Impact of educational methods on the oral health literacy of Brazilian adolescents

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Received on November 3, 2024 **Accepted on November 11, 2025**

Abstract:
The assessment of oral health literacy (OHL) provides information that allows processing and understanding the presence of gaps in patients' basic health knowledge. This is a pre-post intervention study that evaluated the impact of educational approaches on the OHL level of adolescents aged 12 to 14 years from two private schools in São Paulo, Brazil. The sample consisted of 166 participants, who were divided into Group 1 (n = 45), who attended a lecture on oral hygiene; Group 2 (n = 44), who played an interactive educational game; Group 3 (n = 44), who participated in the oral hygiene lecture followed by the interactive game; and Group 4 (n = 33), who received no intervention. The BREALD-30 tool measured literacy initially (T0) and one month after the interventions (T1). OHL scores improved in Groups 1, 2, and 3 by 7%, 11.2%, and 16.4%, respectively. Pearson's test correlated the mean scores, and one-way ANOVA measured the influence of each educational method on OHL. The Chi-square test was used to verify differences in the distribution of gender and school grade among the groups. The correlation test showed a robust coefficient ($r = 0.80$) for each group at the analyzed times. Analysis of variance indicated mean differences ($p < 0.05$) for the groups that received interventions when comparing T0 and T1. However, no significance ($p > 0.05$) occurred between groups and gender and between groups and school grades. The educational measures effectively increased OHL scores, and the lecture followed by the game was the best intervention.
Keywords: Educational measurement, Health literacy, Health promotion, Oral health.

Impacto de métodos educacionais na alfabetização em saúde bucal de adolescentes brasileiros

Resumo:
A avaliação da literacia em saúde bucal (LSB) fornece informações que permitem processar e compreender a presença de lacunas no conhecimento básico de saúde dos pacientes. Trata-se de um estudo pré-pós intervenção que avaliou o impacto de abordagens educacionais no nível de LSB de adolescentes de 12 a 14 anos de duas escolas particulares de São Paulo, Brasil. A amostra foi composta por 166 participantes, os quais foram divididos em Grupo 1 (n = 45), assistiram a uma palestra sobre higiene bucal; Grupo 2 (n = 44), jogaram um jogo interativo educativo; Grupo 3 (n = 44), participaram da palestra sobre higiene bucal seguida do jogo interativo; e Grupo 4 (n = 33), não receberam nenhuma intervenção. A ferramenta BREALD-30 mediu a alfabetização inicialmente (T0) e um mês após as intervenções (T1). Os escores de LSB melhoraram nos Grupos 1, 2 e 3 em 7%, 11,2% e 16,4%, respectivamente. O teste de Pearson correlacionou as pontuações médias, e a ANOVA unidirecional mediu a influência de cada método educacional na LSB. O teste qui-quadrado foi utilizado para verificar diferenças na distribuição de gênero e série escolar entre os grupos. O teste de correlação mostrou um coeficiente robusto (r = 0,80) para cada grupo nos tempos analisados. A análise de variância indicou diferenças médias (p < 0,05) para os grupos que receberam intervenções ao comparar T0 e T1. No entanto, nenhuma significância (p > 0,05) ocorreu entre grupos e gênero e entre grupos e séries escolares. As medidas educacionais aumentaram efetivamente as pontuações da LSB, e a palestra seguida do jogo foi a melhor intervenção.
Palavras-chave: Medição educacional, Alfabetização em saúde, Promoção da saúde, Saúde bucal.

Impacto de los métodos educativos en la alfabetización en salud bucal de los adolescentes brasileños

Resumen:
La evaluación de alfabetización en salud bucal (ASB) proporciona información que permite procesar y comprender la presencia de lagunas en los conocimientos básicos de salud de los pacientes. És un estudio de intervención pre-post que evaluó el impacto de los enfoques educativos en el nivel ALB de adolescentes de 12 a 14 años de dos escuelas privadas de São Paulo, Brasil. La muestra é compuesta por 166 participantes, quienes fueron divididos en el Grupo 1 (n = 45), asistieron a una charla sobre higiene bucal; El grupo 2 (n = 44) jugó un juego educativo interactivo; El grupo 3 (n = 44) participó de la charla sobre higiene bucal seguida del juego interactivo; y el Grupo 4 (n = 33), no recibió ninguna intervención. La herramienta BREALD-30 midió la alfabetización inicialmente (T0) y un mes después de las intervenciones (T1). Las puntuaciones de ALB mejoraron en los Grupos 1, 2 y 3 en un 7%, 11,2% y 16,4%, respectivamente. La prueba de Pearson correlacionó las puntuaciones medias y el ANOVA unidireccional midió la influencia de cada método educativo en la ASB. Se utilizó la prueba de chi-cuadrado para verificar las diferencias en la distribución de género y grado escolar entre los grupos. La prueba de correlación mostró un coeficiente robusto (r = 0,80) para cada grupo en los tiempos analizados. El análisis de varianza indicó diferencias de medias (p < 0,05) para los grupos que recibieron intervenciones al comparar T0 y T1. Sin embargo, no se produjo significación (p > 0,05) entre los grupos y el género ni entre los grupos y los grados escolares. Las medidas educativas aumentaron efectivamente las puntuaciones de ASB y la conferencia seguida del juego fue la mejor intervención.
Palabras clave: Medición educativa, Alfabetización en salud, Promoción de la salud, Salud bucal.

INTRODUCTION

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) states that 773 million people in the global young and adult populations are not fully literate (UNESCO, 2023). However, even literate individuals may have difficulties understanding information, primarily from medical or health-related texts. The lack of knowledge of medical terms can cause an absence of self-care and even the onset of disease in individuals and their families (DAVIS *et al.*, 2006). Therefore, health literacy is the ability to perceive, manage, and understand information about health care and services to maintain adequate health conditions (NATIONAL INSTITUTE OF DENTAL AND CRANIOFACIAL RESEARCH, NATIONAL INSTITUTE OF HEALTH, U.S. PUBLIC HEALTH SERVICE, DEPARTMENT OF HEALTH AND HUMAN SERVICES, 2005).

Health literacy can be divided into three levels: basic functional - patients understand medical forms and medication labels; communicative interactive - patients communicate their health issues and actively participate in self-care decisions; critical literacy - patients critically analyze the validity and reliability of health information received from a provider or the media (NUTBEAM, 2000).

Numerous methods are available to estimate health literacy in a population, including the Rapid Estimation of Adult Literacy in Dentistry, or REALD-30 (LEE *et al.*, 2007). It is a two-minute test consisting of 30 oral health-related words that patients read aloud, scoring one point for each word read without hesitation and with correct pronunciation and intonation (LEE *et al.*, 2007). This tool may quantify health literacy levels and the impact of educational or intervention measures on the health literacy of a population, including Brazilian (JUNKES *et al.*, 2015). Although the BREALD-30 was initially developed and tested with adults, De Lima *et al.* (2019) have demonstrated that the BREALD-30 is a reliable instrument for measuring the OHL of adolescents.

Although insufficient, health education is an effective method for disease prevention and involves health promotion (SURYASA *et al.*, 2022). Populations may use combined practices to acquire and change habits towards recovering and maintaining good health with quality of life benefits (AMIRI *et al.*, 2024). Among several educational options, health teams must consider the age group, demographics, and cultural background of the target population, continuously adjusting the approach according to the subjects (WHO, 2012).

Proposing age-appropriate activities, especially for promoting the health of children and adolescents, is vital for educational activity outcomes. Actions that stimulate intellectual, social, and emotional connections are highly effective in promoting health and habit changes in adolescents (ALVES; ORTOLANI, 2022).

Therefore, this study aimed to measure the initial level of OHL in an adolescent sample and evaluate the efficacy of educational approaches in improving OHL scores. The null hypothesis was the lack of differences between the groups subjected to interventions.

MATERIAL AND METHODS

Ethical aspects

The Institutional Research Ethics Committee approved this study under opinion n. CAAE 46652021.1.0000.5512, opinion no. 4937216. All participants consented to the study, and their parents or guardians signed an informed consent form.

Study design and sample

It was a pre-post intervention study that investigated adolescents of both gender, aged between 12 and 14 years, from two private schools on the outskirts of São Paulo, Brazil. A convenience sample of 166 adolescents was achieved from an initial population of 400 students.

The inclusion criteria were individuals enrolled in either 6th or 7th grades (equivalent to years 7 and 8 of the British Curriculum), native Brazilian Portuguese speakers without cognitive, visual, auditory, or speech impairments, attending school at the initial OHL screening (T0) and rescreening one month later (T1), participating in the proposed educational activity, and whose parents or guardians had signed the consent form.

The subjects were listed alphabetically and divided by four to form unbiased groups with participants from both grades: Group 1 (n = 45), which watched a ten-minute lecture

about oral hygiene and cariogenic diet; Group 2 (n = 44), subdivided into four subgroups of 11 students and guided by an examiner to play a board game (Oral Health Rowing game) (CASSEB *et al.*, 2020) consisting of discussion points about oral health practices; Group 3 (n = 44), which participated in the ten-minute lecture followed by the board game, and subdivided as in Group 2; Group 4 (n = 33), the control group, assessed at T0 and T1 without interventions. However, the participants were invited to the lecture and board game after the OHL screening at T1.

The data was collected between February and September 2021, when school access and student attendance were limited due to the COVID-19 pandemic.

OHL measurement

The OHL of the sample was measured by submitting all students to the BREALD-30 tool (JUNKES *et al.*, 2015) (Brazilian Portuguese translated and culturally adapted version of the REALD-306), an interview-based test that required participants to read aloud 30 flashcards, each containing one health-related word arranged in increasing order of difficulty. The participant sat individually in a designated classroom, 1 m from the examiner, and had two minutes to read the words. Each word read naturally and correctly scored one point, and mispronounced words scored none. The subjects were also encouraged to refrain from trying to read or guess the pronunciation of a word they did not recognize.

Two pre-trained examiners calibrated for investigating OHL with the BREALD-30 conducted the tests at T0 and T1 (Intra-rater agreement was calculated as Intraclass Correlation Coefficient (ICC) ≥ 0.97 [95% confidence interval (95%CI): 0.92–0.99]; inter-rater agreement was calculated as Cohen's Kappa = 0.92; both meant an excellent level of agreement).

Statistical analysis

The scores were collected at T0 and T1 and tabulated in Microsoft Excel® 2010 (Microsoft Corporation, Redmond, USA). Pearson's correlation test correlated the mean scores of the groups, and one-way ANOVA measured the influence of each educational method on the OHL of each group. The Chi-square test was used to verify whether there

were statistically significant differences in the distribution of gender and school grade among the groups. All tests ran on Statistica software, version 13.5 (TIBCO, Palo Alto, USA).

RESULTS

The participants included 82 women and 84 men, and the mean age was 12.43 with a 0.74 standard deviation (SD). The average household income was BRL 6,000.00.

Considering the outcomes of the three intervention methods, the educational lecture alone (Group 1) improved the mean OHL score by nearly 7%. Comparatively, the board game alone (Group 2) increased the score by 11.2%, and the association between both methods (Group 3) improved the mean literacy of the group by 16.4%.

Pearson's correlation test correlated the mean literacy scores for each group at T0 and at T1, showing a robust coefficient ($r = 0.80$). One-way ANOVA showed statistical significance, with $p < 0.05$ for groups that received interventions (Table 1). Group 4 (control) did not show significant changes in pre and post-test scores among OHL assessments ($p > 0.05$).

Table 1 - Analysis of variance findings for mean OHL scores among adolescents of two private schools on the outskirts of São Paulo, Brazil, in T0 and T1 (n = 166).

		T0				T1				
Group	**n**	**Mean**	**SD**	**Min.**	**Max.**	**Mean**	**SD**	**Min.**	**Max.**	**p-value***
1	45	23.35	2.21	19	27	24.97	2.57	20	29	**0.001**
2	44	22.9	3.64	9	27	25.47	3.65	15	30	**< 0.001**
3	44	21.93	4.71	11	27	25.52	3.94	16	30	**< 0.001**
4	33	20.66	2.7	15	27	21.21	2.77	15	27	0.420
Total	166	22.32	3.6	9	27	24.5	3.56	15	30	-

Note: SD – standard deviation; Min. – minimum; Max. – maximum. Bold values are statistically significant (*one-way ANOVA, $p < 0.05$).
Source: Authors.

Regarding the distribution of gender and school grade among the groups, no statistically significant differences were found ($p > 0.05$), as shown in Table 2.

Table 2 - Distribution of gender and school grade among adolescents from two private schools on the outskirts of São Paulo, Brazil, according to intervention group (n = 166).

Variables		Group 1 (n = 45)		Group 2 (n = 44)		Group 3 (n = 44)		Group 4 (n = 33)		p-value*
		n	%	n	%	n	%	n	%	
Gender	Male	22	48.9	23	52.8	21	47.7	16	48.5	
	Female	23	51.1	21	47.7	23	52.3	17	51.5	0.976
School grade	6th grade	22	48.9	25	56.8	23	52.3	18	54.5	0.896
	7th grade	23	51.1	19	43.2	21	47.7	15	45.4	

*Chi-square test, $p < 0.05$.
Source: Authors.

DISCUSSION

The null hypothesis of this study was rejected because the findings indicated the effectiveness of educational interventions for improving OHL scores in the sample of adolescents. The data analysis revealed that an educational lecture associated with a ludic board game most significantly improved OHL scores, followed by the board game and the educational lecture, individually. That may suggest that age-adapted audio-visual health education increases OHL levels more than traditional methods, as the literature corroborates. Cheung and Ng (2021), for instance, investigated the use of an educational game to enhance student learning effectiveness. The authors concluded that gamification combined with traditional learning methods improves student learning outcomes.

Besides highlighting the utility of games in health literacy interventions, this study also supports the life course analysis theory of the social determinants of health. Life course analysis is a sociological framework emphasizing that age, social structures, and historical changes shape life decisions and behaviors (ELDER; JOHNSON, 2003). Moreover, health promotion strategies should use the available and popular tools among the target

population, such as games, social interaction, technology, and social media, to optimize (oral) literacy.

Studies on OHL are relatively recent, but the literature presents sufficient evidence to sustain the relationship between low OHL scores and the clinical incidence of caries (NEVES *et al.*, 2023) and periodontal disease (BADO *et al.*, 2022). Specifically with adolescents, Neves *et al.* (2020) conducted a cross-sectional study with 740 12-year-old students, concluding that a low OHL was a cavitated caries lesion predictor in early adolescence.

However, literacy impacts the self-care practices of individuals and those under their care (ADIL *et al.*, 2020; BASKARADOSS *et al.*, 2019; MARTINS *et al.*, 2021). For example, Silva *et al.* (2024), in a cross-sectional study conducted with 135 elementary school student-parent dyads, suggested that children and parents have high agreement on oral health knowledge. Vichayanrat *et al.* (2014) found that maternal OHL was directly related to their children's oral health. The authors stated that the higher the literacy score, the fewer the carious lesions. They also connected higher OHL levels to more frequent annual dental visits and higher treatment compliance.

Many authors have highlighted the impact of collective educational actions as an essential health promotion tool (RIBEIRO *et al.*, 2024). The plaque index (LLOCLLA-SAUÑE *et al.*, 2024) and DMFT (SANAEINASAB *et al.*, 2022) score of adolescents decreased after applying an oral health education measure. Regarding educational strategies, traditional methods such as school hygiene lectures have knowingly benefited adolescent oral health (ATIF *et al.*, 2024). However, recent literature shows that more efficient activities should be age-specific, and technology and social media are great allies for using education to promote oral health (ALVES; ORTOLANI, 2022; ELDER; JOHNSON, 2003).

The BREALD-30 (JUNKES *et al.*, 2015) was the tool selected for this research, and its relevant use in previous Dentistry studies must be considered, even when applied to adolescents (DE LIMA *et al.*, 2019; NEVES *et al.*, 2021b; LOPES *et al.*, 2023), showing satisfactory psychometric properties for the Brazilian population and fast, simple, and reliable OHL measurement (DE LIMA *et al.*, 2019).

The present literature has a gap in the knowledge of oral health promotion, OHL, and oral health. Studies show a positive relationship between health promotion and oral

health status improvement, and the current literature shows a positive connection between low OHL and high dental plaque index and DMFT, as suggested in this discussion. More recent studies, including the present one, have also correlated oral health promotion and OHL improvement, but oral health promotion research will benefit from further publications linking the impact of educational approaches to the literacy score of populations and clinical outcomes.

It is essential to consider the socioeconomic factors influencing health when examining adolescents' OHL, although, in the present study, this was not the focus. The development of health literacy is directly influenced by factors such as socioeconomic status, education systems, access to healthcare services, and living conditions. According to the literature, individuals from more vulnerable populations, such as those from families with lower education levels and limited resources, are more likely to exhibit lower OHL levels (ASSUNÇÃO *et al*., 2022; GOMES *et al*., 2024).

In the context of this study, educational approaches that combine interactive games and informational materials may be more effective for populations with greater access to resources, such as students in private schools. However, the practical implications of these approaches in other social and cultural contexts must be considered. In communities with limited access to technology or where linguistic barriers exist, more traditional methods and simple resources, such as printed materials or community-based interactive approaches, may be more appropriate.

Moreover, educational interventions must be tailored to the cultural specificities of each social group. Elder and Johnson (2003) suggest that health promotion strategies should integrate life course analysis and the examination of socioeconomic health determinants, ensuring that health messages are both culturally relevant and accessible. In more vulnerable contexts, it is crucial for interventions to consider local health practices and beliefs while adapting educational methods to enhance the effectiveness and responsiveness of the approach.

Ultimately, health education should extend beyond immediate actions to incorporate public policies that address social inequalities and promote more equitable access to healthcare. Developing more inclusive strategies can help ensure that oral health

promotion campaigns are more effective across diverse social and cultural contexts, improving OHL levels and, ultimately, clinical outcomes for the broader population.

The present findings allow an outline of an oral health education protocol for different age groups and socio-cultural backgrounds to increase OHL scores, which has decreased the clinical incidence of caries and periodontal disease. Moreover, it was evaluated the impact of a traditional method (oral hygiene lecture) associated with an interactive board game, showing significant OHL improvement in the study group. Further investigation should use technology with mobile applications and social media because the target population is inserted in this universe.

Nevertheless, the limitations of this study must be considered. The main limitation is the use of a convenience sample composed exclusively of adolescents enrolled in private schools. This sampling approach may restrict the generalizability of the findings, given that school context, socioeconomic status, and prior access to oral health information directly influence health literacy (NUTBEAM, 2000). Evidence suggests that adolescents attending public schools may present different needs, barriers, and perceptions regarding oral health, which may impact the effectiveness of educational interventions (NEVES *et al.*, 2021a). Therefore, caution is advised when extrapolating the results. Future research involving larger and more heterogeneous samples that reflect the educational and social diversity of the Brazilian population is strongly recommended.

CONCLUSION

Educational methods effectively improved oral health literacy. Applying a board game associated with a hygiene instruction lecture to the surveyed adolescents was more effective for increasing the sample's literacy scores than the other educational interventions. Conversely, the absence of educational measures did not show improvements, and only the lecture caused the most discrete score increase.

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