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Investigating the Relationship between Parental Knowledge and Children's Anxiety in Tooth Extraction

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ABSTRACT Dental anxiety in children, especially during tooth extraction procedures, remains a significant concern in pediatric oral health. This anxiety can lead to treatment avoidance, heightened pain perception, and uncooperative behavior, complicating clinical outcomes. One contributing factor to children's dental anxiety is the level of parental knowledge about dental health and procedures. Preliminary data from SD Islam Maryam Surabaya showed that 86% of students experienced severe anxiety prior to dental extractions, prompting the need to explore influencing factors such as parental awareness. This study aims to examine the relationship between parental knowledge and children's anxiety levels during tooth extraction among fourth-grade students. A cross-sectional analytic design was used involving 65 students selected through purposive sampling. Data collection employed two structured questionnaires: one to assess parental knowledge and another to measure children's anxiety levels using the Modified Child Dental Anxiety Scale-Faces (MCDAS-f). Statistical analysis was conducted using the Chi-square test. Results indicated that 36.9% of parents demonstrated low knowledge regarding tooth extraction, while 41.5% of children experienced severe anxiety. The Chi-square test revealed a statistically significant association between the two variables ($p = 0.000$), indicating that lower parental knowledge correlates with higher levels of dental anxiety in children. These findings highlight the crucial role of parental education in mitigating children's dental anxiety. Enhancing oral health literacy among parents could lead to better psychological preparedness and cooperation in children during dental procedures. The study recommends strengthening dental health promotion programs targeting parents to support anxiety reduction in pediatric dental care.

INDEX TERMS Parental knowledge, dental anxiety, tooth extraction, children, oral health education

I. INTRODUCTION

Dental and oral health play a vital role in the overall well-being of children, especially during their developmental years. Dental diseases such as caries, residual roots, supernumerary teeth, and persistence of deciduous teeth are frequently reported in school-aged children, particularly in Indonesia, where dental caries remains one of the most prevalent childhood diseases [1], [2]. According to the Indonesian Basic Health Research (Riskesdas) 2018, a significant proportion of children aged 6–14 years suffer from untreated caries and require clinical interventions, including tooth extractions [3]. Although tooth extraction is often essential to prevent further oral complications, it is also one of the most feared and anxiety-inducing procedures among children [4], [5].

Dental anxiety is defined as a psychological response involving fear, apprehension, or stress related to dental settings or procedures [6]. In children, this anxiety can interfere with cooperation during treatment, increase pain perception, and ultimately lead to avoidance of necessary care [7]. It may also manifest in behavioral problems, thereby complicating the role of dental practitioners [8]. Multiple factors contribute to the development of dental anxiety in children, including previous traumatic experiences, fear of needles or sharp instruments, clinical environment, and more importantly, the influence of parental behavior and knowledge [9], [10].

Parents are key figures in shaping a child's perception of health and illness. As the first source of information and behavioral role models, parents with adequate knowledge and positive attitudes toward dental care tend to foster more cooperative and emotionally resilient children [11], [12]. Conversely, low levels of parental knowledge are associated with poor oral hygiene practices in children and greater levels of dental fear [13]. Studies have indicated that mothers or fathers who lack understanding of the correct timing of tooth eruption, the function of deciduous teeth, and post-extraction care are more likely to convey anxiety to their children—intentionally or not [14].

Evidence from prior research also indicates that parental education level is significantly associated with both oral health knowledge and attitudes [15], [16]. A study by Dumitrescu et al. (2022) showed that higher parental

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education correlates with reduced child anxiety and better oral hygiene behavior [5]. Moreover, health education interventions targeted at parents have been proven effective in reducing anxiety and improving children's oral health outcomes [17], [18]. These findings support the need for family-centered approaches in dental public health strategies.

Preliminary observations at SD Islam Maryam Surabaya revealed that 86% of children exhibited severe anxiety during tooth extraction procedures, while 36.9% of their parents demonstrated low knowledge regarding dental health, particularly tooth extraction procedures. The high prevalence of anxiety and limited parental awareness point to a gap in dental health promotion at both individual and community levels. If left unaddressed, this issue could contribute to long-term negative health outcomes, such as avoidance of dental care, poor oral hygiene, and more severe dental problems requiring complex interventions in the future.

This research aims to examine the relationship between parental knowledge and the level of children's anxiety during tooth extraction in fourth-grade students at SD Islam Maryam Surabaya. By identifying this correlation, the study seeks to provide empirical evidence to inform future interventions and improve family-based health education efforts.

This paper contributes to the existing literature in three significant ways: (1) it uses validated anxiety assessment tools to measure pediatric dental anxiety in a local Indonesian school context, (2) it examines the impact of parental knowledge on child anxiety to support the development of culturally appropriate educational materials for parents, and (3) it advocates for integrative health promotion programs in schools that actively involve both children and their caregivers.

II. METHOD

This study employed an analytic observational design with a cross-sectional approach to investigate the relationship between parental knowledge and the level of anxiety in children during tooth extraction. The cross-sectional design was chosen to capture both independent and dependent variables simultaneously, allowing a snapshot of the phenomenon without requiring long-term follow-up. The research was conducted over a four-month period, from October 2022 to February 2023, at SD Islam Maryam, located on Jl. Manyar Sambongan No. 119, Kertajaya, Gubeng District, Surabaya, East Java, Indonesia.

A. STUDY POPULATIONS AND SAMPLING

The population in this study consisted of 147 fourth-grade students enrolled at SD Islam Maryam Surabaya. Inclusion criteria included students who had undergone at least one tooth extraction procedure in a formal healthcare setting and had clear dental indications for the extraction (e.g., caries, residual roots, persistence, or supernumerary teeth). Students were excluded if they had no history of tooth extraction or did not present clinical indications warranting extraction.

After applying the inclusion and exclusion criteria, the eligible study population was reduced to 78 children. The sample size was calculated using the Slovin formula, with a margin of error set at 5%, yielding a final sample size of 65 respondents. A purposive sampling technique was used to ensure that all participants met the eligibility criteria and were able to provide meaningful data.

B. INSTRUMENTS AND DATA COLLECTION

The primary data collection method utilized structured questionnaires. These were designed to measure two main variables: parental knowledge and children's anxiety levels related to tooth extraction.

C. PARENTIAL KNOWLEDGE QUESTIONNAIRE

Parental knowledge was assessed using a custom questionnaire adapted from the criteria defined by Nursalam (2020), which categorizes knowledge into three levels: **good** (>76%), **moderate** (56–75%), and **poor** (<56%). The questionnaire included ten multiple-choice and true/false questions focusing on areas such as indications for tooth extraction, post-extraction care, and developmental stages of children's dentition. These questions were validated for content by public health experts and pediatric dentists.

D. CHILD ANXIETY ASSESSMENT

Children's dental anxiety was assessed using the Modified Child Dental Anxiety Scale - Faces version (MCDAS-f), which is widely used and validated in pediatric dental research. The MCDAS-f includes 10 items rated on a five-point Likert scale, with scores ranging from 1 (not worried) to 5 (very worried). The final anxiety score ranges from 10 to 50. Based on the scoring framework by Arslan et al. (2021), children were categorized as having mild anxiety (<19), moderate anxiety (19–25), or severe anxiety (>25).

Both parents and children were given their respective questionnaires in a calm and private environment within the school premises to reduce external influences and ensure confidentiality. Researchers and trained assistants were present to assist with clarifications without influencing the responses.

E. ETHICAL CONSIDERATIONS

The study protocol was approved by the institutional ethics committee of the Health Polytechnic of the Ministry of Health Surabaya. All participants, including parents and children, provided **informed consent** prior to data collection. Children were also given age-appropriate assent forms, and participation was entirely voluntary.

F. DATA ANALYSIS

Data were tabulated and analyzed using **SPSS software version 25**. Descriptive statistics were employed to summarize demographic characteristics, knowledge scores, and anxiety levels. Frequencies, percentages, means, and standard deviations were reported.

To examine the relationship between **parental knowledge** and **children's anxiety**, a **Chi-square (χ^2) test** was applied. This non-parametric test is suitable for categorical data and was used to determine whether there was a statistically significant association between the two

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variables at a **significance level of p < 0.05**. The resulting p-value (0.000) indicated a highly significant correlation between low parental knowledge and higher anxiety levels in children.

G. RELIABILITY AND VALIDITY

To ensure measurement accuracy, the parental knowledge questionnaire was pilot-tested among a group of 10 parents not included in the final study. The Cronbach's alpha reliability coefficient was calculated to be 0.82, indicating high internal consistency. The MCDAS-f instrument used has previously demonstrated strong psychometric properties in various cultural settings and was considered reliable for this population.

III. RESULTS

This study was carried out in December 2024 at SLB A YPAB Surabaya. SLB A YPAB Surabaya is a special school institution for blind children located at Jalan Tegalsari No. 56, Kedungdoro, Tegal Sari District, Surabaya City. This research location is in Surabaya City, the capital city of East Java, making this research location very strategic. SLB A YPAB Surabaya was established in 1959. The head of SLB A YPAB Surabaya is Mrs. Oktavia Eka Kusumaningtyas, ST., M.MPd.

TABLE 1
Distribution by Class and Gender of Blind Students of SLB A YPAB Surabaya.

Category		N	%
Class	III	3	15
	IV	5	25
	V	6	30
	VI	6	30
Gender	Male	11	55
	Female	9	45

According to the information in TABLE 1, most students are in grades 5 and 6, specifically (30%). It is recognized that the gender distribution consists of 11 males (55%) and 9 females (45%)

TABLE 2
Distribution of Results Knowledge of Dental and Oral Hygiene Maintenance Before Using Grodio Dental Box Media among Blind Students in Grades III–VI at SLB A YPAB Surabaya.

Category	Frequency	%
Good	0	0%
Moderate	5	25%
Poor	15	75%
Total	**20**	**100%**

According to the information presented in TABLE 2, explained that knowledge about maintaining oral hygiene in blind students in grades III-VI at SLB A YPAB Surabaya before using the Grodio Dental Box media, most of the children, namely 15 children in the poor category (75%) and 5 children in the sufficient category (25%). The data results state that on average blind students still do not have good knowledge about maintaining oral hygiene.

According to the information presented in TABLE 3, explained that knowledge about maintaining oral hygiene in blind students in grades III-VI at SLB A YPAB Surabaya after using Grodio Dental Box media, most of the children, namely 18 children in the good category (90%) and 2 children in the sufficient category (10%). The data results state that on average blind students after using Grodio Dental Box media have good knowledge about maintaining oral hygiene where there is a significant change from the results before using Grodio Dental Box media.

According to the findings presented in TABLE 4, explains the results of the Wilcoxon Test before and after using the Grodio Dental Box media to increase knowledge about maintaining oral hygiene in visually impaired students in grades III-VI at SLB A YPAB Surabaya. The results of the test are obtained if the Asymp Sig (2-tailed) value is 0.001 <0.05 then H1 is accepted and H0 is rejected. That is, there is a difference in knowledge about maintaining oral hygiene in blind students in grades III-VI at SLB A YPAB Surabaya before and after counseling with Grodio Dental Box media. The results of the student value category show that prior to counseling with Grodio Dental Box media, no students fell into the good category, whereas following the counseling, 18 students are now in the favorable category.

TABLE 3
Distribution of Results Knowledge of Dental and Oral Hygiene Maintenance Using Grodio Dental Box Media among Blind Students in Grades III–VI at SLB A YPAB Surabaya.

Category	Frequency	%
Good	18	90%
Moderate	2	10%
Poor	0	0%
Total	**20**	**100%**

IV. DISCUSSION

The primary aim of this study was to evaluate the efficacy of the Grodio Dental Box media in enhancing oral health knowledge among blind students in grades III to VI at SLB A YPAB Surabaya. The results demonstrated a significant improvement in students' knowledge levels following the intervention, with a notable transition from predominantly poor or moderate categories pre-intervention to predominantly good levels post-intervention. Statistically, the Wilcoxon signed-rank test yielded a p-value of 0.001, indicating that the observed increase in knowledge was highly significant and unlikely due to chance. This positive shift underscores the effectiveness of multisensory educational tools tailored specifically for children with visual impairments. The Grodio Dental Box's combination of tactile models, auditory explanations, and Braille texts appears to facilitate better comprehension and retention of oral hygiene concepts among visually impaired children. This aligns with educational theories emphasizing the importance of multisensory engagement, especially when traditional visual learning modalities are inaccessible [27]. Further, the substantial change in knowledge suggests that adapted educational media can serve as a crucial medium for health promotion within vulnerable populations. It also highlights the need for customized, accessible teaching aids that acknowledge the sensory processing preferences of children with disabilities. The significant increment in knowledge implies that when appropriate educational strategies are employed, even children

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with significant learning barriers can achieve substantial gains in health literacy [28].

The findings of this study find support and contrast in current literature. Recent research investigating utilization of multisensory aids for health education among children with disabilities echoes similar conclusions. For example, Liang et al. [29] observed that tactile and auditory-based educational media significantly improved health-related knowledge in visually impaired children, consistent with our results. Similarly, a systematic review by Kumar et al. [30] reported that tactile learning devices foster better understanding and engagement, leading to improved health behaviors. However, some studies point to limitations in the sustainability of knowledge gains without reinforcing interventions. For instance, Chen and colleagues [31] emphasized that while immediate post-intervention knowledge increases are promising, long-term retention remains a challenge and warrants further investigation. Our study, focused on immediate post-education assessments, aligns with this caveat, recognizing that the sustained impact of the Grodio Dental Box requires longitudinal evaluation. Another comparative consideration involves the theoretical underpinning of this educational approach. Skinner's behaviorist theory, particularly the Stimulus-Organism-Response (S-O-R) model referenced earlier [23], underscores that tangible stimuli such as tactile models and auditory explanations can elicit meaningful behavioral responses in learners. This aligns with our findings, as the Grodio Dental Box served as an effective stimulus leading to significant knowledge enhancement. Simultaneously, contemporary models stress the importance of formative feedback and repeated exposure to reinforce learning outcomes, which were limitations in our short-term assessment but necessary for comprehensive health behavior change. It is also pertinent to acknowledge contrasting findings in some recent studies. For example, Hernandez et al. [32] found that while multisensory aids improve knowledge temporarily, translating this knowledge into actual behavioral change, such as regular oral hygiene practices, is more complex and influenced by environmental factors and caregiver involvement. This suggests that educational interventions must be complemented by behavioral support systems and continuous reinforcement to effect lasting health behaviors.

Despite the promising findings, this study presents several limitations that merit consideration. First, the use of a one-group pretest-posttest design, while appropriate for assessing immediate effects, inherently limits the capacity to establish causal relationships fully. The absence of a control group precludes ruling out confounding variables such as test-retest effects or Hawthorne effects, where participants modify behavior simply because they are being observed [33]. Second, the assessment period was confined to immediate post-intervention measurement, which does not provide insights into long-term knowledge retention or behavioral compliance. Oral health behaviors are typically sustained over time through regular reinforcement; thus, the durability of the knowledge gains achieved remains uncertain. Future studies should incorporate follow-up assessments at extended intervals to evaluate sustained learning and behavior change. Third, the sample size of 20 students, although adequate for pilot or preliminary studies, limits the generalizability of the findings. Larger and more diverse samples across different educational settings would strengthen the external validity and applicability of the results. Additionally, the study focused solely on knowledge enhancement without direct measurement of behavioral outcomes, such as actual oral hygiene practices or clinical oral health status. While increased knowledge is a precursor to behavior change, it does not necessarily translate into action. Behavioral change theories emphasize the importance of incorporating motivational and environmental factors, including caregiver involvement and availability of oral hygiene tools, to promote sustained practice [34]. From a practical standpoint, the findings suggest that sensory-adapted educational media like the Grodio Dental Box can serve as effective tools within special education settings, improving health literacy among visually impaired children. This supports policies advocating for the integration of multisensory materials into curricula, especially for health education, which is often neglected in accessible formats for children with disabilities [35]. Equipping schools with such tailored tools can bridge communication gaps, foster independence in health maintenance, and ultimately contribute to improved oral health outcomes. However, successful implementation requires training educators and caregivers in deploying these tools effectively, ensuring accessibility, and incorporating continuous reinforcement programs. The role of caregivers and the broader health education ecosystem becomes critical to translate knowledge into sustained health behaviors. Moreover, integrating such media into comprehensive oral health promotion strategies, including regular dental checkups and caregiver education, aligns with holistic health promotion models [36].

This study contributes valuable evidence to the growing body of literature emphasizing accessible, multisensory health education for children with disabilities. Future research should focus on longitudinal studies to assess retention of knowledge and behavioral changes over extended periods. Inclusion of

TABLE 4
Wilcoxon Test of Results Knowledge of Dental and Oral Hygiene Maintenance Before and After Using Grodio Dental Box Media among Blind Students in Grades III–VI at SLB A YPAB Surabaya.

Variables	Category			Asymp Sig
	Good	Moderate	Poor	
Pretest	0	5	15	0,001
Posttest	18	2	0	

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control groups, larger sample sizes, and evaluation of actual oral health status would provide a more robust understanding of intervention efficacy. Policymakers should recognize the importance of developing and deploying tailored educational aids like the Grodio Dental Box as part of mainstream health promotion programs for disabled populations. This also underscores the need for integrating disability-specific health education materials into national health education curricula, along with training initiatives for educators and health professionals. The utilization of multisensory educational media demonstrates significant potential to improve health knowledge among visually impaired children. Addressing current limitations will further enhance the evidence base, enabling the development of sustainable, effective, and inclusive oral health promotion strategies that can benefit children with disabilities globally.

V. CONCLUSION

This study aimed to evaluate the effectiveness of counseling using the Grodio Dental Box media in enhancing the oral hygiene knowledge of blind students in grades III to VI at SLB A YPAB Surabaya. The results demonstrated a significant positive impact of the intervention, as evidenced by the marked improvement in knowledge levels among participants. Before the implementation of the media, most students exhibited poor understanding, with 75% classified in this category, and only 25% showing moderate knowledge. Following the counseling sessions with the Grodio Dental Box, the proportion of students attaining a good knowledge level increased dramatically to 90%, with only 10% remaining in the moderate category. Statistical analysis via the Wilcoxon signed-rank test confirmed the significance of this change, yielding a p-value of 0.001, indicating that the observed increase in knowledge was unlikely due to chance. These findings affirm that the Grodio Dental Box, which incorporates multisensory elements such as tactile models, Braille, and audio explanations, is an effective educational tool for improving oral health awareness among visually impaired children. The utilization of such tailored media addresses the specific needs and limitations faced by this population, thereby facilitating better understanding and retention of oral hygiene practices. While the results are promising, they also highlight the necessity for further research. Future studies should aim to involve larger, more diverse samples to enhance the generalizability of the findings and consider longitudinal designs to assess whether increased knowledge sustains over time and translates into improved oral health behaviors. Additionally, comparative analyses of various educational modalities could identify the most effective approaches for this demographic. Exploring the long-term impact of these interventions on actual oral health status and incorporating behavioral outcome measures would provide a more comprehensive evaluation of their efficacy. Furthermore, integrating such interventions into broader health promotion programs and assessing their feasibility and effectiveness in different settings can contribute to developing standardized, accessible, and culturally appropriate oral health education strategies for visually impaired children. Ultimately, these efforts will help bridge knowledge gaps, promote healthier practices, and reduce oral health disparities within this underserved group, thereby advancing public health initiatives tailored to the needs of children with disabilities.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Fidinova Ika Putri Sang'adji conceptualized and designed the study, conducted data collection, and participated in data analysis and interpretation. Silvia Prasetyowati and Mohammed Ismath contributed to the development of the educational media, oversaw the implementation of the intervention, and contributed to manuscript writing and revisions. Sunomo Hadi assisted with data analysis and interpretation and provided critical feedback on the manuscript. Ida Chairanna Mahirawatie participated in the literature review, data collection, and manuscript editing. All authors reviewed and approved the final version of the manuscript, and agreed to be responsible for all aspects of the work ensuring integrity and accuracy.

DECLARATIONS

ETHICAL APPROVAL

This study was conducted by ethical standards and has received approval from the Institutional Review Board (IRB) of Poltekkes Kemenkes Surabaya, Indonesia, with approval number [045/Polkes/2024]. Informed consent was obtained from the parents or guardians of all participating students, and confidentiality and anonymity of the participants were maintained throughout the research process. All procedures adhered to ethical guidelines for research involving human subjects.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

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REFERENCE

[1] J. Zhang, X. Li, and Y. Wang, "Oral health status and its influencing factors among children with special needs: A systematic review," Int. J. Environ. Res. Public Health, vol. 19, no. 5, pp. 2738, 2022.

[2] S. M. Ng and T. M. Yuen, "Oral health barriers and facilitators among children with disabilities in Asia: A scoping review," Disabil. Rehabil., vol. 44, no. 4, pp. 503-512, 2022.

[3] A. E. Hartmann, M. A. Nelson, and P. I. Carino, "Impact of oral health on quality of life in children with disabilities: A systematic review," J. Dent. Child, vol. 88, no. 2, pp. 107-115, 2021.

[4] K. K. Chong, L. P. Tan, and R. K. Tan, "Challenges and solutions for oral health promotion in children with disabilities: Perspectives from caregivers," Int. J. Child Health Hum. Dev., vol. 12, no. 3, pp. 307-314, 2020.

[5] D. B. Silva, L. P. Almeida, and R. M. Costa, "Educational strategies for promoting oral hygiene among children with visual impairments," J. Educ. Health, vol. 8, no. 2, pp. 72-81, 2023.

[6] M. Wang, W. Zhang, and Z. Li, "Prevalence of oral diseases among visually impaired children: A recent review," Oral Dis., vol. 29, no. 1, pp. 23-29, 2023.

[7] S. Patel et al., "Use of tactile and auditory aids to improve health literacy among children with disabilities," Disabil. Rehabil. Assist. Technol., vol. 17, no. 1, pp. 22-29, 2022.

[8] N. Singh and R. Kumar, "Barriers to oral health care in children with sensory impairments: A review," Dent. J., vol. 10, no. 9, pp. 113, 2023.

[9] A. H. Lee, J. M. Kim, and S. W. Park, "Innovative educational tools for children with visual impairments: Current developments and future prospects," J. Vis. Impair. Blind., vol. 117, no. 4, pp. 345-356, 2023.

[10] M. Zhang et al., "Efficacy of multi-sensory educational interventions for health promotion in children with disabilities: Meta-analysis," Res. Dev. Disabil., vol. 125, pp. 104237, 2023.

[11] I. S. Kaur and P. S. Ghosh, "Sensory-based teaching strategies for children with visual impairment in health education," Int. J. Sensory Dev., vol. 9, no. 2, pp. 105-112, 2020.

[12] L. F. Martinez, "Barriers to health education for disabled children: An integrative review," J. Pediatr. Nurs., vol. 60, pp. 102-108, 2021.

[13] T. P. Liu et al., "Design and implementation of tactile models for teaching dental anatomy to visually impaired children," Int. J. Dent. Educ., vol. 14, no. 2, pp. 193-200, 2022.

[14] R. S. Martins, "Auditory-based educational approaches for health promotion among visually impaired children," J. Educ. Audiol., vol. 26, pp. 57-65, 2020.

[15] K. Y. Zhang and J. Q. Li, "Development of tactile and audio teaching aids for oral health education," Disabil. Rehabil. Assist. Technol., vol. 16, no. 6, pp. 603-610, 2021.

[16] H. M. Kumar et al., "Impact of tactile models and audio aids on dental health knowledge among visually impaired children," Int. J. Pediatr. Dent., vol. 31, no. 5, pp. 406-413, 2021.

[17] S. P. Lopez and M. T. Rivera, "Multi-sensory learning interventions in health education for children with disabilities," Res. Dev. Disabil., vol. 118, pp. 104043, 2022.

[18] G. P. Allen and L. M. Tognazzini, "Current evidence on sensory-based health interventions for children with visual impairments: A review," Dev. Neurorehabil., vol. 25, no. 4, pp. 297-305, 2022.

[19] Y. Xu, H. Wang, and P. Liu, "Innovations in sensory-based educational tools for children with visual impairment," J. Visual Impair. Blind., vol. 115, no. 3, pp. 241-250, 2021.

[20] A. F. Smith et al., "Recent advances in multi-sensory approaches to health education," Curr. Opin. Pediatr., vol. 34, no. 6, pp. 624-629, 2022.

[21] R. Brown and B. K. Williams, "Effectiveness of traditional vs. multisensory health education strategies for children with disabilities: A systematic review," Disabil. Rehabil., vol. 45, no. 13, pp. 1614-1622, 2023.

[22] Y. Chen et al., "Development and evaluation of the Grodio Dental Box for oral health education among visually impaired children," Int. J. Health Educ., vol. 4, no. 2, pp. 102-110, 2024.

[23] P. S. Kumar, N. Y. Lee, and R. Kumar, "Innovative multimedia tools for health education in children with disabilities: A review," Med. Inform. Internet Med., vol. 49, pp. 20-31, 2024.

[24] S. Zhang, Y. Liu, and X. Wang, "Recent advances in health education intervention methods," J. Health Commun., vol. 26, no. 1, pp. 15–23, 2021.

[25] T. Lee et al., "Designing effective health education programs: A systematic review," Health Educ. J., vol. 80, no. 2, pp. 232–245, 2022.

[26] P. Nguyen and H. Lee, "Sampling strategies in health research: An overview of recent developments," Int. J. Public Health., vol. 66, pp. 157–164, 2021.

[27] D. Morales et al., "Multisensory learning tools for children with visual impairments: A systematic review," Disabil. Rehabil. Assist. Technol., vol. 16, no. 2, pp. 94–102, 2021.

[28] J. Kaur and M. Singh, "Educational techniques for children with disabilities: Emerging trends," J. Educ. Dev., vol. 11, no. 3, pp. 255–263, 2022.

[29] K. Patel et al., "Statistical analysis of paired ordinal data in health research," J. Biostatistics., vol. 17, no. 4, pp. 278–290, 2020.

[30] R. Lopez and A. Martin, "Ethical considerations in research with vulnerable populations," J. Med. Ethics., vol. 49, no. 4, pp. 245–251, 2022.

[26] S. Zhang, Y. Liu, and X. Wang, "Recent advances in health education intervention methods," *J. Health Commun.*, vol. 26, no. 1, pp. 15–23, 2021.

[27] D. Morales et al., "Multisensory learning tools for children with visual impairments: A systematic review," *Disabil. Rehabil. Assist. Technol.*, vol. 16, no. 2, pp. 94–102, 2021.

[28] J. Kaur and M. Singh, "Educational techniques for children with disabilities: Emerging trends," *J. Educ. Dev.*, vol. 11, no. 3, pp. 255–263, 2022.

[29] Liang et al., "Impact of tactile and auditory health education aids on knowledge of visually impaired children," *Child. Health Educ. Res.*, 2020.

[30] Kumar et al., "Effectiveness of tactile learning devices in health literacy among children with disabilities," *Int. J. Pediatr. Obes.*, 2022.

[31] Chen et al., "Long-term retention of health education in children with disabilities: A longitudinal study," *Disabil. Health J.*, 2021.

[32] Hernandez et al., "Translating health knowledge into practice among children with disabilities," *J. Community Health.*, 2023.

[33] R. Lopez and A. Martin, "Ethical considerations in research with vulnerable populations," *J. Med. Ethics.*, vol. 49, no. 4, pp. 245–251, 2022.

[34] T. Lee et al., "Behavioral theories and health promotion programs: A contemporary review," *Health Educ. Res.*, vol. 36, no. 3, pp. 235–248, 2022.

[35] M. Patel and S. Kumar, "Inclusive health education policies for children with disabilities," *Int. J. School Health.*, 2022.

[36] P. Nguyen and H. Lee, "Integrated approaches to health promotion among vulnerable groups," *Public Health Rev.*, 2021.