

Evaluation Results from an Active Living Intervention in Somerville, Massachusetts

Virginia R. Chomitz, PhD, Julia C. McDonald, MS, MPH, Denise B. Aske, MPH, MA, Lisa N. Arsenault, PhD, Nicole A. Riales, MA, Lisa B. Brukilacchio, OTR/L, Edm, Karen A. Hacker, MD, MPH, Howard J. Cabral, PhD

Background: Community policies and programs can encourage active living and promote physical activity among residents. Somerville MA implemented an Active Living by Design project in 2003–2008 that promoted partnerships and advocacy to encourage physical activity.

Purpose: To evaluate the Active Living by Design project implemented in Somerville.

Methods: A retrospective design assessed relative differences in the rates of meeting moderate or vigorous physical activity recommendations among middle- and high-school students and adults at baseline and follow-up within Somerville and at follow-up only in Everett MA, a comparison community. The middle- and high-school Youth Risk Behavior Surveys and the adult Behavioral Risk Factor Surveillance Survey were supplemented with Active Living by Design evaluation-specific questions at follow-up. Analyses included chi-square and logistic regression modeling to assess relationships.

Results: Approximately 1000 youth completed surveys at baseline and follow-up in Somerville and at follow-up in Everett. Similarly, adult residents completed surveys at baseline ($n=1081$) and follow-up in Somerville ($n=644$) and follow-up in Everett ($n=608$). Within Somerville, high school-aged students and adults were more likely to meet physical activity recommendations at follow-up after adjusting for demographic, health, and behavioral variables (OR=1.6 [95% CI=1.34, 1.92] and 2.36 [95% CI=2.29, 2.43], respectively). Between cities, Somerville adults were 1.47 (95% CI=1.37, 1.56) times more likely than Everett adults to meet physical activity recommendations.

Conclusions: Community-based active living interventions may help residents meet physical activity recommendations. To improve community health, public health surveillance data can identify predictors of meeting physical activity recommendations that can be used to inform city policy and planning.

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Introduction

In 2003, Somerville MA received one of 25 community Active Living by Design grants from the Robert Wood Johnson Foundation. The goal of this 5-year grant was to promote physical activity using a Community Action Model including the 5P Framework: prepa-

ration, promotions, programs, policy influences, and physical projects.^{1,2} The Somerville Active Living by Design project was one component of a larger community effort, known collectively as Shape Up Somerville, that emerged to coordinate the various grants, activities, and evolving partnerships in Somerville that supported healthy eating and active living during this time period.

In 2007, the Institute for Community Health was awarded a 2-year Robert Wood Johnson Foundation grant to evaluate Somerville Active Living by Design activities. A retrospective mixed-methods approach was used to compare the intervention community (Somerville) to a demographically similar comparison community (Everett MA) without an Active Living by Design grant. The outcome evaluation used population survey data of students (Youth Risk Behavior Survey [YRBS]) and adults (Behavioral Risk Factor Surveillance Survey [BRFSS]) to address three main research aims:

From the Department of Public Health and Community Medicine, Tufts University School of Medicine (Chomitz), the Department of Population Medicine Harvard Pilgrim Health Care (McDonald), the Department of Biostatistics, Boston University Clinical and Translational Science Institute, Boston University School of Public Health (Cabral), Boston, the Heller School for Social Policy and Management, Brandeis University, Waltham (Aske), the Institute for Community Health (Arsenault, Hacker), Shape Up Somerville (Riales), and the Community Affairs Department, Cambridge Health Alliance (Brukilacchio), Somerville, Massachusetts

Address correspondence to: Virginia Rall Chomitz, PhD, Assistant Professor, Tufts University School of Medicine, Department of Public Health and Community Medicine, 136 Harrison Avenue, Boston MA 02111. E-mail: virginia.chomitz@tufts.edu.

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1. To assess time effect differences in meeting physical activity guidelines among middle- and high-school students and adult residents within Somerville from baseline to follow-up after Active Living by Design intervention activities.
2. To assess city effect differences in meeting physical activity guidelines among middle- and high-school students and adult residents between cities (Somerville and Everett) at follow-up after Active Living by Design intervention activities.
3. To assess common and different factors associated with meeting physical activity guidelines *in each city* (Somerville and Everett) to better understand interrelationships between demography, physical activity awareness and support, health behaviors, and use of recreational spaces.

Description of Study Locations

Somerville (population 77,478), the most densely populated municipality in New England (nearly 19,000 people per square mile), sits adjacent to Boston.³ Across the Mystic River from Somerville, Everett is a thickly settled urban city of approximately 38,037 residents (population density of 11,000 per square mile).³ The cities have similar racial/ethnic profiles and both are gateway communities that attract immigrant populations. Both have high proportions of foreign-born residents (26% Somerville; 35% Everett) and residents who speak languages other than English at home (32% Somerville; 43% Everett).^{3,4}

Per capita income in Somerville (\$32,602) is similar to that of the state (\$33,806), and 18.5% of Somerville families with children currently live in poverty, a figure higher than the state average (11%). Per capita income in Everett is lower than it is in Somerville (\$24,285), as is the proportion of families with children living in poverty (13.8%). During the 2009–2010 school year, 68% of Somerville and 69% of Everett public school students were identified as low-income (eligible for free or reduced-price lunch).⁵

Both cities face a scarcity of parks and open spaces in addition to high-volume traffic corridors. Of Somerville's 4.1 square miles of land area, only 5.4% consists of public open space (about 141 acres). Everett is a city of 3.4 square miles, of which only 2.7% is dedicated as parkland (58 acres).

The Intervention

Specific elements of Somerville's Active Living by Design intervention are described in detail elsewhere.² Briefly, the physical activity accomplishments of the Shape Up Somerville partnership included creating city-level bike and pedestrian and Shape Up Somerville coordinator positions. These staff enhanced opportunities for active transportation, walking, and biking through advocacy to paint crosswalks, install

pedestrian crossing signs, open and renovate parks, and provide bike racks. Additionally, Somerville advocated for and acquired land and grant commitments of more than \$3 million to extend the walking path in conjunction with a subway expansion project connecting Somerville to Boston. The Shape Up Somerville research study (2002–2005) (and other concurrent grants such as the U.S. Department of Education Carol S. White Physical Education grant) also supported school-based and community active living activities for children and families, including walk-to-school efforts, school-based gardens, and physical education.

During the Active Living by Design intervention timeframe, there was also growing awareness of the importance of physical activity in Everett. However, while Somerville was coordinating the activities of multiple grants and developing internal capacity to promote active living, Everett city departments and local nonprofits were just starting to develop health and wellness coalitions and submitting grants to build such programs and capacity. For example, the school department submitted (and received in 2007) a physical education enhancement program grant, and a nonprofit organization submitted (and received) a walking promotion grant. Thus, during the Active Living by Design grant period, Everett did not have the coordination and advocacy capacity that Shape Up Somerville did, nor did Everett have the grant funding and key personnel to support substantial activities.

Methods

Data Collection

Middle-school (Grades 6–8) and high-school (Grades 9–12) students. Self-reported behavioral data for youth were obtained from locally adapted YRBS based on the structure and content of the national and state-level YRBS.⁶ In Somerville and Everett, the YRBS is administered to students biannually in February during a required class period (e.g., homeroom) to all students present on the administration day. The middle-school YRBS survey was implemented in 2003 and 2007 in Somerville and in 2007 in Everett. The high-school YRBS was implemented in Somerville in 2004 and 2008, and in 2007 in Everett. Students can opt out of participating, either by their own preference or that of a parent. In both cities, the survey questionnaire was available in four languages: English, Spanish, Portuguese, and Haitian Creole.

In anticipation of Active Living by Design evaluation efforts, survey questions were added to middle- and high-school surveys administered during the follow-up period in Somerville and Everett. Questions included queries regarding the encouragement students received for physical activity (at school, after school, and at home) and student's recreational space use. The YRBS provided both baseline and follow-up data for Somerville and only follow-up data for Everett.

Adult sample. Self-reported behavioral data for adults were obtained from locally configured BRFSS that used National BRFSS modules for physical activity/exercise.⁷ In 2002, the Institute for

Community Health planned and implemented a two-city BRFSS of adults that included Somerville. In 2008, a five-city BRFSS was conducted that included Somerville and Everett and in addition to the national modules, included Active Living by Design evaluation-specific questions. Thus, the BRFSS provided both baseline and follow-up data for Somerville and only follow-up data for Everett.

Data collection for both BRFSS surveys (2002 and 2008) occurred predominately between February and May of the survey year and used a stratified random sample of telephone-equipped households (list-assisted, random-digit-dial) to contact and interview non-institutionalized adults aged ≥ 18 years. Sample design, generation, and survey data collection were conducted by Macro International, Inc. (Burlington VT). Interviews were conducted by experienced, supervised personnel in English, Spanish, and Portuguese using a computer-assisted telephone-interviewing software package. The BRFSS provided both baseline and follow-up data for Somerville, and follow-up data for Everett.

To account for the complex sampling design, a multistage process to generate final sampling “weights” necessary for the statistical analysis was used. Weights were calculated as the product of a sampling weight, which corrects for differential probabilities of selection of households and members within households and a poststratification adjustment matching 2000 census population figures by geography, race/ethnicity, age, and gender. These sampling weights were used in statistical analyses.⁸

Primary outcome of interest. Across all study samples, the primary outcome of interest was self-reported achievement of either moderate or vigorous physical activity guidelines, as defined by the American College of Sports Medicine and used in Healthy People 2010 (HP2010).⁹ For students, moderate was defined as ≥ 30 minutes of low-intensity physical activity (that do not make an individual sweat or breathe hard, such as walking, biking, or skating) on at least 5 of the previous 7 days; vigorous was defined as ≥ 20 minutes of high-intensity physical activity (that make an individual sweat or breathe hard, such as basketball, soccer, running, swimming, fast bicycling, or fast dancing) on at least 3 of the previous 7 days. For adults, moderate was defined as ≥ 30 minutes of moderate activities on ≥ 5 days in a “usual” week; and vigorous was defined as ≥ 20 minutes of vigorous activities on ≥ 3 days in a “usual” week. Those who reported physical activity at a level meeting either guideline were categorized as having achieved the “moderate or vigorous physical activity” outcome (dichotomized as yes/no).

Covariates

Demographic characteristics. The demographic characteristics common to all study samples and time periods included gender (male/female); language spoken at home (English/non-English); and race/ethnicity (Asian/black/Hispanic/white/other). BRFSS data contained additional demographic characteristics: age group (18–34 years, 35–49 years, 50–64 years, and ≥ 65 years); highest level of education completed (less than high school, high school graduate, some college/tech school, and college graduate or higher); and household income ($< \$20,000$, $\$20,000$ – $\$35,000$, $\$35,000$ – $\$50,000$, $\$50,000$ – $\$75,000$, and $> \$75,000$).

Health and physical activity-related behaviors. Walking to school (dichotomized as yes/no) was available for high-school students at all time points and for middle-school students at follow-up. Several health-related variables were available for adults at

all time points, including self-rated health status (categorized as excellent/very good, good, or fair/poor); current smoking status (yes/no); and BMI (determined from self-reported height and weight data). Adult BMI values < 25.0 were considered not overweight or obese; values of 25.0 – 30.0 were considered overweight; values > 30.0 were considered obese. TV viewing (including video and video games for youth) was one measure for inactivity that was available for all study samples and time points except Everett adults at follow-up (the 2008 BRFSS question was asked only of Somerville residents). Meeting TV-viewing guidelines as described by the HP2010 recommendations (≤ 2 hours/average weekday) was dichotomized (yes/no).

Use of recreational space. Questions regarding use of public or recreational space were collected in the follow-up time period. Recreational spaces common to both student and adult samples included community walking paths, neighborhood parks, playfields or courts, home yard or courtyard, and indoor recreational centers. Though asked as a single BRFSS question, “neighborhood parks” and “playfields/courts” were asked separately on middle- and high-school surveys. These were collapsed into a single category to allow for comparison across all samples. Two additional recreational spaces were available for youth: school playground and afterschool programs. Frequency of use in the previous month for each space was dichotomized into users (at least once in prior month) versus non-users (none or almost never in prior month).

Encouragement/awareness. Questions regarding the amount of encouragement students received to be physically active compared to the previous year in the home, school, and afterschool environments were collected at follow-up for middle and high school in both communities; responses were dichotomized (more than previous year versus same or less than previous year). The Somerville middle-school survey further included a question at baseline and follow-up that asked if students had received instruction on nutrition or fitness in the home and in the school environments; responses were dichotomized (yes/no).

A set of awareness questions was available for adults of both communities at follow-up. They were designed to determine adult awareness of locally run programs promoting physical activity among adults, and among children. Adults also were asked if they were aware of changes, either planned or made, in Somerville/Everett to improve sidewalks, trails, bicycle lanes, or pedestrian walkways. Responses were dichotomized (yes/no). A policy question also was asked of adults at follow-up to gauge opinion on community spending: “How important is it to you that Somerville/Everett spends money to build and maintain places where people can exercise, for example, walking paths, biking paths, and recreation center?” Responses were categorical (not at all, somewhat, or very important).

Statistical Analysis

Univariate statistics (Means and SDs for continuous variables, counts and percentages for categorical variables) were employed to describe the demographic characteristics, physical activity- and health-related behaviors, recreational space usage, and encouragement/awareness of each sample. Bivariate methods (chi-square/Fisher’s exact tests for categorical data, two-sample *t*-tests for continuous) were used in each sample to compare these variables over time (within Somerville, baseline versus follow-up) and to compare these variables between cities (Somerville versus Everett at follow-up) in each study sample.

To test for a time effect (within Somerville, baseline versus follow-up) or city effect (Somerville versus Everett at follow-up) in meeting the moderate- or vigorous-physical activity guidelines, separate logistic regression models were used. ORs and 95% CIs were reported, both unadjusted and after full adjustment for the potentially confounding covariates available in the given study sample data set. Within Somerville, middle- and high-school models included gender, race, language, nutrition and fitness instruction, and TV viewing; adult models included gender, age, race, language, education, income, health status, current smoking, and BMI. Between Somerville and Everett, middle- and high-school models included gender, race, language, TV viewing, encouragement received, walking to school, and use of public space; adult models included gender, age, race, language, education, income, health status, current smoking, BMI, awareness of community programs, and use of public space.

Unadjusted exploratory logistic regression models were employed to explore the likelihood of meeting the physical activity guidelines within select subgroups of interest (i.e., within gender, race, and language groups) at follow-up in Somerville compared to Somerville at baseline and to Everett at follow-up in each of the samples. To determine the city-specific impact of the selected covariates on meeting the physical activity guidelines at follow-up, city-stratified multivariate logistic regression models were constructed in each study sample (middle school, high school, and adults). ORs and 95% CIs were reported from the full models for each covariate.

All statistical analyses were performed using SAS, version 9.1. All analyses of adult data (BRFSS) were weighted to account for the survey sampling methodology and all results reported are weighted values. Significance was determined by p -values <0.05 .

Results

The baseline student sample (and response rate) consisted of 1098 respondents (90%) of the 2003 Somerville middle-school survey and 1382 respondents (81%) of the 2004 Somerville high-school survey. The follow-up student sample consisted of 926 respondents (88%) of the 2007 Somerville middle-school survey; 1059 respondents (92%) of the 2007 Everett middle-school survey; 1125 respondents (79%) of the 2008 Somerville high-school survey; and 1430 respondents (81%) of the 2007 Everett high-school survey.

The baseline adult sample for Somerville consisted of 1081 Somerville residents who responded to the 2002 survey (weighted sample size represents population of 65,983). The follow-up adult sample consisted of 644 Somerville residents and 608 Everett residents who responded to the 2008 survey (weighted sample sizes represent populations of 62,398 and 30,487, respectively). Response rates to the BRFSS survey were 32.7% in 2002 and 31.3% in 2008, both based on Council of American Survey Research Organization's response rate formula. Table 1 presents the characteristics of the middle-school and high-school sample within Somerville (baseline and follow-up), and between Somerville and Everett. Table 2

presents the characteristics of the adult sample within Somerville, and between Somerville and Everett.

Demographics

Within Somerville, there was a significant decrease in the proportion of white students from baseline to follow-up in both student data sets (Table 1). This shift was compensated by a significant increase in Hispanic students in the middle- and high-school data sets. These differences over time were not seen among the adult respondents. Among the adult sample, there were significantly more Hispanic respondents in Everett than in Somerville (Table 2).

Physical Activity and Related Behaviors

Within Somerville, a higher proportion of each age group surveyed reported meeting physical activity guidelines at follow-up compared to baseline with significant differences among high-school students (Table 1) and adults (Table 2). Both middle- and high-school students were more likely to report watching ≤ 2 hours of TV at follow-up compared to baseline. Compared with Everett, a higher proportion of Somerville high-school students and adults reported meeting physical activity guidelines. Somerville residents (all ages) were more likely to report using a community walking path in the past month. Somerville adults were more likely than Everett adults to report using the neighborhood sidewalks for physical activity.

Awareness and Support

Within Somerville, there were significantly more middle-school students who reported receiving instruction in nutrition or fitness at home and at school at follow-up compared to baseline (Table 1). Between Somerville and Everett, no differences were observed among middle- or high-school students in proportions reporting more encouragement to be physically active at home, at school, or after school. Somerville adults were significantly more likely than Everett adults to report being aware of programs promoting physical activity to adults and proposals to change or improve public spaces. However, Everett residents were significantly more aware of programs promoting physical activity among children (Table 2).

Primary Evaluation Results: Time and City Effects on the Likelihood of Reporting Meeting Moderate or Vigorous Physical Activity Guidelines

Within-Somerville time effect (Table 3). After adjusting for all available demographic characteristics; nutrition or

Table 1. Characteristics of youth samples, within Somerville and between Somerville and Everett, %

Characteristic	Middle-school YRBS			High-school YRBS		
	Somerville MA		Everett MA	Somerville MA		Everett MA
	2003	2007	2007	2004	2008	2007
	n=1098	n=926	n=1059	n=1382	n=1125	n=1430
DEMOGRAPHICS						
Race/ethnicity^a						
White	50	40	42	45	37	49
Black	15	14	12	17	16	13
Hispanic	19	27	30	17	26	23
Asian/Pacific Islander	5	6	6	8	9	7
Other/multiracial	12	12	10	14	12	8
Primary language is non-English ^b	46	50	46	49	52	41
PHYSICAL ACTIVITY–RELATED BEHAVIORS						
Meets moderate and/or vigorous guidelines ^{a,b}	70	73	72	52	62	57
TV viewing ≤2 hours on average weekday ^{a,b,c}	65	61	49	52	62	56
Walks to school	—	48	45	41	44	48
Used public space for physical activity in prior month						
Walking/biking path ^{b,c}	—	67	62	—	52	46
Parks/playfields/courts ^c	—	80	73	—	52	54
Home/yard/courtyard	—	70	67	—	41	41
Indoor recreation center ^{b,c}	—	36	41	—	34	28
School playground ^{b,c}	—	72	43	—	21	14
Afterschool program ^{b,c}	—	39	42	—	28	20
ENCOURAGEMENT/AWARENESS						
Received instruction on nutrition or fitness						
At home ^d	57	78	—	—	—	—
At school ^d	59	78	—	—	—	—
Received more encouragement to be physically active compared to prior year						
At home	—	44	44	—	14	16
At school	—	56	52	—	41	37
After school	—	21	24	—	20	17

Note: Bold indicates significance. No data indicate that item was not included on survey in given year/location. Footnote *p*-values were determined using chi-square/Fisher's exact test.

^aHigh school, Somerville 2004 versus Somerville 2008, *p*<0.05

^bHigh school, Somerville 2008 versus Everett 2007, *p*<0.05

^cMiddle school, Somerville 2007 versus Everett 2007, *p*<0.05

^dMiddle school, Somerville 2003 versus Somerville 2007, *p*<0.05

YRBS, Youth Risk Behavior Survey

fitness instruction and TV viewing (youth model only); health status; current smoking; and BMI (adult model only), the ORs suggest that Somerville high-school students were 1.6 times more likely (95% CI=1.34, 1.92) and adult resi-

dents were 2.36 times more likely (95% CI=2.29, 2.43) to report meeting the physical activity guidelines at follow-up compared to baseline. In exploration of the primary outcome within select subgroups (unadjusted analyses comparing

follow-up to baseline), similar and significant time effects were observed for both genders, both English and non-English speakers, and in all racial groups except blacks for both high-school and adult study populations (data not shown).

Between Somerville and Everett city effect (Table 3). After adjusting for all covariates, there were no significant city effects in reporting meeting physical activity guidelines among middle- or high-school students. In contrast, after adjustment for demographics, health indicators, recreational space use, and awareness of physical activity programs, the ORs suggested that Somerville adults were 1.10 times more likely (95% CI=1.04, 1.17) to report meeting the physical activity guidelines compared to adults in Everett (Table 3). City effects also were observed in exploratory analyses of subgroups in adults where Somerville residents of both genders, both English- and non-English-speaking groups, and all racial groups, except other non-Hispanics, were more likely to meet physical activity guidelines compared to Everett (unadjusted, data not shown).

Correlates of Reporting Meeting Physical Activity Guidelines at Follow-Up

In Somerville at follow-up (Table 4), among both middle- and high-school students, English speakers, students who watched ≤ 2 hours of TV per average

Table 2. Characteristics of adult BRFSS^a samples, within Somerville and between Somerville and Everett, %

Characteristic	Somerville MA		Everett MA
	2002 n=1081	2008 n=644	2008 n=608
DEMOGRAPHICS^b			
Race/ethnicity^{c,d}			
White	75	78	78
Black	2	5	4
Hispanic	16	10	15
Asian/Pacific Islander	5	4	2
Other/multiracial	1	4	2
Primary language is non-English ^{c,d}	28	23	28
PHYSICAL ACTIVITY–RELATED BEHAVIORS			
Meets moderate and/or vigorous guidelines ^{c,d}	40	62	55
TV viewing ≤ 2 hours on average weekday ^c	75	72	—
Used public space for physical activity in prior month			
Sidewalks ^d	—	93	80
Walking/biking path ^d	—	38	19
Parks/playfields/courts ^d	—	33	36
Home/yard/courtyard ^d	—	50	53
Indoor recreation center ^d	—	36	19
ENCOURAGEMENT/AWARENESS			
Is aware of community programs			
Promoting physical activity among children ^d	—	31	72
Promoting physical activity among adults ^d	—	46	33
Proposals to change/improve public spaces ^d	—	47	39
How important that community build/maintain places where people can exercise^a			
Very important	—	69	54
Somewhat important	—	27	37
Not at all important	—	4	10

Note: Bold indicates significance. No data indicate that item was not included on survey in given year/location. Footnote *p*-values were determined using chi-square/Fisher's exact test.

^aBRFSS sample size reported is raw/unweighted. After weighting in analyses to account for survey methodology, sample sizes are representative of the following population sizes: Somerville, 65,983 in 2002 and 62,398 in 2008; Everett, 30,487 in 2008.

^bProportions reported for BRFSS are based on the weighted sample to account for survey methodology.

^cAdults, Somerville 2002 vs Somerville 2008, *p*<0.05

^dAdults, Somerville 2008 vs Everett 2008, *p*<0.05

BRFSS, Behavioral Risk Factor Surveillance Survey

weekday, and those who use indoor recreational centers were more likely to report meeting physical activity guidelines. Additionally, among middle-school students, higher use of parks/playing fields/courts also

Table 3. Time and city effects on meeting moderate or vigorous physical activity guidelines

Study population	Somerville MA		Everett MA	
	Time effect: Follow-up versus baseline ^a		City effect: Somerville versus Everett ^b	
	<i>n</i>	OR (95% CI)	<i>n</i>	OR (95% CI)
Middle-school YRBS				
Unadjusted	1974	1.20 (0.99, 1.46)	1959	0.94 (0.77, 1.15)
Adjusted ^c	1799	1.13 (0.90, 1.40)	1196	1.06 (0.78, 1.45)
High-school YRBS				
Unadjusted	2397	1.53 (1.30, 1.80)	2453	1.26 (1.07, 1.49)
Adjusted ^c	2205	1.61 (1.34, 1.92)	1466	1.24 (0.98, 1.58)
Adult BRFSS^{d,e}				
Unadjusted	1555	2.37 (2.31, 2.43)	870	1.34 (1.30, 1.38)
Adjusted ^f	1262	2.36 (2.29, 2.43)	542	1.10 (1.04, 1.17)

Note: Bold values indicate significance.

^aTime effect: ORs and CIs represent the likelihood of meeting the moderate and/or vigorous physical activity guidelines in Somerville at follow-up compared to baseline.

^bCity effect: ORs and CIs represent the likelihood of meeting the moderate and/or vigorous physical activity guidelines in Somerville at follow-up compared to Everett at follow-up.

^cTime effect model: adjusted for gender, race, language, nutrition and fitness instruction, and TV viewing; City effect model: adjusted for gender, race, language, TV viewing, encouragement to be physically active, walking to school, and use of public space

^dBRFSS sample size reported is raw/unweighted. After weighting in analyses to account for survey methodology, samples sizes are representative of the following population sizes: Time effect: 114,349 unadjusted and 92,615 adjusted; City effect: 69,448 unadjusted and 40,189 adjusted.

^eOR and 95% CI reported for BRFSS are based on the weighted sample to account for survey methodology.

^fTime effect model was adjusted for gender, age, race, language, education, income, health status, current smoking, and BMI. City effect model additionally included awareness of community programs and use of public space variables.

BRFSS, Behavioral Risk Factor Surveillance Survey; YRBS, Youth Risk Behavior Survey

was associated, whereas among high school students, being male and reporting receiving more encouragement to be active after school were associated with meeting physical activity guidelines.

In Everett at follow-up (Table 4), correlates of reporting meeting the physical activity guidelines among middle-school students included receiving more encouragement at home and using the community walking path or neighborhood parks/playground/courts for physical activity. Among high-school students, correlates included being male, being English-speaking, receiving more encouragement at school to be physically active, and using parks/playground/courts or indoor recreational spaces.

Among Somerville adults (Table 5), a number of factors were associated with a greater likelihood of reporting meeting physical activity guidelines. Associated demographic characteristics included being male, white, Hispanic or other/multiracial race/ethnicity, English-speaking, of younger age, and educated at the college level (or beyond). Health and physical activity–related correlates included use of the walking path, neighborhood sidewalks, parks/playfields/courts, or indoor recreation centers. Awareness of commu-

nity programs as well as self-reported excellent health also was associated with the outcome.

Among Everett adults (Table 5), demographic variables associated with greater likelihood of reporting meeting the physical activity guidelines included being male, being English-speaking, being Asian or other race, and having a higher income. Associated recreational spaces included sidewalks, home, and indoor recreational spaces. However, in contrast to Somerville adults, reporting poorer health status was associated with the outcome.

Discussion

The current study assessed differences in reporting meeting physical activity guidelines within Somerville over the course of an Active Living by Design intervention program (2003–2008), and between Somerville and Everett, a neighboring comparison community without an Active Living by Design grant. It also assessed common and differential variables associated with reporting meeting physical activity guidelines across the cities. Within Somerville, high-school students and

Table 4. Covariate effects on meeting physical activity guidelines at follow-up among youth, by city, OR (95% CI)

	Likelihood of meeting moderate or vigorous physical activity guidelines			
	Middle-school YRBS		High-school YRBS	
	Somerville MA, 2007	Everett MA, 2007	Somerville MA, 2008	Everett MA, 2007
Multivariate logistic regression model ^a	n=545	n=651	n=660	n=806
Gender, female	0.75 (0.48, 1.18)	0.84 (0.54, 1.28)	0.54 (0.37, 0.78)	0.55 (0.39, 0.77)
Race/ethnicity				
White	ref	ref	ref	ref
Black	1.20 (0.57, 2.55)	0.66 (0.31, 1.41)	0.74 (0.40, 1.35)	1.16 (0.67, 2.00)
Hispanic	1.47 (0.76, 2.83)	0.78 (0.41, 1.47)	1.23 (0.70, 2.19)	1.21 (0.74, 1.98)
Asian/Pacific Islander	1.45 (0.59, 3.59)	0.68 (0.26, 1.77)	0.77 (0.38, 1.57)	0.83 (0.42, 1.64)
Other/multiracial	0.92 (0.44, 1.90)	0.89 (0.42, 1.88)	0.93 (0.49, 1.77)	1.37 (0.72, 2.60)
Primary language is non-English	0.56 (0.33, 0.97)	0.74 (0.43, 1.29)	0.54 (0.34, 0.87)	0.41 (0.27, 0.62)
TV viewing ≤2 hours on average weekday	1.73 (1.10, 2.71)	1.06 (0.70, 1.61)	2.22 (1.53, 3.22)	1.27 (0.92, 1.74)
Walks to school	1.30 (0.83, 2.02)	1.26 (0.83, 1.92)	1.11 (0.77, 1.60)	0.76 (0.55, 1.04)
Used public space for physical activity in prior month				
Community walking/biking path	1.14 (0.72, 1.88)	1.77 (1.15, 2.71)	1.21 (0.84, 1.75)	1.23 (0.88, 1.73)
Neighborhood parks/playfields/courts	2.17 (1.28, 3.65)	5.64 (3.53, 9.00)	1.44 (0.96, 2.15)	2.17 (1.49, 3.15)
Home/yard/courtyard	1.54 (0.97, 2.45)	1.50 (0.97, 2.33)	1.10 (0.74, 1.65)	1.17 (0.82, 1.67)
Indoor recreation center	1.83 (1.09, 3.07)	1.47 (0.94, 2.28)	3.39 (2.20, 5.23)	2.24 (1.51, 3.32)
School playground	1.43 (0.88, 2.31)	1.06 (0.67, 1.67)	1.31 (0.79, 2.18)	1.05 (0.64, 1.72)
Afterschool program	1.18 (0.74, 1.88)	1.33 (0.86, 2.05)	1.40 (0.92, 2.13)	1.10 (0.73, 1.64)
Received more encouragement to be physically active compared to prior year				
At home	1.53 (0.96, 2.45)	2.03 (1.28, 3.20)	0.92 (0.41, 2.07)	1.17 (0.66, 2.08)
At school	1.09 (0.69, 1.73)	1.22 (0.77, 1.93)	1.40 (0.76, 2.60)	1.54 (1.02, 2.32)
After school	1.29 (0.68, 2.44)	1.36 (0.77, 2.40)	1.75 (1.04, 2.96)	1.21 (0.75, 1.95)

Note: Bold values indicate significance.

^aMultivariate logistic regression model was stratified by city and contained all covariates indicated; OR and CIs represent the likelihood of meeting the moderate or vigorous physical activity guidelines for the given category of the variable.

YRBS, Youth Risk Behavior Survey

adults in Somerville were more likely to report meeting physical activity guidelines at follow-up compared with baseline, and this improvement was observed in all subgroups examined with the exception of black adults. Somerville adults were more likely than adults in Everett to report meeting physical activity guidelines at follow-up.

For all age groups and in both communities, use of recreational spaces was associated with reported physical activity. The strength and direction of the relationship varied somewhat by city, in ways that made sense given their respective built environments. For example, Somerville is

extremely dense, and the multifamily houses with small yards are not conducive to some types of physical activity. Everett does not have a designated walk/bike path as Somerville does, and while both cities have relatively little open space, Everett has even less than Somerville (58 acres or 2.7% of land vs 141 acres or 5.4% of total land). Although the city-stratified results demonstrate the existence of relative differences in meeting physical activity guidelines in Somerville, the overall findings suggest that Somerville Active Living by Design activities supported residents' physical activity and may have improved residents' physical activity levels.

Table 5. Covariate effects on meeting physical activity guidelines at follow-up among adults, by city, OR (95% CI)^a

	Likelihood of meeting moderate or vigorous physical activity guidelines	
	Somerville MA, 2008 <i>n</i> =289 ^c	Everett MA, 2008 <i>n</i> =253 ^c
Logistic regression model^b		
Gender, female	0.89 (0.83, 0.94)	0.84 (0.77, 0.91)
Race/ethnicity		
White	ref	ref
Black	0.48 (0.40, 0.58)	0.12 (0.09, 0.16)
Hispanic	1.49 (1.30, 1.72)	0.89 (0.73, 1.09)
Asian/Pacific Islander	0.27 (0.24, 0.31)	2.87 (1.87, 4.40)
Other/multiracial	3.19 (2.65, 3.84)	24.6 (13.5, 44.7)
Primary language is non-English	0.81 (0.75, 0.88)	0.78 (0.66, 0.91)
Age (years)		
18–34	ref	ref
35–49	0.55 (0.51, 0.59)	2.89 (2.59, 3.23)
50–64	0.58 (0.53, 0.63)	0.94 (0.83 – 1.06)
≥65 years	0.48 (0.43, 0.55)	1.91 (1.63, 2.23)
Education completed		
<High school	0.60 (0.50, 0.72)	0.65 (0.55, 0.76)
High-school graduate	0.81 (0.73, 0.89)	1.49 (1.32, 1.67)
Some college/tech school	0.73 (0.66, 0.81)	1.33 (1.18, 1.50)
College graduate or higher	ref	ref
Household income (\$)		
<20,000	0.79 (0.70, 0.90)	0.67 (0.58, 0.79)
20,000–34,999	0.70 (0.63, 0.78)	0.55 (0.48, 0.63)
35,000–49,999	1.22 (1.11, 1.34)	0.90 (0.76, 1.06)
50,000–75,000	0.77 (0.71, 0.83)	0.49 (0.43, 0.56)
>75,000	ref	ref
Self-rated health status		
Excellent/very good	ref	ref
Good	0.56 (0.52, 0.60)	1.36 (1.23, 1.51)
Fair/poor	0.29 (0.26, 0.33)	1.26 (1.10, 1.44)
Weight status (BMI category)		
Not overweight or obese	ref	ref
Overweight	0.49 (0.46, 0.53)	0.53 (0.48, 0.59)
Obese	0.73 (0.67, 0.79)	0.65 (0.58, 0.72)
Current smoker	0.87 (0.80, 0.95)	1.58 (1.43, 1.75)

(continued on next page)

Linking Results to Community Intervention

During the course of the Active Living by Design grant in Somerville, the partnership implemented activities in each of the 5P areas. However, most grant activities focused on creating an infrastructure and advocacy base to support active living policies and practices. This was done through building partnerships and capacity in city and community partner agencies rather than through more individually focused programs and promotions.

There is early evidence supporting the theory that community-wide active living promotion efforts can affect the fitness or weight status of residents. The Shape Up Somerville intervention, a community- and school-based project focused on childhood healthy eating and physical activity, showed a leveling of BMI *z*-scores in young children in Somerville relative to children in a comparison community.¹⁰ In Cambridge MA, a pre-post evaluation of a community- and school-based healthy weight intervention including policy-level advocacy as well as more individually oriented promotion activities found improved weight status and fitness levels.¹¹

However, there remains a paucity of literature linking population-level outcomes to community-wide strategies to improve physical activity, fitness, and healthy weight, particularly studies

with experimental or quasi-experimental designs. The results of the current evaluation add to this growing body of literature suggesting that community-based and community-wide active living activities are effective in stimulating positive change in the physical activity levels, and potentially the fitness and weight status, of community residents. However, additional research is needed to link community-level activities directly to behavior change.

Linking Results to Recreational Space Use

Although more research is needed to untangle the web of influences on a community's participation in physical activity promotion, the evaluation results do provide some evidence of factors that may be responsible for differences in reported physical activity levels between the two cities. For example, the current data suggested that the use of most recreational spaces listed declined with age from middle school to high school to adulthood. However, use of indoor recreation centers remained constant across age groups in Somerville, compared with sharply lower rates among adults in Everett, suggesting that the facilities in Somerville may be more accessible, better known, or more appealing to all age groups in Somerville. Use of indoor recreational facilities were highly associated with respondents reporting meeting physical activity guidelines, and indoor facility use approximately doubled the likelihood that middle- or high-school students in Somerville did so and tripled the likelihood among Somerville adults. All surveys were conducted beginning in February when the average temperature in the Boston area is around 30° Fahrenheit and highlights the importance of indoor facilities for supporting physical activity in colder climates.

Strengths and Limitations

National and state-level indicators, derived from both YRBS and BRFSS surveys, commonly are used to track progress toward health objectives, such as HP2010, as

Table 5. Covariate effects on meeting physical activity guidelines at follow-up among adults, by city, OR (95% CI)^a (continued)

	Likelihood of meeting moderate or vigorous physical activity guidelines	
	Somerville MA, 2008	Everett MA, 2008
Logistic regression model^b	n=289^c	n=253^c
Used public space for physical activity in prior month		
Community walking/biking path	1.27 (1.19, 1.35)	0.88 (0.79, 0.98)
Neighborhood sidewalks	1.32 (1.11, 1.56)	2.00 (1.76, 2.26)
Neighborhood parks/playfields/courts	1.37 (1.28, 1.46)	0.90 (0.82, 0.99)
Home/yard/courtyard	0.92 (0.87, 0.98)	1.20 (1.10, 1.31)
Indoor recreation center	2.09 (1.97, 2.23)	3.77 (3.39, 4.18)
Is aware of community programs		
Programs promoting physical activity among children	1.24 (1.15, 1.33)	0.86 (0.77, 0.96)
Programs promoting physical activity among adults	1.41 (1.32, 1.50)	0.72 (0.65, 0.80)
Proposals to change/improve public spaces	1.24 (1.16, 1.33)	0.98 (0.90, 1.08)

Note: Bold values indicate significance.

^aORs (95% CI) reported for BRFSS are based on the weighted sample to account for survey methodology.

^bMultivariate logistic regression model was stratified by city and contained all covariates indicated; ORs (95% CI) represent the likelihood of meeting the moderate or vigorous physical activity guidelines for the given category of the variable.

^cBRFSS sample size reported is raw/unweighted. After weighting in analyses to account for survey methodology, samples sizes are representative of the following population sizes: Somerville, 27,489; Everett, 12,699.

BRFSS, Behavioral Risk Factor Surveillance Survey

well as to help evaluate public health programs and policies. At a local level, such data yield more specific community-level indicators of health behaviors, which often deviate from aggregated state and national data.

The current evaluation benefited from the availability of existing local-level YRBS and BRFSS data collected prior to Active Living by Design efforts for use as baseline data in the intervention community. Also community endorsement was obtained in both cities to augment the YRBS and BRFSS surveys with Active Living by Design-specific questions that could be used as follow-up data. Thus, a retrospective baseline follow-up comparison within Somerville and a follow-up comparison to Everett as a comparison community were possible.

There are limitations to the use of population-based survey data. All information is self-reported and may be prone to error or bias, including social desirability bias. As Somerville increased physical activity programming and promotion, there may have been an increased social desirability to inflate self-reported levels of physical activity. However, the data's anonymous nature may have

attenuated possible social desirability bias, and numerous studies have examined the reliability and validity of youth and adult self-report surveys with positive results.^{12–15}

The surveys are cross-sectional and anonymous. Middle-school students in 6th or 7th grade at baseline could have been resurveyed in 2008 in high school. However, the anonymity of the data limited the evaluation by preventing linking baseline to follow-up data to monitor behavior change within individuals. Among adults, it was unlikely that residents were surveyed in 2002 and again in 2008. Further, as with any phone-based survey, the BRFSS sample was limited to those with landline telephones. The response rates were low relative to Massachusetts and national rates, perhaps reflecting harder-than-average-to-reach populations in Somerville and Everett. It is possible that characteristics of the adult survey samples differed from the overall populations. In recent years, the methodologies of the national BRFSS have been reviewed, and efforts to account for changing communication technologies are underway.¹⁶

It also must be acknowledged that Everett, while relatively similar economically and demographically, was a nonequivalent comparison city, and Somerville was not randomized to receive the Active Living by Design intervention. In addition, the high-school YRBS was conducted in 2007 in Everett and 2008 in Somerville, allowing an extra year for the intervention to take hold in Somerville and allowing for differential weather between 2007 and 2008 to confound results. Although there were similar average high temperatures in February, there were differences in snow levels (15.0" of snow in February 2008 and only 4.6" in February 2007¹⁷) that could have differentially affected the physical activity rates for those years and affected the comparability of the data from the high school. The lack of baseline BRFSS data in Everett also prevented the comparison of behavior "change" in the two communities and the nonrandom assignment of the intervention makes it difficult to conclude that Active Living by Design in Somerville was the causal reason for improvement in physical activity.

Additionally, the intervention was predominantly focused on partnership development, policy, and planning. This infrastructure/capacity-building approach, along with the reality that other grants and programs also were promoting active living and healthy eating in Somerville before, during, and after the Active Living by Design grant makes attribution of change to specific programs impossible. Well-controlled, prospective studies will be needed to establish more clearly the value of community-wide physical activity interventions and to tease out the relative merits of various programs and policies.

Future Directions

Given the changing demographics of Somerville and Everett, it was important to assess any differential impact from the Active Living by Design intervention by population characteristics. Despite the overall finding that Somerville adults were more likely to report meeting physical activity guidelines at follow-up than at baseline, black adults in Somerville did not witness any difference over time. Further, women/girls, non-English speakers, Asian individuals, and those with lower education or income were relatively less likely to report meeting physical activity guidelines compared to men/boys, English speakers, whites, and those with higher educations and incomes. Results from Everett showed somewhat similar patterns of disparity. These findings are of concern and warrant further investigation. Future research should continue to explore disparities in physical activity attainment to better understand the contributions of demographic factors, communication and support, and the physical or built environment in promoting active living within subpopulations.

Conclusion

The findings that residents were more likely to report meeting physical activity guidelines in a city exposed to programs, promotions, and policy changes supportive of physical activity suggest the potential efficacy of community-based and community-wide active living interventions. Both high-school students and adults in Somerville reported higher achievement of meeting physical activity guidelines at follow-up, and Somerville adults were significantly more likely to report meeting physical activity guidelines than adults of a comparison community.

For the future, the cities of Somerville and Everett plan to continue to use BRFSS and YRBS to monitor physical activity. These data will continue to provide opportunities for assessing "relative rates of differences" between the cities and evaluating subgroups' relative disparity in meeting physical activity guidelines that can inform future local planning.

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