A Community-Based Intervention Increases Physical Activity and Reduces Obesity in School-Age Children in North Carolina

Sara E. Benjamin Neelon, PhD, MPH, RD,^{1,2} Rebecca J. Namenek Brouwer, MS,²
Truls Østbye, MD, PhD,^{1,2} Kelly R. Evenson, PhD,³ Brian Neelon, PhD,⁴
Annie Martinie, MS,⁵ and Gary Bennett, PhD⁶

Abstract

Background: Community-based interventions are promising approaches to obesity prevention, but few studies have prospectively evaluated them. The aim of this study was to evaluate a natural experiment—a community intervention designed to promote active living and decrease obesity within a small southern town.

Methods: In 2011, community leaders implemented the Mebane on the Move intervention—a community-wide effort to promote physical activity (PA) and decrease obesity among residents of Mebane, North Carolina. We measured child PA and BMI before and after the intervention, using a nearby town not implementing an intervention as the comparison. In total, we assessed 64 children from Mebane and 40 from the comparison community 6 months before, as well as 34 and 18 children 6 months after the intervention. We assessed PA with accelerometers worn for 7 days and calculated BMI z-scores using children's height and weight. We conducted multivariable linear regressions examining pre- to postintervention change in minutes of PA and BMI z-score, adjusting for confounders.

Results: At follow-up, children in Mebane modestly increased their moderate-to-vigorous PA (1.3 minutes per hour; 95% confidence interval (CI): 0.2, 2.3; $p=0.03$) and vigorous activity (0.8 minutes per hour; 95% CI: 0.1, 1.5; $p=0.04$) more than comparison children. In intervention children, BMI z-scores decreased 0.5 units (kg/m^2 ; 95% CI: -0.9 , -0.02 ; $p=0.045$), compared to children in the comparison community.

Conclusions: We observed positive effects on PA level and weight status of children in Mebane, despite high rates of attrition, suggesting that the community-based intervention may have been successful.

Introduction

Community-based interventions are promising approaches to obesity prevention, and there is evidence of their success in both the United States^{1–3} and in other developed countries.^{4–8} McLeroy and colleagues⁹ define community-based interventions as initiatives that aim to create healthier environments through systemic changes in policy, services, and institutions. Recent reviews suggest that interventions targeting children are most effective when a school component is included

and community organizations are engaged in the research.^{10,11} An Institute of Medicine workshop summary states that “each community has its own health-related concerns, eating preferences, and activity patterns, as well as socioeconomic conditions, opportunities, and constraints created by the built and natural environments.”¹² National and international organizations have called for additional community-level interventions to help prevent the development of obesity in children.^{12–15} One primary example is First Lady Michelle Obama's “Let's Move! Cities, Towns and Counties” initiative, which calls on

¹Department of Community and Family Medicine, Duke University Medical Center, Duke University, Durham, NC.

²Duke Global Health Institute, Durham, NC.

³Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina–Chapel Hill, Chapel Hill, NC.

⁴Department of Biostatistics and Bioinformatics, Duke University Medical Center, Durham, NC.

⁵Alamance County Health Department, Burlington, NC.

⁶Department of Psychology and Neuroscience, Duke University, Durham, NC.

mayors to take a leadership role to create healthier communities.¹⁶

Additionally, there is growing evidence that physical activity (PA) is influenced by environmental characteristics of communities and neighborhoods where people live and work. Adult residents of walkable neighborhoods with access to recreation facilities are more physically active and less likely to be obese.^{17–21} The availability of safe areas for outdoor activity, such as parks and other open spaces, is associated with higher levels of PA in adults.^{22–24} Park and playground improvements have also been shown to increase use and PA levels of children and adults.^{25,26} Other environmental elements promoting PA in both children and adults include safe roads, low criminal activity, and mixed-use development.^{27–30}

Few studies have prospectively evaluated community-based interventions to improve the built environment.³¹ The 10,000 Steps Flanders and 10,000 Steps Ghent initiatives were community-based interventions designed to increase PA levels of residents within these communities in Belgium.^{32,33} In both studies, researchers found an increase in the number of adults meeting the 10,000-step goal.^{32,33} These efforts were based on the successful 10,000 Steps Rockhampton intervention conducted in Australia.³⁴ The 10,000 Steps intervention is based on a social marketing campaign within communities, schools, worksites, and faith organizations to promote walking and PA. As part of the intervention, participants could borrow pedometers to track their steps. In another study, Fitzhugh and colleagues³⁵ conducted a quasi-experimental study evaluating the impact of retrofitting a community in Knoxville, Tennessee, in the United States with walking trails. They found increases in the number of adult residents walking, cycling, and engaging in PA in the intervention town more so than the comparison community.³⁵ Healthy Living Cambridge Kids and Shape Up Somerville are two examples of community-based interventions targeting obesity and PA in primary school children living in cities in the northeastern United States.^{1,2} In both studies, researchers promoted healthy eating and PA in and around the cities, but the intervention focused mainly on improvements made within schools. Both found significant reductions in BMI z-scores postintervention.^{1–3} Similarly, the Apple (A Pilot Programme for Lifestyle and Exercise) program was a 2-year community-based obesity prevention intervention targeting primary school children in New Zealand.³⁶ The intervention included community activity days, walking school buses, changes to school beverage policies, and increased availability of PA resources within schools. Researchers observed a significant decrease in BMI z-score in intervention, compared to control children, and these effects were sustained 2 years postintervention.^{4,36,37} The It's Your Move! intervention in Australia targeted schools and school environments to create healthier options for teens.⁵ Intervention components included changes to beverage policies, establishment of school gardens, walking clubs, and educational aware-

ness.⁵ Though the results are promising, these previous interventions were primarily initiated by researchers and took place in mostly urban environments. The aim of this study was to evaluate the effect of a community-based intervention, initiated by residents, to promote PA and decrease obesity.

Methods

Study Design

The intervention took place in a small town in central North Carolina. The community members planned and implemented the intervention independent of any outside organization or funding agency. They did not receive any funding outside of the town or community members, and all activities were driven exclusively by the needs of the community. To evaluate this natural experiment, we recruited a second town with similar geographical and sociodemographic characteristics to serve as the comparison community. The comparison community was located 96 miles from the intervention town, which was close enough to allow for travel for data collection, but provided enough distance to avoid contamination.

The intervention town of Mebane occupies 5.9 square miles in central North Carolina, is 4 miles from a major highway, and in 2010 had a population of 11,425 that was 73.5% white, 20.4% African American, and 6.1% other or multiple races at baseline.³⁸ The comparison community covered 8.4 square miles, was 5 miles from a major highway, and had a population of 10,388 that was 85.3% white, 8.0% African American, and 6.7% other or multiple races at baseline.³⁸ Each community includes a small neighborhood park, two larger community parks, and two walking trails. There are two public and two private schools located in each community. All schools offered physical education classes and recess as part of the curriculum.

Intervention Description

The intervention, called Mebane on the Move, was designed by community members to create a healthier living environment for residents. A group of concerned residents raised funds through local, private donations to launch the Mebane on the Move intervention in 2011. Residents engaged business leaders, faith communities, schools, government officials, and local health professionals to promote PA throughout the community. The Mebane on the Move volunteers promoted PA through (1) walking and running clubs in the elementary schools for children and in the community for families, (2) portable play equipment provided to low-income families through home delivery food assistance programs, and (3) sidewalks, crosswalks, and walking trails installed throughout town. Walking and running clubs were established in the elementary schools in the district and were open to all children who attended those schools. Additionally, free community exercise programs were offered to children and adults at the local

recreation center. The Mebane on the Move intervention also included an annual 5-km run that takes place within the downtown area and is open to all residents for a nominal fee. Funds raised through this run help sustain intervention activities. The built environment changes included adding new sidewalks and crosswalks in the downtown area, creating a walking path throughout the town with 60 colorful and engraved stone pavers marking distance, and encouraging enhancements and clean-up efforts for all local parks and existing trails. The new sidewalks and crosswalks were also linked to the walking path to guide walkers and runners through town. Additional information about the history of the Mebane on the Move intervention and intervention activities is available elsewhere.^{39,40} In 2010, before implementation of the intervention, residents approached the research team seeking partners to evaluate their intervention.

Measures

As the evaluators, we worked with community leaders to assess the impact of the intervention, focusing on children within the community. Because we did not develop or implement the intervention, we focused on outcome and not process evaluation. Thus, we opted to assess PA practices of parents and their children by a survey, and child anthropometrics and PA levels through more objective measures. We sent invitation letters to nearly 2000 parents of elementary school children at three schools in each community. We invited parents who completed the survey to enroll their children in a substudy that included anthropometric and more objective PA assessment, with the goal of enrolling a small subset of 100 children ages 5–11 years per community. This sample size was dictated by available funding to conduct the in-depth, child-level assessments measuring PA and weight status. To participate, children needed to attend an elementary school in one of our two communities, and parents needed to be 18 years or older and speak and read English. Parents provided written informed consent and their children provided verbal assent to participate. The Duke University Medical Center Institutional Review Board (Duke University, Durham, NC) approved this study. All procedures were conducted in accord with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

We collected sociodemographic information from parents by a paper survey. We measured child PA during waking hours using an accelerometer (ActiGraph GT1M, Pensacola, FL) for 1 week, affixed by an elastic belt over the right hip. We used the vertical axis with 15-second epochs. Consistent with Evenson and colleagues,⁴¹ we used the following count per 15-second cutpoints: 0–25 = sedentary, 26–573 = light, 574–1002 = moderate, and ≥ 1003 = vigorous. Children were included in the analysis if they had ≥ 3 days of compliant data, defined as ≥ 8 hours of daily wear time (≥ 4 hours at school for ≥ 3 days), which allowed us to retain 87% of the sample. Trained data

collectors, blinded to the study aims, measured each child's height in centimeters without shoes using a Seca 124 stadiometer (Seca GmbH & Co. KG) and weight in kilograms without shoes with a Tanita BWB-800 scale (Tanita Corporation of America, Inc., Arlington Heights, IL) using standard techniques.⁴² We computed age- and sex-specific BMI z-scores using national reference data from the CDC.⁴³ We conducted baseline assessments in spring 2011, the intervention was launched in summer 2011, and we collected followed-up data in spring 2012.

Statistical Analysis

To assess sociodemographic differences between communities at baseline, we conducted Wilcoxon's rank-sum tests for continuous variables and Pearson's exact chi-square tests for categorical variables. We fitted separate multivariable linear regression models with change in minutes of different intensities of PA (sedentary, light, moderate, and vigorous) from baseline to follow-up as the outcome, with intervention group as the primary independent variable, adjusting for baseline PA and covariates that were of *a priori* interest. We computed minutes per hour and adjusted for total daily accelerometer wear time. We also conducted a mixed-effects regression model, with follow-up BMI z-score as the outcome, with a main effect for intervention, and an interaction for weight status, controlling for baseline values and covariates. Analyses included only children with both baseline and follow-up data. We performed all analyses using SAS software (version 9.2; SAS Institute Inc., Cary, NC) and used a significance level of $\alpha < 0.05$.

Results

Among the 458 parents enrolled in the larger study, 64 intervention and 40 comparison children participated in the substudy to assess PA by accelerometer and provide height and weight measurements. Of those, 34 intervention and 18 comparison children met accelerometer compliance standards at the 1-year follow-up. Communities did not differ in child race or age at baseline, but children in the intervention community had lower BMI z-scores at baseline (0.6 vs. 1.2; $p = 0.03$). Parents in the intervention community reported higher family incomes (40.6% intervention vs. 15.0% comparison reported $\geq \$90,001$ per year; $p = 0.01$) and parental education (75.0% intervention vs. 52.5% comparison graduated college; $p = 0.03$; Table 1).

Children in the intervention group wore the accelerometers for an average (standard deviation; SD) of 12.2 (1.1) hours per day at baseline and 12.3 (0.9) hours at follow-up, and children in the comparison group wore them for 11.5 (1.3) hours per day at baseline and 12.2 (1.3) hours at follow-up. Intervention children engaged in an average (SD) of 4.0 (1.7) minutes per hour of moderate-to-vigorous physical activity (MVPA) at baseline and 4.2 (1.9) at follow-up. Comparison children engaged in 3.8 (2.0) minutes per hour at baseline and 3.4 (1.5) at follow-up.

Table 1. Characteristics of the 104 Children and Their Families Who Participated in the Mebane on the Move Evaluation at Baseline, by Community

	Intervention (n=64)	Comparison (n=40)
Child	Mean (SD)	
Age, years	7.8 (1.8)	8.3 (1.9)
BMI z-score	0.6 (1.2)	1.2 (1.2)
	No. (%)	
Sex, female	35 (54.7)	15 (37.5)
Race		
White	49 (76.6)	34 (85.0)
African American	12 (18.8)	5 (12.5)
Other	3 (4.7)	1 (2.5)
Ethnicity, Hispanic or Latino/a	4 (6.3)	0 (0.0)
Parent	Mean (SD)	
Age, years	37.6 (6.6)	38.1 (7.3)
BMI	28.5 (8.4)	32.8 (7.2)
	No. (%)	
Sex, female	55 (85.9)	32 (80.0)
Education		
≤ High school	2 (3.1)	5 (12.5)
Vocational or some college	14 (21.9)	14 (35.0)
≥ College graduate	48 (75.0)	21 (52.5)
Household income, yearly		
≤ \$30,000	11 (17.2)	14 (35.0)
\$30,001–\$90,000	27 (42.2)	20 (50.0)
≥ \$90,001	26 (40.6)	6 (15.0)

SD, standard deviation; BMI, body mass index.

When we compared baseline values of children who completed a follow-up assessment to those who withdrew from the study, we did not observe differences in MVPA levels (3.9 vs. 4.2 minutes per hour; $p=0.42$), BMI z-score (0.6 vs. 1.0 units; $p=0.12$) or any other covariates included in the analyses.

In the multivariable adjusted models, children in the intervention community increased their average daily MVPA by 1.3 minutes per hour (95% confidence interval [CI], 0.2, 2.3; $p=0.03$) and vigorous activity by 0.8 minutes per hour (95% CI, 0.1, 1.5; $p=0.04$), compared to the comparison children (Table 2). This equated to approximately 15 additional minutes of MVPA and approximately 10 additional minutes of vigorous activity over the course of the day. When we examined weekend time only, we found that moderate activity increased (1.5 minutes per hour; 95% CI: 0.3, 2.8; $p=0.03$) and MVPA also increased (2.7 minutes per hour; 95% CI: 0.4, 4.9; $p=0.03$). However, during school hours, moderate activity decreased (−1.6 minutes per hour; 95% CI: −2.8, −0.5; $p=0.01$), as did MVPA (−2.2 minutes per hour; 95% CI: −4.0, −0.4; $p=0.03$). We did not observe significant changes in PA during the weekday after school (data not shown). From pre- to postintervention for the weight outcome, we observed a BMI z-score decrease of 0.5 units (95% CI: −0.9, −0.02; $p=0.045$) in intervention children versus comparison children.

Discussion

In this evaluation of a community-wide intervention, we found that children engaged in more MVPA and modestly decreased their BMI z-scores after the intervention. Although children were less active at school, they increased their overall PA, driven mainly by activity during the weekend. Significant differences were evident at follow-up that suggest that the Mebane on the Move intervention was effective at increasing child PA and decreasing weight status. These findings support previous studies that found that community-based interventions may be successful approaches to obesity prevention in children and that

Table 2. Multivariable Adjusted^a Minutes per Hour and 95% CI of Physical Activity in 52 Children Who Wore Accelerometers for the Mebane on the Move Evaluation

Activity level	Total		School		Weekend	
	Estimate (CI)	p value	Estimate (CI)	p value	Estimate (CI)	p value
Sedentary	−1.8 (−4.1, 0.4)	0.12	2.6 (−1.9, 7.1)	0.28	−5.5 (−11.1, 0.1)	0.07
Light	0.5 (−1.4, 2.3)	0.63	−0.8 (−4.3, 2.8)	0.67	1.7 (−3.6, 7.1)	0.53
Moderate	0.4 (−0.1, 0.9)	0.11	−1.6 (−2.8, −0.5)	0.01	1.5 (0.3, 2.8)	0.03
Vigorous	0.8 (0.1, 1.5)	0.04	−0.6 (−1.4, 0.3)	0.21	1.0 (−0.2, 1.1)	0.11
MVPA	1.3 (0.2, 2.3)	0.03	−2.2 (−4.0, −0.4)	0.03	2.7 (0.4, 4.9)	0.03

^aAdjusted for child sex, race, age, baseline activity, accelerometer wear time, parent BMI, family income, and community.

MVPA, moderate to vigorous physical activity; CI, 95% confidence interval.

opportunities for children to be active over the weekend are especially important.

Although the Mebane on the Move intervention yielded some positive results, other community-based interventions have also increased PA levels or decreased obesity of residents.^{1-7,36,37} However, the majority of these interventions have taken place in larger, urban environments; few have included a comparison community, and even fewer have been initiated by community members. As with these other community-based interventions,^{1-8,32-37} Mebane on the Move aimed to increase PA through changes to the built environment. The previous initiatives were purposeful environmental interventions, often instigated by researchers.¹⁻⁸ However, Mebane on the Move was initiated by residents who engaged researchers to help evaluate the intervention. But, residents designed and implemented all intervention activities based on the needs of their own community.

Our evaluation of the intervention has some limitations. First, our sample was restricted to one small intervention community and a matched comparison community. Finding a comparison community that was similar to the intervention community was challenging. We selected the comparison community based on number of residents, mean household income, cost of housing, racial and ethnic distribution of residents, mean age of residents, number of parks and other recreational facilities, and number of schools. We also considered weather conditions and climate, given that PA levels were of interest. The intervention community, however, had a slightly higher mean annual household income and higher parental education levels—most likely owing to the proximity to two major universities in North Carolina. Even though there were some differences between the intervention and comparison community, the inclusion of the comparison community is a strength of this study.

Because we were evaluating a natural experiment, though, there may have been changes within the comparison community that were not within our control. For example, the schools within the comparison community had strong obesity-prevention initiatives that launched near the start of the study. Two of the schools in the comparison community started promoting healthier eating and active play to the parents of children enrolled. This was not unlike many other schools across the country promoting similar efforts. Though we were able to document some of these initiatives, we were not able to measure their effects on the community beyond our baseline and follow-up assessments. Additionally, not all of the planned components of the Mebane on the Move intervention took place as intended. Some crosswalks and bike lanes were not installed owing to funding limitations and problems obtaining approval from the state department of transportation, and improvements to park equipment and greenery were not implemented due to funding constraints. However, Mebane on the Move intervention efforts are still underway, and residents are committed to completing the proposed

intervention activities as funding allows. Finally, given the fact that we are not able to ascertain whether children were actually exposed to the intervention components, results of this study should be interpreted with caution. It is possible that children in the intervention community increased their PA and decreased their weight status for reasons unrelated to the Mebane on the Move intervention.

Initially, we sought to enroll 100 children from each community. This relatively small sample size was dictated by limited funding to evaluate this natural experiment, and approximately 10% of families who completed a paper survey opted to participate in the substudy to assess child-level PA and weight status. We also did not have direct access to parents at recruitment, owing to the fact that we distributed letters of invitation through their children at school. Importantly, we were not able to reach a number of children for the 1-year follow-up assessment, resulting in high rates of attrition. Rates of attrition in this study were slightly higher than those reported in previous evaluations of community-based interventions.^{1,3,5} Attrition in these studies ranged from 24% to 45%, whereas we lost 50% of our sample at follow-up. In our study, the majority of parents did not communicate directly with the study team to withdraw from the study, but instead did not respond to contacts made by the study team. Thus, we do know the exact reason parents were no longer interested in participating in the study at follow-up. This further reduced our sample size, potentially introducing bias and limiting the generalizability of the findings. However, we did not observe differences in baseline values of children who completed the study, compared to those who withdrew, and our findings are consistent with previous studies evaluating community-based interventions.^{1-7,36,37}

We are not able to identify components of the intervention that may have been more successful than others, given that the community-based intervention was multifaceted. Additionally, we were not able to assess longer-term outcomes of the intervention. We conducted follow-up measures approximately 6 months after the intervention launched, which may not have allowed enough time for changes to take effect. In fact, many of the Mebane on the Move intervention activities were ongoing and had not been fully implemented. Future studies should consider conducting multiple assessments postintervention at later time points to assess sustainability, consistent with an ongoing study evaluating park improvements and PA.⁴⁴

Some community-based interventions have shown mixed results in increasing PA levels or decreasing rates of obesity in children.^{44,45} There is, however, evidence that interventions within towns and cities have the potential to create healthier communities.⁴⁶ In Shape Up Somerville in Massachusetts, researchers found significant reductions in BMI z-scores of children postintervention.¹ Healthy Living Cambridge Kids also improved physical fitness and decreased obesity in children.³ As with these novel interventions, Mebane on the Move aimed to increase activity through community programs

and changes to the built environment. Whereas Shape Up Somerville and Healthy Living Cambridge Kids were interventions initiated by researchers in urban environments, Mebane on the Move originated in the community and in the Southeastern United States, where rates of childhood obesity are higher.^{47,48}

Other US cities, such as Marshall, Texas, and Los Angeles, California, are engaged in similar community-based efforts to increase PA levels of residents. There are also a number of towns and cities that engaged in the Communities Putting Prevention to Work (CPPW) program supported by the CDC. These CPPW awardees worked to reduce obesity and tobacco use within their local communities.⁴⁹ Though it may not always be possible, evaluation of these efforts provides useful information. Sometimes, these natural experiments are not evaluated because researchers do not have sufficient notice to conduct baseline assessments. It can also be challenging to secure funding in time to evaluate the intervention. However, evaluations of natural experiments offer important information about the impact of community-initiated interventions within a real-world setting. A recent report from the NIH highlighted the importance of evaluating natural experiments and stated that this type of research “offers unique opportunities to enrich the evidence base, and can offer advantages not provided by other research designs.”⁵⁰ When possible, researchers should partner with community leaders and local government to evaluate intervention efforts within a community.

Acknowledgments

The authors thank the leaders and residents in both the intervention and comparison community for their partnership and collaboration. The authors are also grateful to Joseph Curtatone, the Mayor of Somerville, Massachusetts, for his guidance throughout the study. The authors also thank Alyssa Platt for her assistance with data analysis. This study was supported, in part, by a grant from Active Living Research, a national program of the Robert Wood Johnson Foundation (RWJF; ID no. 68593). The content is solely the responsibility of the authors and does not necessarily represent the official views of the RWJF.

Author Disclosure Statement

No competing financial interests exist.

References

1. Economos CD, Hyatt RR, Goldberg JP, et al. A community intervention reduces BMI z-score in children: Shape Up Somerville first year results. *Obesity* 2007;15:1325–1336.
2. Burke NM, Chomitz VR, Rioles NA, et al. The path to active living: Physical activity through community design in Somerville, Massachusetts. *Am J Prev Med* 2009;37(6 Suppl 2):S386–S394.
3. Chomitz VR, McGowan RJ, Wendel JM, et al. Healthy Living Cambridge Kids: A community-based participatory effort to promote healthy weight and fitness. *Obesity (Silver Spring)* 2010;18(Suppl 1):S45–S53.
4. Taylor RW, McAuley KA, Barbezat W, et al. Two-year follow-up of an obesity prevention initiative in children: the APPLE project. *Am J Clin Nutr* 2008;88:1371–1377.
5. Millar L, Kremer P, de Silva-Sanigorski A, et al. Reduction in overweight and obesity from a 3-year community-based intervention in Australia: The ‘It’s Your Move!’ project. *Obes Rev* 2011;2:20–28.
6. Sanigorski AM, Bell AC, Kremer PJ, et al. Reducing unhealthy weight gain in children through community capacity-building: Results of a quasi-experimental intervention program, Be Active Eat Well. *Int J Obes (Lond)* 2008;32:1060–1067.
7. de Silva-Sanigorski AM, Bell AC, Kremer P, et al. Reducing obesity in early childhood: Results from Romp & Chomp, an Australian community-wide intervention program. *Am J Clin Nutr* 2010;91:831–840.
8. Swinburn B, Malakellis M, Moodie M, et al. Large reductions in child overweight and obesity in intervention and comparison communities 3 years after a community project. *Pediatr Obes* 2013;6(10):455–462.
9. McLeroy KR, Norton BL, Kegler MC, et al. Community-based interventions. *Am J Public Health* 2003;93:529–533.
10. Bleich SN, Segal J, Wu Y, et al. Systematic review of community-based childhood obesity prevention studies. *Pediatrics* 2013;132:e201–e210.
11. Shapiro A, Arevalo S, Tolentino A, et al. Prevention and management of pediatric obesity: a multipronged, community-based agenda. *Adv Pediatr* 2014;61:261–269.
12. Khan LK, Sobush K, Keener D, et al. Recommended community strategies and measurements to prevent obesity in the United States. *MMWR Recomm Rep* 2009;58:1–26.
13. Institute of Medicine. *Community Perspectives of Obesity Prevention in Children: Workshop Summaries*. The National Academies Press Washington, DC, 2009.
14. World Health Organization. Population-based approaches to childhood obesity prevention. World Health Organization: Geneva, Switzerland, 2012.
15. Department of Health. Healthy Weight, Healthy Lives: A cross-government strategy for England. Department of Health, London, 2008.
16. Let’s Move—America’s move to raise a healthier generation of kids. 2010. Available at www.letsmove.gov/become-lets-move-city-or-town Last accessed December 21, 2014.
17. Duncan DT, Sharifi M, Melly SJ, et al. Characteristics of walkable built environments and BMI z-scores in children: Evidence from a large electronic health record database. *Environ Health Perspect* 2014;122:1359–1365.
18. Zhu X, Yu CY, Lee C, et al. A retrospective study on changes in residents’ physical activities, social interactions, and neighborhood cohesion after moving to a walkable community. *Prev Med* 2014;69(Suppl 1):S93–S97.
19. Calise TV, Heeren T, DeJong W, et al. Do neighborhoods make people active, or do people make active neighborhoods? Evidence from a planned community in Austin, Texas. *Prev Chronic Dis* 2013;10:E102.
20. Sofkova T, Pridalova M, Mitas J, et al. The level of neighborhood walkability in a place of residence and its effect on body composition in obese and overweight women. *Cent Eur J Public Health* 2013;21:184–189.

21. Ranchod YK, Diez Roux AV, Evenson KR, et al. Longitudinal associations between neighborhood recreational facilities and change in recreational physical activity in the multi-ethnic study of atherosclerosis, 2000–2007. *Am J Epidemiol* 2014;179:335–343.
22. Cohen DA, Ashwood JS, Scott MM, et al. Public parks and physical activity among adolescent girls. *Pediatrics* 2006;118:e1381–e1389.
23. Evenson KR, Murray DM, Birnbaum AS, et al. Examination of perceived neighborhood characteristics and transportation on changes in physical activity and sedentary behavior: The Trial of Activity in Adolescent Girls. *Health Place* 2010;16:977–985.
24. Edwards NJ, Giles-Corti B, Larson A, et al. The effect of proximity on park and beach use and physical activity among rural adolescents. *J Phys Act Health* 2014;11:977–984.
25. Cohen DA, Han B, Isacoff J, et al. Impact of park renovations on park use and park-based physical activity. *J Phys Act Health* 2015;12:289–295.
26. Bohn-Goldbaum EE, Phongsavan P, Merom D, et al. Does playground improvement increase physical activity among children? A quasi-experimental study of a natural experiment. *J Environ Public Health* 2013;2013:109841.
27. Lowe M, Boulangé C, Giles-Corti B. Urban design and health: Progress to date and future challenges. *Health Promot J Austr* 2014;25:14–18.
28. Janssen I. Crime and perceptions of safety in the home neighborhood are independently associated with physical activity among 11–15 year olds. *Prev Med* 2014;66:113–117.
29. Carver A, Timperio A, Crawford D. Perceptions of neighborhood safety and physical activity among youth: The CLAN study. *J Phys Act Health* 2008;5:430–444.
30. Davison KK. School performance, lack of facilities, and safety concerns: Barriers to parents' support of their children's physical activity. *Am J Health Promot* 2009;23:315–319.
31. Evenson KR, Sallis JF, Handy SL, et al. Evaluation of physical projects and policies from the Active Living by Design partnerships. *Am J Prev Med* 2012;43(5 Suppl 4):S309–S319.
32. De Cocker KA, De Bourdeaudhuij IM, Brown WJ, et al. Effects of “10,000 steps Ghent”: A whole-community intervention. *Am J Prev Med* 2007;33:455–463.
33. Dubuy V, De Cocker KA, De Bourdeaudhuij IM, et al. ‘10 000 Steps Flanders’: Evaluation of the state-wide dissemination of a physical activity intervention in Flanders. *Health Educ Res* 2013;28:546–551.
34. Mummery WK, Schofield G, Hinchliffe A, et al. Dissemination of a community-based physical activity project: The case of 10,000 steps. *J Sci Med Sport* 2006;9:424–430.
35. Fitzhugh EC, Bassett DR, Jr., Evans MF. Urban trails and physical activity: A natural experiment. *Am J Prev Med* 2010;39:259–262.
36. Taylor RW, McAuley KA, Williams SM, et al. Reducing weight gain in children through enhancing physical activity and nutrition: The APPLE project. *Int J Pediatr Obes* 2006;1:146–152.
37. Taylor RW, McAuley KA, Barbezat W, et al. APPLE Project: 2-y findings of a community-based obesity prevention program in primary school age children. *Am J Clin Nutr* 2007;86:735–742.
38. United States Census Bureau. 2010 census of population and housing, summary population and housing characteristics, CPH-1-35, North Carolina. United States Census Bureau: Washington, DC, 2012.
39. Martinie A, Brouwer RJ, Neelon SE. Mebane on the move: A community-based initiative to reduce childhood obesity. *N C Med J* 2012;73:382–383.
40. Mebane on the Move. 2011. Available at www.mebaneonthemove.org Last accessed December 21, 2014.
41. Evenson KR, Catellier DJ, Gill K, et al. Calibration of two objective measures of physical activity for children. *J Sports Sci* 2008;26:1557–1565.
42. Shorr IJ. How to weigh and measure children. New York: United Nations, 1986.
43. Centers for Disease Control and Prevention. National Center for Health Statistics CDC Growth Charts, USA. Centers for Disease Control and Prevention: Atlanta, GA, 2004.
44. Veitch J, Salmon J, Carver A, et al. A natural experiment to examine the impact of park renewal on park-use and park-based physical activity in a disadvantaged neighbourhood: The RE-VAMP study methods. *BMC Public Health* 2014;14:1471–2458.
45. Baker PR, Francis DP, Soares J, et al. Community wide interventions for increasing physical activity. *Cochrane Database Syst Rev* 2011;(4):CD008366.
46. Mummery WK, Brown WJ. Whole of community physical activity interventions: Easier said than done. *Br J Sports Med* 2009;43:39–43.
47. Tudor-Locke C, Kronenfeld JJ, Kim SS, et al. A geographical comparison of prevalence of overweight school-aged children: The National Survey of Children's Health 2003. *Pediatrics* 2007;120:e1043–1050.
48. Singh GK, Kogan MD, van Dyck PC. Changes in state-specific childhood obesity and overweight prevalence in the United States from 2003 to 2007. *Arch Pediatr Adolesc Med* 2010;164:598–607.
49. Centers for Disease Control and Prevention. Communities putting prevention to work. 2013. Available at www.cdc.gov/nccdphp/dch/programs/CommunitiesPuttingPreventiontoWork Last accessed December 21, 2014.
50. Hunter CM, McKinnon RA, Esposito L. News from the NIH: Research to evaluate “natural experiments” related to obesity and diabetes. *Transl Behav Med* 2014;4:127–129.

Address correspondence to:

Sara E. Benjamin Neelon, PhD, MPH, RD

Associate Professor

Department of Community and Family Medicine

Duke University Medical Center and Duke

Global Health Institute

Duke University

2200 West Main Street

DUMC 104006

Durham, NC 27705

E-mail: sara.benjamin@duke.edu