



LOMA LINDA UNIVERSITY

Loma Linda University  
TheScholarsRepository@LLU: Digital  
Archive of Research, Scholarship &  
Creative Works

---

Loma Linda University Electronic Theses, Dissertations & Projects

---

6-2016

## Oral Health Education Intervention to Assess Oral Health Knowledge and Behavioral Change

Ryan Bakhshi Baker

Follow this and additional works at: <https://scholarsrepository.llu.edu/etd>



Part of the [Pediatric Dentistry and Pedodontics Commons](#)

---

### Recommended Citation

Baker, Ryan Bakhshi, "Oral Health Education Intervention to Assess Oral Health Knowledge and Behavioral Change" (2016). *Loma Linda University Electronic Theses, Dissertations & Projects*. 371.  
<https://scholarsrepository.llu.edu/etd/371>

This Thesis is brought to you for free and open access by TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works. It has been accepted for inclusion in Loma Linda University Electronic Theses, Dissertations & Projects by an authorized administrator of TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works. For more information, please contact [scholarsrepository@llu.edu](mailto:scholarsrepository@llu.edu).

LOMA LINDA UNIVERSITY  
School of Dentistry  
in conjunction with the  
Faculty of Graduate Studies

---

Oral Health Education Intervention to Assess Oral Health Knowledge and  
Behavioral Change

by

Ryan Bakhshi Baker

---

A Thesis submitted in partial satisfaction of  
the requirements for the degree  
Master of Science in Pediatric Dentistry

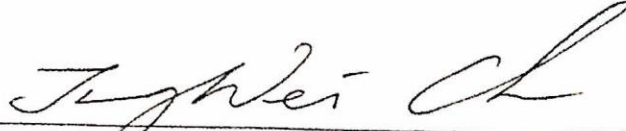
---

June 2016

© 2016

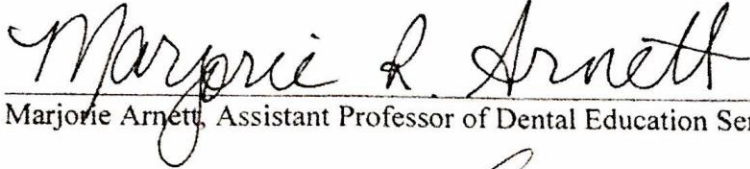
Ryan Bakhshi Baker  
All Rights Reserved

Each person whose signature appears below certifies that this thesis in his opinion is adequate, in scope and quality, as a thesis for the degree Master of Science.

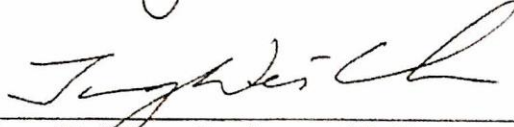


Jung-Wei Chen, Professor of Pediatric Dentistry

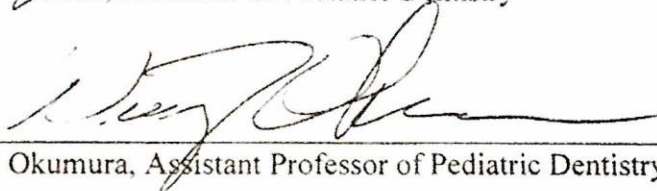
, Chairperson



Marjorie Arnett, Assistant Professor of Dental Education Services



Jung-Wei Chen, Professor of Pediatric Dentistry



Wesley Okumura, Assistant Professor of Pediatric Dentistry

## ACKNOWLEDGEMENTS

I would like to thank all of my committee members and outside reviewers for their help and support. I would also like to thank the four San Bernardino charter schools, which provided access to fifth and sixth grade students.

## CONTENT

Approval Page.....	iii
Acknowledgements.....	iv
List of Figures .....	vi
List of Tables .....	vii
List of Abbreviations .....	viii
Abstract.....	ix
Chapter	
1. Introduction.....	1
2. Materials and Methods.....	2
3. Results.....	9
4. Discussion.....	14
5. Conclusions.....	21
References.....	22

## FIGURES

Figures	Page
1. Interactive Oral Health Game .....	5

## TABLES

Tables	Page
1. Comparison of Pre- and Post-Intervention Survey Questions on Oral Health Behaviors, Oral Health Knowledge, and Diet/Amount of Sugar Consumed .....	4
2. Caries Status.....	7
3. Post-Intervention Satisfaction, Likelihood to Changes Sugar Eating Habits and Likelihood to Increase Brushing and Flossing.....	11
4. Correlations Between Caries Status and Pre-Intervention Survey Questions.....	12
5. Frequency Table.....	16



## ABBREVIATIONS

dmft	decayed, missing, filled teeth index
DMFT	Decayed, Missing, Filled Teeth Index
ICDAS	International Caries Detection Assessment System

## ABSTRACT OF THE THESIS

### Oral Health Education Intervention to Assess Oral Health Knowledge and Behavioral Change

by

Ryan Bakhshi Baker

Master of Science, Graduate Program in Pediatric Dentistry

Loma Linda University, June 2016

Dr. Jung-Wei Chen, Chairperson

The purpose of this study was to evaluate an oral health education intervention on oral health behaviors, oral health knowledge, and diet/amount of sugar consumed by fifth and sixth graders attending charter schools in the city of San Bernardino. Caries status of this particular population was recorded via dmft/DMFT and ICDAS.

143 students (aged 9-13 years) completed a 19 question pre-intervention survey related to oral health behaviors, dental knowledge and diet/amount of sugar consumed. Subjects then participated in an oral health education intervention comprised of an oral health education video and an interactive oral health game. An oral exam recorded caries status via dmft/DMFT and ICDAS. Four weeks later, subjects completed a post-intervention survey to assess the amount of information retained and satisfaction of the intervention. Data was analyzed using SPSS v23, and the level of significance was set as  $P<0.05$ .

Significant improvements were seen with daily brushing and flossing frequency and certain oral health knowledge concepts. Subjects had an average caries rate of 9% and an ICDAS average caries surface percent score of 8%. These percentages are very low considering the national average. ICDAS showed a strong correlation to specific oral

health behaviors and diet/amount of sugar consumed questions.

The oral health education intervention showed significant improvement in certain oral health behaviors and oral health knowledge concepts. The oral exam showed that this group of subjects had a low caries rate. Correlations were also noted between ICDAS and certain pre-intervention survey questions.

# **CHAPTER ONE**

## **INTRODUCTION**

Since the 1960s, many children have seen a decline in dental caries in their permanent teeth (1). Despite this, dental decay is still considered the most common chronic childhood disease in the United States, and can lead to significant consequences amongst children and adolescents (2,3). Dental decay affects all children, however, low socio-economic status (SES) children are at greater risk for developing dental decay (2,4).

San Bernardino is one of the poorest counties in the entire nation (5). Over 28% of children in San Bernardino County live in poverty (6). Typically, decreased health outcomes are associated with poverty (8). Children and adolescents from low SES families are affected the greatest by untreated dental caries (8). Many factors are to blame for these findings in low SES children, including limited access to dental care, poor diet/nutrition (9), and increased consumption of fermentable carbohydrates (8). Providing oral health education with an emphasis on hygiene habits and diet/nutrition is an important component to help inform children and adolescents of the consequences associated with poor oral health (8).

The purpose of this study was to evaluate the effect of an oral health education intervention on the oral health behaviors, oral health knowledge and diet/amount of sugar consumed by fifth and sixth graders (children 9-13 years of age) attending charter schools in the city of San Bernardino. This study also recorded the caries status seen amongst this particular population via the Decayed, Missing, Filled Teeth Index (dmft/DMFT) and International Caries Detection and Assessment System (ICDAS).

## **CHAPTER TWO**

### **MATERIALS AND METHODS**

A total of 170 fifth and sixth grade subjects were recruited from 4 different charter schools within the city of San Bernardino. The inclusion criteria included the subject's: 1) Ability to read/write without assistance, 2) their enrollment in fifth or sixth grade at one of four specific charter schools in the city of San Bernardino, 3) age range of 9 to 13 years, and 4) subjects must have been present for the pre-intervention survey, oral health education intervention, oral exam, and post-intervention survey. Exclusion criteria included: 1) Subjects not within the 9-13 year age range, 2) subjects who declined to take part in the study, and 3) subjects not present for both the pre- and post-intervention surveys.

This study was reviewed and approved by the Loma Linda University's Institutional Review Board (IRB # 5150120). Informed consent was obtained by parental permission and by minor assent.

To protect the identity of the subjects, each subject used their personal student identification number – a number assigned to each student at their respected school. The subjects wrote their student identification number on their pre-intervention survey, post-intervention survey, and on their oral exam sheet (dmft/DMFT and ICDAS). If the subject did not have a student identification number, they provided their first and last initials, and their birthday.

Prior to the start of the intervention, subjects completed a pre-intervention survey composed of 19 questions. Questions were specific to oral health behaviors, oral health

knowledge, oral pain and diet/amount of sugar consumed. The first question obtained minor assent (table 1).

<b>Table 1: Comparison of Pre- and Post-Intervention Survey Questions on Oral Health Behaviors, Oral Health Knowledge, Oral Pain, and Diet/Amount of Sugar Consumed</b>				
		<b>Pre-test</b>	<b>Post-test</b>	<b>P-Value</b>
		<b>N (%)</b>	<b>N (%)</b>	
<b>Oral Health Behavior:</b>				
Q4. Have you been to the dentist in the past year?	Yes	111 (77.6)	100 (69.9)	0.035*
	No	31 (21.7)	42 (29.6)	
	Missing	1 (0.7)	1 (0.7)	
Q5. Do you have your own toothbrush?	Yes	139 (97.2)	141 (98.6)	0.5
	No	3 (2.1)	1 (0.7)	
	Missing	1 (0.7)	1 (0.7)	
Q6. How many times do you brush your teeth each day?	0 times/day	2 (1.4)	0 (0)	0.006*
	1 times/day	29 (20.3)	18 (12.6)	
	2 times/day	80 (55.9)	90 (62.9)	
	3 or more times/day	31 (21.7)	34 (23.8)	
	Missing	1 (0.7)	1 (0.7)	
Q7. Do you share a toothbrush?	Yes	4 (2.8)	3 (2.1)	1
	No	135 (94.4)	139 (97.2)	
	Missing	4 (2.8)	1 (0.7)	
Q8. Do you have toothpaste?	Yes	138 (96.5)	140 (97.9)	0.25
	No	3 (2.1)	1 (0.7)	
	Missing	2 (1.4)	2 (1.4)	
Q9. How many times do you floss your teeth each day?	0 times/day	46 (32.2)	27 (18.9)	0.001*
	1 times/day	41 (28.7)	50 (35)	
	2 times/day	36 (25.2)	45 (31.5)	
	3 or more times/day	19 (13.3)	21 (14.7)	
	Missing	1 (0.7)	0 (0)	
<b>Oral Health Knowledge:</b>				
Q10. Dental Cavities that are not treated can make you sick?	True	97 (67.8)	103 (72)	0.371
	False	46 (32.2)	39 (27.5)	
	Missing	0 (0)	1 (0.7)	
Q11. Dental cavities can damage your adult teeth?	True	118 (82.5)	133 (93)	<0.001*
	False	24 (16.8)	8 (5.6)	
	Missing	1 (0.7)	2 (1.4)	
Q12. Dental cavities are an infection?	True	95 (66.4)	99 (69.2)	0.337
	False	47 (32.9)	39 (27.3)	
	Missing	1 (0.7)	5 (3.5)	

Q13. Soda, candy and other foods high in sugar can cause dental cavities?	True	140 (97.9)	140 (97.9)	1
	False	1 (0.7)	2 (1.4)	
	Missing	2 (1.4)	1 (0.7)	
Q14. Brushing can prevent dental cavities?	True	94 (65.7)	105 (73.4)	0.045*
	False	49 (34.3)	37 (25.9)	
	Missing	0 (0)	1 (0.7)	
<b>Oral Pain:</b>				
Q15. Do you have any oral pain right now?	Yes	20 (14)	22 (15.4)	0.491
	No	122 (85.3)	121 (84.6)	
	Missing	1 (0.7)	0 (0)	
<b>Diet/Nutrition Habits:</b>				
Q16. How many times/week do you eat candy?	0 times/week	25 (17.5)	29 (20.3)	0.066
	1-2 times/week	81 (56.6)	86 (60.1)	
	3-4 times/week	25 (17.5)	19 (13.3)	
	5 or more times/week	11 (7.7)	9 (6.3)	
	Missing	1 (0.7)	0 (0)	
Q17. How many times/week do you drink chocolate milk, soda, juice, sport, or energy drinks?	0 times/week	15 (10.5)	13 (9.1)	0.913
	1-2 times/week	72 (50.3)	74 (51.7)	
	3-4 times/week	30 (21)	33 (23.1)	
	5 or more times/week	25 (17.5)	23 (16.1)	
	Missing	1 (0.7)	0 (0)	
Q18. Do you like candy?	Yes	104 (72.7)	105 (73.4)	1
	No	38 (26.6)	37 (25.9)	
	Missing	1 (0.7)	1 (0.7)	
Q19. Do you like to drink chocolate milk, soda, juice, sport, or energy drinks?	Yes	114 (79.7)	119 (83.2)	0.481
	No	28 (19.6)	24 (16.8)	
	Missing	1 (0.7)	0 (0)	

After completion of the pre-intervention survey, the students watched a 13-minute oral health video (Title: *The Toothbug Samba*). This video, designed and created by Loma Linda University School of Dentistry, discussed the dental caries disease process, the negative impact of sugar consumption, good and bad food choices, and the importance of oral hygiene habits (e.g., proper brushing and flossing) to ensure optimal oral health. After completion of the oral health video, subjects took part in an interactive oral health game based on the video (figure 1). The game had subjects match healthy and

non-healthy food and beverage pictures to a poster board divided into two sections labeled “good dental health” and “bad dental health.”



**Figure 1.** Interactive Oral Health Game

The oral exam followed dmft/DMFT protocols based on modified WHO criteria.<sup>11</sup> For the ICDAS component, full ICDAS codes were used in accordance with ICDAS II criteria, which assigns codes for coronal caries ranging from 0 to 6 pending on the lesion’s severity (11,12), (table 2). The examiner was calibrated by assigning an ICDAS caries code to random pictures of caries over a 20-day period with a washout time of 24 hours. The pictures of caries were taken from a video tutorial located on the ICDAS website that had been assigned a caries code as part of the ICDAS tutorial. Using



Cronbach's alpha coefficient, the intra-rater reliability was calculated at 0.820, which demonstrated good internal consistency and acceptable test reliability.

One examiner conducted an oral exam and recorded each subject's dmft/DMFT and ICDAS at their respective school. Each subject was seated on a chair in daylight and faced away from direct sunlight. Prior to the start of the oral exam, the examiner cleaned the subject's dentition using a dry toothbrush for a period of 30 seconds. All oral exams were performed using an LED headlight. The examiner used a disposable dental mirror and explorer to record dmft/DMFT, and a disposable dental mirror with air from a mobile compressor unit (portable 6 gallon Porter Cable air compressor) to record ICDAS. Per ICDAS II criteria, each tooth surface was first assessed wet, then air dried for a period of 5 seconds and reexamined (12), (table 2).

Table 2: Caries Status					
	Mean	Median	Mode	Std. Deviation	Range
Total Tooth Number	24.72	24	24	1.92	20-28
dmft	1.27	0.00	0.00	2.05	0-8
DMFT	0.96	0.04	0.00	1.50	0-7
Average Caries Rate = (dmft + DMFT)/(Total Teeth)	9%	4%	0%	11%	0-50%
Total Tooth Surfaces	111.66	108	108	9.83	87-128
ICDAS = 0	102.62	102	102	10.74	72-128
ICDAS = 1	4.06	3	2	3.52	0-15
ICDAS = 2	3.94	0.00	0.00	3.56	0-16
ICDAS = 3	0.62	0.00	0.00	1.20	0-5
ICDAS = 4	0.05	0.00	0.00	0.30	0-3
ICDAS = 5	0.23	0.00	0.00	0.76	0-6
ICDAS = 6	0.22	0.00	0.00	1.00	0-7
ICDAS Average Caries Surface Percent Score (sum of ICDAS codes 1-6 carious surfaces/total tooth surfaces)	8%	7.4%	5%	5%	0-24%

ICDAS = 0: Sound tooth surface after air drying for 5 seconds; ICDAS = 1: First visual change in enamel seen only after 5 seconds of air drying (not wider than the pit/fissure); ICDAS = 2: Distinct visual change in enamel seen when wet (wider than the fissure/fossa); ICDAS = 3: Localized breakdown of enamel with no visible dentin; ICDAS = 4: Dark shadow underlying dentin with or without enamel breakdown); ICDAS = 5: Cavitation less than half the tooth surface with visible dentin; and ICDAS = 6: Cavitation involving more than half of the tooth with dentin

A post-intervention survey was completed exactly 4-weeks after the intervention. One study reported individuals retained ~88% of what they learn after a period of 4-weeks (13). Thus, this time frame was chosen for study participants to complete the post-intervention survey to assess the amount of information they retained from the oral health education intervention. The post-intervention survey contained the same pre-intervention survey questions with the addition of three questions (questions #20, #21 and #22), (table 3). These three questions assessed subject satisfaction, likelihood to change sugar eating habits, and likelihood to increase brushing and flossing. The post-intervention survey was called “oral health day” to avoid any confusion among the subjects.

The sample size and power analysis was conducted prior to the start of the study, and calculated at 0.81 using Software G-Power 3.1.7. Descriptive and inferential statistics were analyzed by using SPSS v23 software (SPSS Inc., 2015). All analyses were performed at the 5% significance level ( $P < 0.05$ ). Paired sample T-tests and Wilcoxon signed ranks test were used to compare the pre- and post-intervention surveys, and Pearson correlations were used to analyze dmft/DMFT and ICDAS to the pre-intervention survey questions.

## CHAPTER THREE

### RESULTS

A total of 170 subjects were initially enrolled in the study. However, only subjects who completed both the pre- and post-intervention surveys were included. Thus, a total of 143 subjects were included - 69 males (48.3%), 71 females (49.7%), and three unreported (2.1%), with a mean age of 10.6 years (range = 9-13 years). All subjects were recruited from fifth and sixth grade classes from four different charter schools in the city of San Bernardino.

The pre-intervention survey results regarding oral health behaviors showed most subjects had seen a dentist in the past year (77.6%), had their own toothbrush (97.2%) and toothpaste (96.5%), while 5.6% shared a toothbrush (table 1). Most subjects brushed their teeth 1-3 times/day (97.9%) and flossed their teeth 0-2 times/day (86.1%). The majority of subjects answered the oral health knowledge questions correctly, and most subjects reported they had no oral pain at the time (85.3%). Most subjects ate candy 1-2 times/week (56.6%), consumed sugary drinks 1-2 times/week (50.3%), liked candy (72.7%), and liked sugary drinks (79.7%). The post-intervention survey results closely matched the pre-intervention survey results (table 1).

Pre-intervention and post-intervention comparisons of subjects on oral health behaviors, oral health knowledge, oral pain, and diet/amount of sugar consumed were completed (table 1). With regard to the oral health behavior questions, a significant difference was noted with questions #4, #6 and #9. Questions #6 and #9 reported on the frequency of daily brushing and flossing habits, respectively (table 1). A significant increase was noted in the number of subjects who claimed to brush ( $P = 0.006$ , paired

sample T-test) and floss ( $P = 0.001$ , paired sample T test) their teeth two or more times per day and one or more times per day, respectively. After the oral health education intervention, it was clear subjects improved upon the frequency of their daily brushing and flossing habits. With regard to the oral health knowledge questions, table 1 showed that a significant increase was seen in the percentage of subjects that answered questions #11 and #14 correctly ( $P < 0.001$  and  $P = 0.028$ , respectively; Wilcoxon signed ranks test). While improvements were seen with almost all oral health knowledge questions, subjects showed significant improvement ( $P < 0.05$ ) in their level of understanding that dental cavities can damage adult teeth and brushing can prevent dental cavities.

The mean total tooth number present within the subject's oral cavity was  $24.7 \pm 1.92$ . The mean dmft for subjects was  $1.27 \pm 2.05$ . The mean DMFT for subjects was  $0.96 \pm 1.50$ . The mean total tooth surface for subjects was  $111.66 \pm 9.83$ . The data showed that subjects had an average caries rate (dmft + DMFT/total teeth present) of  $9\% \pm 11\%$  and an ICDAS average caries surface percent score (sum of ICDAS codes 1-6 carious surfaces/total tooth surfaces) of  $8\% \pm 5\%$  (table 2).

Table 3 showed results pertaining to post-intervention satisfaction (question #20), likelihood to decrease sugar eating habits (question #21), and likelihood to increase brushing and flossing (question #22). Most subjects were either satisfied (42%) or very satisfied (21.7%) with oral health day, either likely (35%) or very likely (20.3%) to change their sugar eating habits, and were either likely (42%) or very likely (40.6%) to increase their brushing and flossing. Questions #20, #21, and #22 were positively correlated with a high r-value.

Table 3: Post-Intervention Satisfaction, Likelihood to Change Sugar Eating Habits and Likelihood to Increase Brushing and Flossing							
	Unsatisfied	Somewhat Unsatisfied	Neutral	Satisfied	Very Satisfied	Missing	Pearson Correlation
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Q20. How satisfied are you with oral health day? (Post-Intervention)	6 (4.2)	14 (9.8)	32 (22.4)	60 (42)	31 (21.7)	0 (0)	Q21
							$R = 0.469$ $P < 0.001^*$
							Q22
							$R = 0.412$ $P < 0.001^*$
	Unlikely	Somewhat Unlikely	Neutral	Likely	Very Likely	Missing	Pearson Correlation
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Q21. How likely are you to change your sugar eating habits? (Post-Intervention)	9 (6.3)	22 (15.4)	32 (22.4)	50 (35)	29 (20.3)	1 (07)	Q20
							$R = 0.469$ $P < 0.001^*$
							Q22
							$R = 0.428$ $P < 0.001^*$
Q22. How likely are you to increase your brushing and flossing? (Post-Intervention)	3 (2.1)	4 (2.8)	18 (12.6)	60 (42)	58 (40.6)	0 (0)	Q20
							$R = 0.412$ $P < 0.001^*$
							Q21
							$R = 0.428$ $P < 0.001^*$

Correlations between the oral exam and pre-intervention survey questions were examined (table 4). The results showed that neither dmft nor DMFT correlated with the pre-intervention survey questions. A correlation was noted when comparing ICDAS to certain pre-intervention survey questions (table 4). A negative correlation was seen with ICDAS = 0 and question #4. Positive correlations were seen with ICDAS = 2 and questions #4, #5, and #17. Positive correlations were also seen with ICDAS = 3 and question #5, however, negative correlations were noted with questions #6, #9, and #15.

Positive correlations were also found between ICDAS = 6 and questions #4 and #17. A positive correlation was also seen between the average ICDAS and question #4.

Table 4: Correlations Between Caries Status and Pre-Intervention Survey Questions							
	ICDAS 0	ICDAS 1	ICDAS 2	ICDAS 3	ICDAS 5	ICDAS 6	Average ICDAS
Q4. Have you been to the dentist in the past year?	r = -0.170 P = 0.043*	N.S.	r = 0.208 P = 0.013*	N.S.	N.S.	r = 0.174 P = 0.038*	r = 0.244 P = 0.003*
Q5. Do you have your own toothbrush?	N.S.	N.S.	r = 0.197 P = 0.019*	r = 0.250 P = 0.003*	N.S.	N.S.	N.S.
Q6. How many times do you brush your teeth each day?	N.S.	N.S.	N.S.	r = -0.172 P = 0.040*	N.S.	N.S.	N.S.
Q9. How many times do you floss your teeth each day?	N.S.	N.S.	N.S.	r = -0.212 P = 0.011*	N.S.	N.S.	N.S.
Q15. Do you have any oral pain right now?	N.S.	N.S.	N.S.	r = -0.232 P = 0.005*	N.S.	N.S.	N.S.
Q17. How many times/week do you drink chocolate milk, soda, juice, sport, or energy drinks?	N.S.	N.S.	r = 0.176 P = 0.036*	N.S.	N.S.	r = 0.264 P = 0.001*	N.S.
OHI Behaviors 1 (Q6 + Q9)	N.S.	N.S.	N.S.	r = -0.220 P = 0.008*	N.S.	N.S.	N.S.
OHI Behaviors 2 (Q5 + Q8)	N.S.	N.S.	r = 0.166 P = 0.050*	N.S.	N.S.	N.S.	N.S.
Oral Health Knowledge (Q10 + Q11 + Q12 + Q13 + Q14)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Diet (Q16 + Q17)	N.S.	N.S.	r = 0.195 P = 0.020*	N.S.*	N.S.	r = 0.185 P = 0.028*	N.S.
dmft	r = -0.329 P < 0.001*	r = -0.228 P = 0.006*	r = 0.246 P = 0.003*	r = 0.222 P = 0.008*	r = 0.450 P < 0.001*	r = 0.319 P < 0.001*	r = 0.232 P = 0.005*
DMFT	N.S.	N.S.	r = 0.297 P < 0.001*	r = 0.331 P < 0.001*	r = 0.251 P = 0.002*	N.S.	r = 0.366 P < 0.001*

Correlations were also found when comparing pre-intervention survey questions related to OHI behavior and diet/amount of sugar consumed to ICDAS (table 4). A negative correlation was seen between OHI behavior 1 (questions #6 and #9) and ICDAS

= 3. A positive correlation was seen between OHI behavior 2 (questions #5 and #8) and ICDAS = 2. Positive correlations were also seen between diet (questions #16 and #17), ICDAS = 2 and ICDAS = 6. The results showed no correlations between dmft, DMFT, OHI behavior 1, OHI behavior 2, and oral health knowledge questions (Q10 + Q11 + Q12 + Q13 + Q14). In addition, no correlation was seen with ICDAS and oral health knowledge questions.

The correlation between dmft/DMFT and ICDAS was also examined (table 4). The results showed that dmft was correlated with all ICDAS values except for ICDAS = 4, and DMFT was correlated with all ICDAS values except for ICDAS = 0, ICDAS = 1, and ICDAS = 6. A negative correlation was seen between ICDAS = 0, ICDAS = 1 and dmft. A positive correlation was seen between ICDAS = 3, ICDAS = 5, ICDAS = 6, ICDAS average caries surface percent score, dmft and DMFT (table 4).



## CHAPTER FOUR

### DISCUSSION

This cross-sectional study assessed the oral health behaviors, oral health knowledge, and diet/nutrition habits of fifth and sixth grade students attending charter schools in the city of San Bernardino. Prior to the start of the oral health education intervention, 77% of subjects reported they had been to the dentist in the past year, which is close to the national average of 83% for 2-17 year olds (14). Thus, the majority of our subjects appeared to have access to a dental provider. Most of our subjects (97.9%) reported brushing one or more times/day. In comparison, a study conducted on 10-year-old Greek school children showed that ~94% brushed 1-2 times/day (15), while another study conducted on 12 year old Chinese school children showed that 84% brushed 1-2 times/day (16). The majority of our subjects (67.2%) flossed 1 or more times/day. In comparison, a study on 10-year-old Greek school children showed that 36.8% used dental floss (15). These results demonstrated that a higher percentage of our subjects brushed and flossed more frequently than subjects from other developed countries. The majority of subjects answered all oral health knowledge questions correctly prior to the implementation of the oral health education intervention. Increased social knowledge regarding oral health may be what attributed to these results. The majority of subjects also reported they liked to consume candy and sugary drinks, and did so one or more times/week. This coincides with data that overall sugar consumption in the United States has drastically increased since the latter half of the last century (17).

A significant difference was noted when comparing pre- and post-intervention survey results specific to certain oral health behaviors and oral health knowledge concepts (table 5). The frequency results for question #6 showed that the majority of subjects (75.2%) did not change their daily brushing frequency after the oral health education intervention, 15.6% increased their brushing frequency by one additional time/day, 2.1% increased their brushing frequency by two additional times/day, and 7.1% decreased their brushing frequency by one less time/day. The frequency results for question #9 showed that the majority of subjects (59.9%) did not change their daily flossing frequency after the oral health education intervention, 23.9% increased their flossing frequency by one additional time/day, 2.8% increased their flossing frequency by two additional times/day, 1.4% increased their flossing frequency by three additional times/day, 11.3% decreased their flossing frequency by one less time/day, and 0.7% decreased their flossing frequency by two less times/day. These results showed that the oral health education intervention helped to increase daily brushing and flossing frequency. It also demonstrates how oral health education can potentially influence certain oral health behaviors. Question #10 showed that 85.7% of subjects did not change their answer after the oral health education intervention, 1.4% of subjects answered incorrectly, and 12.9% answered correctly (improved their knowledge level). The frequency results for question #14 showed that 78.9% of subjects did not change their answer after the oral health education intervention, 14.8% of subjects answered correctly (improved their knowledge level), and 6.3% answered incorrectly. These results showed that the oral health education intervention helped increase knowledge level regarding the

concepts that dental cavities can damage adult teeth and brushing can prevent dental cavities.

<b>Table 5: Frequency Table (<math>P &lt; 0.05</math>)</b>	
<b>Q6. How many times do you brush your teeth each day?</b>	
<b>Valid</b>	<b>N (%)</b>
-1	10 (7)
0	106 (74.1)
1	22 (15.4)
2	3 (2.1)
<b>Missing</b>	2 (1.4)
<b>Q9. How many times do you floss your teeth each day</b>	
<b>Valid</b>	<b>N (%)</b>
-2	1 (0.7)
-1	16 (11.2)
0	85 (59.4)
1	34 (23.8)
2	4 (2.8)
3	2 (1.4)
<b>Missing</b>	1 (0.7)
<b>Q11. Dental cavities can damage your adult teeth</b>	
<b>Valid</b>	<b>N (%)</b>
-1	18 (12.6)
0	120 (83.9)
1	2 (1.4)
<b>Missing</b>	3 (2.1)
<b>Q14. Brushing can prevent dental cavities</b>	
<b>Valid</b>	<b>N (%)</b>
-1	21 (14.7)
0	112 (78.3)
1	9 (6.3)
<b>Missing</b>	1 (0.7)

In this study, most subjects were either satisfied or very satisfied with the oral health education intervention, were likely or very likely to change their sugar eating habits, and were likely or very likely to increase their brushing and flossing (table 3). These questions were found to be positively correlated to one another, which showed that subjects that were satisfied with the oral health education intervention were more likely to change their sugar eating habits and increase their brushing and flossing. This demonstrated how oral health education potentially influences certain oral health behaviors and dietary habits amongst young adolescents.

Correlations were noted when comparing ICDAS to certain pre-intervention survey questions (table 4). A negative correlation was seen between ICDAS = 0 and question #4, which indicated that subjects with no caries were more likely to have seen a dentist in the past year. Positive correlations were seen between ICDAS = 2 and questions #4, #5, and #17, which indicated that subjects with more white lesions were less likely to have been to the dentist in the past year, less likely to have owned their own toothbrush, and more likely to have consumed sugary drinks. Positive correlations were also seen between ICDAS = 3 and question #5, however, negative correlations were noted between questions #6, #9, and #15. This indicated subjects with caries were less likely to own their own toothbrush, less likely to brush and floss their teeth regularly and more likely to have oral pain. Positive correlations were also noted between ICDAS = 6 and questions #4 and #17, which indicated subjects with gross caries were less likely to have been to the dentist in the past year and more likely to have consumed sugary drinks. A positive correlation was also observed between the ICDAS average caries surface percent score and question #4, which indicated that subjects with caries were less likely

to have been to the dentist in the past year.

Correlations were also found when comparing pre-intervention survey questions related to OHI behavior and diet/amount of sugar consumed to ICDAS (table 4). A negative correlation was seen between OHI behavior 1 (questions #6 and #9) and ICDAS = 3. This indicated that subjects with caries were less likely to brush and floss their teeth as frequently. Furthermore, a positive correlation was seen between OHI behavior 2 (questions #5 and #8) and ICDAS = 2. This indicated that subjects with white lesions were less likely to have their own toothbrush and toothpaste. Lastly, positive correlations were seen with diet (questions #16 and #17), ICDAS = 2 and ICDAS = 6. This indicated that subjects with white lesions and gross caries were more likely to eat candy and sugary drinks more frequently.

The correlations between the dmft/DMFT, ICDAS, and ICDAS average caries surface percent score were also examined (table 4). The results showed that dmft was correlated with all ICDAS values except for ICDAS = 4, and DMFT was correlated with all ICDAS values except for ICDAS = 0, ICDAS = 1, and ICDAS = 6. This indicated that the two caries status recording systems were highly correlated with one another even though one is specific to actual tooth surfaces (ICDAS) and the other is specific to the actual tooth (dmft/DMFT). A negative correlation was seen with ICDAS = 0, ICDAS = 1 and dmft, which indicated that subjects with no caries should have had a high number of caries free tooth surfaces. A positive correlation was seen with ICDAS = 3, ICDAS = 5, ICDAS = 6, ICDAS average caries surface percent score, dmft and DMFT, which indicated that subjects with caries should have had a high percentage of tooth surfaces with caries.

With regard to caries status, our group of subjects had an average caries rate of 9% and an ICDAS average caries surface percent score of 8% (table 2). Data from the National Health and Nutrition Examination Survey, which recorded caries status using DMFT/S and dft/s, reported that 41% of children 2 to 11 years of age had dental caries in their primary teeth, and 42% of 6- to 19-year-olds had dental caries in their permanent teeth (3). Our study did not record DMFS/dfs, but did assess each tooth surface via ICDAS. Thus, the caries rate of our group of subjects was low compared to the national average.

This study presented with three limitations. Only a 4-week follow-up was done. Thus, long-term behavior changes cannot be evaluated. Additionally, the length of the surveys and complexity of some of the questions may have confused some of the subjects, which would have introduced bias. Lastly, recall bias was possible and may have explained why the post-intervention survey results showed a decrease in the number of subjects that reported visiting a dentist in the past year.

Our study also presented with several strengths. No other study has been done on oral health behaviors, oral health knowledge, diet/amount of sugar consumed, and caries status of students in the city of San Bernardino. Additionally this study was the first of its kind to include an ICDAS average caries surface percent score. Finally, the study presented with an optimal sample size.

As previously mentioned, a cross-sectional design was applied, which does not allow for the collection of long-term behavior changes. Future studies should have a longitudinal design to allow for a longer follow-up time to see if there is a change in caries status, and to further evaluate oral health behaviors, oral health knowledge and

diet/amount of sugar consumed by subjects. In addition, the pre- and post-intervention surveys should be shorter with simpler questions.

## **CHAPTER FIVE**

### **CONCLUSIONS**

In conclusion, this oral health education intervention showed a significant improvement in oral health behaviors, including daily brushing and flossing frequency over a 4-week period. A significant improvement was also observed with certain oral health knowledge concepts over the same period of time (4-weeks). These oral health knowledge concepts were dental cavities can damage adult teeth and brushing can prevent dental cavities. Our oral exam showed these subjects had a low caries rate. ICDAS showed a strong correlation with certain oral health behaviors and diet/amount of sugar consumed. Lastly, the subject's oral health behaviors and diet/amount of sugar consumed were highly correlated with the subject's caries rate, but not oral health knowledge.



## REFERENCES

1. Dye B, Thornton-Evans G, Li X, Lafolla T. Dental caries and sealant prevalence in children and adolescents in the United States, 2011-2012 [Internet]. Hyattsville, MD: National Center for Health Statistics; 2015. Available from: <http://www.cdc.gov/nchs/products/databriefs/db191.htm>
2. U.S. Department of Health and Human Services. Oral health in America. A report of the Surgeon General. 2000 [cited 2016 May 2016]. Available from: <http://silk.nih.gov/public/hck1ocv.@www.surg.eon.fullrpt.pdf>
3. Vargas C, Crall J, Schneider D. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988–1994. *The Journal of the American Dental Association*. 1998;129(9):1229-1238.
4. Edelstein B. Disparities in oral health and access to care: findings of national surveys. *Ambulatory Pediatrics*. 2002;2(2):141-147.
5. Romero D. America's second poorest big city is right here in Southern California: San Bernardino [Internet]. *LA Weekly*. 2011 [cited 1 June 2016]. Available from: [http://America's Second Poorest Big City is Right Here in Southern California: San Bernardino](http://America's%20Poorest%20Big%20City%20is%20Right%20Here%20in%20Southern%20California%20-%20San%20Bernardino).
6. The Community Foundation. San Bernardino county 2014 community indicators report [Internet]. San Bernardino: The Community Foundation; 2014. Available from: [http://cms.sbcounty.gov/portals/21/resources%20Documents/CIR\\_2014\\_Report.pdf](http://cms.sbcounty.gov/portals/21/resources%20Documents/CIR_2014_Report.pdf)
7. California Department of Alcohol and Drug Programs. Racial/ethnic disparities - a data-informed perspective [Internet]. California Department of Alcohol and Drug Programs; 2013. Available from: [https://www.cdph.ca.gov/programs/Documents/ADP\\_Race-Ethnicity\\_Report\\_Final.Pdf](https://www.cdph.ca.gov/programs/Documents/ADP_Race-Ethnicity_Report_Final.Pdf)
8. Dülgergil Ç, Dalli M, Hamidi M, Çolak H. Early childhood caries update: A review of causes, diagnoses, and treatments. *Journal of Natural Science, Biology and Medicine*. 2013;4(1):29.
9. Hamesha A, Warren J, Levy S, Broffitt B, Kanellis M. Oral health behaviors of children in low and high socioeconomic status families. *Pediatric Dentistry* [Internet]. 2006 [cited 15 September 2015];28(4):310-315. Available from: <http://www.aapd.org/assets/1/25/Hamasha-28-4.pdf>
10. WHO. Oral health surveys: basic methods [Internet]. 5th ed. WHO; 2013 [cited 23 June 2015]. Available from: <http://www.icd.org/content/publications/WHO-Oral-Health-Surveys-Basic-Methods-5th-Edition-2013.pdf>

11. ICDAS. ICDAS Public health [Internet]. 2016 [cited 25 October 2015]. Available from: <https://www.icdas.org/public-health>
12. International Caries Detection and Assessment System (ICDAS) Coordinating Committee. International Caries Detection and Assessment System (ICDAS II) [Internet]. 2009. Available from: [https://www.icdas.org/uploads/ICDAS%20Criteria%20Manual%20Revised%202009\\_2.pdf](https://www.icdas.org/uploads/ICDAS%20Criteria%20Manual%20Revised%202009_2.pdf)
13. Bahrick H. Maintenance of knowledge: Questions about memory we forgot to ask. *Journal of Experimental Psychology: General*. 1979;108(3):296-308.
14. FastStats [Internet]. Cdc.gov. 2016 [cited 17 February 2016]. Available from: <http://www.cdc.gov/nchs/fastats/dental.htm>
15. Angelopoulou M, Kavvadia K, Oulis C, Reppa C. Oral hygiene facilitators and barriers in Greek 10 year old schoolchildren. *Int J Clini Pediatr Dent*. 2015;8(2):87-93.
16. Petersen P, Sheng Z. Dental caries and oral health behaviour situation of children, mothers and schoolteachers in Wuhan, People's Republic of China. *Int Dent J*. 1998;48(3):210-216.
17. Decker R, Loveren C. Sugars and dental caries. *Am J Clin Nutr* [Internet]. 2003 [cited 9 June 2016];78(4):881S-892S. Available from: <http://ajcn.nutrition.org/content/78/4/881S.full>