

Changes in Knowledge and Oral Hygiene After Educational Interventions Conducted at an Educational Center in Managua, Nicaragua *

Cambios en conocimientos e higiene bucal tras intervenciones educativas realizadas en un centro educativo de Managua, Nicaragua

Mudanças no conhecimento e na higiene bucal após intervenções educativas realizadas em um centro educacional em Manágua, Nicarágua

María Mercedes Castro Sánchez ^a
Universidad Americana. Managua, Nicaragua
maria.castro@uamv.edu.ni
<https://orcid.org/0009-0001-9479-9188>

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Juan Ramón Vanegas Sáenz ^a
Universidad Americana. Managua, Nicaragua
Tohoku University. Sendai, Japan
juan.vanegas@uamv.edu.ni; juan.vanegas.a1@tohoku.ac.jp
<https://orcid.org/0000-0001-9735-0872>

Authors' Note: ^a **Correspondence:** juan.vanegas@uamv.edu.ni; juan.vanegas.a1@tohoku.ac.jp; maria.castro@uamv.edu.ni

ABSTRACT

Background: Despite the growing awareness of the importance of general and oral health through educational interventions, there are still gaps in understanding and implementing effective strategies to address health issues in specific groups of population. Therefore, it is necessary to assess the effect of such interventions. **Purpose:** To assess the effect of educational interventions on general and oral health conducted with students of the Eduardo Contreras Educational Center in Managua, Nicaragua. **Methods:** We conducted a study with a quasi-experimental design. It focused on assessing knowledge about general and oral health through a questionnaire and oral hygiene skills through the O'Leary index of students of the Eduardo Contreras Educational Center in Residential Las Colinas, Managua. Assessments were performed before and after the educational intervention. **Results:** 174 students participated in the study. The students' average knowledge scores about general and oral health before and after the educational intervention were 9.66 and 10.76 points, respectively ($p < 0.001$). O'Leary index averages before and after the intervention was 28.28 % and 12.98 %, respectively, with a difference of 15.3 % ($p < 0.001$). **Conclusions:** Knowledge increased, and dental plaque decreased after implementing the educational interventions among the students of the Eduardo Contreras Educational Center who participated in the study. The findings suggested the interventions were successful.

Keywords: dental health education; dental hygiene; dental plaque index; dentistry; educational intervention; health education; knowledge; Managua; Nicaragua; oral health; oral health knowledge

RESUMEN

Antecedentes: A pesar de la creciente conciencia sobre la importancia de la salud general y bucal a través de intervenciones educativas, todavía existen lagunas en la comprensión e implementación de estrategias efectivas para abordar los problemas de salud. Por tanto, es necesario evaluar el efecto de dichas intervenciones en grupos específicos de población. **Objetivo:** Evaluar el efecto de intervenciones educativas sobre la salud general y bucal realizadas con estudiantes del Centro Educativo Eduardo Contreras de Managua, Nicaragua. **Métodos:** Se realizó un estudio de diseño cuasiexperimental, que se centró en evaluar conocimientos sobre salud general y bucal a través de un cuestionario y habilidades de higiene bucal a través del

índice O'Leary de los estudiantes del Centro Educativo Eduardo Contreras del Residencial Las Colinas, Managua. Las evaluaciones se realizaron antes y después de la intervención educativa. **Resultados:** Participaron en el estudio 174 estudiantes. Los puntajes promedio de conocimientos de los estudiantes sobre salud general y bucal antes y después de la intervención educativa fueron de 9,66 y 10,76 puntos, respectivamente ($p < 0,001$). El promedio del índice de O'Leary antes y después de la intervención fue de 28,28 % y 12,98 %, respectivamente, con una diferencia de 15,3 % ($p < 0,001$). **Conclusiones:** Los conocimientos aumentaron y la placa dental disminuyó después de implementar las intervenciones educativas entre los estudiantes del Centro Educativo Eduardo Contreras que participaron en el estudio. Los hallazgos sugirieron que las intervenciones fueron exitosas.

Palabras Clave: conocimiento en salud bucal; conocimientos; educación en salud; educación en salud oral; higiene oral; índice de placa dental; intervención educativa; Managua; Nicaragua; odontología; salud bucal

RESUMO

Antecedentes: Apesar da crescente consciência da importância da saúde geral e oral através de intervenções educativas, ainda existem lacunas na compreensão e implementação de estratégias eficazes para abordar questões de saúde. Portanto, é necessário avaliar o efeito de tais intervenções em grupos específicos da população. **Objetivo:** Avaliar o efeito das intervenções educativas sobre a saúde geral e bucal realizadas no Centro Educacional Eduardo Contreras em Manágua, Nicarágua. **Métodos:** Foi realizado um estudo de desenho quase experimental. O foco foi medir o conhecimento sobre saúde geral e bucal por meio de um questionário e habilidades de higiene bucal por meio do índice O'Leary de alunos do Centro Educacional Eduardo Contreras no Residencial Las Colinas, Manágua. As avaliações foram realizadas antes e após a intervenção educativa. **Resultados:** Participaram do estudo 174 estudantes. A média dos escores de conhecimento dos estudantes sobre saúde geral e bucal antes e depois da intervenção educativa foi de 9,66 e 10,76 pontos, respectivamente ($p < 0,001$). As médias do índice de O'Leary antes e depois da intervenção foram de 28,28% e 12,98%, respectivamente, com diferença de 15,3% ($p < 0,001$). **Conclusões:** O conhecimento aumentou e a placa dentária diminuiu após a implementação das intervenções educativas entre os alunos do Centro Educacional Eduardo Contreras que participaram do estudo. Os resultados sugeriram que as intervenções foram bem-sucedidas.

Palavras-chave: conhecimento; conhecimento em saúde bucal; educação em saúde bucal; higiene dental; índice de placa dentária; intervenção educativa; educação em saúde; Manágua; Nicarágua; odontologia; saúde bucal

INTRODUCTION

Good health is essential for personal, economic, and social progress. Oral diseases, such as dental caries and gingivitis, constitute an important public health problem due to their high prevalence and impact on individuals and society. Many of the risk factors associated with oral diseases arise from inadequate habits and lifestyle acquired over time (1,2). Health promotion is a global process that seeks to improve individual and collective health by modifying social, environmental, and economic conditions (3). Within health promotion, health education is recognized by the World Health Organization (WHO), which defines it as the transmission of information and the promotion of motivation, personal skills, and self-esteem necessary to adopt measures that improve health from preventive, health promotion, and appropriate use perspectives of health resources (4).

Over time, there have been significant changes in the understanding of health and the factors that can affect it both at the individual level and in populations (5). Health education is a process that informs, motivates, and helps people to adopt and maintain healthy lifestyles and practices. It is essential to start health promotion, education, and preventive activities from an early age to thwart the appearance or to stop the progression of oral diseases (6,7).

The importance of oral health should not be underestimated, as it affects physical, emotional, psychological, and socioeconomic well-being at the individual, interpersonal, community and social levels (8). Until now, dentistry has mainly focused on treating existing oral diseases, unlike other health disciplines that follow children from birth to prevent diseases and improve their quality of life. It is common for parents to seek care only when a child has cavities or dental pain (9,10).

Several studies establish the need to continually implement school programs to promote general and oral health through educational interventions at an early age, to improve the oral health knowledge of

the student population (11-15). Such educational interventions have the purpose of informing and motivating the population to adopt and maintain healthy practices, in addition to promoting environmental changes and directing the training of human resources and research (16). The types of interventions in health promotion and education at the local level include counseling and advice, individual, group or collective health education, information and communication, among others (17,18). When intervention programs are executed correctly, they are capable of generating positive changes in the way children think and act in relation to general and oral health (19,20).

Health education is a multidisciplinary task, a social commitment that all health personnel acquire, which is why at the Dental School of the American University of Nicaragua (UAM), students from their freshman year conduct health education interventions in public and/or private educational centers. Accepted knowledge about eating habits and general and oral hygiene are essential for individuals or groups to perform activities to avoid the onset of a number of chronic diseases. UAM's focus is to reduce risk factors, deliver practical content, and work in teams to achieve learning, assimilation, motivation, action, and favorable changes from children's early age. Thus, as part of instructional activities, it is necessary to assess the effect of such interventions, particularly, when they are implemented by dental students at educational institutions. Assessment should ensure that health promotion strategies are effective and adapted to the needs of a population, in this case, schoolchildren (2,4,6-8,12,16,17,19,20).

This study aimed to assess the effect of educational interventions on general and oral health carried out by dental students studying Dentistry at the UAM, specifically in the student population of the Eduardo Contreras Educational Center. The study focused on the following objectives: a) To assess knowledge about lifestyles, personal and oral hygiene of children before educational interventions and the O'Leary index. b) To implement educational interventions about general and oral health adapted to the context and needs of the students of the educational center. c) To assess the impact of such interventions on the knowledge and O'Leary index of the schoolchildren.

The results obtained in this study offer valuable information to design effective oral health promotion programs, thus contributing to improving the oral health of the children's population in the future. Furthermore, it establishes a reference for subsequent research projects and intervention programs by the UAM. This starting point is not only essential for improving oral health in the child population but will also play a central role in the ongoing evaluation of similar educational programs, providing a valuable framework for comparisons and analysis in future research.

MATERIALS AND METHODS

We conducted a study with a quasi-experimental design at the Eduardo Contreras Educational Center located in Residencial Las Colinas, city of Managua, Nicaragua. The universe consisted of 540 elementary school students enrolled at the center in 2022. All third-to-sixth-grade students made up the population of study, that was, 233 children. The sample size (minimum) was calculated through the OpenEpi® software. The expected result was unknown, but it was estimated that 50 % of the results were positive and 50 % were negative. The standard error determined was 5 % and the confidence level was 95 %. The minimum sample size was estimated at 146 children. As a selection criterion, all parents and their children enrolled at the educational center were invited to participate and to give their consent to voluntarily participate in the study. A total of 174 students accepted to participate. Table 1 summarizes the variables analyzed in the study.

TABLE 1
Variables in the Study. Source: the authors.

Variable	Type of Variable	Definition	Indicator	Value
Knowledge about general and oral health	Qualitative	It is the individual's ability to use reason after having gone through the teaching-learning phenomenon about the concepts of general and oral health, which have been transmitted explicitly through counselors.	Questionnaire	Expressed in points and classified in: Good (8-12) Regular (5-7) Poor (0-4)
O'Leary Index	Qualitative	Simple control procedure that allows measuring the presence or absence of dental plaque on the smooth surfaces of the teeth. (21,22)	O'Leary Index	Expressed in percentage and classified in: Good Poor

Educational Intervention Activities

An initial assessment of the children's general and oral health knowledge was performed, as well as oral hygiene through the O'Leary index. Based on this evaluation, specific educational interventions were designed in the areas of general and oral health.

The intervention plan was conducted using health education program of the UMA Dental School as a framework and targeted preschool and elementary school students (grades 1 to 6) of the Eduardo Contreras Educational Center in Managua, Nicaragua, though the study focused on third to sixth graders. First-year students of the dental program implemented the interventions with guidance from professors of the Health Education course.

For the implementation of the educational interventions, dental students organized groups of 4-6 children each. The interventions included planning and execution of various techniques, tailored by the students. Dental students met six times with the participants and covered topics, such as eating habits and physical activity, personal hygiene, oral hygiene, tooth brushing and flossing techniques, and topical fluoride application (Table 2). To guarantee direct monitoring of the children's motor skills, all activities were performed individually, establishing a direct interaction between the dental students and the participants. This setting promoted a collaborative learning and personalized environment.

The dental students used diverse techniques, which they adapted according to the initial knowledge and the number of children per section. The dental students used games as instructional strategies for effectiveness and motivation, including word searches, crossword puzzles, and riddles. In addition, images and drawings facilitated content acquisition and retention. Other techniques allowed children to put into practice what they learned through talks and practical activities, such as hand washing and toothbrushing. Resources included blackboards, models created by the students, and typodonts (dental models). After the educational interventions, additional assessment of knowledge acquisition and change about general and oral health through a questionnaire and oral hygiene using the O'Leary index were applied.

TABLE 2
Health Education Program Planning. Source: the authors.

I	Planning activity #1	Introduction - identify educational needs First assessment
II	Activity #1	
III	Planning activity #2	Eating habits - physical activity habits
IV	Activity #2	
V	Planning activity #3	Personal hygiene habits
VI	Activity #3	
VII	Planning activity #4	Oral hygiene habits (flossing, brushing, and rinsing)
VIII	Activity #4	
IX	Planning activity #5	Brushing and topical fluoride application
X	Activity #5	
XI	Planning activity #6	Conclusions - farewell Second assessment
XII	Activity #6	

Knowledge Assessment

Data collection was carried out by applying an online questionnaire (2,19,23) that was created through the Google Forms platform (Google Inc., USA) to third to sixth graders to identify knowledge degree in relation to lifestyles and personal and oral hygiene. The questionnaire consisted of 12 multiple-choice questions on general and oral health, preventive measures, lifestyles, and the most common oral diseases. For each question questionnaire, a 12-point answer key was created, and the degree of knowledge was established as: Good: 8-12 points; Medium: 5 -7 points; Poor: 0-4 points.

O'Leary Index

In the first meeting with the participants, oral hygiene was assessed using the O'Leary Index. This index assesses the amount of dental plaque on dental surfaces. To make the plaque visible, the dental students used a DiTonos® biofilm developer (EUFAR, Colombia) that was applied and dissolved in the children's mouths to stain those tooth surfaces with biofilm accumulation. Only smooth dental surfaces were considered (mesial, buccal, distal, and lingual/palatal). Premolar and molar occlusal surfaces were not excluded in the index calculation. The pigmented areas were visualized and registered on an instrument for data collection. The index was calculated (in percentage) by dividing the number of dyed surfaces by the total number of surfaces and multiplying it by one hundred. Recent research shows that if the index is $\pm 20\%$, oral hygiene is considered good, and the risk of dental caries is lower (21,24). Only data of those children who completed all the activities of the educational intervention were included in the analysis, which allowed us to compare knowledge and oral hygiene before and after of the intervention.

Data Processing and Statistical Analysis

All the data collected were organized and summarized in tables and figures with absolute and relative frequencies for subsequent analysis and interpretation, using Microsoft Excel® software (Microsoft, USA) The Student's t-test was calculated with the JASP® software (University of Amsterdam, Netherlands) to

determine if there were statistically significant differences between the initial and final assessments of knowledge and oral hygiene. P values lower than 0.05 were considered statistically significant.

RESULTS

The educational health interventions were performed with first-year students of Dentistry and supervised by the instructors of the “Health Education” course. The program was successfully implemented at the Eduardo Contreras Educational Center in the city of Managua, Nicaragua (Figure 1).



FIGURE 1

Health Education Interventions at the Eduardo Contreras Educational Center. Source: the authors.

A total of 174 schoolchildren participated in the program. Participation was higher in the first assessment than in the second, regarding both knowledge (172 v. 133) and the O’Leary index for oral hygiene (174 v. 157). The average age of children in the study was 9.71 years, with a relatively homogeneous gender distribution with 52.5 % females and 47.5 % males. The distribution of children according to their academic grades prior to the educational intervention is presented in Figure 2.

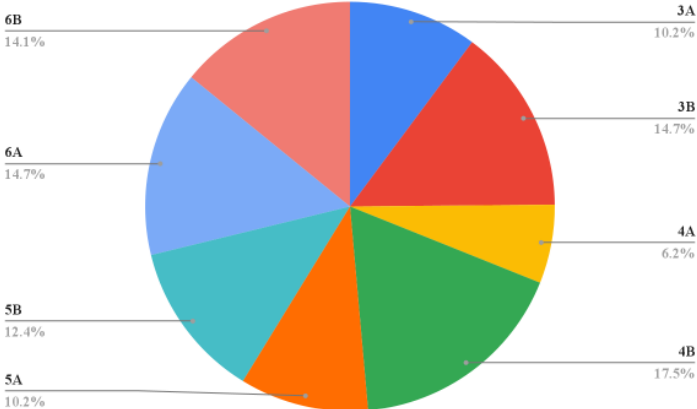


FIGURE 2

Distribution of Participants According to Grade (3 to 6) the Eduardo Contreras Educational Center according to grade. A and B represent specific classrooms. Source: the authors.

Figure 3 shows the distribution of scores on the level of knowledge in general and oral health of the schoolchildren surveyed. Before the intervention, the average score was 9.66 points (172 students surveyed), and after the intervention, the average score was 10.76 points (133 students surveyed). The Student’s t-test of paired samples revealed significant differences in the level of knowledge before and after the educational intervention ($p < 0.001$) (Table 3).

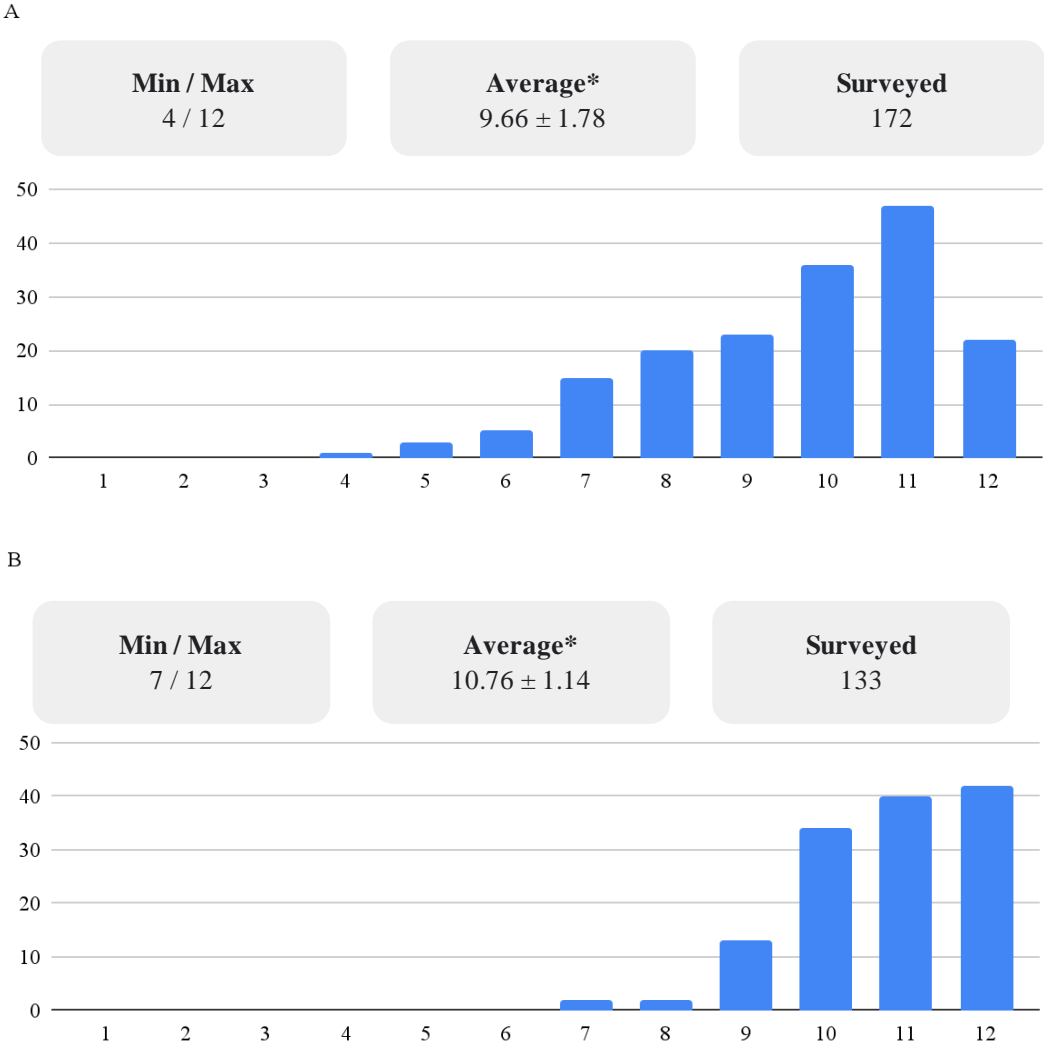


FIGURE 3

Scores on the level of knowledge about general and oral health among the schoolchildren before (A) and after (B) the oral health intervention ($p < 0.001$). Source: the authors.

TABLE 3

Student t-test of paired samples on the level of knowledge about general and oral health before and after the intervention

Measure 1	Measure 2	t	df	p
Initial score	Final score	- 7.290	98	< .001

Source: the authors.

Table 3 shows the distribution of the average O’Leary Index of the 3rd to 6th grader, before and after the educational intervention. Overall, a decrease in the O’Leary index was observed in all students by grade after the educational intervention. A difference of 15.3 % was found between the average of the O’Leary index before and after the educational intervention ($p < 0.001$) (Table 4) (Figure 5).

TABLE 4
Average O’Leary Index (%) of the 3rd to 6th graders before and after the intervention, by classroom

Grade-Classroom	n	Before	SD	n	After	SD
3A	18	28.85	11.20	15	12.55	3.30
3B	26	22.71	16.90	25	20.98	14.60
4A	11	48.86	28.10	11	10.63	8.40
4B	29	17.40	7.50	27	6.39	4.70
5A	17	44.28	17.60	15	18.91	14.80
5B	22	34.05	18.50	17	6.65	1.50
6A	26	28.80	21.30	22	18.84	11.10
6B	25	20.72	11.60	25	8.96	4.80
Total	174	28.28	18.80	157	12.98	10.70

Source: the authors.

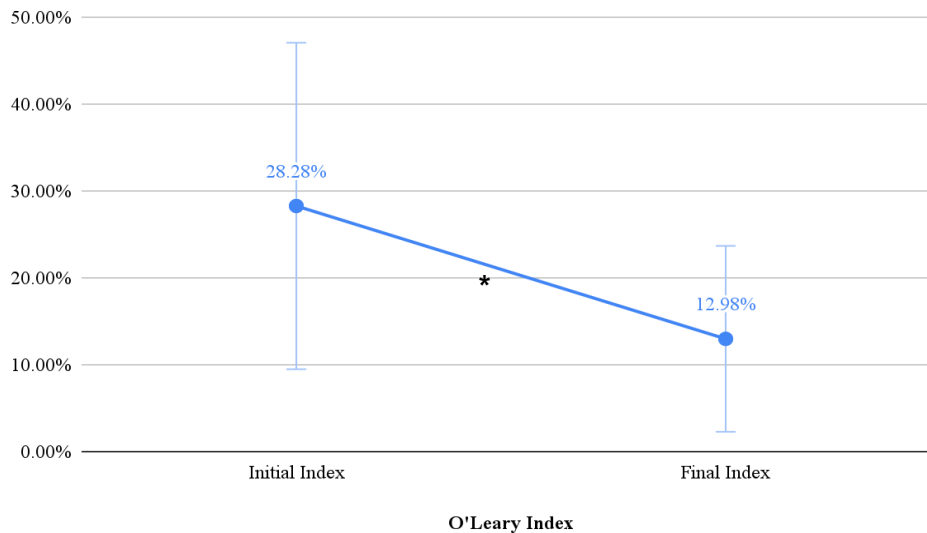


FIGURE 5
Average O’Leary Index of the 3rd to 6th graders before and after the intervention

TABLE 4
Student t-test of paired samples of the O’Leary Index before and after the intervention

Measure 1	Measure 2	t	df	p
Initial Index	Final Index	11.013	155	< .001

Source: the authors.

DISCUSSION

Educational interventions in public health are considered a fundamental part of the health processes of every society, whose aim is to promote healthy lifestyle habits, prevent diseases, and improve the quality of life of the population (16). In this perspective, it is not only essential to conduct such interventions, but also to continually assess their impact to regularly refine public health programs. This study presents the educational interventions on general and oral health performed by students of the Health Education course of the UAM Dental School and assesses their effect regarding the level of knowledge and oral hygiene as measured with the O'Leary Index of schoolchildren attending the Eduardo Educational Center Contreras, in Managua, Nicaragua.

A maximum participation of 174 schoolchildren from the educational center was achieved, which is 28 more than estimated through sample calculations. However, after the educational intervention, a decrease in participation was observed when measured the level of knowledge and the O'Leary Index, going from 172 to 133 children and from 174 to 157 schoolers, respectively. This decrease was attributed to enrollment withdrawals and absences during the intervention and post-intervention assessment sessions. The overall average age of the participant children was 9.71 years, with a balanced distribution by sex, which was in accordance with the classrooms included in the present study.

Oral health, which is influenced by social, economic, political, and environmental factors, benefit from education from an early age by promoting the development of healthy habits through lifespan (9,25). Within the framework of the Health Education course at UAM, our study assessed the knowledge of general and oral health of the schoolchildren of the Eduardo Contreras Educational Center. A significant increase in the average score was observed, from 9.66 to 10.76, after the intervention ($p < 0.001$). This result suggests the continuous knowledge gained on health after three years of educational interventions at this center. Similar results have been observed in previous studies, such as the educational program by Soto, *et al.* (19), which achieved meaningful improvements in knowledge about brushing and the causes of gum disease in sixth graders. Another study by Suárez, *et al.* (28), showed an increase in knowledge from 88.4 % to 97.6 % in fourth grader students after an educational intervention. Ariza, *et al.* (29), highlighted deficiencies in oral hygiene habits in primary school students, underscoring the need for dental-based information to improve knowledge transfer. The importance of oral health education from an early age has been supported by various studies (12,19,23,26-29). Our study adds to this evidence, highlighting the positive effect on the knowledge and oral hygiene of students after the educational intervention at the Eduardo Contreras Educational Center.

It should be noted that a positive aspect derived from the use of the O'Leary Index in this study was the significant contribution to the children's educational process. Although an O'Leary Index of less than 20 % does not guarantee the complete absence of dental caries, it does serve as a potential indicator of a lower risk. However, it is important to remember that other factors, such as diet and genetics, also play a role in overall dental health. The addition of the disclosing substance not only made it easier to identify areas with dental plaque, but also improved the children's understanding of the importance of good oral hygiene. This didactic approach not only translated into a notable decrease of 15.3 % in the O'Leary Index, reducing plaque from 28.28 % to 12.98 % after the educational intervention ($p < 0.001$), but also promoted learning about healthy oral care practices. In this way, the use of the O'Leary Index not only emerges as an effective tool to assess oral health, but also serves as a valuable motivational strategy to strengthen the education and awareness of children in relation to oral hygiene (6).

Our study supports the notion that oral health education can improve students' understanding of the importance of oral health and promote appropriate oral hygiene practices throughout their lives. These findings underscore the continued need for oral health educational programs to promote healthy habits and prevent oral diseases in the student population.

Despite these positive results, it is important to recognize limitations, such as the decrease in student participation during the later stages of the intervention and the absence of a control group. This absence was primarily due to ethical considerations, as creating a control group that did not receive oral health education could have had a negative impact on the long-term oral health of those students. On the other hand, in this study, a specific indicator, the O'Leary index, was used to measure skills in children at a given time. However, it is crucial to highlight the importance of future research that expands the assessment by incorporating additional risk indicators, such as the Caries Severity Index (IGS) and Caries Management by Risk Assessment (CAMBRA) studies (30). This expansion will allow for a more complete and accurate understanding of the skills acquired over time. These limitations point to the need for future research with more robust experimental approaches.

CONCLUSIONS AND RECOMMENDATION

In this study, the effect of educational interventions on knowledge about general and oral health conducted by dental students at the Eduardo Contreras Educational Center was investigated.

The results show a meaningful improvement in schoolchildren's knowledge of general and oral health after the intervention, highlighting the value of education in promoting healthy lifestyles. Furthermore, we found a significant decrease in the O'Leary index, indicating an improvement in the students' oral hygiene after the intervention.

Despite the lack of a control group due to ethical considerations, these findings support the effectiveness of educational interventions in improving oral hygiene and knowledge in this population. However, it is important to highlight the need for future research that addresses this question with a more robust experimental approach. In summary, this study highlights the importance of general and oral health education as an effective tool to improve the health and lifestyle of the school population.

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