Original Article

Effectiveness of Behavioral Vaccine on the Oral Health of Children in Komarapalayam, South India: A Randomized Controlled Pilot Trial

Umamaheswari N, Sharath Asokan[1], Thangakumaran S[2]

Department of Pediatric Dentistry, J.K.K. Nataraja Dental College and Hospital, Komarapalayam, [1]Department of Pediatric Dentistry, K.S.R Institute of Dental Science and Research, Tiruchengode, [2]Department of Periodontology and Oral Implantology, J.K.K. Nataraja Dental College and Hospital, Komarapalayam, Tamil Nadu, India

Abstract

Background: Oral health education and promotion have emerged as a strong force against the traditional, dominant, and curative model of health practice. In pediatric dentistry, the utilization of an entertaining, easy to understand, and practical educational material is warranted. Behavioral vaccine is a simple, scientifically proven practice that is repeated to increase well-being. **Aim:** The aim of this study is to compare the effectiveness of conventional (instructional) dental hygiene program and "Good Behavior Game" (GBG) (contingency dental hygiene program – a behavioral vaccine) on the practice of oral hygiene among 5–7-year-old schoolchildren. **Study Design:** A total of sixty children aged 5–7 years were divided into two groups. Each group had thirty children. **Materials and Methods:** A pretest estimation of debris index-simplified (DI-S) was carried out. Children in Group A were given oral health education through instructional oral hygiene program. Children in Group B were allowed to participate in GBG daily for a week. The DI-S was recorded on the 8th day and 3 months after the intervention in both the groups. **Results:** In Group B, the good oral hygiene score dramatically increased from 10% to 93.3% 1 week after the intervention. There was a relative decrease in percentage of children who scored fair and poor also. At the end of 3-month follow-up, 90% of children had good oral hygiene. In Group A, there was a significant improvement in oral hygiene after 1 week, but it was not significant after 3 months. **Conclusion:** The present study was undertaken to advance the area of behavioral vaccine as an alternative for teaching basic oral health concepts in children. In this study, the GBG was found to be an effective intervention aid for educating children.

Keywords: *Behavioral vaccine, conventional health education, Good Behavior Game*

Introduction

Oral health educational programs have been considered as an important and integral part of oral health policies for a long time. There has been a serious lack of experimentally verified, effective dental hygiene programs in the schools. The most frequently implemented school dental health education program consists of a lecture and demonstration through models, charts, or video tapes.[1] Extensive reviews on such oral health education programs have shown that they were relatively ineffective on the cleanliness of the children's teeth.[1-3] Despite their ineffectiveness, these programs continue to be the major form of dental education provided in the schools. Instructions contain discriminative stimuli which signal the occurrence of instruction-following behaviors.[4] Instruction-following behaviors (e.g., effective tooth brushing) are operants and as such to be maintained they must be reinforced. Thus, behavior modification principles have much to offer in producing compliance with dental hygiene instructions. Behavior modification has been used in a children's oral hygiene program by Stacey *et al.* At a summer camp, children were reinforced with toys and activities to maintain good oral hygiene. Moderately effective results were obtained regarding the improvement of their oral hygiene skills.[5] Sprod *et al*., 1996 suggested that health promotion in schools conducted in a comprehensive and interesting way might benefit the oral health status of the children.[6]

Behavioral vaccine is a simple, scientifically proven practice that is repeated to increase well-being. The hallmark of behavioral vaccine is that a simple action yields large results and is typically very inexpensive. A historical example of a behavioral vaccine is the use of antiseptics in hand washing by the doctors and medical students reduced

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Address for correspondence:
Dr. Umamaheswari N, Department of Pediatric Dentistry, J.K.K. Nataraja Dental College and Hospital, P.B.No: 151, Natarajapuram, NH-47 (Salem to Coimbatore), Komarapalayam, Namakkal - 638 183, Tamil Nadu, India.
E-mail: umsipedo@rediffmail.com

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the mortality rate of mothers who died due to childbed fever in the maternity ward.[7] In the current scenario, diseases with high levels of morbidity, such as dental caries, cry out for a low-cost, widespread behavioral intervention. In public health, universal programs are usually the strategic first line of defense; such as chlorine in drinking water, fluoride in toothpaste, and vaccines against influenza.[8]

Good Behavior Game (GBG) is a universal intervention which is cost-effective, easy to implement behavioral procedure from applied behavior analysis. Barrish *et al.* thought disruptive, disagreeable behaviors by students might happen because peers and others somehow reinforced them in school settings. Perhaps, the smiles, giggles, laughs, and even pointed taunting from other students were reinforcing the high rate of the behaviors that teachers found so difficult to handle or harmful to the learning process. In this context and time, the graduate students and senior scientists reasoned that some kind of group-based reward for inhibiting negative behavior might be a boon for classrooms. The idea for the GBG was born.[9] The GBG reinforces good habits in schoolchildren. There is a substantial research to consider its use as a behavioral vaccine. The GBG has been considered as the "best practice" for the prevention of substance abuse or violent behavior. GBG is unique because it is implemented by individual teachers in elementary schools and has been documented to have long-term effects. The Game is the simplest of behavioral strategies. The Game has procedures for how to play in certain circumstances, how to keep it exciting, how to improve generalization, and how to solve problems.[10] The Game might be one of the most cost-beneficial prevention strategies available for schools and other settings. Games can be used as an innovative and challenging educational tool. They have long been used as a teaching strategy in both child and adult education, promoting self-learning and participation. By involving repetition and allowing important points to be reiterated, games appear to increase retention and application.[11]

In dentistry, certain simple-to-apply behavioral interventions do confer some sort of "immunity" against multifactorial diseases such as dental caries. Swain *et al*. designed the school-based "Tooth Brushing Game" and assessed the effectiveness of tooth brushing skills of Grade 1 and 2 children. They concluded that the "Good Toothbrushing Game" produced more effective tooth brushing behavior and greatly increased the effectiveness of children's oral hygiene skills. Thus, proper implementation of behavioral principles is essential to the success of oral hygiene programs.[12] Hence, the present study was planned to compare the effectiveness of conventional (instructional) dental hygiene program and "GBG" (contingency dental hygiene program – a behavioral vaccine) on the practice of oral hygiene among 5–7-year-old children. The rationale for the study was to advance the area of oral health intervention by proper implementation of behavioral principles in game-based teaching, which the conventional intervention program does not focus and behavioral vaccine as an alternative for teaching basic oral health concepts in younger children.

Materials and Methods

A randomized controlled intervention study was carried out after the study protocol was analyzed and approved by the Institutional Review Board of J.K.K. Nataraja Dental College and Hospital. The study followed the Declaration of Helsinki, 1975 revised in 2000. Written consent was obtained from the parents of all the participating children. The study was conducted in an elementary school in Komarapalayam, Tamil Nadu, India. The school had 128 children aged 5–7 years. Among them, sixty children were randomly selected for the study using a software-generated table of random numbers. These sixty children were again randomly assigned into thirty children to Group A – the conventional health education group – and thirty children to Group B – the (GBG) group. To have a uniform assessment criteria and minimum variability during the clinical examination, four undergraduate dental students (interns) and two dental hygienists were trained by the investigators/authors of this project. The oral hygiene status was assessed by the primary investigator using the debris index-simplified (DI-S) proposed by Greene and Vermillion and modified by Greene. It was estimated by running the side of the explorer along the tooth surface being examined. Six selected index teeth and six surfaces were considered for the estimation of DI-S. The score ranged from 0 to 3. A group of children were selected and examined for DI-S. Twenty percent of the children were reexamined on successive days to check for the reliability. The kappa statistics score for inter-examiner variability was 0.8 and for intra-examiner variability was 0.9. The baseline oral health examination was done by the dental students and dental hygienists in the school premises under standard aseptic conditions in the broad daylight.

The dental health education followed the oral examination. Thirty children in Group A were given oral health education through instructional dental hygiene program, i.e., conventional teaching method once daily for 7 days. The undergraduate dental students under the supervision of two investigators carried out the educational approach. A 20-min lecture on oral health, brushing technique, healthy snacking, and diet was delivered. The dental students were trained for the presentation before delivering the lecture in the school. A contingency dental hygiene program was designed for thirty children in Group B, and they were allowed to participate in the "GBG." First, all the behaviors needed to establish good oral health such as twice a day brushing; regular dental checkup was listed out to these children. These were labeled as "Good oral health behavior we all want." The behaviors that would interfere with the

desirable outcomes were labeled as "fouls," i.e., "Bad oral health behavior we all need to quit" (e.g., How many times should brush your teeth daily? Once). Second, examples of both were presented visually in a large poster format. Children in this group were divided into six teams, five children per team. A specially designed pro forma with 10 closed-ended questionnaires regarding oral health behavior was used. It was recorded for each team by a calibrated interviewer. Each question was scored as 0 ("foul" wrong answer) or 1 (correct answer), and hence, the total score ranged from 0 to 10. The team with fewer fouls, i.e., more good behavior, has happened would win the game. Winning teams received rewards as material reinforcers. A daily scoreboard is highly visible, just like the scoreboard of baseball or football, with fouls much smaller than wins. The investigator explained the rules for the game and they were allowed to play once daily for a week. The children in both the groups were assessed for the DI-S on the 8th day of the program. A follow-up score was also recorded after 3 months. The resulting data were coded and analyzed to assess inter-group differences. Chi-square test and Paired *t*-test (SPSS version 17, SPSS Statistics For Windows, Version 17.0.Chicago: SPSS Inc) were used to evaluate the association between the variables. $P \leq 0.05$ was considered statistically significant, and $P \leq 0.001$ was considered highly significant.

Results

Table 1 shows the changes in the DI-S score inference in both Group A and Group B in two periods: 1 week and 3 months after the intervention. In Group B, the good oral hygiene score dramatically increased from baseline and 1 week after the intervention. There was a relative decrease in the fair and poor debris scores also. At the end of 3-month follow-up, 90% of children had good oral hygiene. The scores were well above the baseline. There was no significant difference in the DI-S score in both the time periods in Group A. Table 2 shows the comparison of the mean DI-S among children in Group A and Group B at baseline, post-1 week, post-3 months. There was a highly significant difference in the mean score in Group B. In Group A, there was a significant improvement in oral hygiene after 1 week, but it was not significant after 3 months.

Discussion

Over the last few decades, health education and promotion have emerged as a strong force against the traditional, dominant, and curative model of health practices. This strategy aims at reducing the differences in the health status of people. It ensures equal opportunities to all to achieve their fullest health potential.[13] Henceforth, health educational interventions began to focus more on health promotion strategies. In pediatric dentistry, health education actions should address the process of enabling children to improve their oral health. This can be achieved by providing them with knowledge concerning the prevailing oral health problems and methods for their prevention and control. It also provides them with the skills, social support, and environmental reinforcement they need to adopt long-term healthy behaviors.[14] The utilization of an entertaining, easy to understand, and practical educational material is warranted.

Currently, the society has two current operative definitions of the vaccine concept. In medicine, a vaccine is a preparation containing weakened or dead microbes of the kind that cause a particular disease administered to stimulate the immune system, protecting the individual from future exposure. In computer science, it is a software program that protects a computer from a virus or worm infection. Both the concepts can be extended to the behavioral realm. With a behavioral vaccine, a person might be exposed to a weakened behavioral risk, which could stimulate a protective response or a person might learn a protective program of behavior that attacks, dislodges, or protects against any exposure.[7]

Examples of behavioral vaccines from the injury control literature promoted in the 1960s and 1970s include the use of seat-belt use in adults and car seats for children. Like medical vaccines, behavioral vaccines can provide "herd immunity" as protection against behavioral contagion – a phenomenon well documented in behavioral and epidemiological science.

The GBG was first used in 1967 by Muriel Saunders in a class room setting. Later Muriel Saunders, Harriet Barrish and the professor and co-founder of applied-behavior analysis, Montrose Wolfe co-created the Good Behavior Game in 1969.[9] It involves concepts and principles of learning, including self-learning, cooperative learning,

Table 1: Comparison of the inferences of Debris Index-score in Group A and Group B at baseline, 1 week, and 3 months

Group	DI score inference	Baseline, *n* (%)	Post-1 week, *n* (%)	Post-3 months, *n* (%)	*P**
Group A	Good	4 (13.3)	9 (30)	7 (23.3)	0.088 (NS)
	Fair	24 (80)	21 (70)	23 (76.6)	
	Poor	2 (6.6)	0	0	
Group B	Good	3 (10)	28 (93.3)	27 (90)	<0.000** (HS)
	Fair	24 (80)	2 (6.6)	3 (10)	
	Poor	3 (10)	0	0	

NS: Not significant; HS: Highly significant; DI: Debris Index; *$P \leq 0.05$, **$P \leq 0.01$

Table 2: Comparison of mean Debris Index score in Group A and Group B at baseline, 1 week, and 3 months

Group	Time periods	Mean±SD of DI-S scores	*P**
Group A	Baseline-post-1 week	0.232±0.360	0.001** (S)
	Baseline-post-3 months	0.168±0.329	0.090 (NS)
Group B	Baseline-post-1 week	0.996±0.374	0.000** (HS)
	Baseline-post-3 months	0.966±0.375	0.000** (HS)

S: Significant; NS: Not significant; HS: Highly significant; SD: Standard deviation; DI-S: Debris index-simplified; *$P \leq 0.05$, **$P \leq 0.01$

and participation.[11] It is an adult-supervised education which relies on peers interacting, sharing, planning, and supporting each other.[4] It develops visual alertness, increases attention span, and assists with memory strategies and reasoning. Younger children (<8 years) remember more when participating in cooperative learning.[15,16] In didactic learning, a teacher delivers lecture to students and is mostly a one-way communication. This type of learning is more effective in older children. Hence, in this study, only children <8 years of age were included. The conventional health education program was more a didactic way of learning, and it may not be the best way of teaching younger children. According to the relativity theory of reinforcement, by Premack (1959), allowing the children to win and setting them up for success is key in the behavior change.[17] In our study, GBG-based oral health intervention program involved cooperative learning. It was found to be very effective than the instructional-based health education that was based on didactic learning.

Barrish *et al.* evaluated the effectiveness of the GBG on reducing out-of-seat behavior and talking-out behavior with 24 first-grade students. The results indicated a significant decrease in disruptive behavior. Talking-out behavior decreased from 96% to 19% and out-of-seat behavior was reduced from 82% to 9% during the intervention.[9] Joanne *et al*. showed that school-based contingency dental hygiene programs resulted in significant reductions of the plaque scores. In the present study, although the instructional-based dental hygiene program played a role in immediate reduction of debris score after 1 week, there is no significant reduction after 3-month follow-up. This indicated that the instructional-based dental hygiene program did not have long-term effect in imparting oral health education. However, GBG helped in significant reduction of the debris scores. The changes observed is a sign of improvement in the children's skills to control dental plaque accumulation, one of the essential biological factors associated with oral diseases. In addition, the follow-up data indicated that the oral hygiene status was maintained over a substantial period. The effect of the game was durable over time, and this is important to change the attitude of the child in maintaining good oral health. There are few limitations of the study such as inclusion of homogenous study population, relatively short-term study, and small sample size. Further research shall study the effects of the game on a larger sample for longer period and in children with characteristically poor oral health.

The present study was undertaken to advance the area of behavioral vaccine as an alternative for teaching basic oral health concepts in younger children. In this study, the "GBG" was found to be an effective intervention aid for teaching the basic oral health concepts compared to the conventional instructional method of teaching children.

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Conflicts of interest

There are no conflicts of interest.

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