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ORIGINAL RESEARCH

Intervention leads to improvements in the nutrient profile of snacks served in afterschool programs: a group randomized controlled trial

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Abstract

Widely adopted nutrition policies for afterschool programs (ASPs) focus on serving a fruit/vegetable daily and eliminating sugar-sweetened foods/beverages. The impact of these policies on the nutrient profile of snacks served is unclear. Evaluate changes in macro/micronutrient content of snacks served in ASPs. A 1-year group randomized controlled trial was conducted in 20 ASPs serving over 1700 elementary-age children. Intervention ASPs received a multistep adaptive framework intervention. Direct observation of snack served was collected and nutrient information determined using the USDA Nutrient Database, standardized to nutrients/100 kcal. By post-assessment, intervention ASPs reduced total kcal/snack served by 66 kcal (95CI −114 to −19 kcal) compared to control ASPs. Total fiber (+1.7 g/100 kcal), protein (+1.4 g/100 kcal), polyunsaturated fat (+1.2 g/100 kcal), phosphorous (+49.0 mg/100 kcal), potassium (+201.8 mg/100 kcal), and vitamin K (+21.5 μg/100 kcal) increased in intervention ASPs, while added sugars decreased (−5.0 g/100 kcal). Nutrition policies can lead to modest daily caloric reductions and improve select macro/micronutrients in snacks served. Long-term, these nutritional changes may contribute to healthy dietary habits.

Keywords

Obesity, Policy, Standards, Fruits, Vegetables, Dips, Children, School, Nutrition, Community-based programs, Food

Implications

Research: Snacks served in ASPs can have an important public health impact on the macro and micronutrient intake of the millions of children enrolled nationwide.

Practice: Afterschool program providers require support to assist them with meeting snack nutrition policies.

Policy: Continued efforts should be made to consolidate nutrition guidelines for ASPs that focus on guiding snack purchases that have the most potential public health impact.

INTRODUCTION

Over the past decade, afterschool programs (ASPs) have been recognized as a setting, outside of the regular school day, with the potential to address childhood obesity. As one component of this effort, ASPs have been called to change the nutritional quality of snacks served to the millions of children enrolled in their programs nationally [1–4]. Efforts have largely focused on the development and adoption of policies that clearly define the types of foods and beverages ASPs can serve daily for snacks. These policies mostly emphasize serving fruits and/or vegetables daily, while eliminating sugar-sweetened foods and beverages.

The most widely adopted nutrition policies for ASPs are the Healthy Eating (HE) Standards from the National Afterschool Association [3, 5] which call on programs to, on a daily basis, (1) serve a fruit or vegetable; (2) offer water at the table and has water accessible at all times; (3) serve no candy or other foods that are primarily sugar-based; (4) serve no beverages that are primarily sugar-based; and (5) avoid foods and beverages made with artificial ingredients (sweeteners, flavors, or colors). Intervention studies have shown that ASPs can effectively work toward achieving the HE Standards and that they can do this without increasing the costs associated with purchasing more healthful snacks [6–10]. Moreover, direct observation has shown that, when children are served more healthful snacks like fruits and vegetables, they consume them [6, 10].

Recently, an intervention focused on capacity building with ASPs to develop menus that met the HE Standards and identifying low-cost outlets to purchase snacks reported that programs can make substantial changes in the types of foods and beverages served [11, 12]. Although the HE Standards do not specify the energy value or micronutrients or macronutrients of snacks, understanding how changes in the foods

and beverages served relate to improvements in the overall caloric value, as well as the macronutrient and micronutrient content of snacks is necessary. Such information is valuable as programs across the nation look toward achieving nutrition-focused policies in ASPs to help contribute to solutions for childhood obesity [13, 14]. The purpose of this study was to evaluate the changes in total calories and macronutrient content of the foods and beverages served to children attending ASPs that were part of a group randomized controlled trial focused on achieving the HE Standards [12]. A secondary goal was to evaluate changes in the micronutrients of snacks served.

METHODS

A complete description and overview of the study can be found elsewhere [12]. For this study, ASPs were defined as child care programs operating immediately after the school day, every day of the school year for a minimum of 2 h. Programs had to serve a minimum of 30 children of elementary age (6–12 years) and could operate in a school, community, or faith setting. Programs had to provide a snack, homework assistance/completion time, enrichment, and opportunities for physical activity to participate in this study [15]. Program eligibility consisted of operating within 1.5-h drive from the university and classification as an ASP as defined above. Across the 20 ASPs, mean enrollment was 88 children (range 30 to 162). Programs that were singularly focused (e.g., dance, tutoring) and/or physical activity focused (e.g., sports, activity clubs), were not eligible for participation. All children enrolled, staff, and ASP leaders in the programs were eligible to participate in the study. A total of 20 ASPs, representing 13 different organizations were randomly selected from an existing registry of 535 ASPs in South Carolina and invited to participate in an intervention targeting healthy eating and physical activity – Making Healthy Eating and Physical Activity Policy Practice [12]. Of the 535 programs, 376 met the eligibility criteria–76 did not operate Mon-Fri, 53 enrolled fewer than 30 children, and 30 did not have sufficient information to evaluate eligibility. The information presented represents baseline (March-April 2013) and first year outcomes (August 2013 to May 2014) snack information. Five programs received federal or state reimbursement for snacks. All study procedures were approved by the university's Institutional Review Board. Additional nutrition outcomes associated with this study are reported elsewhere [11].

The design of the study was a group randomized controlled trial. The 20 ASPs were randomized into one of two conditions: (1) intervention or (2) control group. Randomization to intervention versus control groups was performed after baseline data collection, during June 2013. Programs were match-paired based on enrollment size, and average number of days per week a fruit or vegetable was served. In order to minimize contamination, ASPs within the same organization were matched with ASPs from other organizations and were all randomized to the same condition. Once an ASP from within an organization was randomized to the intervention or control group, all other ASPs from this organization were also designated to this group. Enrollment size was selected as a matching variable to assure comparable group composition on a marker of organizational complexity (e.g., an ASP of 30 children is less complex than an ASP serving >150 children/day). Fruit and vegetable servings were identified as pertinent matching variables because they were the primary outcomes of interest. Randomization was conducted by study staff using a random number generator. Descriptive characteristics of the intervention and control groups at baseline are provided in Table 1.

Intervention

A detailed description of the Strategies To Enhance Practice for Healthy Eating (STEPs-HE) conceptual framework can be found elsewhere [16]. In brief, the STEPs-HE conceptual framework involves a multistep, adaptive approach to incorporating healthy eating strategies into daily routine practice. The framework was informed by the authors' extensive empirical work [12–14, 17–20] conducted within this setting, as well as their practical experience working with ASP organizations. The approach consists of identifying essential ASP characteristics that represent fundamental building blocks that function as necessary programmatic components to achieving full integration of healthy eating strategies and eventual achievement of the Healthy Eating (HE) Standards [4, 5].

The STEPs-HE approach departs from traditional intervention models that are based on a predefined package of intervention components all provided identically to those individuals or settings allocated to a treatment condition [21]. The STEPs-HE conceptual framework recognizes that each ASP is unique and, therefore, will require some similar and some different resources/strategies to achieve the HE Standards (i.e., there is no "one size fits all" intervention). The approach taken in STEPs-HE is one where some degree of local site-level tailoring will occur that is both responsive and adaptive to the characteristics of each ASP. [22] This assists with the local relevancy of the healthy eating strategies and subsequent uptake/integration of them within daily practice. STEPs-HE is designed so that any one ASP can enter anywhere along the continuum from lower to higher levels of capacity, with the understanding that some ASPs will enter at a lower level indicating the need for greater technical assistance to achieve the HE Standards versus those programs that enter at a higher level. STEPs-HE was informed from a systems framework for translating childhood obesity policies into practice in ASPs [14], the principles of community-based participatory research [23], the theory of human motivation [24], nonspecific hypothesis in psychotherapy [25, 26], and adaptive interventions [27].

Table 1 | Baseline (spring 2013) characteristics of afterschool programs and children enrolled by treatment condition

Afterschool program characteristics	Control (n=10)		Intervention (n=10)		p Difference[b]
Presence nutrition policy (n)					
None	8		6		
Written, nonspecific language	1		0		
Written, explicit language [a]	1		4		
Staff training for nutrition (n)					
None	9		10		
1–4 h/year	1		0		
Use of nutrition curriculum (n)					
None	6		10		
Nonevidence-based	3		0		
Evidence-based	1		0		
Total kids enrolled	870		895		
Average enrollment (M, SD)	87.0	±47.8	89.5	±52.0	0.961
Daily program length (minutes per day, M, SD)	205.5	±134.3	190.5	±128.7	0.303
Reimbursement for snack (n)	1		4		
Percentage of population in poverty, Census 2010	17.5	±10.2 %	13.3	±15.6 %	0.089
Location (n)					
School	6		3		
Faith/church	1		3		
Community (e.g., recreation center)	3		4		
Food Preparation and storage (n)					
Refrigerator and freezer combination unit	7		10		0.210
Standalone freezer	3		2		0.900
Pantry or storage closet for dry goods	9		9		1.000
Portable cooler/ice chest	7		6		0.900
Kitchen	5		6		0.900
Food preparation sink that is not in a bathroom	4		9		0.029
Stove/oven	4		5		0.900
Microwave	9		10		0.900
Serving plates or bowls	9		10		0.900
Child characteristics					
Boys (%)	52.4		53.3		
Age (years, M, SD)	8.1	±1.8	7.9	±1.8	0.394
Race/Ethnicity (%)					‹0.001
White non-Hispanic	48.4		64.6		
African American	44.7		29.7		
Other	6.9		5.7		

[a] The written explicit policies were from the federal reimbursement guidelines, Child and Adult Food Care Program

[b] p Value for comparison between intervention and control at baseline. Continuous variables at the ASP level compared using two-sample t tests; categorical variables compared using χ^2 tests or Fisher exact test for small sample size (N=20)

The STEPs-HE [16] framework initially targets the program leader for integrating the HE Standards into routine practice. Implementing STEPs-HE includes (1) the identification and/or development of a schedule/menu of daily/weekly snack offerings, (2) following the developed schedule/menu, (3) budgeting the amount for snacks (either daily cost per snack per child per day or annual budget), and (4) determination of where snacks are purchased (i.e., location). These steps are consistent with requirements outlined by the USDA to receive federal reimbursement for snacks and help program leaders identify what snacks align with the HE Standards while also accommodating their budget [28]. For ASPs who have not implemented these steps, technical assistance is provided by research staff, initially focused on developing a 2- or 4-week rotating snack menu that clearly defines the snacks to be served and their respective serving size, as well as determining challenges associated with serving the menu-specified snacks. For ASPs without knowledge of snack expenditures, monthly snack purchase receipts were collected and subsequent computation of monthly and per snack/child/day costs were performed. Where ASPs were identified as having a limited budget and/or were purchasing snacks from retailers where the retail cost of snacks that meet the HE Standards is prohibitive, support was provided to link ASPs with an existing network of grocery stores that provide a discount on snacks to ASPs that meet the HE Standards [6, 14, 29]. Where access to a partner grocery store was not feasible, most likely due to travel distance, alternative food purchasing outlets, such as more conveniently located grocery stores not currently part of the partnership or large bulk warehouse stores, were identified to assist ASPs in maintaining snack expenditures while meeting the HE policies.

Trainings for the intervention ASPs, conducted by Policy to Practice in Youth Programs staff (P2YP.org, a service organization for professional development trainings for ASPs), occurred at the beginning of the school year (August 2013) and lasted approximately 3 h, along with 4 (3 in the fall separated by 3 to 4 weeks and 1 in Jan/Feb) booster sessions per intervention ASP. Booster sessions included a walkthrough with the program leader to review opportunities to meet the HE Standards and happened concurrently with a review of physical activity. For the boosters, research personnel, program leaders, and staff convened a 20- to 30-min meeting immediately following the end of the ASP to discuss areas that were consistent and inconsistent with meeting the HE Standards. Strategies to address challenges were agreed upon and implemented in subsequent days. Follow-up technical support phone calls were completed 2 weeks after the booster session. These calls provided additional technical assistance for agreed upon strategies and monitored progress toward meeting program HE Standards. Consistent with routine practice, the control ASPs did not receive any formal trainings related to snack purchasing during this time.

Measures

Direct observation and classification–The types of foods and beverages served as snack were recorded via direct observation by trained research personnel [6, 30]. Each ASP was visited on four nonconsecutive unannounced days between March and April 2013. At the start of snack, the trained observer recorded the brand name(s), size, and packaging, where appropriate, of the foods and beverages served as snack for that day. Foods and beverage items served as snacks were classified according to existing categories for snacks and beverages [13, 31], sugar-sweetened beverages (e.g., soda, powered drink mixed, sport drinks), dairy food unsweetened (e.g., string cheese), dairy food sweetened (e.g., Trix® yogurt), milk unsweetened (nonfat, 1 %, 2 %, and whole), milk sweetened (e.g., chocolate, strawberry), 100 % fruit juice, salty flavored snacks (e.g., Doritos®, Chex Mix®), salty unflavored snacks (e.g., pretzels, plain corn tortilla chips), desserts (e.g., cookies, Pop-Tarts®), candy (e.g., chocolate, frozen treats), nonfruit fruit (e.g., Fruit Roll-Ups®; fruit leather), prepackaged fruit (e.g., applesauce, fruit in syrup), cereal sugar-sweetened (e.g., Fruit Loops®); cereal unsweetened (e.g., Cheerios®), and fruits and vegetables (e.g., fresh, frozen, dried) recorded separately. Water was recorded if programs provided water in cups or bottles during snack time. All foods and beverages were divided into the following three categories for analysis–foods, dips, and beverages. Inter-rater agreement on the individual food items served during snack was 98.4 % (kappa 0.98) across 133 reliability observations of snacks.

Nutrient analysis–All foods and beverages served for snack were identified in the USDA Nutrient Database with corresponding values for macronutrients and micronutrients extracted [32]. The macronutrient and micronutrient composition for each food and beverage were estimated based on the serving size observed during the program. Where serving sizes were not available, such as handfuls of pretzels served on a paper towel, a standard snack serving size was used that was based on snack serving sizes observed in previous ASP studies [7, 9, 20, 33, 34]. All macronutrients and micronutrients were standardized to represent the amount per 100 kcal [35, 36].

Additionally, at baseline the Healthy Afterschool Activity and Nutrition Document (HAAND) was collected on all 20 programs. [12, 17] The HAAND is collected from a single day site visit by a trained research assistant that includes direct observation of foods and beverages served, a semistructured interview with the program leader, and written document review. Only the nutrition portion of the HAAND is presented in this study.

Statistical analysis

All analyses were performed using Stata (v.13.0, College Station, TX). Initially, descriptive statistics (means and standard deviations) were computed for all foods, dips, and beverages observed. Secondly, the daily

average macronutrient and micronutrient content of all of the components of the snack as it was intended to be served were summed to represent the total snack nutrient profile for programs when a food, dip, and beverage were served to children on a given day. Primary comparisons were made for overall energy (kcals) and macronutrient content and secondary comparisons made for micronutrients for foods, dips, beverages, and total snack between intervention and control ASPs were made using mixed model linear regressions, adjusting for multiple days of observation occurring within each programs across time.

RESULTS

The baseline characteristics of the intervention and control programs are presented in Table 1. Intervention and control programs were equivalent on all characteristics except for four intervention programs having a written policy that used explicit language versus only a single control program, four control programs using some form of nutrition education versus none in the intervention, nine intervention programs having access to a food preparation sink not located in a bathroom versus four control programs, and control programs serving more African American children. Information on the most commonly observed foods, dips, and beverages served at baseline and post-assessment are presented in Table 2. At baseline, the two most commonly observed foods for both groups was low-nutrient density desserts (30–32 %) and flavored salty snacks (23–27 %). For beverages, the most commonly observed beverage for the control programs was water (33 %), whereas intervention programs top beverage served as powdered-drink mixes (58 %). For control ASPs, relatively no changes were observed in the types of foods or beverages served at post-assessment. In contrast, the top five foods served by intervention ASPs at post-assessment were altered substantially to include fruit, vegetables, unflavored salty grains, flavored salty grains, and dairy. Similar changes were observed for the beverages, with intervention ASPs top five beverages at post-assessment being water, unflavored milk, and 100 % juice.

The descriptive statics for macronutrient and micronutrient profile of the snacks (i.e., foods, dips, and beverages) served at baseline and post-assessment can be found in Table 3. Information for foods, dips, and beverages, separately, can be found in the supplemental online tables. At baseline, the only differences ($p<0.05$) between intervention and control programs were with three minerals (i.e., magnesium, phosphorous, and potassium) for the beverages and a single vitamin (i.e., riboflavin) for the total macro/micronutrients combined. For the overall macronutrient profile of snacks served (i.e., sum of the food, dip [if present], and beverage [if present]), by post-assessment intervention programs served snacks with fewer kcals (−66 kcal, 95CI −114.13 to −18.74), more protein (+1.4 g/100 kcal, 95CI 0.21 to 2.59), polyunsaturated fat (+1.2 g/100 kcal, 95CI 0.23 to 2.22), fiber (+1.7 g/100 kcal, 95CI 0.59 to 2.79), and less added sugars (−5.0 g/100 kcal, 95CI −9.50 to −0.49). For micronutrients, intervention programs were serving snacks with more phosphorous (+49.0 mg/100 kcal, 95CI 17.82 to 80.26), potassium (+201.8 mg/100 kcal, 95CI 38.80 to 364.88), and vitamin K (+21.5 μg/100 kcal, 95CI 8.68 to 34.36).

For foods, by post-assessment intervention programs were serving foods with fewer kcals (−99 kcal, 95CI −131 to −76.6), higher protein (+0.8 g/100 kcal, 95CI 0.07 to 1.43), less monounsaturated fat (−0.4 g/100 kcal, 95CI −0.80 to −0.05), higher fiber (+1.6 g/100 kcal, 95CI 0.84 to 2.26), and less added sugars (−3.9 g/100 kcal, 95CI −5.6 to 2.1). For micronutrients, intervention programs were serving foods with increased magnesium (+9.3 mg/100 kcal, 95CI 3.36 to 15.19), phosphorus (+24.8 mg/100 kcal, 95CI 8.52 to 41.15), and potassium (+191.2 mg/100 kcal, 95CI 88.45 to 293.95), decreased folate (−48.5 μg/100 kcal, 95CI −85.07 to −11.9), and increased vitamin K (+24.5 μg/100 kcal, 95CI 8.72 to 40.24). For dips, no analyses were conducted due to too few observations of dips served in the intervention (observations=7) at baseline and in the control group at baseline (observations=2) and post-assessment (observations=0). By post-assessment, intervention programs served beverages with more protein (+1.6 g/kcal, 95CI 0.63 to 2.60) and less total (−13.4 g/100 kcal, 95CI −19.84 to −6.89) and added sugars (−9.3 g/100 kcal, 95CI −14.39 to −4.21). For micronutrients, intervention programs were serving beverages with more calcium (+41.3 mg/100 kcal, 95CI 4.48 to 78.13), phosphorous (+40.6 mg/100 kcal, 95CI 10.15 to 70.97), potassium (+79.2 mg/100 kcal, 95CI 21.25 to 137.19), zinc (+0.2 mg/100 kcal, 95CI 0.03 to 0.28), riboflavin (0.1 mg/100 kcal, 95CI 0.03 to 0.15), vitamin B_6 (+0.02 mg/100 kcal, 95CI 0.01 to 0.04), folate (+6.5 mg/100 kcal, 95CI 0.54 to 12.39), and less magnesium (−25.2 mg/100 kcal, 95CI −38.64 to −11.72) compared to beverages served in the control ASPs.

DISCUSSION

This is one of the first studies to evaluate changes in the nutrient profile of foods and beverages served for snack in ASPs. Our findings indicate that as ASPs work toward meeting national standards for the types of snacks they serve, these efforts can result in a modest reduction of the overall caloric content of the snack provided, while improving select macronutrients and micronutrients. These changes, in the long term, may contribute to healthier dietary habits and provide further evidence of the important role ASPs play in addressing childhood obesity by proving access to healthy choices for snacks.

Of interest was that as programs changed their daily snack offering to serve more fruits and vegetables each day, the number of dips served alongside increased substantially (see Table 2 and 3). In turn, the caloric contribution of dips increased by ~50 kcal, while the caloric contribution of foods and beverages reduced

Table 2 | Five most frequently observed food, dip, and beverage categories served in intervention and control afterschool programs at baseline and post-assessment

	Control				Intervention			
	Baseline		Post-assessment		Baseline		Post-assessment	
	Item description	Percentage of items observed	Item description	Percentage of items observed	Item description	Percentage of items observed	Item description	Percentage of items observed
Food								
1	Low-nutrient density desserts (*Graham Crackers, Cookies*)	30 %	Low-nutrient density desserts (*Graham Crackers, Cookies*)	38 %	Low-nutrient density dessert (*Graham Crackers, Cookies*)	32 %	Fruit (*apples, bananas, oranges*)	39 %
2	Flavored salty grains (*Fritos, Goldfish, Snack Mix*)	27 %	Flavored salty grains (*Fritos, Goldfish, Snack Mix*)	17 %	Flavored salty grain (*Fritos, Goldfish, Snack Mix*)	23 %	Vegetable (*baby carrots, celery*)	17 %
3	Unflavored salty grains (*Plain Tortilla Chips, Pretzels*)	11 %	Sugar-sweetened cereals (*Fruit Loops, Apple Jacks*)	11 %	Unflavored salty grain (*Plain Tortilla Chips, Pretzels*)	15 %	Unflavored salty grain (*Plain Tortilla Chips, Pretzels*)	12 %
4	Sugar-sweetened cereals (*Fruit Loops, Apple Jacks*)	9 %	Unsweetened cereal (*Cheerios*)	6 %	Sugar-sweetened cereals		Flavored salty grain (*Fritos, Goldfish, Snack Mix*)	9 %
5	Dairy (*String Cheese*)	8 %	Fruit (*apples, bananas, oranges*)	5 %	Fruit (*apples, bananas, oranges*)	8 %	Dairy (*String Cheese*)	7 %
Dips								
1	Low-fat ranch dressing	50 %			Salsa	71 %	Low-fat ranch dressing	39 %
2	Salsa	50 %			Peanut butter	14 %	Peanut butter	23 %
3					Cheese (*nacho, cream*)	14 %	Salsa	16 %
4							Hummus	13 %
5							Cheese (*Nacho, Cream*)	6 %
Beverages								
1	Water	33 %	100 % fruit juice (*apple, cranberry, orange*)	29 %	Powdered drink mix (*lemonade, Kool-Aid*)	58 %	Water	66 %
2	100 % fruit juice (*apple, cranberry, orange*)	27 %	Water	27 %	Water	26 %	Milk unflavored (*low and non-fat*)	29 %
3	Powdered drink mix (*lemonade, Kool-Aid*)	18 %	Powdered drink mix (*lemonade, Kool-Aid*)	21 %	Milk unflavored (*low and non-fat*)	12 %	100 % fruit juice (*apple, cranberry, orange*)	3 %
4	Milk flavored (*chocolate, strawberry*)	12 %	Milk flavored (*Chocolate, Strawberry*)	13 %	100 % fruit juice (*apple, cranberry, orange*)	4 %		
5	Milk unflavored (*low and non-fat*)	8 %	Milk unflavored (*low and non-fat*)	6 %				

Table 3 | Comparison between control (n=10) and intervention (n=10) afterschool programs in energy and macro- and micronutrients for the snacks (includes foods, dips, and beverages) served at baseline and post-assessment

Control afterschool programs						Intervention afterschool programs					
Macronutrients and micronutrients (per 100 kcal)	Baseline (spring 2013)		Post-assessment (spring 2014)		Change over time	Baseline (spring 2013)		Post-assessment (spring 2014)		Change overtime	Baseline equivalency[a]
	M	(SD)	M	(SD)	Δ	M	(SD)	M	(SD)	Δ	p Value
Total macronutrients/micronutrients[c]											
Energy (kcal)	261.81	(102.36)	246.77	(92.08)	−15.03	252.92	(77.85)	177.33	(87.67)	−75.59	0.954
Protein (g)	2.42	(2.06)	2.14	(1.11)	−0.28	2.75	(2.32)	3.88	(3.24)	1.12	0.614
Total lipid (fat) (g)	3.60	(2.55)	3.51	(1.89)	−0.08	3.96	(2.64)	5.57	(5.56)	1.61	0.547
Saturated (g)	0.93	(0.64)	0.97	(0.74)	0.05	1.11	(1.07)	1.39	(1.67)	0.28	0.468
Monounsaturated (g)	1.09	(0.76)	1.16	(0.87)	0.07	1.19	(1.22)	1.54	(1.65)	0.36	0.665
Polyunsaturated (g)	1.29	(1.45)	1.05	(0.80)	−0.23	1.12	(0.84)	2.15	(2.68)	1.03	0.569
Trans (g)	0.03	(0.05)	0.03	(0.08)	0.00	0.04	(0.09)	0.07	(0.14)	0.03	0.831
Cholesterol (mg)	3.21	(5.80)	2.24	(4.08)	−0.96	2.55	(4.75)	4.85	(8.57)	2.30	0.619
Carbohydrate, by difference (g)	29.32	(13.75)	22.71	(10.85)	−6.61	29.77	(14.54)	23.26	(7.26)	−6.50	0.841
Fiber, total dietary (g)	1.48	(1.56)	1.18	(1.09)	−0.30	1.99	(2.45)	3.41	(2.18)	1.41	0.356
Sugars, total (g)	17.63	(11.51)	12.47	(10.13)	−5.16	18.12	(13.04)	12.81	(7.08)	−5.31	0.804
Added sugars (g)[b]	14.49	(10.66)	10.71	(10.19)	−3.78	10.16	(7.84)	2.04	(5.35)	−8.12	0.210
Minerals											
Calcium, Ca (mg)	67.53	(74.62)	50.31	(54.12)	−17.22	62.18	(71.75)	84.61	(96.13)	22.43	0.816
Iron, Fe (mg)	1.44	(1.54)	1.50	(1.47)	0.06	1.20	(0.91)	1.17	(1.30)	−0.03	0.466
Magnesium, Mg (mg)	24.43	(22.13)	20.85	(18.50)	−3.58	37.20	(33.67)	30.16	(22.80)	−7.04	0.120
Phosphorus, P (mg)	60.67	(51.04)	50.23	(33.20)	−10.44	55.96	(51.38)	95.69	(87.78)	39.73	0.710
Potassium, K (mg)	200.60	(229.48)	150.71	(140.93)	−49.89	239.20	(384.98)	397.52	(326.21)	158.33	0.621
Sodium, Na (mg)	247.34	(471.23)	143.21	(82.18)	−104.13	489.98	(955.96)	402.16	(745.60)	−87.82	0.215
Zinc, Zn (mg)	0.68	(0.73)	0.82	(1.02)	0.14	0.48	(0.44)	0.70	(0.81)	0.22	0.238
Vitamins											
Vitamin C, total ascorbic acid (mg)	15.15	(22.36)	14.67	(24.04)	−0.49	15.07	(20.73)	17.38	(18.34)	2.31	0.974
Thiamin (mg)	0.14	(0.14)	0.12	(0.11)	−0.02	0.10	(0.07)	0.12	(0.07)	0.01	0.292
Riboflavin (mg)	0.17	(0.14)	0.14	(0.14)	−0.03	0.10	(0.07)	0.15	(0.15)	0.05	0.049
Niacin (mg)	1.86	(1.72)	1.71	(1.61)	−0.15	1.72	(1.62)	1.80	(2.07)	0.07	0.782
Vitamin B_6 (mg)	0.18	(0.20)	0.17	(0.19)	−0.02	0.19	(0.25)	0.25	(0.21)	0.05	0.865
Folate, DFE (µg)	41.99	(59.57)	68.40	(107.73)	26.40	38.11	(34.51)	46.27	(48.96)	8.15	0.729
Vitamin B_{12} (µg)	1.62	(6.83)	0.23	(0.41)	−1.39	0.14	(0.24)	0.19	(0.42)	0.05	0.167
Vitamin A, RAE	73.05	(125.39)	100.21	(239.93)	27.16	39.71	(45.11)	150.08	(247.38)	110.38	0.146
Vitamin A, IU	722.95	(2279.35)	1325.50	(4347.71)	602.56	410.06	(806.72)	2401.64	(4609.82)	1991.57	0.408
Vitamin E (alpha-tocopherol) (IU)	0.63	(1.00)	0.45	(0.69)	−0.18	0.99	(1.81)	1.16	(1.76)	0.17	0.320
Vitamin D (D2+D3) (IU)	0.22	(0.40)	0.19	(0.37)	−0.03	0.10	(0.21)	0.08	(0.28)	−0.02	0.107
Vitamin D (IU)	8.82	(16.16)	7.58	1	−1.23	4.12	(8.40)	3.54	(11.24)	−0.58	0.099
Vitamin K (phylloquinone) (µg)	6.29	(23.97)	2.07	(3.44)	−4.21	3.63	(6.22)	21.08	(33.43)	17.45	0.492
Other											
Caffeine (mg)	0.07	(0.25)	0.07	(0.18)	−0.01	0.04	(0.18)	0.02	(0.18)	−0.02	0.523

Control afterschool programs	Between-group differences			
Macronutrients and micronutrients (per 100 kcal)	Intervention effect		Effect size[b]	
	Coefficient	(95CI)	Baseline	Post
Total macronutrients/micronutrients[c]				
Energy (kcal)	−66.43	(−114.13, −18.74)	−0.09	−0.75
Protein (g)	1.40	(0.21, 2.59)	0.16	1.56
Total lipid (fat) (g)	1.68	(−0.30, 3.65)	0.14	1.09
Saturated (g)	0.26	(−0.34, 0.86)	0.28	0.55
Monounsaturated (g)	0.29	(−0.37, 0.94)	0.13	0.44
Polyunsaturated (g)	1.22	(0.23, 2.22)	−0.11	1.37
Trans (g)	0.03	(−0.03, 0.09)	0.07	0.46
Cholesterol (mg)	3.38	(−0.03, 6.79)	−0.11	0.64
Carbohydrate, by difference (g)	−0.70	(−7.05, 5.66)	0.03	0.05
Fiber, total dietary (g)	1.69	(0.59, 2.79)	0.33	2.03
Sugars, total (g)	−0.92	(−6.52, 4.68)	0.04	0.03
Added sugars (g)[b]	−5.00	(−9.50, −0.49)	−0.41	−0.85
Minerals				
Calcium, Ca (mg)	38.15	(−2.03, 78.34)	−0.07	0.63
Iron, Fe (mg)	−0.16	(−0.88, 0.55)	−0.15	−0.22
Magnesium, Mg (mg)	−4.79	(−17.97, 8.39)	0.58	0.50
Phosphorus, P (mg)	49.04	(17.82, 80.26)	−0.09	1.37
Potassium, K (mg)	201.84	(38.80, 364.88)	0.17	1.75
Sodium, Na (mg)	11.99	(−363.00, 386.98)	0.51	3.15
Zinc, Zn (mg)	0.05	(−0.38, 0.47)	−0.26	−0.12
Vitamins				
Vitamin C, total ascorbic acid (mg)	1.77	(−10.00, 13.54)	0.00	0.11
Thiamin (mg)	0.03	(−0.03, 0.08)	−0.24	0.00
Riboflavin (mg)	0.07	(0.00, 0.14)	−0.46	0.10
Niacin (mg)	0.19	(−0.79, 1.17)	−0.08	0.06
Vitamin B_6 (mg)	0.06	(−0.06, 0.18)	0.05	0.41
Folate, DFE (µg)	−20.02	(−58.10, 18.06)	−0.07	−0.21
Vitamin B_{12} (µg)	1.43	(−0.44, 3.30)	−0.22	−0.11
Vitamin A, RAE	78.73	(−28.36, 185.82)	−0.27	0.21
Vitamin A, IU	1324.09	(−650.30, 3298.49)	−0.14	0.25
Vitamin E (alpha-tocopherol) (IU)	0.32	(−0.50, 1.14)	0.36	1.02
Vitamin D (D2+D3) (IU)	0.00	(−0.18, 0.19)	−0.29	−0.29
Vitamin D (IU)	0.49	(−6.80, 7.78)	−0.29	−0.27
Vitamin K (phylloquinone) (µg)	21.52	(8.68, 34.36)	−0.11	5.52
Other				
Caffeine (mg)	−0.01	(−0.12, 0.10)	−0.12	−0.24

[a] Baseline equivalency test between intervention and control programs

[b] Effect size (mean standardized difference, Cohen's *d*) at baseline with intervention minus control using the control group's standard deviation at baseline and at post-assessment with intervention minus control using the control group's standard deviation at post-assessment

[c] Total macro/micronutrients represent average daily values for foods, dips, and beverages. Values represent average amounts given some days programs might serve only a food item, and others serve a food and dip or food, dip and beverage

[d] Minus fruit, vegetable, and unsweetened dairy food sugars

by ~105 and ~18 kcal, respectively. The two most popular dips in the current study were low-fat ranch dressing served with vegetables and peanut butter served with fruit. Recent studies have suggested that dips help young children to consume vegetables and, therefore, may be useful in getting children to eat the provided snack [37, 38]. However, the introduction of a dip may offset the overall caloric reduction gained from serving fruits, vegetables, and water. Thus, it is important for providers and policy makers to understand that increasing fruit and vegetable servings within ASPs may introduce other food items, not typically observed (i.e., dips), and with this potentially minimize the energy reduction the policies were originally designed to address. Emphasizing low calorie dips, such as salsa or fat-free Italian dressing, may help ASPs reduce caloric intake while still allowing for the inclusion of dips. Over one third of the dips observed in the intervention ASPs were hummus or peanut butter, both of which are good sources of protein and fiber. The intervention sites saw significant increases in both the protein and fiber content of snacks served. Since protein and fiber are satiating [39, 40], inclusion of these dips has the potential to reduce caloric intake at later meals, such as dinner, resulting in lower overall daily energy intake. Additionally, high fiber intake is associated with low visceral adiposity and biomarkers of inflammation in adolescents [41]. The new higher fiber snacks may lead to improvements in these over time.

While reductions in overall caloric density of the snacks were observed, the reduction was modest. Prior studies [42, 43] have shown that fruit and vegetable intake displaces energy intake from non-fruit and vegetable sources, with overall caloric intake remaining stable. A recent study [9] in YMCA ASPs reported a similar change in overall energy from 300 to 267 kcal per snack per child per day from the adoption of snack nutrition policies. Of note is the substantial increase in potassium content of the snacks served in the intervention group in the current study. Potassium has been identified as a nutrient of concern from the 2010 Dietary Guidelines [44]. Specifically, some children may gain additional health benefits from increasing dietary potassium [44]. Along with potassium, the US Dietary Guidelines have identified three other nutrients of concern: fiber, vitamin D, and calcium. The present intervention increased two (fiber and potassium) of the four nutrients of concern. While the intervention programs saw an increase in calcium and control programs saw a decrease, these changes were not significantly different and were largely due to the increase in milk being served in the intervention ASPs. Future interventions could find ways to encourage consumption of calcium-containing snacks that are low in saturated fat and do not have added sugar such as almonds, low-fat string cheese, or oranges. However, it is important to note that some of these food items may be cost prohibitive to many ASPs [6, 12, 45].

There are numerous strengths to this study that includes the group randomized controlled trial design, large sample size of ASPs, and direct observation of foods, dips, and beverages served. However, several limitations were present. First, the direct observation protocol and the number of children served snack at the same time in a program precluded the ability to determine whether some children ate one or more snacks on any given day. Second, no information was collected on plate waste; thus, all estimates reflect what is served not what children actually consumed. Nevertheless, based on previous studies, children consume snacks that are served, regardless of the type [6, 10]. Third, given the limited micronutrient information on many nutrition labels is limited, this information was extracted from the USDA database. The values within the database are not brand specific but represent averages of several brands. Despite these limitations, this study represents one of the largest conducted to date on changes in nutrient profiles of snacks served in ASPs. Nevertheless, more research is necessary to understand the contribution of snacks to overall daily energy intake and its relation to body weight.

In conclusion, this study found that modest reductions in overall energy and improvements in select macronutrients and micronutrients can be achieved in ASPs working toward achieving national endorsed nutrition policies for snacks. This holds considerable promise for the impact such changes can have in contributing to solutions to address childhood obesity.

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1. National Afterschool Association. The NAA standards for quality school-age care. Washington, D.C.: National Afterschool Association; 2008.
2. National Afterschool Association. Standards for Healthy Eating and Physical Activity in Out-Of-School Time Programs 2011 [cited 2011 December 2]. Available from: http://naaweb.org/resources/item/56-healthy-eating.
3. Peterson E. First lady announces two new commitments to healthy eating and physical activity afterschool: Afterschool Alliance; 2014 [cited 2014 March 1]. Available from: http://www.afterschoolalliance.org/afterschoolsnack/printPage.cfm?idBlog=6FD1B2AD-215A-A6B3-02AAB84B1F59DA3F; http://ahealthieramerica.org/media/news-releases/#5482,news.
4. Wiecha JL, Gannett L, Hall G, Roth BA. National Afterschool Association Standards for Healthy Eating and Physical Activity in Out-Of-School Time Programs Wellesley, MA2011 [cited 2011 August 8]. Available from: Available at: www.niost.org.
5. Wiecha JL, Hall G, Gannett E, et al. Development of healthy eating and physical activity quality standards for out-of-school time programs. Child Obes. 2012; 8(6): 572-6.
6. Beets MW, Tilley F, Weaver RG, Turner-McGrievy G, Moore JB, Webster C. From policy to practice: addressing snack quality, consumption, and price in after-school programs. J Nutr Educ Behav. 2013.
7. Cassady D, Vogt R, Oto-Kent D, et al. The power of policy: a case study of healthy eating among children. Am J Public Health. 2006; 96(9): 1570-1.
8. Giles CM, Kenney EL, Gotrtmaker SL, et al. Increasing water availability during afterschool snack: evidence, strategies, and partnerships from a group randomized trial. Am J Prev Med. 2012; 43(3S2): S136-S42.

9. Mozaffarian RS, Wiecha JL, Roth BA, et al. Impact of an organizational intervention designed to improve snack and beverage quality in YMCA after-school programs. Am J Public Health. 2010; 100(5): 925-32.
10. Beets MW, Tilley F, Turner-McGrievy G, et al. Community partnership to address snack quality and cost in after-school programs. J School Health. 2014; 84(8): 543-8.
11. Beets MW, Weaver RG, Turner-McGrievy G, Huberty J, Ward DS, Freedman DA, et al. Making healthy eating policy practice: A group randomized controlled trial on changes in snack quality, costs, and consumption in afterschool programs. American Journal of Health Promotion. in press.
12. Beets MW, Glenn Weaver R, Turner-McGrievy G, et al. Making healthy eating and physical activity policy practice: the design and overview of a group randomized controlled trial in afterschool programs. Contemp Clin Trials. 2014; 38(2): 291-303.
13. Beets MW, Tilley F, Kim Y, et al. Nutritional policies and standards for snacks served in after-school programmes: a review. Public Health Nutr. 2011; 14(10): 1882-90.
14. Beets MW, Webster C, Saunders R, et al. Translating policies into practice: a framework for addressing childhood obesity in afterschool programs. Health Promot Pract. 2013; 14(2): 228-37.
15. Beets MW. Enhancing the translation of physical activity interventions in afterschool programs. Am J Lifestyle Med. 2012; 6(4): 328-41.
16. Beets MW, Weaver RG, Turner-McGrievy G, Huberty J, Ward D, Freedman DA, et al. Making healthy eating and physical activity policy practice: the design and overview of a group randomized controlled trial in afterschool programs. Contemporary Clinical Trials. in press.
17. Ajja R, Beets MW, Huberty J, et al. The healthy afterschool activity and nutrition documentation instrument. Am J Prev Med. 2012; 43(3): 263-71.
18. Weaver RG, Beets MW, Webster C, et al. A conceptual model for training after-school program staffers to promote physical activity and nutrition. J School Health. 2012; 82(4): 186-95.
19. Beets MW, Huberty J, Beighle A. Systematic observation of physical activity in afterschool programs: preliminary findings from movin' afterschool intervention. J Phys Act Health. 2013; 10(7): 974-81.
20. Beets MW, Tilley F, Weaver RG, et al. From policy to practice: addressing snack quality, consumption, and price in after-school programs. J Nutr Educ Behav. 2014; 46(5): 384-9.
21. Wandersman A, Duffy J, Flaspohler P, et al. Bridging the gap between prevention research and practice: the interactive systems framework for dissemination and implementation. Am J Community Psychol. 2008; 41(3-4): 171-81.
22. Hawe P, Shiell A, Riley T. Complex interventions: how "out of control" can a randomised controlled trial be? BMJ. 2004; 328(7455): 1561-3.
23. Israel BA, Schulz AJ, Parker EA, et al. Review of community-based research: assessing partnership approaches to improve public health. Annu Rev Public Health. 1998; 19: 173-202.
24. Maslow AH. A theory of human motivation. Psychol Rev. 1943; 50: 370-96.
25. Butler SF, Strupp HH. Specific and nonspecific factors in psychotherapy—a problematic paradigm for psychotherapy research. Psychotherapy. 1986; 23(1): 30-40.
26. Chatoor I, Krupnick J. The role of non-specific factors in treatment outcome of psychotherapy studies. Eur Child Adolesc Psychiatry. 2001; 10(Suppl 1): I19-25.
27. Collins LM, Murphy SA, Bierman KL. A conceptual framework for adaptive preventive interventions. Prev Sci. 2004; 5(3): 185-96.
28. U.S. Department of Agriculture Food and Nutrition Service. Monitoring Handbook for State Agencies: A Child and Adult Care Food Program Handbook. U.S. Department of Agriculture, 2013.
29. Beets MW, Tilley F, Turner-McGrievy G, Weaver RG, Jones SJ. Community partnership to address snack quality and cost in afterschool programs. J Sch Health. in press.
30. Tilley F, Beets MW, Jones S, Turner-McGrievy G. Evaluation of compliance to national nutrition policies in summer day camps. Public Health Nutr. 2014:1-6.
31. Mozaffarian RS, Wiecha JL, Roth BA, Nelson TF, Lee RM, Gortmaker SL. Impact of an Organizational Intervention Designed to Improve Snack and Beverage Quality in YMCA After-School Programs. Am J Public Health. 2009.
32. US Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 25 2012 [cited 2014 August 8]. Available from: Nutrient Data Laboratory home page. Available at www.ars.usda.gov/ba/bhnrc/ndl.
33. Beets MW, Tilley F, Kyryliuk R, et al. Children select unhealthy choices when given a choice among snack offerings. J Acad Nutr Diet. 2014; 114(9): 1440-6.
34. Beets MW, Weaver RG, Tilley F, et al. Salty or sweet? Nutritional quality, consumption, and cost of snacks served in afterschool programs. J School Health. 2015; 85(2): 118-24.
35. Darmon N, Darmon M, Maillot M, et al. A nutrient density standard for vegetables and fruits: nutrients per calorie and nutrients per unit cost. J Am Diet Assoc. 2005; 105(12): 1881-7.
36. Drewnowski A, Maillot M, Darmon N. Should nutrient profiles be based on 100 g, 100 kcal or serving size? Eur J Clin Nutr. 2009; 63(7): 898-904.
37. Fisher JO, Mennella JA, Hughes SO, et al. Offering "dip" promotes intake of a moderately-liked raw vegetable among preschoolers with genetic sensitivity to bitterness. J Acad Nutr Diet. 2012; 112(2): 235-45.
38. Savage JS, Fisher JO, Marini M, et al. Serving smaller age-appropriate entree portions to children aged 3-5 y increases fruit and vegetable intake and reduces energy density and energy intake at lunch. Am J Clin Nutr. 2012; 95(2): 335-41.
39. Keenan MJ, Zhou J, McCutcheon KL, et al. Effects of resistant starch, a non-digestible fermentable fiber, on reducing body fat. Obes (Silver SpringMd. 2006; 14(9): 1523-34.
40. Astrup A. The satiating power of protein—a key to obesity prevention? Am J Clin Nutr. 2005; 82(1): 1-2.
41. Parikh S, Pollock NK, Bhagatwala J, et al. Adolescent fiber consumption is associated with visceral fat and inflammatory markers. J Clin Endocrinol Metab. 2012; 97(8): E1451-7.
42. Bontrager Yoder AB, Schoeller DA. Fruits and vegetables displace, but do not decrease, total energy in school lunches. Child Obes. 2014; 10(4): 357-64.
43. Fulton SL, McKinley MC, Young IS, Cardwell CR, Woodside JV. The effect of increasing fruit and vegetable consumption on overall diet: a systematic review and meta-analysis. Critical reviews in food science and nutrition. 2014.
44. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2010. U.S. Government Printing Office: Washington, DC, 2010 December 2010. Report No.
45. Beets MW, Weaver RG, Tiley F, Turner-McGrievy G, Huberty J, Ward DS, et al. Salty or Sweet? Nutritional quality, consumption, and cost of snacks served in afterschool programs. J Sch Health. in press.