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Effect of oral health education model on tooth brushing behavior and oral hygiene among children with intellectual disabilities

Efeito de um modelo de educação em saúde bucal no comportamento da escovação dentária e na higiene bucal em crianças com deficiências intelectuais

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ABSTRACT

Objective: The aim of this study was to evaluate the effectiveness of an oral health education model in improving tooth brushing behavior and oral hygiene among children with intellectual disabilities. **Material and Methods:** This study used a quasi-experimental design with a pretest-posttest control group. The intervention involves implementing the "Tell-Show-Feel-Do" educational model for the intervention group, while the control group receives standard oral health education. Data collection is conducted at baseline and after the intervention period 21 day. The Tell-Show-Feel-Do (TSFD) educational model was implemented in three sessions, with a 4-day gap between each session, and each session lasting 120 minutes. Participants were selected using simple random sampling, focusing on children with intellectual disabilities attending a Special School for Children with Disabilities. A total of 52 children were recruited, divided equally into two groups: 26 in the intervention group and 26 in the control group, taken from September 02 to October 11, 2024. **Results:** The analysis seen significant differences in the changes in tooth brushing behavior and oral hygiene between the intervention and control groups, as determined by an independent sample t-test ($p<0.001$). This suggests that the intervention was effective in improving oral hygiene outcomes compared to the control group, where no notable improvement was observed. **Conclusion:** This study confirms that structured oral health education improves tooth brushing and hygiene in children with intellectual disabilities. Implementing such programs in special education settings, school curricula, and community initiatives can enhance long-term oral health outcomes and overall well-being.

KEYWORDS

Child; Health education, dental; Intellectual disability; Oral hygiene; Toothbrushing.

RESUMO

Objetivo: O objetivo deste estudo foi avaliar a efetividade de um modelo de educação em saúde bucal para melhorar a comportamento da escovação dentária e a higiene bucal em crianças com deficiências intelectuais. **Material e Métodos:** Este estudo usou um modelo quase-experimental com um grupo controle pré-teste-pós-teste. A intervenção envolveu a implementação do modelo educacional "Falar-Mostrar-Sentir-Fazer" para o grupo intervenção, enquanto o grupo controle recebeu a educação em saúde bucal padronizada. Os dados foram realizados antes e após a intervenção de 21 dias. O modelo educacional Falar-Mostrar-Sentir-Fazer (CMSF) foi implementado através de três sessões durante 21 dias, com 4 dias de intervalo entre cada sessão, com duração 120 minutos/cada. Os participantes foram selecionados usando amostragem intencional, focando em crianças

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com deficiências intelectuais que frequentam uma Escola Especial para Crianças com Deficiências. Um total de 52 crianças foram recrutadas e divididas igualmente em dois grupos: 26 no grupo intervenção e 26 no grupo controle, no período de 02 de setembro a 11 de outubro de 2024. **Resultados:** A análise mostrou diferenças significantes nas mudanças de comportamento da escovação dentária e na higiene bucal entre os grupos intervenção e controle, como determinado pelo teste t independente ($p<0.001$). Isso sugere que a intervenção foi eficaz na melhoria dos resultados de higiene bucal comparado ao grupo controle, onde não foram observadas melhorias notáveis. **Conclusão:** Este estudo confirma que a educação em saúde bucal estruturada melhora a escovação dentária e a higiene bucal em crianças com deficiências intelectuais. A implementação desses programas em ambientes de educação especial, currículos escolares e iniciativas comunitárias pode melhorar os resultados de saúde bucal em longo prazo e o bem-estar geral.

PALAVRAS-CHAVE

Criança; Educação em saúde bucal; Deficiência intelectual; Higiene bucal; Escovação dentária.

INTRODUCTION

Oral health is a critical component of overall well-being and quality of life, particularly for children with intellectual disabilities [1], who often face unique challenges in maintaining proper oral hygiene due to limited cognitive and motor skills [2]. These difficulties hinder their ability to perform daily activities such as tooth brushing [3], leading to serious consequences like dental caries, periodontal disease, and systemic health issues [4]. Sensory sensitivities [5], communication barriers [6], and lack of motivation further exacerbate these issues [7], making it difficult for children to understand the importance of oral hygiene and follow proper brushing techniques [8]. Addressing these challenges requires tailored educational interventions that equip children with essential skills and knowledge to improve their oral health outcomes [9].

Research highlights the effectiveness of targeted educational approaches in improving oral health outcomes for children with intellectual disabilities. For instance, Surija et al. [10] demonstrated that structured educational materials, such as electronic books on tooth injuries for children with Down Syndrome, significantly enhance understanding and management of oral health. These findings underscore the importance of integrating tailored interventions that address the unique needs of children with intellectual disabilities, reinforcing the value of structured, interactive learning methods in promoting better oral hygiene practices [10].

Dental anxiety and disruptions in routine care present significant barriers to maintaining oral health in children with intellectual disabilities [11]. Studies highlight that anxiety can lead to higher rates of dental caries, emphasizing the need for supportive interventions [12]. Additionally, disruptions in oral health maintenance, such as those seen during the COVID-19 pandemic, have worsened gingival outcomes for children with disabilities, reinforcing the importance of consistent support and education [13]. The "Tell-Show-Feel-Do" method has emerged as a promising educational model [14], incorporating step-by-step instructions, demonstrations, sensory engagement, and hands-on practice [15]. By aligning with the cognitive and sensory profiles of children with intellectual disabilities, this approach enhances their ability to retain and apply oral hygiene knowledge [16], making it a valuable strategy for improving oral health outcomes.

Research has highlighted the positive impact of structured oral health education programs on the behavior and oral hygiene of children with disabilities [17]. These programs not only improve the children's ability to perform tooth brushing independently but also enhance their understanding of the importance of maintaining oral health [18]. Despite these promising findings, there remains a lack of widespread implementation of such models, particularly in resource-limited settings [19].

Oral hygiene, as a measurable outcome, reflects the success of behavioral interventions and serves as an indicator of the child's ability to perform tooth brushing [20]. Studies suggest that children who receive consistent, tailored oral health education demonstrate significant improvements in oral hygiene indices, highlighting the importance of targeted educational models [21].

This study aims to explore the effect of the "Tell-Show-Feel-Do" oral health education model

on tooth brushing behavior and oral hygiene among children with intellectual disabilities. By focusing on both behavioral and hygiene outcomes, the research seeks to provide evidence for the efficacy of this model and its potential for broader application.

Furthermore, addressing the oral health needs of children with intellectual disabilities requires innovative, evidence-based educational approaches. The "Tell-Show-Feel-Do" model offers a structured and interactive framework for teaching essential oral hygiene skills, making it a valuable tool for enhancing the quality of life for these children. This study seeks to contribute to the growing body of knowledge on effective oral health education practices and advocate for their integration into care programs for children with intellectual disabilities.

MATERIAL AND METHODS

Research design

This study used a quasi-experimental design with a pretest-posttest control group approach to evaluate the effect of an oral health education model on tooth brushing behavior and oral hygiene among children with intellectual disabilities. The intervention involves implementing the "Tell-Show-Feel-Do" educational model for the intervention group, while the control group receives standard oral health education. Data collection is conducted at baseline and after the intervention period 21 day. The Tell-Show-Feel-Do (TSFD) educational model was implemented in three sessions, with a 4-day gap between each session, and each session lasting 120 minutes and was conducted in small groups of 3–5 children to ensure individualized attention while maintaining group interaction benefits. The intervention was delivered through Focus Group Discussions (FGD) involving children with intellectual disabilities, caregivers, and trained facilitators. The TSFD method follows a systematic approach: Tell: Providing verbal instructions using simple and clear language tailored to the cognitive abilities of the children. Show: Demonstrating correct brushing techniques, toothpaste application, flossing, and tongue cleaning using visual aids and real-time demonstrations. Feel: Allowing children to physically interact with toothbrushes and hygiene tools to build confidence and familiarity. Do: Encouraging children to practice brushing under supervision with immediate guidance, correction, and positive reinforcement.

Parental involvement was emphasized to reinforce learning at home. Caregivers were provided with instructional materials and practical demonstrations to support their children's oral hygiene routines. They were encouraged to monitor and assist their children in brushing daily and to provide feedback on their progress.

The intervention was conducted by researchers and trained enumerators who were randomly assigned. Participants were divided into two groups:

Intervention Group: Received oral health education through the Tell-Show-Feel-Do method. Control Group: Received conventional standard dental health education through the Tell-Show-Do method. The control group received a standard single-session intervention that included:

Tell: Verbal instructions on tooth brushing techniques, toothpaste application, and general oral hygiene practices. Show: Demonstration of brushing techniques using a model or visual aids. Do: Encouragement for children to imitate the demonstrated techniques with minimal supervision, without systematic correction or reinforcement. Unlike the TSFD method, this approach relied on repetitive verbal reminders and general reinforcement without practical correction or hands-on practice. The education was delivered in a short, direct manner, primarily focusing on brushing and basic hygiene practices, without extensive engagement or positive reinforcement. Both groups underwent pre-test and post-test assessments to evaluate the impact of the intervention. The observer ensured that the study followed the Standard Operating Procedures (SOPs).

This study was approved by the Ethics Committee of the Faculty of Dentistry - Prof. Soedomo Dental Hospital, Universitas Gadjah Mada (Approval No. 149/UNI/KEP/FKG-RSGM/EC/2024), ensuring compliance with ethical standards for research involving human participants. Furthermore, the study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Sample selection

Participants were selected using simple random sampling, focusing on children with intellectual disabilities attending a Special School

for Children with Disabilities. The randomization was conducted simply by writing the names of the children and their schools on separate pieces of paper, which were then sealed in envelopes by a third party. These envelopes were drawn by the researcher and an examiner to assign participants to either the intervention or control group. The allocation sequence was concealed in sealed envelopes and remained unknown to both the researcher and the participants until the intervention was administered, in order to prevent selection bias. The random allocation sequence was generated by a researcher who was not involved in the recruitment of participants. Participant enrollment was carried out by the research team, while assignment to the intervention and control groups was performed by the principal investigator based on the results of the sealed envelope draw. The study initially required 36 participants based on G*Power 3.1.9.4 calculations, with an additional 10% added to anticipate dropouts. Ultimately, 52 children were included, evenly divided into intervention (n=26) and control (n=26) groups, from September 2 to October 11, 2024.

Dropout criteria included the inability of a child to fully participate in the intervention. Children were required to attend Tell-Show-Feel-Do-based oral health education through Focus Group Discussions (FGD), facilitated by the researcher with a moderator and a notetaker, alongside guidance and counseling. Observers assisted in ensuring adherence to standard operating procedures throughout the study.

Inclusion and exclusion criteria

Inclusion criteria:

- Parents/caregivers provided written informed consent to participate in the study.
- Participants were actively enrolled as students in a Special School for Children with Disabilities.
- Age ranged between 6 and 24 years.
- Children were classified as having mild or moderate intellectual disabilities.
- Availability of a baseline Personal Hygiene Index-Modified (PHP-M) score.
- Demonstrated the ability to cooperate during data collection and intervention sessions.

Exclusion criteria:

- Children who were ill or received permission to miss school during the study period.
- Presence of systemic diseases that could impair functional ability.
- Classification as having severe or very severe intellectual disabilities.
- Absence during critical phases of the study.

Research instruments

The feasibility test involved completing a closed-ended questionnaire assessed on a four-point Likert scale. Three experts, including a researcher and educator specializing in dental health for children with special needs, a pediatric dentistry specialist, and an expert in media and dental health education for children with special needs, evaluated the research materials (format, content, and language) and research instruments. This method was applied to calculate content validity by collecting expert assessment scores and determining value for each instrument item. The validation instrument was developed and adapted based on three key aspects: format (construct), content, and language. This validation process aimed to assess the feasibility of the oral health education model and validate the research instruments.

Questionnaire and checklist formation, application, and evaluation

The questionnaire was developed to assess tooth brushing behavior among children with intellectual disabilities. It included 12 structured questions covering aspects such as brushing frequency, technique, fluoride toothpaste use, parental supervision, and additional oral hygiene habits (e.g., flossing and mouthwash use). The questionnaire utilized a four-point Likert scale to measure clarity, relevance to research objectives, answer feasibility, and language accuracy.

The checklist was designed to evaluate actual brushing performance, including step-by-step observations of the child's brushing behavior, such as applying an appropriate amount of toothpaste, correct brushing technique, and rinsing. This checklist was used by trained observers to ensure standardized assessment of the participants' oral hygiene practices.

Validation process

The questionnaire and checklist underwent a content validity assessment using Aiken's V Method, evaluated each item. Reliability was tested using the Intraclass Correlation Coefficient (ICC) to ensure consistency across evaluations. The questionnaire and checklist were administered before and after the 21-day intervention to assess changes in oral hygiene knowledge and brushing behavior.

Data collection

Data were collected using structured observation tools and validated questionnaires to assess tooth brushing behavior and oral hygiene. The PHP-M index was used to quantify oral hygiene status, while direct observation and caregiver reports evaluated tooth brushing behavior. Pretest data were gathered at baseline, and posttest data were collected 21 day after the intervention.

Research variables

Independent variable:

Oral Health Education Model: The "Tell-Show-Feel-Do" model for the intervention group and standard education for the control group.

Dependent variables:

Tooth Brushing Behavior: Measured using a checklist assessing routine, frequency, duration, brushing time and technique.

Oral Hygiene: Quantified using the PHP-M index.

Data analysis

Data were analyzed using application for statistical significance. Descriptive statistics (mean, standard deviation) were used to summarize demographic data and baseline characteristics. Paired and independent sample t-tests assessed within- and between-group differences. A significance level of $p<0.05$. $p<0.05$ was set for all analyses.

Interpretation of results

The results of this study are expected to provide evidence on the efficacy of the "Tell-Show-Feel-Do" model in improving tooth brushing behavior and oral hygiene among children with intellectual disabilities. A statistically significant improvement in the intervention group compared to the control group would underscore the

Table I - Characteristics of Children with Intellectual Disabilities

Variable	Intervention Groups		Control Group	
	n	Percentage (%)	n	Percentage (%)
Gender				
Male	20	76.93	18	69.23
Female	6	23.07	8	30.77
Age				
6-9 years	1	3.85	1	3.85
10-13 years	11	42.31	11	42.31
14-17 years old	13	50	11	42.31
18-20 years old	1	3.85	3	11.54
Education				
Special Needs Primary School	8	30.76	9	34.62
Special Needs Junior High School	14	53.85	9	34.62
Special Needs Senior High School	4	15.39	8	30.76
Capability Categories				
Able to educate	11	42.31	13	50
Able to train	15	57.69	13	50
Tooth Arrangement				
Normal	-	0	-	0
Crowding	26	100	26	100
Crowding Criteria				
Mild	13	50	11	42.31
Moderate	10	38.46	7	26.93
Severe	3	11.54	8	30.76

importance of tailored oral health education models for this population.

RESULTS

The characteristics of children with intellectual disabilities in this study can be seen in Table I as follows:

The characteristics of children with intellectual disabilities in the intervention and control groups reveal several trends. Males dominate both groups, with 76.93% in the intervention group and 69.23% in the control group. Most children fall into the 14-17 years age range (50% in the intervention group and 42.31% in the control group), followed by those aged 10-13 years (42.31% in both groups). Few participants are in the 6-9 years (3.85% in both groups) and 18-20 years (3.85% in the intervention group and 11.54% in the control group).

Educationally, most children in the intervention group attend Special Needs Junior High School (53.85%), while the control group is evenly distributed across Special Needs Primary School (34.62%), Special Needs Junior High School (34.62%), and Special Needs Senior High School (30.76%). Regarding capability, the intervention group has more children classified as "able to train" (57.69%), while the control group has an even distribution (50%). All participants exhibit crowding in their teeth, with mild cases being most common in both groups, followed by moderate and severe crowding. The results of the bivariate analysis of the research variables with *the paired sample t test* in the intervention group can be seen in Table II.

The results in Table II seen that significant improvements in both tooth brushing behavior and oral hygiene among participants in the intervention group after the implementation of the educational model. The mean score for tooth brushing behavior increased from 23.46 ± 4.810 before the intervention to 29.52 ± 2.506 afterward, with a statistically significant difference ($p<0.001$). This indicates a meaningful enhancement in the participants' ability to perform proper tooth brushing, likely due to the tailored oral health education provided during the intervention.

Similarly, oral hygiene scores demonstrated a significant improvement. The mean score decreased from 43.92 ± 9.055 to 19.73 ± 5.977 post-intervention, reflecting better oral hygiene conditions. The significant reduction ($p<0.001$) suggests that the intervention effectively addressed plaque control and improved overall oral cleanliness. The results of the bivariate analysis of the research variables with *the paired sample t test* in the control group can be seen in Table III

The mean score for tooth brushing behavior showed a slight increase from 21.40 ± 5.097 before the intervention to 22.38 + 2.561 after. Despite this increase, the $p>0.205$ indicates that the change is not statistically significant ($p>0.05$). This suggests that the minor improvement observed is likely due to natural variations or minimal influences from general practices rather than the impact of a specific intervention.

Table II - Pre and Post of Research Variables in the Intervention Group

Variable	Pre	Post	Sig.*
	Mean + SD	Mean + SD	
Tooth Brushing Behavior	23.46 + 4.810	29.52 + 2.506	<0.001
Oral Hygiene	43.92 + 9.055	19.73 + 5.977	<0.001

**Paired sample t test* with p<0.05.

Table III - Pre and Post of Research Variables in the Control Group

Variable	Pre	Post	Sig.*
	Mean + SD	Mean + SD	
Tooth Brushing Behavior	21.40 + 5.097	22.38 + 2.561	0.205
Oral Hygiene	41.12 + 8.262	42.73 + 7.917	0.226

**Paired sample t test* with p<0.05.

Table IV - Comparison of Pre-Post Change Differences in Variables between the Intervention and Control Groups

Variable	Intervention	Control	Sig.*
	Mean + SD	Mean + SD	
Tooth Brushing Behavior	1.04 + 0.940	0.15 + 0.929	0.001
Oral Hygiene	-24.19 + 10.837	1.62 + 6.634	<0.001

** Independent sample t test* with p<0.05.

Consequently, the control group's tooth brushing behavior did not show a meaningful enhancement.

For oral hygiene, the mean score experienced a negligible increase from 41.12 ± 8.262 to 42.73 + 7.917. The p>0.226 indicates no statistically significant change (p>0.05), demonstrating that the oral hygiene conditions of the control group remained effectively unchanged. This lack of significant improvement points to the insufficiency of standard care routines in producing noticeable changes in oral health outcomes without a targeted educational or behavioral intervention. The results of the bivariate analysis of research variables using the independent sample t-test before and after between groups can be seen in Table IV

The analysis in Table IV seen significant differences in the changes in tooth brushing behavior and oral hygiene between the intervention and control groups, as determined by an independent sample t-test (p<0.001). The mean score for tooth brushing behavior in the intervention group after the intervention was 1.04 + 0.940, substantially higher than the control group's mean score of 0.15 + 0.929. This indicates that the intervention group demonstrated a significant improvement in tooth brushing behavior compared to the control group. The mean oral hygiene score in the intervention group was -24.19 + 10.837, much lower (indicating better oral hygiene) than the control group's mean score of 1.62 + 6.634. This suggests that the intervention was effective in improving oral hygiene outcomes compared to the control group, where no notable improvement was observed.

DISCUSSION

The data seen several trends among children with intellectual disabilities in the intervention and control groups. The predominance of males in both groups (76.93% in the intervention group and 69.23% in the control group) can be explained by genetic and biological factors. Recent research confirms that intellectual disabilities are more prevalent in males, potentially due to X-linked genetic disorders and inherent differences in male neurodevelopmental pathways [22,23]. The age distribution, with a majority of children in the 14-17 years range followed by the 10-13 years range, could be attributed to the typical stages of educational transitions. Intellectual disabilities often become more apparent during school years, particularly as academic and social demands increase. As highlighted by Gutman et al. [24], early adolescence is a critical period for identifying and addressing developmental delays, which explains the clustering of interventions during these years [24]. The age range in this study (6 to 20 years old) does not impact the findings, as chronological age is not the primary factor in determining the effectiveness of the intervention. Instead, the study focuses on the social age of children with intellectual disabilities, which reflects their cognitive and adaptive functioning rather than their actual age. Therefore, differences in chronological age do not introduce significant variability in the study outcomes. The social age related to cognitive and adaptive behavior in this study aligns with the classification of children with intellectual disabilities into two categories: educable and trainable, as assessed by the school.

Educational trends show that most children in the intervention group attend Special Needs Junior High School (53.85%), whereas the control group is evenly distributed across different educational levels. This indicates a strategic focus on junior high school interventions, aligning with the findings of Kuntz and Carter [25], who emphasize that targeted interventions during middle school years can significantly improve cognitive and social outcomes for children with intellectual disabilities [25].

Regarding capability, the intervention group has a higher proportion of children classified as "able to train" (57.69%), suggesting that intervention programs are better at identifying

and enhancing the abilities of children with higher functional potential. This aligns with research by Schalock et al. [26], which highlights the importance of individualized support plans in maximizing the developmental potential of children with intellectual disabilities [26]. Finally, the presence of dental crowding in all participants, predominantly mild cases, reflects common dental issues in this population. Recent studies, such as those, have noted a higher prevalence of dental problems among children with intellectual disabilities due to factors like poor oral hygiene, limited access to dental care, and behavioral challenges [27]. This underscores the necessity for comprehensive health care services within educational programs to address the holistic needs of these children [28].

The data indicates significant improvements in both tooth brushing behavior and oral hygiene among participants in the intervention group following the implementation of the educational model. The increase in the mean score for tooth brushing behavior from 23.46 ± 4.810 to 29.52 + 2.506 ($p<0.001$) suggests a substantial enhancement in the participants' ability to perform proper tooth brushing. This improvement is likely attributable to the tailored oral health education provided during the intervention, which may have included practical demonstrations, interactive activities, and regular reinforcement, helping participants internalize and apply effective brushing techniques.

Similarly, oral hygiene scores showed a significant improvement, with the mean score decreasing from 43.92 ± 9.055 to 19.73 ± 5.977 post-intervention ($p<0.001$). This reduction reflects enhanced plaque control and overall oral cleanliness. The educational model likely addressed critical areas such as the importance of oral hygiene, correct brushing methods, and consistent practice, which collectively contributed to better oral health outcomes.

Recent research supports these findings. For, a study by Aljafari et al. [29] demonstrated that customized oral health education programs significantly improve oral hygiene behaviors and outcomes, particularly when they incorporate engaging and interactive elements [29]. Additionally, recent research found that educational interventions effectively enhance oral hygiene practices and reduce plaque levels in children with special needs [30]. Both studies emphasize the critical role of tailored, interactive education in fostering sustainable improvements in oral health behaviors and outcomes, aligning with the results observed in this intervention [31].

The analysis of the control group's data shows a slight increase in the mean score for tooth brushing behavior from 21.40 ± 5.097 to 22.38 + 2.561, with $p > 0.205$, indicating that this change is not statistically significant ($p > 0.05$). This suggests that the observed minor improvement is likely due to natural variations or the minimal impact of general routines rather than any specific intervention. The lack of a structured and focused educational approach in the control group likely contributed to the minimal improvement in tooth brushing behavior. Similarly, the oral hygiene mean score showed a negligible increase from 41.12 ± 8.262 to 42.73 + 7.917, with $p > 0.226$, indicating no statistically significant change ($p > 0.05$). This reflects that the oral hygiene conditions in the control group remained effectively unchanged. The absence of a targeted intervention or educational program likely prevented any meaningful improvement in oral hygiene, as standard care routines alone were insufficient to induce significant changes.

These findings are consistent with recent studies. For instance, Das et al. [32] found that routine dental care practices without targeted educational interventions resulted in minimal improvements in oral health behaviors and outcomes [32]. Similarly, a study, emphasized that structured, interactive oral health education programs are crucial for achieving significant and lasting improvements in oral hygiene, particularly among populations with specific needs [33]. Both studies highlight the importance of tailored educational approaches to foster meaningful changes in oral health behaviors, reinforcing the observed lack of improvement in the control group [34].

Significant differences between the intervention and control groups regarding both tooth brushing behavior and oral hygiene, with a $p<0.001$. The intervention group demonstrated considerable improvements in both areas compared to the control group, which did not show significant changes. The mean score for tooth brushing behavior in the intervention group post-intervention was 1.04 + 0.940, significantly higher than the control group's post-intervention

score of 0.15 + 0.929. This difference indicates that the intervention was effective in significantly enhancing tooth brushing behavior in the intervention group. The substantial improvement is likely due to the educational model provided, which likely incorporated interactive learning, hands-on demonstrations, and consistent reinforcement of proper brushing techniques, helping participants internalize and apply effective tooth brushing habits.

The positive impact of such interventions aligns with findings in recent research. According to a study, interactive and tailored oral health education programs significantly improve tooth brushing behavior, particularly among children with intellectual disabilities [35]. The structured educational approach was found to help participants learn and maintain effective oral hygiene habits [36]. Similarly, a study, demonstrated that tailored oral health education, especially when it involves active engagement and continuous feedback, can lead to significant improvements in the adoption of proper tooth brushing techniques [37]. The mean oral hygiene score in the intervention group was -24.19 + 10.837, which was substantially lower (indicating better oral hygiene) compared to the control group's score of 1.62 + 6.634. This difference suggests that the intervention group had significantly better oral hygiene after the intervention, likely due to more effective plaque control and adherence to recommended oral hygiene practices, facilitated by the structured education provided.

This result is consistent with findings from recent studies. For a study, highlighted that targeted educational interventions that focus on plaque control and oral hygiene techniques result in significant improvements in oral hygiene, especially when participants receive personalized guidance [38]. Another study, emphasized the importance of continuous education and the use of individualized strategies to improve oral hygiene behaviors and outcomes, particularly in children with intellectual disabilities [39]. Additionally, findings by Surija et al. [10] reinforce the importance of parental education in managing the oral health of children with intellectual disabilities. This underscores the critical role of equipping parents with adequate knowledge and tools to support the oral health of their children effectively [10].

The results suggest that the "Tell-Show-Feel-Do" model effectively enhances oral hygiene behavior in children with intellectual disabilities. These findings can be applied in special education settings, dental health programs, and caregiver training to improve long-term oral health outcomes for this population. Integrating this method into school curricula and community health programs may lead to sustained improvements in dental hygiene practices, reducing the risk of oral diseases.

The study has a direct impact on the lives of children with intellectual disabilities by promoting better oral health, which contributes to their overall well-being and quality of life. Improved oral hygiene reduces the risk of dental issues, enhances self-care abilities, and fosters greater independence in daily routines, ultimately improving their general health and social inclusion.

The 21-day study period was designed to assess the short-term effectiveness of the intervention in improving brushing behavior and oral hygiene, focusing on immediate behavioral changes rather than long-term habit maintenance. Previous studies have shown that short-term educational interventions can lead to meaningful improvements in health behaviors. To reinforce learning at home, parental involvement was emphasized by providing caregivers with instructional materials and practical demonstrations. They were encouraged to monitor and assist their children in brushing daily and to provide feedback on their progress, helping extend the impact of the intervention beyond the study period.

The limitations of this study include the varying needs and abilities of children with intellectual disabilities, as communication and comprehension challenges may have influenced the outcomes. Parental involvement, environmental factors, and the consistency of education also played a role. Additionally, some children required familiarity and multiple interactions before they were willing to participate fully. Another limitation is the relatively short 21-day follow-up period, which may not fully capture long-term habit retention. While the intervention effectively improved brushing behavior and oral hygiene, extended monitoring in future research could provide deeper insights

into the sustainability of these behavioral changes and long-term adherence.

CONCLUSION

This research demonstrates that an oral health education model significantly improves tooth brushing behavior and oral hygiene among children with intellectual disabilities. The intervention group, receiving structured and tailored education, showed substantial improvements compared to the control group, which had minimal changes. The results emphasize the effectiveness of personalized, interactive teaching strategies in enhancing tooth brushing habits and oral hygiene. These findings underscore the importance of targeted oral health education programs for this population, promoting better oral health and overall well-being. Future research should explore the long-term effects and potential adaptations to further enhance such interventions.

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Author's Contributions

MFS: was responsible for the overall concept and design of the study, data collection, and analysis. We conducted the intervention sessions, assessed the outcomes, and were primarily responsible for writing the manuscript, including drafting the introduction, methods, results, and discussion sections. Additionally, reviewed and revised the manuscript based on feedback from the co-authors. HK: provided guidance throughout the research process, including refining the research design, methodology, and data analysis approach. As the corresponding author, handled the manuscript submission, communication with the journal, and ensured that all necessary revisions were completed. Author 2 also contributed to the critical revision of the manuscript, particularly in the discussion and conclusion sections. LH: played a key role in providing methodological and analytical support, offering suggestions for improving the study's design and execution. Contributed to the interpretation of the results and the final revision of the manuscript. Author 3 also assisted in ensuring the scientific accuracy and relevance of the content related to the education model used in the study. SK: supported the overall direction of the research and provided expert advice in the area of oral health education and its application in children with intellectual disabilities. instrumental in reviewing the manuscript, providing feedback on the content, and assisting with the final revisions to ensure the clarity and completeness of the manuscript.

Conflict of Interest

The authors have thoroughly reviewed and confirmed that there are no conflicts of interest arising from this review. They have diligently ensured that personal, financial, and professional relationships do not influence the objectivity or integrity of their work. This commitment to transparency and ethical standards underscores the credibility and reliability of the findings and conclusions. "The authors have no conflicts of interest to declare."

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enhancing oral hygiene and well-being in this vulnerable population.

Regulatory Statement

This study was conducted in accordance with all provisions of the local human subjects oversight committee guidelines and policies of the Ethics Committee of the Faculty of Dentistry - Prof. Soedomo Dental Hospital, Universitas Gadjah Mada. The study protocol was reviewed and approved by the Ethics Committee, with approval number 149/UNI/KEP/FKG-RSGM/EC/2024. This ethical approval ensures that the study complies with established standards for research involving human participants.

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