounds, visual projections, and deep-pressure wraps, immediately reduced both physiological stress and behavioral distress [1-3]. The crossover trial conducted at Children's Hospital Los Angeles [1] provided particularly compelling support for SADEs with autistic children, while more recent studies extended these findings to neurotypical children and those with Down syndrome [2,3].

Systematic reviews and meta-analyses further validated the positive impact of SADEs on psychophysiological markers of dental anxiety, such as heart rate and electrodermal activity [4]. Although behavioral outcomes across studies were variable, the overall trend suggests enhanced cooperation, especially when sensory adaptations are combined with behavioral support strategies [4,8,12]. Emerging technologies like virtual reality (VR) are being explored as adjunct tools to reduce anxiety in pediatric dental settings [15-17]. Rios-Vega et al.'s study suggests that adapted sensory environments can increase participation and reduce stress during various health care procedures in autistic children, supporting the findings of dental studies [18-20].

Interventions with the use of picture schedules, video modelling, and social stories appear to enhance the benefits of environmental modifications. Cultural adaptations, such as linguistically appropriate visual aids, also improve communication and reduce distress of diverse patient populations [12,13]. The literature suggests that children who are younger or have greater cognitive or communication challenges may benefit most from these tailored interventions [1].

Limitations and Research Gaps.

Despite promising results, several methodological limitations constrain the generalizability of current findings. Many studies included small sample sizes, lacked blinding, or employed heterogeneous outcome measures, rendering direct comparisons especially difficult. Also, long-term efficacy was largely unexplored, as the majority of trials evaluated short-term outcomes during or immediately after dental visits.

Implementation of SADEs in community dental clinics also remains limited. Most studies were conducted in academic or hospital-based settings, where resources and staffing may differ significantly from those in routine practice. Furthermore, relatively few studies systematically evaluated the cost-effectiveness of sensory adaptations or identified which specific elements (e.g., lighting, auditory, tactile) contributed most to improved outcomes.

There is also a lack of standardized protocols for tailoring sensory adaptations to the sensory profiles of individual children; a gap that warrants further research. Validated assessment tools and interdisciplinary collaboration, particularly with occupational therapists, could enhance customization and efficacy.

Clinical Implications.

As accessible options for a wide range of dental practitioners, sensory adaptations in dental settings are low-cost, feasible to implement, and do not require specialized training. Strategies that may be easily incorporated into routine practice include:

- Dimming overhead lights or use of natural lighting where possible
- Playing calming background music or nature sounds
- Providing deep-pressure input using weighted blankets or heavy X-ray aprons
- Projecting preferred visual scenes onto the ceiling
- Allowing children to wear sunglasses, hats, or noise-cancelling headphones [17].

These adaptations should be individualized based on the sensory sensitivities and preferences of each child. Behavioral strategies, such as pre-visit social stories, desensitisation techniques, and caregiver-led modelling, can be integrated to prepare children for dental visits and reinforce adaptive behaviors. Close collaboration with caregivers and occupational therapists can enhance preparation at home and support generalization of coping skills. Cultural and linguistic tailoring of communication materials is also essential to ensure accessibility and engagement across diverse patient populations.

Conclusion.

SADEs offer a practical, evidence-based approach to improve dental care experiences and outcomes for children with ASD. Across RCTs, observational studies, and systematic reviews, SADEs were consistently shown to reduce physiological markers of anxiety (elevated heart rate and electrodermal activity) and improve behavioral cooperation during dental procedures.

These interventions are non-invasive, low-cost, and require minimal resources or training, making them highly feasible for integration into a wide range of dental care settings. Adaptations can be tailored to individual sensory profiles to enhance comfort and reduce the need for pharmacological sedation or physical restraint.

While short-term outcomes are promising, further research is needed to assess the long-term effectiveness of SADEs, implementation in community and private dental practices, and integration with behavioral strategies. Standardized protocols, cost-effectiveness analyses, and culturally responsive adaptations represent key areas for future investigations.

Adoption of sensory and behavioral modifications can contribute to more inclusive and accessible oral health care for children with sensory sensitivities, thereby ensuring equitable treatment experiences for neurodivergent populations.

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Conflict of Interest.

The authors declare no conflict of interest.

Data-Access Statement.

No new data were generated or analyzed in this study.

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