

# Evaluation of Knowledge, Attitudes, and Self-Reported Behaviors Among 3-5 Year Old School Children using an Oral Health and Nutrition Intervention.

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**Methods:** Ninety 3-5 year old children, 43 in the control group and 47 in the intervention group, participated in the study. An age and developmental appropriate prop-based oral health and nutrition intervention program was used. Subjects in the intervention group received a pre-test, an 8-10 minute prop-supported intervention, followed by an immediate post-test. The same test was repeated two weeks later. The control group received a pre-test and post-test two weeks later but no intervention. **Results:** Intervention improved scores in the immediate post-test but these improvements were not sustained two weeks later. The only positive relationship found for the entire group between pre-and two week post-test scores was for oral health knowledge. There were no significant findings when adjusted for race, intervention type or group. **Conclusions:** Changing oral health and nutrition knowledge, attitude and behavior may require intense and repetitive interventions to have a significant effect in this age cohort.

**Keywords:** Dental health, oral health knowledge, nutrition and diet, pre-school  
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## INTRODUCTION

Children gradually develop an understanding of complex concepts, such as health, during childhood. These early recognitions continue to be reflected into adulthood and impact adult well-being.<sup>1,2,3,4</sup> However, there is limited literature on the influence of oral health messages among young children.<sup>5,6,7,8,9</sup> Oliveira *et al*<sup>10</sup> investigated the oral health knowledge, attitudes and preventive practices of third grade school children. The children in this study with inadequate

oral health knowledge were twice as likely to have caries than children with adequate knowledge. They concluded that there was a need to improve the oral health knowledge and preventive practices among the study population.

Byrd-Bredbenner *et al*<sup>11</sup> developed a self-contained age appropriate nutrition curriculum to meet the objectives of Head Start. The effect of six weeks of nutrition instruction and intervention was investigated. No difference in nutrition knowledge and attitudes between the intervention and control group was reported. But, the intervention group decreased their refusal of some served foods and increased their request for low-sugar snacks. Goerlick and Clark<sup>12</sup> focused on nutrition intervention but also included tooth brushing in a study group of 3-5 year old children. Those in the intervention groups had higher post-test nutrition knowledge scores than the control groups, particularly in food identification, and an increased knowledge of tooth brushing and food choices among the older children. They concluded that a classroom nutrition education program can be effectively implemented with children as young as three to five years of age.

The purpose of our study was to evaluate knowledge, attitudes and self-reported behaviors among 3-5 year old children participating in an oral hygiene and nutrition intervention using age and developmental appropriate materials and techniques. We wanted to determine whether interactive teaching is beneficial in changing oral hygiene knowledge, attitudes and behaviors, and nutrition attitudes and behaviors that can be of value in promoting children's health.

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**METHODS**

**Subjects**

Head Start is a federally funded program designed to meet the emotional, social, health, nutrition and psychological needs of high-risk children and their families. Children ranging from 3-5 years of age were enrolled from seven Head Start Centers in Chapel Hill/Carrboro, North Carolina (HSC-CH/C). Consent to solicit parent/student participation was obtained from the HSC-CH/C administration and parent advisory council. Approval for the study was obtained from the University of North Carolina Institutional Review Board (IRB#07-1556, November 15, 2007).

The inclusion criteria included being enrolled in the HSC-CH/C, fluent in English or Spanish with the ability to converse, and age-appropriate decision-making skills as confirmed by the Head Start teacher. A power analysis was performed to determine the number of subjects needed for the study. One hundred and five parents completed the consent forms permitting their children to participate in the study. Fifteen subjects were later removed from the study due to absences or failure to cooperate. The children were randomly assigned to either the intervention or control group based on their classroom location. The examining group consisted of an interviewer and a recorder. All interviews/tests/interventions were conducted in the morning.

**Intervention and tests**

The study was a parallel two group pre-and-post survey design. (Figure 1) The intervention subjects that completed the study (N=47) were given a pre-intervention oral hygiene knowledge, attitude and behavior, and a nutrition attitude and behavior test, followed by an oral health and nutrition educational intervention scripted by the investigators with the aid of the consulting child psychologist. The intervention and tests were designed to teach health and nutrition themes supported by props designed to stimulate the child’s recall of the material and assess outcome variables of interest.<sup>13,14,15,16,17</sup> Prop-based material designed for Pre-K through 3rd grade students (Toothfairy Island, LLC, 60 San Miguel, Ste. 204, Newport Beach, CA 92660) were used to aid in the intervention. The teaching aids chosen by the researchers reflected the types of questions that the children would be asked during the test. The selected Toothfairy Island intervention materials included “Mr. Tooth” puzzle, various nutrition and oral health coloring sheets, Tooth Brushing and Hand Washing Song, Magic Brush Bag, and the healthy food education module.

Prior to the study, a pilot study group of twenty-five 3-5 year old children reflecting similar socioeconomic and demographic background to the Head Start centers was conducted with specific parts of the survey to determine if 3-5 year old children understood the difference between a caricature of a “happy” face and a “sad” face (Microsoft® clip art) and could respond to a prop-based intervention. One hundred percent of the children correctly identified the “Happy” and “Sad” cartoon faces and completed the prop

based interview by successfully identifying images of foods and hygiene objects.

The intervention lasted 8-10 minutes. The same test was repeated approximately 35 minutes after the initial intervention. Fourteen to sixteen days later the same test was again administered. The consulting child psychologist for the study had validated that approximately two weeks was an appropriate interval to test the efficacy of single intervention for children in this age group.<sup>18,19</sup>

To assess oral health knowledge and behavior, and nutritional behavior, the examiner asked questions that required a “yes/no” or “use “ or “do not use” response. Action item questions were used to assess the children’s oral health attitudes and food items were used to assess the child’s attitude toward nutrition. The children were asked if these actions or foods made their teeth feel “happy” or “sad”. (Tables 1, 2) Before each interview, the subjects were asked several pre-interview distracter questions to ensure that they understood the instructions.

The interviews were divided into five sections.

- Oral health knowledge: Is brushing and flossing good for your teeth in the morning/bedtime? (Yes/No)
- Oral health attitudes: How does brushing your teeth in the morning/bedtime make them feel? (Happy/Sad)  
How does it feel to have a dentist clean your teeth? (Happy/Sad)
- Oral behaviors: Do you use a toothbrush to clean your teeth in the morning/bedtime? (Use or Do Not Use)  
If you brush your teeth in the morning/bedtime, do you use toothpaste? (Use or Do Not Use)  
Do you use floss to help clean your teeth in the morning/bedtime? (Use or Do Not Use)
- Nutritional attitudes: How do these foods make your teeth feel? (Happy/Sad)
- Nutritional behaviors: Do your teeth like eating these foods? (Use or Do Not Use)

Each of the prop based tests lasted approximately two minutes. Current behaviors were scored on a dichotomous “child practices” or “child does not practice” scale. One point was given for each correct answer or practice reported. A composite score for each section was developed based on correct answers. Each question was examined independently to reflect inter and intra-subject behavior, knowledge and attitudes regarding a particular area.

**Analysis**

For each outcome a descriptive analysis was conducted to examine three covariates (race, interview/test type-Spanish/

**Table 1.**  
**Object/Action Items Used in General/Oral Health Knowledge Test Questions**

Wash your hands	Comb your hair
Take a bath	Brush your teeth
Floss your teeth	

**Object/Action Items Used in General/Oral Health Behaviors Test Questions**

Comb	Bar of soap
Toothpaste	Floss
Toothbrush	Hairbrush
Deodorant	Washcloth
Lotion	Towel

**Table 2.**  
**Foods used in evaluating nutrition behaviors**

Apple	Banana
Candy Bar	Cupcake
Cookies	Cheese
Donut	Peas
Raisins	Water

**Foods used in evaluating nutrition attitude**

Happy (Correct Answer)	Sad (Correct Answer)
Apple	Candy Bar
Banana	Fruit Rollup
Broccoli	Donut
Celery	Cookie
Cheese	Cupcake
Milk	Gummy Bears
Nuts	Lollipops
Peas	Potato Chips
Water	Soda
Strawberries	Raisins

English and group) and assess whether the two groups (intervention/control) differed. A mixed effect model was fitted for each outcome with a random effect for children’s classroom using the method of restricted maximum likelihood (REML). The classroom was considered a random effect since the children were clustered within a classroom and it was the classroom that was randomized to intervention or control group. The within classroom variability was less than 10% of the total variation. Explanatory fixed effects included were pre-intervention composite scores, race and interview type (Spanish/English) and group (intervention/control) status.

**RESULTS**

Ethnic and health characteristics of the participating students were provided by program officials of the HSC-CH/C. The children were identified as White/Non-Hispanic (21.1%),

Hispanic (44.4%), African American (32.2%) and other (2.3%). A majority of the subjects had no health issues (82.2%). Asthma (13.3%) was the most frequently reported health problem. (Table 3) Fifty-six percent of the interviews were conducted in English and 44% in Spanish. Descriptive analysis showed an increase in composite score for the intervention group at the immediate post-intervention test for each area: oral health knowledge, attitude and behavior, and nutrition attitude and behavior. (Tables 4a-e) However, this increase in composite score was not maintained over the two-week post intervention period.

A Pearson Correlation Coefficient was used to measure the strength of the association between the pre and two week post-interview scores. The positive correlation between the pre and post interviews scores of all outcomes was statistically significant in the control group except for nutritional behavior. Only oral knowledge and oral health attitude were significantly correlated in the intervention group. (Table 5) The mixed effect models indicated that there were no statistically significant differences between the two groups in any areas tested after adjusting for the explanatory variables (pre-score, race, interview/test type-English/Spanish, or group). (Table 6)

**Table 3.** Descriptive statistics for the control and intervention groups

Covariants	Control % (N=43)	Intervention % (N=47)
<b>Race</b>		
Black	34.9	29.8
Hispanic	44.2	44.7
White/Non-Hispanic	18.6	23.4
Other	2.3	2.1
<b>Type of Interview</b>		
English	58.1	55.3
Spanish	41.9	44.7
<b>Personal Health</b>		
No problems	88.3	76.6
Respiratory	7.0	19.2
Cardiac	0.0	2.1
Auditory	2.3	2.1
Visual	2.3	0.0

**Table 4a.** Oral health knowledge: Percentage of children answering “Yes”

	Pre (%)	Immediate Post (%)	2 Weeks Post (%)
<b>Morning: Brush</b>			
Control	90.7		90.7
Intervention	<b>87.2%</b>	<b>97.7*</b>	78.7
<b>Morning: Floss</b>			
Control	62.8		76.7
Intervention	<b>70.2*</b>	<b>74.4*</b>	74.5
<b>Bedtime: Brush</b>			
Control	88.4		97.7
Intervention	<b>91.5*</b>	<b>97.7%</b>	85.1
<b>Bedtime: Floss</b>			
Control	62.8		72.1
Intervention	70.2	67.4	63.8

**Bolded to indicate increase in pre- and immediate post-interview scores for intervention group**

**Table 4b.** Oral health behaviors: Percentage of children answering “Yes”

	Pre (%)	Immediate Post (%)	2 Weeks Post (%)
<b>Morning:</b>			
<b>Toothpaste</b>			
Control	58.1		69.8
Intervention	<b>59.6*</b>	<b>77.3*</b>	48.9
<b>Morning: Floss</b>			
Control	53.5		51.2
Intervention	<b>42.6*</b>	<b>59.1*</b>	38.3
<b>Morning: Toothbrush</b>			
Control	65.1		76.7
Intervention	<b>66.0*</b>	<b>86.4*</b>	59.6
<b>Bedtime:</b>			
<b>Toothpaste</b>			
Control	58.1		69.8
Intervention	<b>57.4*</b>	<b>70.5*</b>	57.4
<b>Bedtime: Floss</b>			
Control	44.2		51.2
Intervention	<b>36.2*</b>	<b>38.6*</b>	42.6
<b>Bedtime: Toothbrush</b>			
Control	69.8		67.4
Intervention	<b>55.3*</b>	<b>70.5*</b>	59.6

\*Bolted to indicate increase in pre- and immediate post-interview scores for the intervention group

**Table 4c.** Oral health attitudes: Percentage of children choosing “Happy” item

	Pre (%)	Immediate Post (%)	2 Weeks Post (%)
<b>Brush: Morning</b>			
Control	74.4		79.1
Intervention	<b>72.3*</b>	<b>81.8*</b>	67.4
<b>Brush: Bedtime</b>			
Control	51.2		60.5
Intervention	66.0	63.6	54.3
<b>Do not brush teeth</b>			
Control	4.9		23.3
Intervention	<b>27.7*</b>	<b>38.6*</b>	34.8
<b>Hitting teeth</b>			
Control	11.6		7.0
Intervention	17.0	11.4	10.0
<b>Have teeth counted</b>			
Control	58.1		65.1
Intervention	<b>53.2*</b>	<b>59.0*</b>	54.3

\*Bolted to indicate increase in pre- and immediate post-interview scores for the intervention group

**DISCUSSION**

It has been long understood by commercial businesses that consumer habits are established early and transcend a lifetime trajectory. This recognition has promoted early nurturing of children in order to influence their choices and habits. Beder *et al*<sup>20</sup> described children as “spending influencers”. They influence their parents/caregivers’ actions from requests, demands, hints of purchase, to joint decision-making where children actively participate in family purchases.

**Table 4d.** Nutrition attitudes: Percentage of children who chose the “Happy” item

	Pre (%)	Immediate Post (%)	2 Weeks Post (%)
<b>Carrots</b>			
Control	69.8		65.1
Intervention	<b>66.0*</b>	<b>74.4*</b>	61.4
<b>Cookies</b>			
Control	58.1		58.1
Intervention	63.8	60.5	63.6
<b>Juice</b>			
Control	79.1		74.4
Intervention	68.1	65.1	70.5
<b>Water</b>			
Control	74.4		74.4
Intervention	<b>63.8*</b>	<b>65.1*</b>	70.5
<b>Milk</b>			
Control	81.4		69.8
Intervention	<b>68.1*</b>	<b>83.7*</b>	70.5
<b>Candy</b>			
Control	32.6		32.2
Intervention	46.8	41.9	50.0
<b>Cola</b>			
Control	41.9		55.8
Intervention	<b>44.7</b>	<b>60.5</b>	47.7
<b>Cheese</b>			
Control	65.1		65.1
Intervention	<b>57.4*</b>	<b>69.8*</b>	50.0
<b>Green beans</b>			
Control	62.8		60.5
Intervention	<b>53.2*</b>	<b>55.8*</b>	50.0
<b>Donuts</b>			
Control	51.2		39.5
Intervention	<b>55.3*</b>	<b>62.8*</b>	52.0

\*Bolted to indicate increase in pre- and immediate post-interview scores for the intervention group

It would seem reasonable to assume that early health teaching and training of children could also have long-term positive benefits as well.

The manners in which children perceive multifaceted concepts such as health probably vary with personal characteristics, development and experiences.<sup>21</sup> Our study evaluated selected knowledge, attitude and behavior among 3-5 year old Head Start children related to oral health and nutrition intervention. We found an increase in the children’s general oral health knowledge, attitudes and behaviors immediately after the intervention but this was not sustained at the two weeks post-interview/intervention.

To be effective from an educational perspective, these findings suggest the probable need for comprehensive teaching materials with repetitive, longitudinal and intense intervention to result in retained knowledge among children of this age group. It was also apparent that there was value in having the teaching materials constructed to be race, cultural and language sensitive. To ensure oral health and nutrition retention and positive attitude/behavior changes there appears to be a need for a consistent integrated message to the children from teachers/providers and parents.<sup>22,23,24,25,26</sup> Parents/caregivers control the oral health and nutrition prac-

**Table 4e.** Nutrition behaviors: Percentage of children who chose the “Happy” item

	Pre (%)	Immediate Post (%)	2 Weeks Post (%)
<b>Apple</b>			
Control	90.7		93.0
Intervention	<b>87.2*</b>	<b>100*</b>	87.2
<b>Banana</b>			
Control	88.4		93.0
Intervention	<b>83.0*</b>	<b>97.7*</b>	87.2
<b>Candy</b>			
Control	81.4		76.7
Intervention	<b>76.6*</b>	<b>81.8*</b>	76.6
<b>Cupcake</b>			
Control	79.1		86.0
Intervention	<b>76.6*</b>	<b>86.4*</b>	78.7
<b>Cookies</b>			
Control	79.1		90.7
Intervention	<b>68.1*</b>	<b>88.6*</b>	78.7
<b>Cheese</b>			
Control	79.1		83.7
Intervention	<b>72.3*</b>	<b>93.2*</b>	78.7
<b>Donut</b>			
Control	74.4		79.1
Intervention	<b>72.3*</b>	<b>88.6*</b>	74.5
<b>Peas</b>			
Control	76.7		86.0
Intervention	<b>68.1*</b>	<b>86.4*</b>	68.1
<b>Raisins</b>			
Control	74.4		79.1
Intervention	<b>74.5</b>	<b>81.8*</b>	66.0
<b>Water</b>			
Control	88.4		90.7
Intervention	<b>88.4*</b>	<b>90.9*</b>	85.1

\*Bolded to indicate increase in pre- and immediate post-interview scores for the intervention group

tices of young children. Therefore, intuitively it would seem important to engage both the child and the parent/caregiver in interventions designed to stimulate positive influences. It is also plausible to assume that the teachers’ knowledge and attitude toward good oral hygiene and nutrition practices may have an impact on the effectiveness of the educational component for young children.

Although the findings in this study were consistent with that of Byrd-Bredbenner *et al*,<sup>11</sup> the lack of significant increase at 14-16 days in knowledge, attitude, and behaviors regarding an oral health and nutrition intervention for this study cohort should not result in abandoning education opportunity modes regarding oral health and nutrition to children of this age. Rather, it challenges clinicians, researchers and educators to construct age-appropriate teaching materials and to continue to refine the teaching schedule that will maximize positive long-term knowledge, attitude and behavior changes.

This study should be viewed in light of its limitations. The intervention was brief and sample size was limited. The effects of teacher and classroom variables were also not addressed.

**Table 5.** Pearson correlation coefficients for the association of the pre - and - post interview composite scores for control and intervention groups

Outcomes	Control		Intervention	
	r	p	r	p
Oral health knowledge	0.71	<0.0001	0.34	0.02
Oral health behavior	0.43	0.004	0.09	0.55
Oral health attitudes	0.42	0.005	0.36	0.01
Nutrition behavior	0.23	0.13	-0.05	0.76
Nutrition attitudes	0.65	<0.0001	0.27	0.06

**Table 6.** F-statistics for the effect of the explanatory variables on the post-intervention composite scores

Effect	DF	F value	P-value
<b>Oral Health Knowledge</b>			
KNOWLEDGE: pre-intervention	(1,79)	22.17	<0.0001
RACE	(2,79)	0.16	0.85
INTERVIEW TYPE (ENGLISH/SPANISH) GROUP (INTERVENTION VERSUS CONTROL)	(1,79)	0.18	0.67
<b>Oral Health Behavior</b>			
BEHAVIOR: pre-intervention	(1,79)	5.73	0.02
RACE	(2,79)	0.83	0.44
INTERVIEW TYPE (ENGLISH/SPANISH) GROUP (INTERVENTION VERSUS CONTROL)	(1,79)	1.53	0.22
<b>Oral Health Attitude</b>			
ATTITUDE: pre-intervention	(1,79)	16.11	<0.0001
RACE	(2,79)	0.51	0.60
INTERVIEW TYPE (ENGLISH/SPANISH) GROUP (INTERVENTION VERSUS CONTROL)	(1,79)	0.11	0.74
<b>Nutrition Behavior</b>			
BEHAVIOR: pre-intervention	(1,79)	0.51	0.48
RACE	(2,79)	1.14	0.33
INTERVIEW TYPE (ENGLISH/SPANISH) GROUP (INTERVENTION VERSUS CONTROL)	(1,79)	0.16	0.69
<b>Nutrition Attitude</b>			
ATTITUDE: pre-intervention	(1,79)	20.81	<0.0001
RACE	(2,79)	0.88	0.42
INTTYP (ENGLISH/SPANISH) GROUP (INTERVENTION VERSUS CONTROL)	(1,79)	1.40	0.24
<b>CONCLUSIONS</b>			

**CONCLUSIONS**

Based on the study results, the following conclusions are made:

1. Delivering oral health and nutrition related knowledge to a group of 3-5 year old Head Start children has a limited impact two weeks after intervention when no additional educational reinforcement is provided.
2. Obtaining a more positive impact on oral health knowledge, attitude and behavior, and nutritional attitudes and behaviors may require a more intense, repetitive intervention in this age cohort.

- Intuitively, the inclusion of teachers and parents/caregivers in oral health and nutritional interventions may be important in maximizing positive changes as they control or significantly influence the oral health care behaviors and diets of children of this age.

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