Nutrition and Physical Activity in Child Care
Results from an Environmental Intervention

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Background: With evidence of increased levels of obesity in younger children, the child-care setting is an important intervention target. Few environmental interventions exist, and none target both diet and physical activity. The Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) intervention was developed to fill this research and practice gap.

Design: Randomized controlled.

Setting/participants: Health professionals (child-care health consultants) serving child-care centers in North Carolina were recruited (n=30), randomly assigned into intervention or delayed-intervention control groups, and trained to implement the NAP SACC program. Up to three child-care centers were recruited (n=84) from each consultant's existing caseload.

Intervention: Implemented in 2005, the NAP SACC intervention includes an environmental self-assessment, selection of areas for change, continuing education workshops, targeted technical assistance, and re-evaluation. Implementation occurred over a 6-month period.

Main outcome measures: An observational instrument, Environment and Policy Assessment and Observation (EPAO), provided objective evidence of intervention impact and was completed by trained research staff blinded to study assignment. Data were collected in 2005 and 2006. Statistical analyses were conducted in 2006.

Results: Intention-to-treat analysis results were nonsignificant. Exploratory analyses using only centers that completed most of the NAP SACC program suggest an intervention effect.

Conclusions: Factors in the intervention design, the fidelity of implementation, the selection of outcome measure, or a combination of these may have contributed to the lack of intervention effect observed. Because of this study's use of existing public health infrastructure and its potential for implementation, future studies should address strategies for improving effectiveness.

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Introduction

The prevalence of obesity and overweight, even among young children,[1,2] is on the rise. Based on the 2003–2004 National Health and Nutrition Examination Survey (NHANES) data, over one quarter of children aged 2–5 years in the U.S. are classified as overweight or obese.[1] This trend demonstrates a pressing need for innovative efforts to prevent obesity in children.

Organized child care has recently emerged as an important setting for obesity prevention in young children[3] considering that nearly three quarters of U.S. children aged 3–6 years spend time in child-care settings.[4] For many, this time may constitute the majority of waking hours during the week. In addition, at child care, children may consume as many as three meals and/or snacks per day and experience most of the physical activity they will have. The American Heart Association[5] and the American Dietetic Association[6] suggest that multicomponent preschool interventions can be effective in promoting healthy behaviors.

A limited number of childhood obesity interventions target children aged <6 years[7]; fewer address children in child-care settings.[8–11] Moreover, interventions rarely are designed to disseminate or focus attention on nutrition and physical activity environmental factors to encourage obesity prevention in child-care settings. Given the absence of such programs, the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) program was developed.[12] Initially, the NAP SACC program was pilot-tested for feasibility and acceptability, with promising results, in a sample of child-care centers.[13] The current study tests the effectiveness of

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the NAP SACC intervention using an observation-based assessment instrument developed specifically for this study. It was hypothesized that centers assigned to the intervention arm would experience a positive increase in their nutrition environments, physical activity environments, or both, compared to those centers randomized to control.

Methods

Study Design

NAP SACC consultants. In Spring 2005, all child-care health consultants (CCHCs) working in North Carolina were invited to participate in an evaluation of the NAP SACC program. CCHCs are health professionals whose expertise includes child health, child development, and health/safety in child-care settings. A convenience sample was selected by recruiting the first 30 CCHCs (only one per county) who indicated an interest in participation, worked with at least three child-care centers meeting eligibility requirements, and had not participated in the previous NAP SACC pilot project. CCHCs provided consent and were randomized into either an intervention group (n=20) or a delayed-intervention control group (n=10).

Child-care centers. A convenience sample of licensed child-care centers, with a current enrollment of 15–150 children, was recruited to participate. Centers were excluded if they had an open case of abuse or neglect or served only a special population. All centers associated with the same CCHCs were in the same study arm and were provided modest incentives for participation. This study was reviewed and procedures approved by the University of North Carolina IRB.

NAP SACC Intervention

NAP SACC was designed to promote healthy weight development in preschool children and employs components of social cognitive theory (SCT)[14] against a social–ecologic framework.[15] Based on extensive formative research, national-level expert review, and input from a child-care community advisory committee, NAP SACC includes best practices for the promotion of proper nutrition and regular physical activity at child care. A comprehensive description of the intervention is published elsewhere.[12]

This program was designed for implementation through an existing infrastructure of public health professionals already in position to provide information, support, and technical assistance to child-care providers, who are trained as NAP SACC consultants and deliver the NAP SACC intervention to local child-care facilities. The intervention has five steps: (1) self-assessment, (2) action planning, (3) continuing education workshops, (4) technical assistance, and (5) re-assessment. The self-assessment instrument guides child-care providers in the action-planning process and is a unique and critical component of the NAP SACC intervention. Improvement goals, based on the self-assessment instrument, are chosen to affect about 20% of the nutrition and physical activity components. This incremental approach is based on the idea that small, manageable change may be more realistic and achievable than larger targets that seem unreachable. The intervention is designed to be used as continuous quality improvement.

Consultant Training

Consultants were randomly assigned to either an in-person (n=10) or web-based (n=10) training approach. In-person sessions lasted 3 hours, while the time spent on the web-based training site averaged 124 minutes. Both training modes included similar content. On a knowledge test administered pre- and post-training, there were no differences in the scores of the two training groups.[16]

Outcome Measure

The Environment and Policy Assessment and Observation (EPAO) instrument was developed as the primary outcome measure for this study. It assesses child-care nutrition and physical activity environments, policies, and practices,[17] and was developed using the standards, recommendations, and research literature upon which the NAP SACC intervention itself was based.[12] The EPAO consists of a 1-day observation and review of pertinent center documents. Seventy-five items were selected a priori to evaluate the impact of the NAP SACC intervention.

All 75-item responses were converted to a 3-point scale (0, 1, and 2), averaged within a given subscale, and multiplied by 10, with the average of all subscale scores representing total nutrition and physical activity scores (main outcome measures). The average agreement between observers at the same center on the same day was 87.3% and 79.3%, respectively, for the observation and document-review portions of the EPAO. Additional information regarding instrument protocol and inter-observer agreement is reported elsewhere.[17]

Data Collection

The EPAO was administered in all centers by trained field observers before (Fall 2005) and immediately following (Spring 2006) implementation of the NAP SACC intervention. All observers were trained by a study investigator during an intensive day-long workshop that included a review of EPAO items and criteria, lessons on observational techniques, a mock observation, and certification in a child-care center. Inter-observer agreement testing was conducted throughout both data-collection periods, and all field observers periodically underwent retraining to prevent observer drift. Field observers were blinded to center group assignment, were not part of the intervention staff, and—other than completing the day-long observations—did not interact with the NAP SACC consultants or centers.

Statistical Analysis

Baseline demographic characteristics for both consultants and child-care centers were compared using chi square, Fisher's exact tests, or Wilcoxon rank-sum tests. Mixed-model ANCOVA was used to examine intervention effects for the primary outcome measures (nutrition and physical activity total scores). The intention-to-treat (ITT) analysis included all intervention and control centers with the exception of two centers that closed operation during the intervention period. In addition, two exploratory analyses were conducted to more closely investigate intervention impact. Exploratory analyses included an as-per-protocol (APP) analysis and an item analysis. The APP analysis was conducted like the ITT analysis, but included only centers exposed to all or most (>75%) of the NAP SACC intervention components, based on process

Table 1. Baseline child-care center demographic characteristics

	Intervention (n=56)	Control (n=26)
Median star rating[a]	3	3
Median years in operation	16	14.5
Median enrollment (#)	59	76.5
All children aged (years)		
3	11	12
4	12	11.5
5	2	4
Race/ethnicity of children enrolled* **(%)**		
White	40	35
Nonwhite	60	65
CACFP participant (%)	77	88
NAEYC accredited (%)	9	23

[a]North Carolina Division of Child Development's 5-star child care rating system issues star-rated licenses to all eligible child-care centers and family child-care homes. A 1-star rating is the minimum licensing standard. Programs that choose to voluntarily meet higher standards can apply for a 2–5-star license. Rating not available for one center.
*$p<0.01$, two-tailed test
CACFP, Child and Adult Care Food Program; NAEYC, National Association for the Education of Young Children

evaluation data. In both the ITT and APP analyses, study groups were compared using mixed-effects ANCOVA models, with adjustment for baseline score and a random intercept for consultant. While training approach (web versus in-person) was not the focus of this study, a three-group analysis (web, in-person, and control) was conducted as well. All tests of intervention effect were one-sided, based on pilot data that the intervention did not produce negative effects, and conducted at an α=0.05 significance level. All other analyses should be considered exploratory, with p-values <0.05 indicating areas for further investigation.

Because centers were asked to address only some aspects of the nutrition and physical activity environment, total nutrition and total physical activity scores may not be sufficiently sensitive to reveal changes made by individual centers. Thus, a summary of change in item, using 75 individual items from the EPAO instrument, was produced. A change score (–2 to +2) was constructed for each item based on the degree of change at follow-up from the original item score (0, 1, or 2). Change scores were summed across all nutrition and all physical activity items, and differences between intervention and control centers were compared using a mixed-effects ANCOVA model. All analyses were performed in December 2006 using SAS 9.1.

Results

Initially, 30 CCHCs from an eligible pool of 77 volunteered for participation and were randomized into intervention (n=20) and control (n=10) groups. However, one control CCHC failed to nominate centers for participation and was dropped from the study. In general, intervention consultants were similar to controls, but median values indicate that they were younger (aged 32 years versus aged 50 years) and had a lower caseload of centers (11 vs 27; data not shown).

From these 29 consultants, 84 child-care centers were recruited into the study. During the intervention period, two centers closed and were excluded from the study, resulting in a final total of 82 centers (56 intervention, 26 control) in the ITT analysis. Intervention centers were not significantly different from control centers except in the area of child race/ethnicity, where intervention centers had a slightly higher percentage of nonwhite children (40% vs 35%; Table 1).

One CCHC failed to participate in training, resulting in non-implementation in three centers; two additional CCHCs were unable to implement the intervention in their respective three centers, and an additional six centers chose not to follow through with implementation. Of the 56 centers included in the intervention group, 41 completed most or all of the intervention and were included in the APP analysis.

After adjusting for consultant (random effect) and baseline EPAO score, the intervention centers showed an 11% improvement from baseline to follow-up, while no change was observed in the control centers (Table 2); however, the difference did not reach significance (p=0.06). When this analysis was repeated, removing those centers that failed to implement the intervention (APP analysis), a significant pre–post difference be-

Table 2. Comparison of intervention and control centers: EPAO nutrition and physical activity scores[a]

	Intervention (SD)			Control (SD)			
	Baseline	**Follow-up**	**Difference**	**Baseline**	**Follow-up**	**Difference**	***p*-value**[b]
Intention-to-treat[c]							
Total nutrition	8.6 (1.5)	9.5 (1.7)	0.9	9.0 (1.8)	9.0 (1.7)	0.0	0.06
Total PA	10.1 (2.4)	10.9 (2.6)	0.8	11.0 (2.8)	10.7 (1.8)	−0.3	0.19
As-per-protocol[d]							
Total nutrition	8.3 (1.4)	9.6 (1.7)	1.3	9.0 (1.8)	9.0 (1.7)	0.0	0.01
Total PA	10.1 (2.4)	11.1 (2.5)	1.0	11.0 (2.8)	10.7 (1.8)	−0.3	0.15

[a]Scores range from 0–20, with higher scores closer to best-practice recommendations.
[b]One-sided ANCOVA
[c]Intervention centers (n=56), control centers (n=26)
[d]Intervention centers (n=41), control centers (n=26)
EPAO, Environment and Policy Assessment and Observation; PA, physical activity

Table 3. Item change score for nutrition and physical activity: mixed-model analysis[a]

	Mean change score[b] (SD)		Range (min, max)	
	Intervention	**Control**	**Intervention**	**Control**
Nutrition (51 items)	4.3 (7.3)*	−0.5 (7.5)	−11, 29	−19, 15
Physical activity (24 items)	3.6 (6.6)**	−0.2 (6.8)	−9, 15	−15, 21

[a]Intervention centers (n=41), control centers (n=26)
[b]Change score based on possible range of −2 to +2
*p<0.01; **p<0.05
max, maximum; min, minimum

tween intervention and control centers (p=0.01) was observed for the total nutrition score (Table 2).

For the EPAO physical activity score, no significant difference was observed between intervention and control groups in either the ITT analysis or the APP analysis (Table 2). However, in both analyses a positive change was noted for the intervention group compared to a negative change in the control group.

For the individual-item analysis (Table 3), centers exposed to the NAP SACC intervention experienced a significant mean change score of +4.3 for the nutrition items, compared to a negative change score of −0.5 for control centers (p<0.01). For physical activity items, the intervention group's average change score was +3.6 and the control's was −0.2 (p<0.05).

In the consultant training-group comparison (web, in-person, and control), no significant differences among the groups were observed (data not shown).

Discussion

In this evaluation of a comprehensive intervention to improve nutrition and physical activity environments at child-care centers, no overall difference between intervention and control centers was found using an ITT analysis. However, exploratory analyses suggest significant positive findings among the centers that implemented the program. It is unclear whether the overall lack of significant results in the ITT analysis occurred because of inadequate strength of the intervention, a lack of implementation fidelity, an inadequate assessment tool, or a combination of these factors.

Because NAP SACC was designed as a low-cost, easy-to-implement intervention using available public health structures, insufficient dedicated consultant and/or center staff time to create measurable change in the nutrition and physical activity environments at child care may have resulted. Additionally, the use of self-assessment and self-selection by center staff may have resulted in a low-demand intervention. However, creating change in the child-care environment may require an approach that is more carrot than stick. An additional consequence of self-selection may have been the choice of *items* for change rather than entire areas (e.g., targeting a change from whole to skim milk only, rather than improving the entire beverage area). Even when implemented as designed, the intervention asks centers to focus only on part of the overall environment (~20%). While focusing on small, manageable changes may be a reasonable approach, it may have resulted in modest and less-measurable changes.

Another potential moderating factor was implementation fidelity. However, process data indicate that most consultants were able to implement a majority (>75%) of intervention components. Differential implementation by consultants may be of concern, but outcome change scores were similar for intervention consultants, and correlations between scores and age and center caseload were not significant (data not shown).

The lack of significant findings in the ITT analysis could be related to the measurement instrument used. Prior to the development of the EPAO, no instrument existed that specifically assessed the nutrition and physical activity environments at child-care settings. The most widely used measures of child-care quality (the Early Childhood Environment Rating Scale [ECERS] and the Infant/Toddler Environment Rating Scale [ITERS])[18,19] include only a few items that address these areas. The EPAO includes a scoring strategy based on best-practice findings from an extensive review of the literature and expert opinion,[12] and EPAO physical activity environment scores were associated with child physical activity at the child-care facility.[20] Also, only one day of EPAO observation was used in this study, which may have been inadequate to detect small changes. The authors are currently involved in a study to determine whether different data-collection strategies can be used to improve the information obtained with the EPAO instrument.

Other child-care–based interventions have employed research or project staff to conduct and deliver the intervention, which threatens sustainability and reproducibility.[8,10,11,21] NAP SACC, however, is a true public health program that builds on existing community infrastructure to deliver the intervention. A minimal time commitment was required from the NAP SACC consultants and the child-care staff, with little to no assistance provided by research staff,[12] and the NAP SACC consultants did not receive extra compensation for their time. Although these results are small, NAP SACC is designed for repeated use, as evidenced by its final step: "Evaluate, revise, and repeat." While these

factors may not have significantly increased the study's effect size, they greatly increase the potential for long-term program maintenance, which is ultimately critical to the intervention's public health impact. In future NAP SACC implementations, greater support at the agency level (e.g., the groups responsible for hiring CCHCs) may be necessary, possibly requiring NAP SACC as part of the consultants' scope of work.

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References

1. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the U.S., 1999–2004. JAMA 2006;295:1549–55.
2. Sherry B, Mei Z, Scanlon KS, Mokdad AH, Grummer-Strawn LM. Trends in state-specific prevalence of overweight and underweight in 2- through 4-year-old children from low-income families from 1989 through 2000. Arch Pediatr Adolesc Med 2004;158:1116–24.
3. Story M, Kaphingst KM, French S. The role of child care settings in obesity prevention. Future Child 2006;16:143–68.
4. Federal Interagency Forum on Child and Family Statistics. America's children: key national indicators of well-being. Washington DC: U.S. Government Printing Office, 2002.
5. Hayman LL, Williams CL, Daniels SR, et al. Cardiovascular health promotion in the schools: a statement for health and education professionals and child health advocates from the Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. Circulation 2004;110:2266–75.
6. American Dietetic Association. Position of the American Dietetic Association: benchmarks for nutrition programs in child care settings. J Am Diet Assoc 2005;105:979–86.
7. Bluford DA, Sherry B, Scanlon KS. Interventions to prevent or treat obesity in preschool children: a review of evaluated programs. Obesity 2007;15:1356–72.
8. Dennison BA, Russo TJ, Burdick PA, Jenkins PL. An intervention to reduce television viewing by preschool children. Arch Pediatr Adolesc Med 2004;158:170–6.
9. Fitzgibbon ML, Stolley MR, Schiffer L, Van Horn L, KauferChristoffel K, Dyer A. Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. J Pediatr 2005;146:618–25.
10. Fitzgibbon ML, Stolley MR, Schiffer L, Van Horn L, KauferChristoffel K, Dyer A. Hip-Hop to Health Jr. for Latino preschool children. Obesity 2006;14:1616–25.
11. Williams CL, Strobino BA, Bollella M, Brotanek J. Cardiovascular risk reduction in preschool children: the "Healthy Start" project. J Am Coll Nutr 2004;23:117–23.
12. Ammerman AS, Ward DS, Benjamin SE, et al. An intervention to promote healthy weight: Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) theory and design. Prev Chronic Dis 2007;4:A67. www.cdc.gov/pcd/issues/2007/jul/06_0115.htm.
13. Benjamin SE, Ammerman A, Sommers J, Dodds J, Neelon B, Ward DS. Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC): results from a pilot intervention. J Nutr Educ Behav 2007;39:142–9.
14. Bandura A. Social foundations of thought and action: a social cognitive theory. Engelwood Cliffs NJ: Prentice-Hall, 1986.
15. Stokols D. Translating social ecological theory into guidelines for community health promotion. Am J Health Promot 1996;10:282–98.
16. Benjamin SE, Tate DF, Bangdiwala SI, et al. Preparing child care health consultants to address childhood overweight: a randomized controlled trial comparing web to in-person training. Matern Child Health J 2007. doi 10.1007/s10995-007-0277-1.
17. Ward DS, Hales D, Haverly K, et al. An instrument to assess the obesogenic environment of child care centers. Am J Health Behav 2008;32:380–6.
18. Harms T, Clifford RM, Cryer D. Early childhood environment rating scale. Rev. ed. New York: Teachers College Press, 2005.
19. Harms T, Cryer D, Clifford RM. Infant/toddler environment rating scale. New York: Teachers College Press, 1990.
20. Bower JK, Hales DP, Tate DF, Rubin DA, Benjamin SE, Ward DS. The childcare environment and children's physical activity. Am J Prev Med 2008;34:23–9.
21. Fitzgibbon ML, Stolley MR, Dyer AR, VanHorn L, KauferChristoffel K. A community-based obesity prevention program for minority children: rationale and study design for Hip-Hop to Health Jr. Prev Med 2002;34:289–97.