

Increasing Fruit and Vegetable Consumption among Preschoolers: Evaluation of *Color Me Healthy*

Kendra E. Witt, PhD, MPH^{1,†}; Carolyn Dunn, PhD²

ABSTRACT

Objective: Determine whether *Color Me Healthy* (CMH), an interactive nutrition and physical activity program for preschool children, increases fruit and vegetable consumption.

Design: Intervention study. Data were collected at baseline, 1 week post-intervention, and 3 months post-intervention.

Setting: Child care centers.

Participants: Preschool children (n = 263) in 17 child care centers.

Intervention: Child care centers were randomly assigned to 1 of 2 conditions; children (n = 165) in 10 centers received the CMH curriculum, and children (n = 98) in 7 centers acted as comparisons and did not receive the curriculum.

Main Outcome Measures: Process and outcome evaluation. Consumption of fruit and vegetable snacks.

Analysis: Data were analyzed using repeated-measures analysis of variance and hierarchical linear modeling.

Results: Children who received CMH significantly increased their consumption of fruit snacks by approximately 20.8% and vegetable snacks by approximately 33.1% between baseline assessment and the assessment conducted 3 months after the completion of the CMH program. Hierarchical linear modeling determined that group assignment (ie, CMH or control) was the only significant predictor of fruit and vegetable consumption.

Conclusions and Implications: Findings suggest that CMH may be used in child care settings for developing healthful eating habits.

Key Words: nutrition education, child care, fruit, vegetable, child (*J Nutr Educ Behav.* 2012;44:107-113.)

INTRODUCTION

Overweight and obesity are critical public health issues facing the United States. Approximately 1 out of every 4 preschool children is either overweight or obese.¹ Data from the National Health and Nutrition Examination Survey II (1976-1980) and National Health and Nutrition Examination Survey 2003-2006 show that the prevalence of overweight children ages 2-5 years in the United States has increased from 5%-12.4%.² Many children have eating patterns that are not consistent with the recommendations for a healthful diet; children consume too

much fatty food and sugar-sweetened beverages, and not enough fruits and vegetables.^{3,4} The combination of nutrients, antioxidants, photochemicals, and fiber in fruits and vegetables provides multiple health benefits. Specifically, consumption of fruits and vegetables is associated with a reduced risk of certain forms of cancer, heart disease, and diabetes, and consuming fruits and vegetables is beneficial in achieving and maintaining a healthful weight.⁵ The majority of children do not consume the recommended amounts of fruits and vegetables.⁶ Additionally, the amount consumed frequently con-

sists of fruit juice and potatoes that are often fried. A previous study found that french fries constituted nearly 25% of the vegetables that were consumed by children and adolescents.^{7,8}

The reliance on child care outside the home has significantly increased over the past 3 decades.⁹ Forty-one percent of preschool age children are in child care for 35 hours or more each week.¹⁰ Thus, parents and child care providers now share responsibility during developmentally important years. Child care settings have been relatively overlooked in the fight against childhood obesity and provide an underused opportunity to teach children healthful behaviors.⁹ Very few studies have evaluated the efficacy of nutrition and physical activity programs in child care settings, indicating a need to develop and evaluate effective strategies to change children's health habits.⁹

The current study provided a systematic evaluation of the *Color Me Healthy* (CMH) program to determine whether the program positively influences fruit and vegetable intake

¹Blue Cross of Idaho Foundation for Health, Meridian, ID

²Department of 4H Youth Development and Family & Consumer Sciences, North Carolina Cooperative Extension, North Carolina State University, Raleigh, NC

[†]Dr. Kendra E. Witt was a doctoral student at the University of Texas–El Paso at the time this study was completed.

Address for correspondence: Kendra Witt, PhD, MPH, Blue Cross of Idaho Foundation for Health, 3000 E. Pine Ave, Meridian, ID 83642; Phone: (208) 286-3461; Fax: (208) 286-3535; E-mail: kwitt@bcidaho.com

©2012 SOCIETY FOR NUTRITION EDUCATION AND BEHAVIOR

doi:10.1016/j.jneb.2011.01.002

among preschool-aged children. A full description of the CMH program has been published previously.¹¹ The previous evaluation of CMH revealed that teachers perceived that the program positively influenced children's eating behavior and physical activity. In addition, teachers reported that the program was easy to use and they would continue to use the program in the future.¹² The current study determined whether children who participate in the CMH program increase fruit and vegetable consumption at child care centers compared with children who do not take part in the program. The study also conducted a process evaluation to ensure fidelity of program implementation.

METHODS

Design

Seventeen preschool classrooms were randomly assigned to 1 of 2 groups. Ten classrooms were assigned to receive the CMH program, and 7 acted as comparisons. Table 1 displays characteristics of the CMH and comparison groups. Comparison and CMH classrooms were located on separate campuses. During the study, comparison classrooms did not incorporate nutrition curriculum into their lesson plans. *Color Me Healthy* was implemented for 6 weeks; 2 circle-time lessons and 1 imaginary trip were taught to the children each week. Lessons were 15-30 minutes in duration. Since the majority of the CMH curriculum focuses on fruits and vegetables, these food items were of interest in the current evaluation. The current study included an outcome evaluation that assessed the efficacy of the intervention and a process evaluation that assessed the fidelity of program implementation. The outcome evaluation determined whether children's consumption of fruits and vegetables significantly increased during snack time in the child care classrooms after exposure to the CMH program. The process evaluation assessed delivery of lessons to the children, children's attendance at the lessons, and the completion of take-home activities. The institutional review board at University of Texas–El Paso approved the project, and consent was obtained from center directors and parents.

To determine whether the CMH program increased children's consumption of fruits and vegetables in the classroom, children were given fruit and vegetable snacks 1 week before CMH was initiated, 1 week after the program was completed, and 3 months after the program was completed. To determine the amount of fruit and vegetable snack consumed, the fruit and vegetable snacks were weighed before they were served to children and then weighed again after children had had an opportunity to consume the snack. Fruit and vegetable items that were included in the snack were items that are presented in CMH. The fruit snack for each child consisted of 1 cup of mixed fresh fruit: 4 purple grapes, 4 pineapple chunks, 4 cantaloupe chunks, and 2 strawberries. The vegetable snack for each child consisted of 1 cup of mixed fresh vegetables: 2 cherry tomatoes, 2 celery sticks, 3 broccoli florets, and 3 baby carrots. Fat-free ranch dressing, in a 2-ounce plastic cup, was distributed with the veggie snack. Children could dip the raw vegetables in the fat-free ranch dressing as desired. Each snack also contained 2 Ritz crackers and half of a large graham cracker; these items were included in the snack to determine whether consumption changes only among fruit and vegetable items or the entire snack. Initially, the fruit mixture and vegetable mixture were weighed, in grams, and recorded for each child. Then the mixture was placed into a styrofoam container labeled with each child's name.

Fruit snacks were served in the classrooms on Tuesdays and Wednesdays. Vegetable snacks were served in the classrooms on Thursdays and Fridays. The snacks were delivered to the classrooms 15-45 minutes before snack time. At snack time, teachers distributed the containers to each child. Teachers were instructed to avoid commenting on the snack and avoid encouraging children to eat the snack. The remaining fruit and vegetable mixtures were then re-weighed, in grams, and recorded for each child. Percentage of fruit and vegetable snack consumed was calculated for each child.

Subjects

Children. Two hundred sixty-three preschool-aged children participated

Table 1. Characteristics of *Color Me Healthy* and Comparison Groups

	Number of Sites	Number of Children Who Participated in All 3 Time Periods	Class Size (number of children)	Child Sex	Teacher Experience (y in child care)	Teacher Education
Color Me Healthy	10	Fruit snack: 83 Vegetable snack: 70	Median = 18 25th Percentile = 11 75th Percentile = 21	47% Female 53% Male	Median = 10 25th Percentile = 7 75th Percentile = 22	40% Some college 60% Bachelor's degree
Comparison	7	Fruit snack: 70 Vegetable snack: 52	Median = 12 25th Percentile = 10 75th Percentile = 18	47% Female 53% Male	Median = 10 25th Percentile = 5 75th Percentile = 14	29% Some college 71% Bachelor's degree

in the evaluation. Fifty-three percent were male. The researchers were not permitted to obtain specific ages of each child but were informed by the centers' directors that the majority of the children were 4 or 5 years old.

Child care centers. Seventeen preschool classrooms participated in the evaluation of the CMH program. Fifteen of the classrooms were from the Boise School District's child care program. Two preschool classrooms from the Boise State Children's Center also participated in the evaluation. The average class size was 15 children ($SD \pm 5.5$). All of the classrooms offered half-day and full-day child care; 28% of the children attended only in the morning, 44% attended only in the afternoon, and 28% attended all day. All of the classrooms participated in the United States Department of Agriculture's Child and Adult Care Food Program and provided meals and snacks to the children. The classrooms that were operated through the Boise School District were located in a separate building adjacent to an elementary school. The classrooms consisted of a lead teacher and assistant teacher. The lead teachers were responsible for teaching the CMH curriculum.

Teachers. Ninety-four percent of the lead teachers were female. The lead teachers had worked in child care for an average of 14 years ($SD \pm 9.3$) and had been employed with the current center for an average of 5 years ($SD \pm 4.2$). Thirty percent of the lead teachers had completed some vocational training or college, and 70% had received a bachelor's degree.

Parents. Two hundred sixty-three parents were invited to participate in the evaluation, and 38% ($n = 100$) completed the initial surveys, which assessed changes in children's fruit and vegetable consumption in the home environment and included a 3-day food diary, food frequency questionnaire, and a general health survey. At follow-up, 14% ($n = 38$) of the parents had completed the surveys. Thus, there were not enough data to make substantive conclusions about changes in fruit and vegetable consumption in the home environment.

Color Me Healthy Curriculum

Color Me Healthy is a program designed to reach children ages 4 and 5 years. It provides fun, interactive learning opportunities on physical activity and healthful eating. It uses color, music, and exploration of the senses to teach children about healthful eating and physical activity. *Color Me Healthy* comes in a "toolkit" that includes a teacher's guide, 4 sets of picture cards, classroom posters, a music CD that contains 7 original songs, a hand stamp, and reproducible parent newsletters. Most of the kit materials emphasize fruits and vegetables of different colors. *Color Me Healthy* is composed of 12 circle-time lessons and 6 imaginary trips. The majority of the CMH circle-time lessons focus on fruits and vegetables of different colors. Several of the lessons provide opportunities for children to try fruits and vegetables. For example, in the "Brown Paper Bag Mystery" lesson, fruit and vegetables are placed into brown paper bags; children put a hand into the bags, and based on the shape, texture, and smell of the food item, the children guess which fruit or vegetable they are feeling. The teacher then takes the fruits and vegetables out of the bags and talks about the color and shape and passes it around to the children. At the end of the lesson, the fruits and vegetables are washed, cut up, and distributed for the children to taste. The 6 imaginary trips included in CMH encourage children to use their imagination to explore places, be physically active, and eat fruits and vegetables. For each imaginary trip, the teacher is provided a script that contains dialogue they read aloud and activities with the children. For example, in the "Climb Every Mountain" imaginary trip, children pretend that they are going to the mountains. The teacher leads the group of children and they imagine activities, such as setting up the camp, going for a hike, going for a canoe ride, and making and eating a healthful vegetable stew. These imaginary trips allow children to be physically active and role play eating nutritious food. Six interactive take home activities were developed for the current evaluation. These interactive activities coincided with the circle-time lessons. The lead teachers from the 10 CMH classrooms attended

a training session that was held prior to program implementation. The teachers learned about the curriculum and were instructed on how to teach each lesson and imaginary trip.

Statistical Analysis

There were 83 CMH children and 70 comparison children who received fruit snacks at all 3 time periods (baseline, immediately posttest, and 3 months posttest). In total, there were 70 CMH children and 52 comparison children who received vegetable snacks at all 3 time periods. There was no statistically significant difference in baseline consumption between the children who received all 3 fruit ($t = 1.1, df = 213, P = .29$) and vegetable ($t = 1.3, df = 192, P = .21$) assessments compared with those children who were either absent or disenrolled from the center at the follow-up assessments.

The immediate follow-up average pre-weight fruit snack was statistically different from the average pre-weight fruit snack at baseline assessment ($t = 30.3, df = 224, P < .01$) and the pre-weight at 3-month follow-up assessment ($t = -35.9, df = 221, P < .01$). The immediate follow-up assessment was conducted in December, when most fruit is not in season and the fruit in the mixture was smaller in size and weighed slightly less than the fruit at baseline and 3-month follow-up. To account for this small difference, the percentage of snack consumed was calculated at each assessment instead of subtracting the post-weight from the pre-weight at each assessment. To determine whether children who received the CMH program consumed significantly more fruit and vegetable snack after receiving the program, a repeated-measures ANOVA was conducted.

The current evaluation was a nested design; children were nested within classrooms. The classrooms were the units of assignment, but the outcome data were collected among the children. This nested structure often violates the assumption that observations are independent and the use of traditional statistical techniques yields biased estimates. If data are analyzed at the individual level and the nesting of individuals within organizational units is ignored, estimated

standard errors would be too small and the risk of type I errors (ie, reject the null when it is true) is inflated.¹³ Hierarchical linear modeling (HLM) is a regression technique that takes into account the hierarchical structure of data.

Hierarchical Linear and Nonlinear Modeling (HLM) software (version 6, Scientific Software International, Inc., Lincolnwood, IL, 2004) was used to analyze the data. Separate HLM analyses were conducted for the fruit snack and the vegetable snack. The study design was a 3-level design: the first level was the repeated measures; the second level included child variables; and the third level included classroom and teacher variables. The HLM 6 software is not capable of performing a 4-level analysis, which would have been repeated measures at the first level, child variables at the second level, teacher variables at the third level, and classroom variables at the fourth level. Because of these limitations, 2 separate analyses were conducted: 1 analysis with teacher-level variables in the third level and 1 analysis with classroom variables in the third level.

Level 1 consisted of the repeated measures, which assessed the amount of fruit snack and vegetable snack consumed at the 3 time periods: baseline, immediate follow-up, and 3-month follow-up. The second level consisted of child variables: sex and the timing of when the snack was served to the children. The third level consisted of classroom and teacher variables. Teacher variables in the third level included group assignment, years of experience in child care, and education level. The classroom variables included group assignment, socioeconomic status, and classroom size. The children in the classrooms were from the geographic region that the elementary school served. To determine socioeconomic status, Social Explorer, an interactive geographic map that displays 2000 United States Census data, was used to determine the percentage of low-income families in the area served by the child care centers.¹⁴

RESULTS

Process Evaluation

Child attendance. Child attendance at the 12 circle-time lessons and 6

imaginary trips ranged from 63%-85%. Children attended an average of 14.2 lessons (SD \pm 4.0). Children attended an average of 9.5 (SD \pm 2.7) circle-time lessons and 4.7 imaginary trips (SD \pm 1.5).

Parent take-home activities. On average, 3.4 weekly take-home activities (SD \pm 2.4) were completed. Moreover, 22% (n = 22) of the children completed all 6 take-home activities with a parent or guardian. Twenty-four percent (n = 25) of the children did not complete any of the take-home activities. The 2 initial take-home activities had higher completion rates compared with the other 4 take-home activities.

Teacher survey. All 10 lead teachers who implemented the CMH program completed the teacher survey. The majority (90%) of the teachers thought that the children were more willing to try new food since initiating the program. Ninety percent of the teachers thought that the children were eating more fruits and vegetables since initiating the program. All of the teachers thought that children were recognizing more fruits and vegetables since initiating the program. The 10 lead teachers either strongly agreed (30%) or agreed (70%) with the following statement: "Using CMH has increased children's knowledge about fruits and vegetables."

Outcome Evaluation

Fruit snack. Figure 1 displays the percentage consumed at the 3 time periods. Since percentages were used, an arcsine transformation was conducted before ANOVA analyses were conducted. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2 = 15.32$, $P < .05$); therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.91$). There was a significant main effect for the amount of fruit consumed over the 3 time periods ($F [1.82,271.33] = 13.70$, $P < .001$). There was a significant interaction effect between group assignment and the amount of fruit snack consumed ($F [12.73,271.33] = 34.18$, $P < .001$). Contrasts determined that children who received CMH consumed significantly more fruit snack at the immediate follow-up ($F [1,149] = 62.26$, $P < .001$, $d = 1.29$) and 3-month follow-up ($F [1,149] = 17.41$, $P < .001$, $d = 0.68$) compared with children who did not participate in the program.

Repeated-measures ANOVA was conducted for the amount of the fruit item (ie, pineapple, cantaloupe, grape, and strawberry) and cracker item (Ritz cracker and graham cracker) remaining after children had an opportunity to consume the fruit snack. Table 2 displays the average amount of fruit snack items remaining for CMH and control children at each time period. The analysis determined that children who participated in CMH consumed

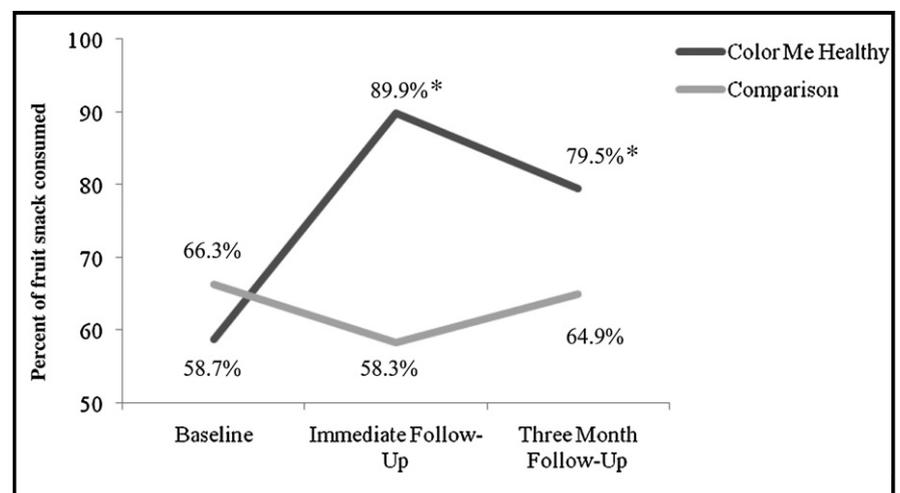


Figure 1. Percent of fruit snack consumed by preschoolers in childcare at the 3 time periods. $n_{\text{Color Me Healthy}} = 83$; $n_{\text{comparison}} = 70$; * $P < .001$ from baseline assessment to follow-up assessments.

Table 2. Average Number of Fruit Snack Pieces/Units Remaining for *Color Me Healthy* and Comparison Children at the 3 Time Periods

Fruit Snack Item	Baseline	Immediate Follow-Up	3-Month Follow-Up
<i>Pineapple</i>			
Color Me Healthy	1.9	0.6*	1.1*
Comparison	1.5	2.0	1.5
<i>Cantaloupe</i>			
Color Me Healthy	2.4	0.6*	1.3*
Comparison	1.5	1.9	1.6
<i>Purple grape</i>			
Color Me Healthy	1.2	0.3*	0.5*
Comparison	0.3	0.6	0.5
<i>Strawberry</i>			
Color Me Healthy	0.8	0.2*	0.5*
Comparison	0.8	0.8	0.8
<i>Ritz cracker</i>			
Color Me Healthy	0.4	0.6	0.7
Comparison	0.6	0.4	0.6
<i>Graham cracker</i>			
Color Me Healthy	0.4	0.5	0.7
Comparison	0.4	0.4	0.6

* $P < .01$.
 Note: Fruit snack consisted of 4 pineapple chunks, 4 cantaloupe chunks, 4 purple grapes, 2 strawberries, 2 Ritz crackers, and 2¼ squares graham cracker.

significantly more pineapple, cantaloupe, grape, and strawberry with less remaining at the immediate follow-up and 3-month follow-up compared with children who did not participate in the program. There was a nonsignificant interaction effect between group assignment and the amount of Ritz cracker and graham cracker remaining over the 3 time periods.

Vegetable snack. Figure 2 displays the percentage consumed at the 3 time periods. Since percentages were used, an arcsine transformation was conducted before ANOVA analyses were conducted. Mauchley's test indicated that the assumption of sphericity had not been violated ($\chi^2 = 2.63$, $P > .05$). There was a main effect for the amount of vegetable consumed

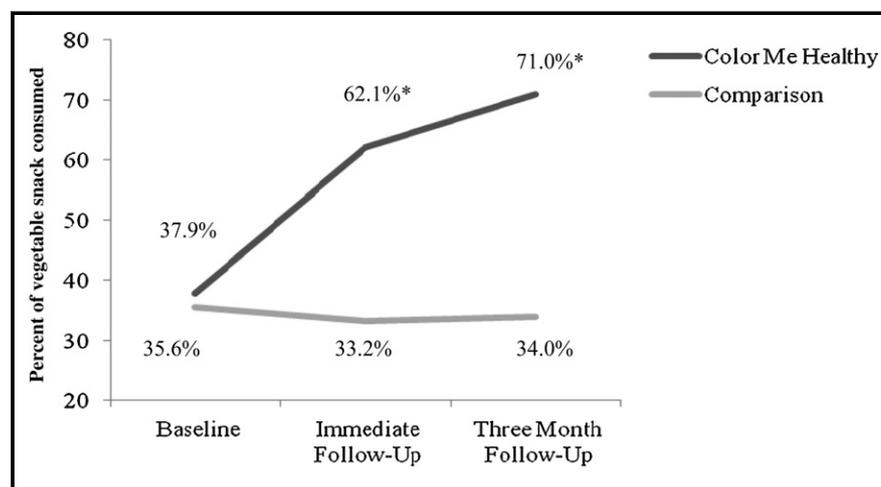


Figure 2. Percent of vegetable snack consumed by preschoolers in childcare at the three time periods. $n_{\text{Color Me Healthy}} = 70$; $n_{\text{comparison}} = 52$; * $P < .001$ from baseline assessment to follow-up assessments.

across the 3 time periods ($F [2,240] = 21.67$, $P < .01$). There was a significant interaction effect between group assignment and the amount of vegetable snack consumed ($F [2,240] = 27.65$, $P < .01$). Contrasts determined that children who received CMH consumed significantly more vegetable snack at the immediate follow-up ($F [1,120] = 24.14$, $P < .001$; $d = 0.90$) and 3-month follow-up ($F [1,120] = 43.41$, $P < .001$, $d = 1.20$) compared with children who did not receive the program.

Repeated-measures ANOVA was conducted for the amount of vegetable item (ie, carrot, cherry tomato, celery, and broccoli) and cracker item (ie, Ritz and graham) remaining after children had had an opportunity to consume the vegetable mixture. Table 3 displays the average amount of vegetable snack items remaining for CMH and children in the control group. Contrasts determined that children who received CMH consumed significantly more carrot, cherry tomato, celery, and broccoli, with less remaining at the 3-month follow-up compared with children who did not receive the program. There was a nonsignificant difference between children who received CMH and children in the control group for the amount of carrot and cherry tomato remaining at the immediate follow-up. There was a nonsignificant interaction effect between group assignment and the amount of Ritz crackers and graham cracker remaining at the 3 time periods.

Hierarchical Linear Modeling

Fruit snack. The HLM model that assessed child predictors at level 2 and teacher predictors at level 3 found that group assignment was the only significant predictor for fruit consumption from baseline to immediate follow-up ($\gamma = 1.11$, $t = 6.11$, $P < .01$) and from baseline to 3-month follow-up ($\gamma = 0.58$, $t = 3.35$, $P < .01$). The HLM model that assessed child predictors at level 2 and classroom predictors at level 3 found that group assignment was the only significant predictor for fruit consumption from baseline to immediate follow-up ($\gamma = 1.04$, $t = 5.02$, $P < .01$) and from baseline to 3-month follow-up ($\gamma = 0.55$, $t = 3.19$, $P < .01$).

Table 3. Average Number of Vegetable Snack Pieces/Units Remaining for *Color Me Healthy* and Comparison Children at the 3 Time Periods

Vegetable Snack Item	Baseline	Immediate Follow-Up	3-Month Follow-Up
<i>Carrot</i>			
Color Me Healthy	1.4	0.8	0.6*
Comparison	1.5	1.5	1.2
<i>Cherry tomato</i>			
Color Me Healthy	1.1	1.1*	0.8*
Comparison	1.3	1.3	1.4
<i>Celery</i>			
Color Me Healthy	1.4	1.0*	0.8*
Comparison	1.4	1.5	1.5
<i>Broccoli</i>			
Color Me Healthy	2.1	1.4*	1.1*
Comparison	2.4	2.4	2.4
<i>Ritz cracker</i>			
Color Me Healthy	0.5	0.6	0.7
Comparison	0.9	0.7	0.7
<i>Graham cracker</i>			
Color Me Healthy	0.7	0.5	0.7
Comparison	0.6	0.5	0.7

* $P < .01$.
 Note: Vegetable snack consisted of 3 baby carrots, 2 cherry tomatoes, 3 celery sticks, 3 broccoli florets, 2 Ritz crackers, and 2¼ squares graham cracker.

Vegetable snack. The HLM model that assessed child predictors at level 2 and teacher predictors at level 3 found that group assignment was the only significant predictor of vegetable consumption over the 3 time periods ($\gamma = 0.83$, $t = 8.17$, $P < .01$). The HLM model that assessed child predictors at level 2 and classroom predictors at level 3 found that group assignment was the only significant predictor for vegetable consumption at the 3 time periods ($\gamma = 0.83$, $t = 7.52$, $P < .01$).

DISCUSSION

Children who were exposed to the CMH program increased their consumption of fruit snack by approximately 31.2% and vegetable snack by approximately 24.2% between the baseline assessment and the assessment conducted 1 week after the completion of the study. More importantly, children continued to display an increase in their fruit and vegetable consumption 3 months after the completion of the curriculum. Children exposed to the CMH program increased their consumption of fruit

snack by approximately 20.8% and vegetable snack by approximately 33.1% between baseline assessment and the assessment conducted 3 months after the completion of the CMH program. The findings suggest that the impact of the CMH program on children's behavior was not transient; future studies would benefit from longer longitudinal designs assessing the impact of the CMH program at 1 year and 2 years post-intervention. Few evaluations of nutrition programs in child care settings have extended post-intervention assessments to 1 year after program completion.^{15,16} Notably, evaluations of nutrition programs conducted among elementary school children have found that increases in fruit and vegetable consumption are maintained 1 and even 2 years after program implementation.¹⁷⁻¹⁹

The impact of the CMH program on fruit and vegetable consumption was not restricted to a specific fruit or vegetable. Children who were exposed to the CMH program increased their consumption of all 4 vegetables (ie, carrots, celery, broccoli, and cherry tomatoes) included in the assessments; children exposed to the

CMH program also increased their consumption of all 4 types of fruit (ie, pineapple, cantaloupe, strawberries, and grapes) included in the assessments. These findings suggest that the impact of the CMH program is not an artifact of a particular fruit or vegetable included in the assessment. Additionally, it is notable that the consumption of graham crackers and Ritz crackers did not differ significantly between CHM and control children. Thus, the CMH program did not simply increase the consumption of any food item, but specifically fruits and vegetables. Children in the study did consume more of the fruit snack compared with the vegetable snack. This finding is consistent with results found in previous studies,^{8,17,19} perhaps because fruit is naturally sweet and appeals to children more than vegetables.

Hierarchical linear modeling did not reveal child, classroom, or teacher variables that predicted fruit snack and vegetable snack consumption at post-intervention assessments. Future studies would benefit from the investigation of additional child and teacher variables, such as child and teacher ethnicity, body mass index, or other personal attributes that were not measured in the current study.

The current study yielded mixed results regarding the ability to involve parents in the program's activities. Of the 6 parent-child activities, on average, 3.4 were completed and returned to the classroom. Twenty-two percent of the children completed and returned all 6 parent-child activities. Engaging parents has been a challenge in previous studies investigating nutrition and physical activity programs.^{17,20-22} Future studies would benefit from a greater focus on parental involvement and determine methods for increasing parental participation.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Findings from the current study suggest that child care centers can serve as important venues for teaching children healthful eating habits during developmentally important years and that children's consumption of fruits

and vegetables can be modified through the implementation of an interactive nutrition program in child care settings. Future studies need to determine the effectiveness of CMH in additional child care settings, such as family child care. Finally, there are few regulations regarding what is served in child care settings.⁹ Future research needs to investigate the efficacy of modifying the child care food system and providing more fruits and vegetables during meal and snack times.

REFERENCES

- Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1992-2002. *JAMA*. 2004;291:2847-2850.
- Overweight and Obesity. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/nccdphp/dnpa/obesity/index.htm>. Accessed May 17, 2011.
- Munoz KA, Krebs-Smith SM, Ballard-Barbash R, Cleveland LE. Food intake of US children and adolescents compared with recommendations. *Pediatrics*. 1997;100:323-329.
- Ludwig DS, Peterson KE, Gortmaker SL. Relationship between consumption of sugar sweetened drinks and childhood obesity: a prospective, observational analysis. *The Lancet*. 2001;357:505-508.
- Fruits & Veggies More Matters. Fruit & Vegetable Benefits. Centers for Disease Control and Prevention Web site. <http://www.fruitsandveggiesmatter.gov/benefits/index.html>. Accessed May 17, 2011.
- National Cancer Institute. Cancer Trend Progress Report. US National Institutes of Health Web site. http://progressreport.cancer.gov/doc_detail.asp?pid=1&did=2007&chid=71&coid=70mid. Updated April 15, 2010. Accessed May 17, 2011.
- Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J, Kahle LL. Fruit and vegetable intake of children and adolescents in the United States. *Arch Pediatr Adolesc Med*. 1997;150:81-86.
- Lorson BA, Melgar-Quinones R, Taylor CA. Correlates of fruit and vegetable intakes in US children. *J Am Diet Assoc*. 2009;109:474-478.
- Story M, Kaphingst KM, French S. The role of child care setting in obesity prevention. *Future Child*. 2006;16:143-168.
- Capizzano J, Adams G. The hours that children under five spent in child care. *The Urban Institute*. 2000;B-8:1-8.
- Dunn C, Thomas C, Pegram L, Ward D, Schmal S. Color Me Healthy, preschoolers moving and eating healthfully. *J Nutr Educ Behav*. 2004;36:327-328.
- Dunn C, Thomas C, Ward D, Pegram L, Webber K, Cullitan C. Design and implementation of a nutrition and physical activity curriculum for child care settings. *Prev Chron Dis*. 2006;3:A58. http://www.cdc.gov/pcd/issues/2006/apr/05_0039.htm. Accessed May 17, 2011.
- Raudenbush SW, Byrk AS. *Hierarchical Linear Models: Applications and Data Analysis Methods*. Thousand Oaks, CA: Sage Publications, Inc; 2002.
- Social Explorer Web site. <http://www.socialexplorer.com/pub/home/home.aspx>. Accessed May 17, 2011.
- Gorelick MC, Clark EA. Effects of a nutrition program on knowledge of preschool children. *J Nutr Educ*. 1985;17:88-92.
- Koblinsky SA, Guthrie JF, Lynch L. Evaluation of a nutrition education program for headstart parents. *J Nutr Educ*. 1992;24:4-13.
- Perry CL, Bishop DB, Taylor G, et al. Changing fruit and vegetable consumption among children: the 5-a-Day Power Plus program in St. Paul, Minnesota. *Am J Public Health*. 1998;88:603-609.
- Gortmaker SL, Cheung LWY, Peterson KE, et al. Impact of school-based interdisciplinary intervention on diet and physical activity among urban primary school children. *Arch Pediatr Adolesc Med*. 1999;153:975-983.
- Warren JM, Henry CJK, Lightower HJ, Bradshaw SM, Perwaiz S. Evaluation of a pilot school programme aimed at the prevention of obesity in children. *Public Health Nutr*. 2003;18:287-296.
- Baskin ML, Zunker C, Worley CB, Kimbrough L, Dial B. Design and implementation of a pilot obesity prevention program in a low-resource school: lessons learned and research recommendations. *Health Educ*. 2009;109:66-85.
- Blom-Hoffman J, Wilcox KR, Dunn L. Family involvement in school based health promotion: bringing nutrition information home. *School Psych Rev*. 2008;37:567-577.
- Story M, Warren-Mays R, Bishop CL, Taylor G, Smyth M, Gray C. 5-a-Day Power Plus: process evaluation of a multicomponent elementary school program to increase fruit and vegetable consumption. *Health Educ Behav*. 2000;27:187-200.