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Objectives of community policies and programs associated with more healthful dietary intakes among children: Findings from the Healthy Communities Study

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Summary

Background—Rational planning of community policies and programs (CPPs) to prevent obesity requires an understanding of CPP objectives associated with dietary behaviors.

Objective—To identify objectives of CPPs associated with healthful dietary behaviors.

Methods—An observational study identified 4,026 nutrition CPPs occurring in 130 communities in the prior six years. Dietary intakes of fruits and vegetables (FV), added sugar, and sugar-sweetened beverages (SSBs), among others, were reported among 5,138 children 4–15 years of age from the communities, using a Dietary Screener Questionnaire with children age nine and older (parent assisted), or parent proxies for younger children. CPP objectives were documented through key informant interviews and characterized by their intensity, count, target dietary behavior, and food environment change strategy. Associations between dietary intakes and CPP objectives were assessed using hierarchical statistical models.

Results—CPPs with the highest intensity scores that targeted fast food or fat intake or provided smaller portions were associated with greater FV intake (0.21,0.19,0.23 cup equivalents/day, respectively with p-values <0.01,0.04,0.03). CPPs with the highest intensity scores that restricted the availability of less healthful foods were associated with lower child intakes of total added sugar (−1.08tsp/day, p<0.01) and sugar from SSBs (−1.63tsp/day, p=0.04). Similar associations

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Authors' contributions

KLW, SH conceived and wrote the manuscript; LEA contributed to the draft manuscript and interpretation of results; KLW, LR, CML, and DKW designed the dietary assessment measures and data collection protocol; VC**A** and SF designed the CPP measures and data collection protocol; RS managed training and data collection, WS, JN, AL conducted the data analyses. All authors made critical intellectual revisions to the manuscript and approved the final manuscript.

were observed between CPP count and dietary outcomes. No other significant associations were found between CPP target behaviors or environmental strategies and dietary intakes/behaviors.

Conclusion—CPPs that targeted decreases in intakes of less healthful foods and/or aimed to modify the availability of less healthful foods and portions were associated with healthier child dietary behaviors.

Keywords

Community programs and policies; childhood obesity; fruit and vegetable intake; sugar-sweetened beverages; food environment; Healthy Communities Study

Introduction

Authoritative organizations have recommended various strategies, including strong community programs, to improve dietary and physical activity (PA) behaviors associated with obesity.[1–4] Increasing emphasis is being placed on approaches targeting the reduction of less healthful foods such as SSBs and increases in healthful foods such as FV.[3,4] Among guidelines addressing food environments were those issued by a 2009 Centers for Disease Control and Prevention expert group, recommending that programs target behaviors most associated with obesity, and move beyond informational campaigns and educational programs to include policy and environmental strategies to make healthier behaviors easier choices for children and families known as Common Community Measures for obesity prevention or COCOMO strategies.[4] This panel called for changing food environments by working with food providers to improve the availability and affordability of healthful foods and beverages and restrict the availability of those less healthful.[4] In 2012, the Institute of Medicine called for focused efforts to improve the nutrition quality of foods in all food environments, and to make schools a national focal point for obesity prevention.[3]

In response, federal and state policies have been introduced for community-level implementation, including nutrition standards for school and pre-school meals,[5–7] improved nutrition quality of government foods that supply schools,[8] and food package vouchers provided to low-income women infants and children.[9] Communities are working with small food retail outlets to provide more healthful choices;[10] expanding markets and access to local produce, such as approval for farmers markets to accept food assistance benefits[11] and expanding farm to school programs.[12] These initiatives are implemented by extensive networks of organizations and staff in communities and are supported by “practice tested” models, and emerging evidence about their impact.[13]

Yet, the relative success of these types of community programs and policies (CPPs) is unclear,[14] and the features contributing to success have not been documented. Evidence is needed to better understand features such as the objectives of nutrition CPPs and their effects, when taken in the context of total community efforts. Such information underpins rational planning of programs and policies to accelerate progress in obesity prevention.

The Healthy Communities Study (HCS) sought to measure the relationship between program and policy activity at the community level, and obesity-related outcomes, to inform

future community-based efforts. This paper examines the associations between selected dietary behaviors of children and the objectives of CPPs: the dietary behavior changes they reported targeting and the aims of the strategies they reported using to modify food environments in a large, diverse sample of over 5,000 school children in 130 U.S. communities.

Methods

Study Design

The design of the HCS is described in detail elsewhere.[15–18] In brief, it was an observational study of a diverse sample of US 130 communities across sociodemographics, geographic region, and implementing various types of CPPs. Current and retrospective data over the past ten years were collected about obesity-related CPPs in these communities. Children in grades K-8 were recruited from up to four elementary and middle schools in each community, resulting in 5,138 final participants, or an average of 40 children per community.

Independent Measures: Features of Community Policies and Programs

The identification, characterization, and scoring protocol for CPPs is described in detail elsewhere.[16] Briefly, CPPs addressing obesity prevention were identified and described through structured interviews by trained research staff with key informants (from non-profits, schools, youth/health organizations, city government) in each community.[16] Informants (n=1421) were asked to recall CPPs over the past ten years, and this information was supplemented with that from document abstraction by researchers.[16]

For this paper, CPPs addressing nutrition (alone or with PA) were classified into sub-types according to two characteristics: 1) the specific nutrition behaviors they targeted (increasing consumption of FV, whole grains, water, and decreasing consumption of SSBs, high calorie snacks and sweets, fat, and fast food, etc)[19,20] and 2) the aim of any reported food environment change strategy (increasing the availability or the affordability of healthful foods, restricting the availability of less healthy foods, instituting smaller portion sizes) as described by COCOMO and listed in Table 1.[4] CPPs not reporting COCOMO strategies were coded as “not applicable”, and those with insufficient information about their strategies were coded as “other”. Information on each CPP was used to calculate an intensity score (CPP-Int) based on population reach, duration, and behavior change strategy, and a count score (CPP-Count) for each type of CPP, standardized from 0 to 1 to enable comparisons across communities.[15,16] This paper examines the specific objectives of CPPs in the communities we studied including target nutrition behaviors, and objectives of any reported COCOMO strategies. We analyzed associations between these CPP objectives and dietary behaviors of children from the communities, taking into account the CPP-Int and CPP-Count scores.

Dietary intake measures

Dietary intakes were measured using a 27-item modified version of the National Health and Nutrition Examination Survey (NHANES) Dietary Screener Questionnaire (DSQ)

administered at home visits by trained interviewers to children ages 9 years and older, with parent assistance, or parent proxies for younger children 4–8 years of age.[19,21] Scoring algorithms derived from age- and sex-specific NHANES 2009–2010 data were used to calculate quantitative estimates of intake per child per day.[22] In this paper, we present statistically significant results for FV, total added sugar, and sugar from SSBs. Non-significant results for those outcomes and for whole grains are reported in the supplementary tables.

Statistical Analysis

Multiple imputation and hierarchical modeling using Rv3.3.0 and SASv9.4 was conducted to investigate the association between the intensity and count scores of selected CPP sub-types and child dietary intakes. The fully adjusted model controlled for covariates including child's age, sex, race, ethnicity, parental education, employment, family income, interview seasonality, clustering by school and community, and community-level variables including US region, minority classification, urbanicity, and markers of poverty. Multiple imputation was used to address missing data.[23] Only statistically significant associations ($p<0.05$) for either of the time points (CPPs in place one and six years prior to the study) are included in the tables in this paper. Supplementary tables present all results including those not significant and those for unadjusted models, for all CPP target behaviors and COCOMO strategies, at the one and six year time points.

Results

Participants

Children ranged in age from 4–15 years, were approximately equally distributed by sex, 45% were Hispanic, and 20% were African American. Over half were from low-income households (<$35,000 per annum); a majority had a parent with an education level higher than a high school diploma; and most had at least one parent who was employed, either full-time or part-time (Table 1).

By design, the 130 communities included a higher proportion of disadvantaged communities; more were located in the Southern region of the US, over half were in a "minority" census tract (greater than 30% African American or Hispanic populations), and in urban or suburban areas. Approximately one-fifth of the population in HCS communities were living below the poverty level (Table 1).

Objectives of nutrition CPPs by target behaviors and COCOMO strategies

Nutrition CPPs occurred most commonly in schools, youth organizations (e.g. 4-H, Scouts), and community (e.g. food pantries, community gardens) settings, accounting for around 70% of nutrition CPPs (Supplementary Table 5). They addressed one or more of the target behaviors listed in Table 2, most commonly: 1) increasing consumption of FV (e.g., school gardens); 2) decreasing consumption of foods of minimal nutritional value (e.g., healthy after-school snack programs); 3) increasing consumption of whole grain foods (e.g., nutrition standards at food pantries); and/or 4) decreasing consumption of SSBs (e.g.,

removal of vending machines). Notably, CPPs targeting at least one of these four behaviors also had the highest intensity scores at the one and six-year time points (Table 2).

Over 60% of CPPs reported nutrition-related COCOMO strategies to modify community food environments. Most commonly these aimed to: 1) increase the availability of healthier foods and beverages; and/or 2) restrict the availability of less healthy foods and beverages (Table 2). Intensity and count scores were highest among CPPs using these COCOMO strategies, at both time points (Table 2).

Associations between nutrition CPP target behaviors and nutrition-related COCOMO strategies with child FV intake

Two nutrition CPP target behaviors—decreasing consumption of fast food and decreasing consumption of fat—were significantly associated with children's intake of FV. Higher intensity scores among CPPs that targeted decreased consumption of fast food (past six years) or fat (past one and six years) (e.g., corner store initiatives, free-breakfast programs) were associated with higher children's intakes of FV (Table 3). In addition, higher intakes of FV were observed in communities with the highest count scores for nutrition CPPs targeting decreased consumption of fast food (Table 3). No significant associations were found between child intake of FV and the intensity or count scores for CPPs targeting any other dietary behaviors, including those targeting FV consumption.

The COCOMO strategy aiming to 'institute smaller portion sizes' (e.g., entrees, snacks, or SSBs on menus (mainly in school settings) was significantly associated with children's increased FV intakes. Children in communities with the highest CPP intensity score for this strategy consumed an average of 0.23 cup equivalents more per day of FV than children in communities with the lowest intensity score (Table 3).

No significant associations were found between child intake of FV and the CPP scores for any other COCOMO food environment strategy. An exception was "other" COCOMO strategies for which a significant negative association was seen for FV (Table 3).

Associations between features of CPPs children's intake of total added sugar and sugar from SSBs

Children in communities in which CPPs utilized the COCOMO strategy of aiming to restrict the availability of less healthy foods and beverages (e.g. policies restricting soda in schools) had lower intakes of sugar from SSBs and total added sugar. Intakes of sugar from SSBs were, on average, 1.08 tsp/day lower comparing communities with the highest versus the lowest intensity scores for CPPs utilizing this strategy over the past six years (Table 3).

Similar significant associations were observed for total added sugar. Children in communities with the highest intensity and count scores for CPPs that aimed to restrict the availability of less healthy foods/beverages, consumed on average, 1.63 and 1.69 tsp/day less, respectively, of total added sugar than children in communities with the lowest scores for this strategy (Table 3). No significant associations were found between the nutrition CPP intensity or count scores targeting specific behaviors (Table 2) and children's intakes of sugar from SSBs or total added sugar (supplementary tables).

Discussion

Ritchie et. al. investigated relationships between count and intensity scores and dietary measures.[19] Building on that paper, here we aimed to look in-depth at relationships between dietary outcomes and CPP objectives: which nutrition behaviors were addressed, and the aims of food environment change strategies used, if any. In this large and diverse sample of U.S. communities, we found associations with CPP objectives and more healthful dietary intakes. CPPs with the highest intensity scores that targeted reduced consumption of fast food or fat, or that introduced smaller portion sizes in food service environments, were associated with greater FV intake. CPPs with the highest intensity or count scores and that restricted the availability of less healthful foods were associated with lower dietary intakes of total added sugar and sugar from SSBs.

Our findings regarding dietary targeting of nutrition CPPs were surprising. CPPs that targeted fast food and/or fat were associated with higher FV intake, while CPPs targeting FV directly showed no significant association with reported FV intake. Given that over 90% of the CPPs targeting fast food or fat also targeted FV intake (data not shown), there may be a synergistic effect of this combination of target behaviors, perhaps by recommending simultaneous increases in one food group while recommending decreases in another. The DSQ did not measure quantity of fat or fast food intake, so it is unclear whether other positive changes also occurred. However, we did not find any significant associations with frequency of fast food intake (data not shown). The lack of association between targeting FV and dietary change in FV may be due to lower intensity of FV CPPs compared to CPPs targeting fat or fast food, although this is not well supported by the small variation in mean standardized intensity scores for these types of CPPs over the past year: 0.33, 0.31, and 0.28, respectively. These results raise questions about whether CPPs should target multiple dietary behaviors; if so, which combinations or ‘behavioral clusters’ to target; and whether the unit of interest should be the community rather than a single CPP.[24] Multiple dietary behavior changes are usually necessary to prevent excess weight gain, yet, experience in clinical settings suggests greater changes when focusing on a limited set of behavior changes. Although results from the HCS only answer questions about associations rather than CPP impact, our results suggest that it is worthwhile considering which and how many behaviors are targeted in future planning and evaluation of CPPs.

Environmental approaches such as the COCOMO strategies have not been systematically evaluated as a “package” of community programs or policies, yet addressing changes in food environments in school settings has shown promise for restricting the availability of SSBs on consumption and on weight status.[25] In our study, a second COCOMO strategy, instituting smaller portion sizes (reducing standard portion sizes or offering an optional small portion) in food service venues, was associated with increased FV intake. Since most CPPs using this strategy reported targeting FV, it is possible that they recommended simultaneous increases in FV to compensate for smaller entrée portions. This strategy was reported infrequently (by less than 2% of CPPs). Although the Healthy Hunger Free Kids Act requires lower limits on calories for the main entrée in school meals, which can be achieved by reduced portion size or recipe reformulation of entrée items,[5,26] key informants may not have identified federal nutrition standards in schools as a discrete CPP because of their universality.

The interpretation is unclear for the significant association we found between CPPs classified as “other” for COCOMO strategies and a lower intake of child FV. This group of 154 CPPs reported a wide range of food environment strategies that either did not meet the specific definitions of any of the COCOMO strategies, or lacked information to enable classification.

Another unexpected finding was that CPPs targeting decreased consumption of SSBs, or high calorie snacks or sweets, were *not* associated with lower frequency of intake of these items, although nearly 40% of nutrition CPPs targeted these behaviors. Indeed, no other dietary behaviors targeted by CPPs were significantly associated with either total added sugar or sugar from SSBs. Yet, utilizing the COCOMO strategy that aimed to restrict the availability of less healthy foods was significantly associated with lower intakes of both total added sugar and added sugar from SSBs, when taking into account CPP intensity and count scores. It is notable that a majority of CPPs reporting activities consistent with this strategy also reported targeting decreased consumption of high calorie snacks, desserts, sweets and candy (74%) and/or decreased consumption of SSBs (68%) (data not shown). Thus, the observed associations may be attributable to the combination of the food environment strategy, and the target dietary behaviors, among CPPs of greater strength.

The magnitude of the differences in child intakes of total added sugar were modest; intakes differed on average by 1.7 tsp/day when comparing those in communities with no CPPs restricting availability to the community with the highest number of CPPs using this strategy (about 80 programs cumulatively over six years, or an average of about 13 CPPs per year). In context, children 6–19 years of age in the U.S. consume about 7 tsp/day more than recommended.[27,28] Thus, our findings tentatively suggest that restricting the availability of SSBs and other foods high in sugar in a variety of food environments may contribute to a modest reduction in sugar intakes among children. While reducing sugar intake is an important dietary goal for US children, attention to other dietary guidelines such as increasing whole grains, and FV are likely still required, to improve diet quality. A recent study, for example, which simulated effects from an SSB tax found a reduced sugar intake by pre-schoolers (an effect size similar to ours), but a slight decline in overall diet quality from the change[29].

Of the CPPs described in the HCS, nearly 40% did not utilize any of the COCOMO environmental and policy approaches for modifying food environments. Rather, many nutrition CPPs involved potentially weaker strategies such as nutrition education classes, and community one-time events, such as health fairs. [20] Given the small but positive and significant associations we found with two COCOMO strategies and children’s intakes, a continued effort is warranted to evaluate the effectiveness of CPPs that address changes in the food environment to achieve meaningful improvements in child diets. This is consistent with the direction to consider systems thinking in planning and evaluating obesity prevention programs.[30]

This observational study had a number of limitations including the lack of a prospective design for establishing temporality and causality of higher quality dietary behaviors. The counts and objectives of CPPs reported by key informants may have been subject to recall

error or bias, and detail about implementation was limited. Dietary intakes were measured at one time point, were reliant on child/parent reports, and were thus subject to recall error and bias. The DSQ did not enable assessment of all outcomes of interest (e.g. fat and total calories). Strengths of this study include the diverse sample of communities and children, multiple methods to document CPP characteristics, and multiple levels of information from communities, schools, families and children, which enabled us to account for other factors influencing dietary intakes.[15]

Conclusions

CPPs targeting a decrease in fat or fast food (most of which also targeted an increase in FV) were associated with higher child intakes of FV. Further investigation of potential synergistic effects of targeting various dietary behaviors and combinations could inform future planning and enhance the likelihood of dietary behavior changes from CPPs. Strategies aiming to restrict the availability of less healthful foods, and to reduce portion sizes served in youth settings, were associated with higher FV intake and lower sugar intake.

These findings suggest potential benefits from a greater focus of CPPs on food environments influencing children's food choices. Further evaluation efforts should assess causal relationships between features of CPPs and children's dietary intakes, identify the most effective combinations of CPP objectives, and determine how their effects are modified by number and intensity of CPP in settings such as schools, youth organizations and communities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

CPPs	Community Programs and Policies
HCS	Healthy Communities Study
FV	fruit and vegetables
PA	physical activity
SSBs	sugar sweetened beverages
NHANES	National Health and Nutrition Examination Survey
DSQ	Dietary Screener Questionnaire

COCOMO Common Community Measures to Prevent Obesity

References

1. Farley TA, Dowell D. Preventing childhood obesity: what are we doing right? Am J Public Health. 2014; doi:10.2105/ajph.2014.302015.
2. World Health Organization. Population based approaches to Childhood Obesity Prevention. 2012 http://apps.who.int/iris/bitstream/10665/80149/1/9789241504782_eng.pdf?ua=1 Accessed 23 Nov 2016.
3. IOM/NAS. Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation. Washington DC: The National Academies Press: 2012.
4. Keener D, Goodman K, Lowry A, Zaro S, Kettel Khan L. Recommended community strategies and measurements to prevent obesity in the United States: Implementation and measurement guide 2009 Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention http://www.cdc.gov/obesity/downloads/community_strategies_guide.pdf. Accessed 23 Nov 2016.
5. Food and Nutrition Service USDA. Healthy Hunger Free Kids Act of 2010. Pub L No 111–296. 2010 https://www.gpo.gov/fdsys/pkg/PLAW-111publ296/pdf/PLAW-111publ296.pdf. Accessed 17 Nov 2016.
6. Food and Nutrition Service USDA. Child and Adult Care Food Program; Nutrition Standards for Meals and Snacks; Final Rule. Federal Register, 4 25, 2016 https://www.federalregister.gov/documents/2016/04/25/2016-09412/child-and-adult-care-food-program-meal-pattern-revisions-related-to-the-healthy-hunger-free-kids-act. Accessed 17 Nov 2016.
7. Food and Nutrition Service USDA. Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule. Federal Register, 1 26, 2012 https://www.federalregister.gov/documents/2012/01/26/2012-1010/nutrition-standards-in-the-national-school-lunch-and-school-breakfast-programs. Accessed 18 Nov 2016.
8. Zimmerman T, Sun B, Dixit-Joshi S, Westat, prepared for Food and Nutrition Service USDA. Nutrient and Food Group Analysis of USDA Foods in Five of its Food and Nutrition Programs-2014. 2016 http://www.fns.usda.gov/sites/default/files/ops/USDAFoodsHEIUpdate.pdf. Accessed 20 Nov 2016.
9. Food and Nutrition Service USDA. Special Supplemental Food Program for Women Infants and Children (WIC); Revisions in the WIC food packages; final rule. Federal Register, 3 04, 2014 http://www.fns.usda.gov/wic/final-rule-revisions-wic-food-packages. Accessed 20 Nov 2016.
10. Bentzel D, Weiss S, Bucknum M, Shore K. Healthy Food and Small Stores: Strategies to Close the Distribution Gap. 2015 Philadephia PA: The Food Trust http://thefoodtrust.org/uploads/media_items/healthy-food-and-small-stores.original.pdf. Accessed 25 Nov, 2016.
11. Food and Nutrition Service USDA. SNAP and Farmers markets. 2016 http://www.fns.usda.gov/ebt/snap-and-farmers-markets. Accessed 25 Nov 2016.
12. Food and Nutrition Service USDA. The Farm to School Program at USDA; 4 years in review 2012 to 2015. 2016, http://www.fns.usda.gov/sites/default/files/f2s/Farm-to-School-at-USDA−−4-Years-in-Review.pdf. Accessed 25 Nov 2016.
13. Foltz JL, May AL, Belay B, Nihiser AJ, Dooyema CA, Blanck HM. Population-level intervention strategies and examples for obesity prevention in children. Annu Rev Nutr. 2012; doi:10.1146/annurev-nutr-071811-150646.
14. IOM/NAS. Evaluating Obesity Prevention Efforts, a plan for measuring progress. Washington DC: The National Academies Press; 2013 p. 29.
15. Arteaga SS, Loria CM, Crawford PB, Fawcett SB, Fishbein HA, Gregoriou M, et al. The Healthy Communities Study: Its Rationale, Aims, and Approach. Am J Prev Med. 2015; doi:10.1016/j.amepre.2015.06.029.
16. Fawcett SB, Collie-Akers VL, Schultz JA, Kelley M. Measuring Community Programs and Policies in the Healthy Communities Study. Am J Prev Med. 2015; doi:10.1016/j.amepre.2015.06.027.

17. John LV, Gregoriou M, Pate RR, Fawcett SB, Crawford PB, Strauss WJ , et al. Operational Implementation of the Healthy Communities Study: How Communities Shape Children's Health. Am J Prev Med. 2015; doi:10.1016/j.amepre.2015.06.019.

18. Strauss WJ, Sroka CJ, Frongillo EA, Arteaga SS, Loria CM, Leifer ES, et al. Statistical Design Features of the Healthy Communities Study. Am J Prev Med. 2015; doi:10.1016/j.amepre. 2015.06.021.

19. Ritchie LD, Woodward-Lopez G, Crawford PB, et al. Community programs and policies in relation to child nutrition—the Healthy Communities Study. Pediatr Obes 2018; XX: xxx-xxx. (paper submitted for this supplement)

20. Collie-Akers VL, Schultz JA, Fawcett SB, et al. Measuring intensity of community programs and policies to prevent childhood obesity in a diverse sample of U.S. communities: The Healthy Communities Study. Pediatr Obes 2018; XX: xxx-xxx. (paper submitted for this supplement)

21. Ritchie LD, Wakimoto P, Woodward-Lopez G, Thompson FE, Loria CM, Wilson DK, et al. The Healthy Communities Study Nutrition Assessments: Child Diet and the School Nutrition Environment. Am J Prev Med. 2015; doi:10.1016/j.amepre.2015.06.016.

22. National Cancer Institute (NCI). Dietary screener questionnaire in the NHANES 2009–10; data processing & scoring procedures. https://epi.grants.cancer.gov/nhanes/dietscreen/scoring/. Accessed November 20, 2016.

23. Buuren Stef, and Groothuis-Oudshoorn Karin. "mice: Multivariate imputation by chained equations in R." Journal of statistical software 453 (2011).

24. Prochaska JJ, Prochaska JO. A Review of Multiple Health Behavior Change Interventions for Primary Prevention. Am J Lifestyle Med. 2011; doi: 10.1177/1559827610391883.

25. Chriqui JF, Pickel M, Story M. Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review. JAMA pediatrics. 2014; doi:10.1001/ jamapediatrics.2013.4457.

26. Bergman EA, Englund T, Taylor KW, Watkins T, Schepman S, Rushing K. School Lunch Before and After Implementation of the Healthy Hunger-Free Kids Act. J Child Nutr Manag. 2014;38(2): 1–12.

27. Drewnowski A, Rehm CD. Consumption of added sugars among US children and adults by food purchase location and food source. Am J Clin Nutr. 2014; doi:10.3945/ajcn.114.089458.

28. USDHHS, USDA. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition 12 2015 http:// health.gov/dietaryguidelines/2015/guidelines/. Accessed 23 Nov 2016.

29. Ford CN, Poti JM, Ng SW, Popkin BM. SSB taxes and diet quality in US preschoolers: estimated changes in the 2010 Healthy Eating Index. Pediatr Obes. 2017 4;12(2):146–154. doi: 10.1111/ijpo. 12121. Epub 2016 Apr 5. [PubMed: 27059293]

30. Cheskin LJ, Frutchey R, McDermott AY, Esposito L, Lee BY, Kumanyika S. Motivating systems-oriented research on environmental and policy changes for obesity prevention. Pediatr Obes. 2017 6;12(3):e20–e23. doi: 10.1111/ijpo.12132. Epub 2016 Apr 6. [PubMed: 27060703]

What is already known about this subject?

- Community programs and policies (CPPs) use a range of strategies to prevent obesity, based on “practice tested” models and those with emerging evidence about their success.
- Yet, understanding the relationship of types and features of CPPs that contribute to success of CPPs, including program and policy objectives in the context of the whole community effort, would inform rational planning for obesity prevention.

What this study adds

- We studied dietary intakes of 5138 children 4–15 years of age and objectives of CPPs (dietary behaviors targeted and food environment change strategies) in a diverse sample of 130 communities across the U.S.
- We found significant associations between CPPs that aimed to modify community food environments (by restricting availability of less healthful foods and instituting smaller portion sizes) and higher fruit and vegetable (FV) intake as well as lower sugar and sugar-sweetened beverage intake. We also found associations between CPPs that targeted less healthful dietary behaviors (fat, fast food) with higher child FV intake. Yet, dietary intakes of interest were not generally consistent with the dietary targets reported by CPPs, e.g. those targeting FV were not associated with higher intakes of FV.
- Our findings suggest potential benefits from a greater focus of CPPs on food environments. Further evaluation is recommended to identify causal relationships between objectives of CPPs and child diets, and which combinations of CPP objectives are most successful.

Table 1.

Characteristics of children and their communities in the Healthy Communities Study, USA, 2013–2015. (n=5138 children, 130 communities)

Child characteristics	
	n (%)
Age	
4–8y	2196 (42.7)
9–11y	1639 (31.9)
12–15y	1303 (25.4)
Female	2614 (50.9)
Hispanic	2300 (44.8)
Race	
Black Only	1035 (20.1)
White Only	3612 (70.3)
Multiple/Other	491 (9.5)
Annual household income	
<$35K	2634 (51.3)
≥$35K	2504 (48.7)
Maximum parental education[1]	
High school diploma or less	2196 (42.7)
More than high school diploma	2942 (57.3)
Maximum parental employment[1]	
Full-time/Part-time	4264 (83.0)
Unemployed/Other[2]	874 (17.0)
Community characteristics	
Region of U.S.	
Midwest	991 (19.3)
Northeast	791 (15.4)
South	2135 (41.6)
West	1221 (23.8)
In minority tract[3]	
African American minority tract	1059 (20.6)
Hispanic minority tract	2045 (39.8)
Not minority tract	2034 (39.6)
Urbanicity	
Urban	1942 (37.8)
Suburban	2034 (39.6)
Rural	1162 (22.6)

Sociodemographics	(mean %± SD)[7]
% African American	19.7 ± 23.4
% Hispanic	34.7 ± 29.6
% Below poverty level	20.6 ± 10.6
% Unemployed	8.8 ± 3.4

[1] Maximum for biological parents.

[2] Unemployed/other category includes temporary layoff, leave of absence, retired, disabled, keeping house, or student.

[3] Minority tracts defined as having at least 30% of the community population being African American or Hispanic.

[4] Urban defined as contiguous, built-up areas containing 50,000+ people based on USDA Rural-Urban Commuting Area.

[5] Suburban defined as areas in which 30–49% of the population commutes to Urban Core areas for work.

[6] Rural defined as areas in which the population is less than 49,999 people and there is limited commute to Urban Core areas.

[7] Socio-demographic variables for the community catchment areas were calculated using estimates from the 2009– 2013 5-year American Community Survey. These variables were area-weighted based on the percent of each census tract that fell within the community catchment area.

Table 2.

Nutrition-related Community Policies and Programs (CPPs) by sub-types (target dietary behavior and COCOMO[1] Strategies) during the Past 1 and 6 Years[2], prevalence, and CPP-Int[3] and CPP-Count[4] scores, Healthy Communities Study, USA, 2013–2015.

Nutrition CPPs classified by target behavior and COCOMO strategy, descending order by % of CPPs	Past 1 Year (n = 3740 Nutrition CPPs)			Past 6 Years[2] (n = 4026 Nutrition CPPs)		
	Nutrition CPPs n (%)	Nutrition CPPs CPP-Int Score[5] Mean (SE)	Nutrition CPPs CPP-Count Score[5] Mean (SE)	Nutrition CPPs n (%)	Nutrition CPPs CPP-Int Score[5] Mean (SE)	Nutrition CPPs CPP-Count Score[5] Mean (SE)
Nutrition CPPs by Target Behavior						
Increase consumption of FV	2585 (69.1)	0.33 (0.02)	0.30 (0.02)	2771 (68.8)	0.29 (0.02)	0.26 (0.02)
Decrease consumption of high calorie snacks, desserts, sweets, and candy	1649 (44.1)	0.37 (0.02)	0.31 (0.02)	1751 (43.5)	0.34 (0.02)	0.25 (0.02)
Increase consumption of whole grain foods	1492 (39.9)	0.32 (0.02)	0.32 (0.02)	1594 (39.6)	0.31 (0.02)	0.31 (0.02)
Decrease consumption of sugar sweetened beverages (SSBs)	1442 (38.6)	0.41 (0.02)	0.33 (0.02)	1540 (38.3)	0.39 (0.02)	0.30 (0.02)
Increase consumption of water	1181 (31.6)	0.29 (0.02)	0.25 (0.02)	1260 (31.3)	0.28 (0.02)	0.23 (0.02)
Decrease consumption of fat	1090 (29.2)	0.31 (0.02)	0.28 (0.02)	1170 (29.1)	0.28 (0.02)	0.27 (0.02)
Decrease consumption of fast food	1026 (27.4)	0.28 (0.02)	0.26 (0.02)	1100 (27.3)	0.30 (0.02)	0.21 (0.02)
Increase eating breakfast	767 (20.5)	0.29 (0.02)	0.27 (0.02)	817 (20.3)	0.26 (0.02)	0.21 (0.02)
Decrease calories overall	670 (17.9)	0.30 (0.02)	0.27 (0.02)	716 (17.8)	0.28 (0.02)	0.24 (0.02)
Increase breastfeeding/improved infant health	125 (3.3)	0.11 (0.01)	0.12 (0.02)	135 (3.4)	0.15 (0.02)	0.16 (0.02)
Any other diet-related behavior	990 (26.5)	0.25 (0.02)	0.21 (0.02)	1083 (26.9)	0.22 (0.02)	0.20 (0.02)
Nutrition CPPs by COCOMO Strategy						
Increase availability of healthier food and beverage choices	1834 (49.1)	0.32 (0.02)	0.31 (0.02)	1944 (48.3)	0.28 (0.02)	0.28 (0.02)
Restrict availability of less healthy foods and beverages	729 (19.5)	0.32 (0.02)	0.34 (0.02)	760 (18.9)	0.29 (0.02)	0.31 (0.02)
Improve affordability of healthier food and beverage choice	254 (6.8)	0.16 (0.02)	0.18 (0.02)	269 (6.7)	0.15 (0.02)	0.16 (0.02)
Improve production distribution and procurement of foods from local farms	208 (5.6)	0.13 (0.01)	0.12 (0.01)	230 (5.7)	0.13 (0.02)	0.12 (0.01)
Institute smaller portion size options	56 (1.5)	0.09 (0.01)	0.09 (0.01)	58 (1.4)	0.10 (0.02)	0.09 (0.02)
Increase support for breastfeeding	55 (1.5)	0.05 (0.01)	0.06 (0.01)	57 (1.4)	0.07 (0.01)	0.07 (0.01)

Nutrition CPPs classified by target behavior and COCOMO strategy, descending order by % of CPPs	Past 1 Year (n = 3740 Nutrition CPPs)			Past 6 Years[2] (n = 4026 Nutrition CPPs)		
	Nutrition CPPs n (%)	Nutrition CPPs CPP-Int Score[5] Mean (SE)	Nutrition CPPs CPP-Count Score[5] Mean (SE)	Nutrition CPPs n (%)	Nutrition CPPs CPP-Int Score[5] Mean (SE)	Nutrition CPPs CPP-Count Score[5] Mean (SE)
Improve geographic availability of supermarkets/food retailers in underserved areas	53 (1.4)	0.07 (0.01)	0.07 (0.01)	58 (1.4)	0.09 (0.01)	0.08 (0.01)
Limit advertisements of less healthy foods and beverages	23 (0.6)	0.06 (0.01)	0.06 (0.01)	23 (0.6)	0.09 (0.02)	0.08 (0.02)
Any other policy or environmental strategy	154 (4.1)	0.07 (0.01)	0.07 (0.01)	167 (4.2)	0.07 (0.01)	0.07 (0.02)
Not Applicable[6]	1449 (38.8)	0.33 (0.02)	0.34 (0.02)	1595 (39.6)	0.33 (0.02)	0.29 (0.02)

[1] Common community measures for Preventing Obesity Project.[6]

[2] Cumulative including all unique CPPs occurring at any time within the past six years.

[3] CPP intensity score

[4] CPP count score

[5] Standardized scores (range from 0 to 1).

[6] No COCOMO strategy for modifying food environments was reported by these CPPs.

Table 3.

Significant associations between the CPP-Int[1] and CPP-Count[2] scores for Nutrition CPP sub-types and child dietary intakes[3, 4] Past 1 and 6 Years; Healthy Communities Study, USA, 2013–2015. (n=130 communities, 5138 children)

	Index	Past 1 year			Past 6 years		
		Coefficient	SE	p-value	Coefficient	SE	p-value
Outcome: Child Intake of FV (cup equiv/day)							
CPP Target Behavior							
Decrease consumption of fast food	CPP-Int	0.21	0.09	**0.01**	0.17	0.08	**0.03**
	CPP-Count	0.17	0.09	**0.05**	0.17	0.10	0.08
Decrease consumption of fat	CPP-Int	0.19	0.09	**0.04**	0.18	0.10	0.06
	CPP-Count	0.16	0.09	0.09	0.13	0.09	0.16
CPP COCOMO Strategy							
Institute smaller portion size options	CPP-Int	0.23	0.11	**0.03**	0.18	0.10	0.06
	CPP-Count	0.19	0.11	0.09	0.13	0.10	0.19
COCOMO strategies classified as “Other”	CPP-Int	−0.30	0.11	**0.01**	−0.31	0.11	**0.01**
	CPP-Count	−0.22	0.11	**0.04**	−0.21	0.10	**0.04**
Outcome: Child Sugar from SSBs (tsp/day)							
CPP COCOMO Strategy							
Restrict availability of less healthy foods and beverages	CPP-Int	−0.73	0.42	0.08	−1.08	0.43	**0.01**
	CPP-Count	−0.73	0.42	0.08	−1.06	0.43	**0.01**
Outcome: Child Total Added Sugar (tsp/day)							
CPP COCOMO Strategy							
Restrict availability of less healthy foods and beverages	CPP-Int	−1.04	0.77	0.18	−1.63	0.80	**0.04**
	CPP-Count	−1.11	0.77	0.15	−1.69	0.79	**0.03**

[1] CPP intensity score

[2] CPP count score

[3] Model adjusted for child variables including: age, gender, race, ethnicity, family income, maximum parental education from both biological parents, seasonality of interview, maximum employment status of biological parents, clustering of participants within schools and communities; and community variables including: U.S. region, minority classification, urbanicity, percent of catchment population with African American, Hispanic, households living below poverty level, and with unemployed adults.

[4] Standardized for CPP scores for intensity index and count index.

See supplementary tables for unadjusted model results for associations between child dietary outcomes and all target behaviors and COCOMO strategies for intensity scores and count scores.