APPLIED PSYCHOLOGY: Health and Well-Being

APPLIED PSYCHOLOGY: HEALTH AND WELL-BEING, 2015, *7* (3), 365–386
doi:10.1111/aphw.12058

Are People Living in Walkable Areas Healthier and More Satisfied with Life?

Shigehiro Oishi*
University of Virginia, USA

Masao Saeki
Keio University, Japan

Jordan Axt
University of Virginia, USA

Are people who live in more walkable areas healthier and more satisfied with life? This study investigates that question by using the 2005 Behavioral Risk Factors Surveillance System (BRFSS) survey, the largest telephone survey on health in the US (302,841 respondents from 989 metropolitan and micropolitan statistical areas [MSA]; 177,524 respondents from 703 MSAs had complete data). Using multilevel random coefficient modeling, we found that people living in walkable areas reported being generally healthier than people living in less walkable areas. In addition, aside from higher self-reported health, people living in walkable areas also had a lower body mass index (BMI). However, contrary to our prediction, people in more walkable areas were less satisfied with their lives than people in less walkable areas after controlling for various individual-level variables (age, gender, race, education, marital status, income, and unemployment). People who live in walkable areas are healthier but not happier than those living in less walkable areas.

Keywords: health, life satisfaction, social ecology, walkability

INTRODUCTION

Social scientists have documented important variations in physical health (e.g. Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997) and subjective well-being (defined here as the subjective evaluation of one's overall life; e.g. Oswald &

* Address for correspondence: Shigehiro Oishi, Department of Psychology, University of Virginia, P.O. Box 400400, Charlottesville, VA 22904-4400, USA. Email: soishi@virginia.edu

Wu, 2010; Rentfrow, Mellander, & Florida, 2009) at the state, county, and city levels. For instance, average life satisfaction is higher in US states and counties with wealthier, more educated populations (Lawless & Lucas, 2011; Rentfrow et al., 2009). However, the macro-factors that have been investigated in the subjective well-being literature have thus far mainly centered on economic and demographic factors (Diener, Oishi, & Lucas, 2003; Oishi, 2012, for a review). As a result, we know little about the role of physical environments in subjective well-being (although there is a plethora of research on the role of built-environments in physical health; see Ferdinand, Sen, Rahurkar, Engler, & Menachemi, 2012; Haselwandter et al., 2015; McGrath, Hopkins, & Hinckson, 2015; Sallis, Owen, & Fisher, 2008, for review).

Using the socio-ecological framework (Oishi, 2014; Oishi & Graham, 2010; Stokols, 1992; Sallis et al., 2006), in this study, we explore the role of walkability, an important aspect of physical environments that captures the degree to which people can walk to nearby destinations such as restaurants, services, and cultural or recreational facilities (Norman et al., 2013). Are people who live in walkable areas healthier and more satisfied with life than those people in less walkable areas? We tested this question using a nationally representative US sample.

What is Walkability?

Researchers have often used geographic information systems (GIS) to create a walkability index based on county-level tax assessors, land use, and street connectivity (Frank et al., 2009; Sallis et al., 2009). Specifically, the walkability of one's environment has often been indexed by "the sum of z-scores of measures of residential density, retail floor area ratio, intersection density, and land use mix" (Norman et al., 2013, p. 278). In the present article, we used Walk Score, provided by www.walkscore.com, as an indicator of an area's walkability. Walk Score is defined as:

> The walkability of any address using a patent-pending system. For each address, Walk Score analyzes hundreds of walking routes to nearby amenities. Points are awarded based on the distance to amenities in each category. Amenities within a 5-minute walk (.25 miles) are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30-minute walk. Walk Score also measures pedestrian friendliness by analyzing population density and road metrics such as block length and intersection density. Data sources include Google, Education.com, Open Street Map, the US Census, Localeze, and places added by the Walk Score user community.

Each address (e.g. 143 Park Street, Charlottesville, VA) has a Walk Score, which is computed based on the distance from this address to nearby amenities (e.g. restaurants, post office, library). Each block's Walk Score is calculated by taking the mean of all the addresses on that block (e.g. the mean Walk Score of 143 Park Street, 145 Park Street, 147 Park Street). A city's Walk Score is then computed by taking the mean of all its block-level Walk Scores and weighting by each block's population density (i.e. a block with more residents is more heavily weighted than a block with fewer residents). Thus, a city's Walk Score indicates how walkable an average resident's block is, ranging from 0 to 100, with higher scores indicating greater walkability.

Walk Score has been validated with the GIS data. For instance, Walk Scores were highly correlated with retail destinations ($r = .80$), service destinations ($r = .67$), cultural/educational destinations ($r = .69$) within the roughly 1 mile radius of 733 participants' homes who resided in various regions of the US (Duncan, Aldstadt, Whalen, Melly, & Gortmaker, 2011; see also Carr, Dunsiger, & Marcus, 2011, for validation data from 379 residential and non-residential addresses in Rhode Island). Given that the Walk Score for a city is an aggregate of block-level Walk Scores, it is likely to be valid. It should be noted, however, that Walk Score has not yet been formally validated at the city level, as such an effort would require enormous GIS data.

Prior Evidence Linking Walkability and Health

Numerous studies have demonstrated that physical activities such as walking are important for promoting physical health (e.g. Surgeon General's Report on Physical Activity and Health—see United States. Public Health Service, 1996). Considering that more than half of US adults are overweight (Must et al., 1999) and do not get enough physical activity (Troiano et al., 2008), public health researchers and urban planners have been paying more attention to how physical and social environments determine physical well-being (e.g. Carlson et al., 2015; Ferdinand et al., 2012; Haselwandter et al., 2015; Norman et al., 2013).

Although several studies have found a connection between walkability and physical health (e.g. Haselwandter et al., 2015; Norman et al., 2013), there are very few studies linking walkability and subjective well-being. In this study, we focus on walkability as a potential community-level predictor of subjective well-being. Recent studies have found that subjective well-being is related to macro-social factors such as wealth (Diener, Tay, & Oishi, 2013), education (Lawless & Lucas, 2011), and progressive taxation (Oishi, Schimmack, & Diener, 2012). While income, education, and taxation capture somewhat diffuse aspects of communities, walkability is a more physical aspect of one's community.

By definition, residents living in walkable cities should have more opportunities to walk in their everyday lives than people living in less walkable cities (Carlson et al., 2015). As a consequence, residents of walkable cities should be healthier than residents of less walkable cities (see Christian et al., 2015; Ferdinand et al., 2012; McGrath et al., 2015; Renalds, Smith, & Hale, 2010, for reviews). For instance, respondents who reported having a place to walk within 10 minutes of their home also reported engaging in more regular physical activity than those who reported not having a place to walk (Powell, Martin, & Chowdhury, 2003; see also Carlson et al., 2015). Similarly, adults (age 20–65) living in high-walkability neighborhoods had higher physical activity and lower body mass index (BMI) than those living in low-walkability neighborhoods (Sallis et al., 2009; see Berke, Koepsell, Moudon, Hoskins, & Larson, 2007b, for null findings).

Since subjective well-being is positively associated with general health (e.g. Okun, Stock, Haring, & Witter, 1984), it is plausible to assume that residents of walkable cities would be more satisfied with their lives than residents of less walkable cities. In addition, previous research has shown that people living in walkable communities trust others more and have better relationships with their neighbors than people in less walkable communities (Leyden, 2003; Rogers, Halstead, Gardner, & Carlson, 2011). This increased social capital is also positively associated with subjective well-being (Helliwell & Putnam, 2004). From such previous research, it may be reasonable to expect that people living in walkable communities are happier and healthier.

Yet the empirical evidence regarding subjective well-being and walkability is highly mixed. For instance, after controlling for potential confounding variables such as education, income, age, ethnicity, and marital status, Sallis and colleagues (2009) found that those living in walkable neighborhoods did not differ from others in terms of depression and mental health, despite those living in neighborhoods with high walkability having higher rates of physical activity and lower body mass indexes. On the other hand, Berke, Gottlieb, Moudon, and Larson (2007a) found that older men (over 65) living in walkable neighborhoods reported fewer depressive symptoms than those living in less walkable neighborhoods, even after controlling for variables such as education, income, age, ethnicity, physical activities, and whether participants lived alone. Finally, Patterson and Chapman (2004) found that older women (above 70) living alone in urban areas of Portland, Oregon had more opportunities to walk to services than older women living alone in suburban areas. However, these urban women reported being less healthy and having a lower quality of life than the more suburban women. It should be noted, however, that urban residents had lower income than suburban residents, and the researchers did not statistically control for this difference in income.

The Present Research

In sum, previous research on the relationship between walkability and well-being has yielded mixed results. Moreover, several of these earlier studies did not statistically control for various demographic variables that are known to be associated with subjective well-being (Diener, Suh, Lucas, & Smith, 1999, for review).

We conducted the present study to advance the literature in three important aspects.

First, the extant, mixed results may have arisen from an issue with sampling. As the previous studies focused on particular age groups and/or specific locations, it is important to examine the relationship between walkability and subjective well-being across a broad range of populations and locations.

Second, previous studies used indirect measures of subjective well-being, such as depression and quality of life. Although depression and quality of life are related to subjective well-being, depression is not simply the opposite of high levels of well-being (Steel, Schmidt, & Shultz, 2008). In addition, quality of life is often the aggregate of satisfaction with various domains, including satisfaction with one's neighborhood. Thus, making inferences about general subjective well-being from studies on depression and quality of life requires some caution. The outcome variable in this study, life satisfaction, is a clearer indicator of subjective well-being (Diener et al., 2003).

Third, several previous studies did not control for obvious potential confounding variables, at either the community or the individual level. For example, the walkability of cities may be associated with various other community-level variables, such as median income, residential mobility, and commute time. That is, walkable communities might be more urban (producing shorter commute times), more residentially mobile (perhaps because of more apartment units), and wealthier (perhaps because housing prices are higher in walkable areas), and these factors might be making people healthier rather than walkability per se. In other words, the previously shown association between walkability and well-being could be driven by third variables such as median income, residential mobility, and commute time. In addition, some of the previous research had not controlled for individual-level variables known to be associated with subjective well-being and health, such as age, gender, race, education, income, employment status, and marital status (Diener et al., 1999). For instance, older people are typically more satisfied with their lives than younger people (Siedlecki, Tucker-Drob, Oishi, & Salthouse, 2008). In other words, to the extent that some communities have more elderly, higher income, married, employed individuals than others (Diener et al., 1999), and the individual's well-being is determined by both macro-factors (e.g. wealth of community) and micro-factors (e.g. unemployed, married), it is important to use an ecological approach and multilevel analyses (Oishi & Graham, 2010; Sallis et al., 2006) to understand the relationship between walkability, health, and life satisfaction. Therefore, in our study, we control for both community-level and individual-level third variables on well-being.

Using a large nationally representative sample, we examine whether walkability is associated with life satisfaction and self-reports of general health, while controlling for a host of individual and community-level variables. In addition, we examine the association between walkability of cities and participants' body mass index (BMI), which is calculated as weight in kilograms divided by height in square meters. BMI is known to be an indicator of physical health (Stevens et al., 1998). For instance, higher BMI is generally associated with higher risk for hypertension, diabetes, coronary heart disease, asthma, and arthritis (Stommel & Schoenborn, 2010; see, however, Flegal, Kit, Orpana, & Graubard, 2013, for non-linearity of BMI effects). The inclusion of BMI is an important aspect of our study because self-reported health reflects not just objective health conditions but also respondents' personality (e.g. neuroticism; Costa & McCrae, 1987). As a result, it is important to corroborate self-reports with an objective indicator of physical health.

METHOD

This study used data from the 2005 Behavioral Risk Factors Surveillance System (BRFSS). We chose the BRFSS because it is the largest nationally representative survey in the US that includes questions about life satisfaction, physical health, and geographical information at the city level. While there are other datasets with life satisfaction, physical health, and some geographical information such as General Social Surveys, these datasets are too small to reliably estimate city-level well-being.

Participants were 302,841 adults (115,579 males, 187,262 females). We decided to analyze data from 2005 because this is the only year that assessed life satisfaction and included metropolitan and micropolitan statistical area (MSA) information. MSA is defined by the Office of Management and Budget for use by Federal agencies. A metropolitan statistical area "contains a core urban area of 50,000 or more population", while a micropolitan area "contains an urban core of at least 10,000 (but less than 50,000)" (http://www.census.gov/population/metro/). For instance, the Washington, DC MSA includes DC as well as surrounding counties such as Alexandria and Arlington.

Furthermore, the 2005 survey contained a question about whether respondents lived within the city. Thus, in supplementary analyses, we were able to select only the respondents who lived in the city (e.g. Washington, DC). The 2005 BRFSS included 989 MSAs. Walk Scores were available for 720 of these MSAs (Walk Score®: Hirsch et al., 2013). Many of these MSAs without Walk Scores in our data set are counties. For instance, Augusta-Richmond county area (MSA = 1,260) is the county that covers several small towns. It was too difficult for us to obtain an accurate Walk Score for MSAs with multiple counties.

The BRFSS is a telephone survey, and the population is all the landline telephone numbers used for residences (but not for commerce). The sampling scheme was a disproportionate stratified sample design with high-density and low-density strata, which were determined by "the number of households with the same area code, prefix, and first two digits of the suffix, and all possible combinations of the last two digits" (http://www.cdc.gov/brfss/ 2005 BRFSS overview, p. 3). Thus, the BRFSS sample is a probability sample of all households with telephones in the US. Detailed information about the materials and procedures can be found in the BFRSS documentation (see 2005 BRFSS overview on http://www.cdc.gov/brfss/).

The BRFSS assessed life satisfaction using a single item: "In general, how satisfied are you with your life?" Participants responded using a scale of 1 (*very dissatisfied*) to 4 (*very satisfied*). To measure self-reported general health, we used the following question, "Would you say that in general your health is. . ." (1 = *poor* to 5 = *excellent*). Respondents also self-reported body weight and height. For our analyses, we used the BMI based on weight in kilograms divided by height in square meters.

Walk Scores were obtained from www.walkscore.com. This site provides Walk Scores for 720 cities of 989 MSAs in the BFRSS data. Walk Scores range from 0 to 100. Higher numbers indicate that a city is more walkable (see www.walkscore.com for details). For instance, the most walkable metropolitan areas were New York City (Walk Score = 83) and Boston (78), whereas the least walkable metropolitan areas included Jacksonville (36), Charlotte (38), and Nashville (38).

Residential mobility, commute, and median income were all obtained from the American Community Surveys 2005–09 (http://www.census.gov/acs/www/). Residential mobility was defined as the average one-year mobility, meaning the average percentage of residents who changed their home address within one year. Commute was defined as the percentage of workers commuting more than 30 minutes each way. In the end, 703 MSA areas had all four community-level variables: walk score, residential mobility, commute, and median income data, resulting in a total of 177,524 respondents with life satisfaction, general health, and BMI data.

Analytic Procedure

We first present the MSA-level correlations to give the reader a general idea of the association between walkability and well-being (mean life satisfaction, self-reported health, and BMI). Although these MSA-level correlations provide intuitive understanding of our findings, the MSA-level associations reported in Table 1 are biased estimates because simple correlational analyses ignore the nested nature of the current data as respondents are nested within MSA; that is, all the respondents are not completely independent. In addition, the MSA-level correlation analyses weigh large MSAs (e.g. the New York area) equally with small MSAs (e.g. Charlottesville). In order to take into account the nested nature of the data and the differential standard errors across different MSAs (e.g. larger errors in general for smaller MSAs), we

TABLE 1
Correlations among Metropolitan Statistical Area-Level Variables

	Mobility	*Commute*	*Income*	*LS*	*Health*	*BMI*	*BMI22*	M (SD)
Walk Score	−.01	−.02	.35**	.02	.37**	−.16**	−.17**	47.88 (9.18)
Mobility	–	−.30**	−.06	.12**	.17**	−.12**	−.11**	16.65 (4.38)
Commute		–	.08*	−.01	−.15**	−.01	−.01	.25 (.08)
Median Income			–	.15**	.63**	−.29**	−.32**	43.52 (9.43)
Life Satisfaction				–	.35**	−.25**	−.25**	3.37 (.09)
General Health					–	−.41**	−.43**	3.38 (.25)
BMI						–	.97**	27.54 (1.02)
BMI22							–	6.07 (.93)

Note: Walk Scores range from 0 to 100. The higher number indicates that a city is more walkable (there are many things to walk to; see www.walkscore.org for details). Residential mobility was the average one-year mobility taken from the American Community Surveys 2005–09. Commute indicates the percentage of workers commuting more than 30 min each way. Median income was also taken from the American Community Surveys 2005–09. Life Satisfaction is assessed on the 4-point scale (1 = very dissatisfied; 4 = very satisfied). General health is a self-reported health condition (1 = poor to 5 = excellent). BMI = Body Mass Index. BMI22 = the absolute difference from BMI of 22. N = 703 for walk score, 918 for mobility, 931 for commute and median income, 967 for life satisfaction, general health, BMI, and BMI22.

next tested our hypothesis using the HLM 7.01 program. The simple multilevel model was as follows:

$$\text{Level 1 (Within-MSA)}Y_{ij} = \beta_{0j} + r_{ij},$$

where Y_{ij} indicates the well-being score of person i in city j.

$$\text{Level 2 (Between-MSA)}\beta_{0j} = \gamma_{00} + \gamma_{01} * (\text{Walk Score}) + u_{0j},$$

where β_{0j} (the mean well-being score for MSA j) is regressed on the area's Walk Score.

Conceptually, this is equivalent to the correlation between mean well-being scores and Walk Scores. The difference is that in the multilevel random coefficient model, more reliable information is weighted more heavily (i.e. the mean well-being score of larger samples is weighted more than the mean well-being score of smaller samples). We repeated this analysis for each outcome measure (life satisfaction, general health, and BMI), separately, and for each predictor variable.

However, just as simple correlations could be driven by third variables, the associations obtained by the simple multilevel model could also be driven by third variables. We next entered the four MSA-level predictors simultaneously in the multilevel model. The Level 1 model was identical to the above analysis. However, the Level 2 model was now modified to the following:

$$\begin{aligned}\beta_{0j} = {} & \gamma_{00} + \gamma_{01} * (\text{Walk Score}) + \gamma_{02} * (\text{Mobility}) + \gamma_{03} * (\text{Commute}) + \\ & \gamma_{04} * (\text{Median Inc}) + u_{0j}\end{aligned}$$

The multilevel analyses above did not control for individual-level variables that are known to be associated with health and life satisfaction. Because some MSAs have more educated, married, European American, elderly, and employed residents than others, it is important to examine whether the MSA-level variables predict well-being above and beyond the individual-level variables. In the next analyses, therefore, we modified the Level 1 model such that life satisfaction is predicted by various individual-level variables.

$$\begin{aligned}\text{Level 1}: Y_{ij} = {} & \beta_{0j} + \beta_{1j} * (\text{age}) + \beta_{2j} * (\text{gender}) + \beta_{3j} * (\text{marriage}) + \\ & \beta_{4j} * (\text{education}) + \beta_{5j} * (\text{unemployment}) + \beta_{6j} * (\text{income}) + \\ & \beta_{7j} * (\text{Black}) + \beta_{8j} * (\text{Hispanic}) + \beta_{9j} * (\text{Asian}) + \\ & \beta_{10j} * (\text{Hawaiian}) + \beta_{11j} * (\text{American Indian}) + \\ & \beta_{12j} * (\text{Other}) + r_{ij},\end{aligned}$$

where Y_{ij} is life satisfaction of an individual i who is living in MSA j, β_{0j} is a random coefficient representing the intercept for MSA j, β_{1j} to β_{12j} are random coefficients for age (grand-centered), gender (female = 0; male = 1), marriage (not married = 0; married = 1), education (grand-centered), unemployment (employed = 0; unemployed = 1), income (grand-centered), 6 race dummies (European American = reference group). The results from this analysis (no Level 2 predictors) are described in Table 3.

In the critical analyses, well-being, after adjusting for the individual-level control variables, was predicted by MSA-level variables, one at a time. For instance,

$$\text{Level 2(Between-MSA)}\beta_{0j} = \gamma_{00} + \gamma_{01} * (\text{Walk Score}) + u_{0j}$$

In the final series of analyses, in addition to the individual-level control variables, all the MSA-level variables were included simultaneously.

RESULTS

Preliminary Analyses

As seen in Table 1, residents of walkable metropolitan and micropolitan areas reported having better health on average than did residents of less walkable areas (r [701] = +.37, $p < .01$). Likewise, residents of MSAs with shorter commutes reported having better health than residents of MSAs with longer commutes (r [928] = −.15, $p < .01$). Not surprisingly, the residents of wealthy areas reported greater health than those in less wealthy areas (r [929] = +.63, $p < .01$). Whereas walkability and commute were associated with general health, they were not associated with the mean life satisfaction of residents. Residents of mobile areas and wealthy areas were more satisfied with their lives on average than those of stable (r [916] = +.12, $p < .01$) and relatively poor areas (r [929] = +.15, $p < .01$).

Hypothesis Testing

The results are summarized in Table 2. These results are largely consistent with the simple correlation analyses reported in Table 1. Consistent with previous research (e.g. Sallis et al., 2009), residents of walkable areas reported better health (d = +.842) and their reported BMIs were also lower (d = −.431). However, walkability (d = −.037) was not associated with life satisfaction (Cohen's effect size ds were calculated based on t-values and dfs from HLM outputs using the following formula: 2t*sqrt of df).

TABLE 2
Simple Multilevel Analyses Predicting Well-Being from MSA-Level Variables One at a Time and Simultaneous Multilevel Analyses Predicting Well-Being from MSA-Level Variables Simultaneously (Individual-Level Variables are not Included)

	Individual-Level Variables Not Adjusted								
	Life Satisfaction			*General Health*			*BMI*		
Simple Model	γ	(SE)	t-*value*	γ	(SE)	t-*value*	γ	(SE)	t-*value*
Walkability	−.00013	(.00027)	−0.485	.00838	(.00075)	11.14**	−.01817	(.00319)	−5.702**
Mobility	.00345	(.00059)	5.884**	.008213	(.00175)	4.706**	−.03493	(.00709)	−4.926**
Long Commute	.00243	(.03117)	0.078	−.03954	(.09806)	−.403	−.44706	(.038727)	−1.154
Median Income	.001357	(.00027)	4.961**	.01365	(.00065)	20.894**	−.03552	(.00304)	−11.704**
	Life Satisfaction			*General Health*			*BMI*		
Simultaneous Model	γ	(SE)	t-*value*	γ	(SE)	t-*value*	γ	(SE)	t-*value*
Walkability	−.00074	(.00027)	−2.776**	.00353	(.00059)	5.947**	−.00671	(.00300)	−2.239*
Mobility	.00384	(.00059)	6.509**	.00992	(.00127)	7.806**	−.042934	(.00645)	−6.652**
Long Commute	−.01947	(.03187)	−.611	−.37953	(.07163)	−5.298**	.31700	(.36081)	.879
Median Income	.00193	(.00030)	6.473**	.01391	(.00066)	21.123**	−.03654	(.00333)	−10.984**

Note: * $p < .05$; ** $p < .01$.

Next we present the results of another series of multilevel models, in which all four MSA-level predictors were entered simultaneously in the multilevel model. The results are shown in the second half of Table 2. Consistent with the simple multilevel analyses, residents of walkable ($d = +.449$) areas reported better health than residents of less walkable areas, controlling for median income, residential mobility, and percentage of long commute. Likewise, residents of walkable ($d = -.169$) areas had lower BMIs than those of less walkable areas, controlling for MSA-level variables. In contrast, walkability was now *negatively* associated with life satisfaction ($d = -.210$). That is, controlling for residential mobility, median income, and commute, residents of more walkable areas reported lower levels of life satisfaction than residents of less walkable areas.

Controlling for Individual-Level Variables

The multilevel analyses presented above did not control for individual-level variables that are known to be associated with health and life satisfaction. Next, we present the results from a series of multilevel analyses, in which we control for various individual-level variables (see Table 3). Consistent with previous research (e.g. Siedlecki et al., 2008), older people reported higher levels of life satisfaction than younger people ($d = +.140$). Women also reported higher levels of life satisfaction than men ($d = +.068$). As in previous research (Diener et al., 1999), married people reported higher levels of life satisfaction than non-married people ($d = +.230$). Likewise, educated people ($d = +.098$) and high-income individuals ($d = +.339$) reported higher levels of life satisfaction than those with less education and lower income. Again, consistent with previous research (Lucas, Clark, Georgellis, & Diener, 2004), unemployed people reported lower levels of life satisfaction ($d = -.133$). In terms of race, African Americans ($d = +.012$), Hawaiians/Pacific Islanders ($d = +.011$), and Hispanics ($d = +.033$) reported higher levels of life satisfaction than European Americans, whereas Asians ($d = -.018$) and others (those who reported being multiple races, those who said "others", and those who did not report this info, $d = -.028$) were less satisfied with their lives than European Americans. Likewise, these individual-level variables were associated with general health and BMI (see Table 3 for details).

Table 4 reports the critical analysis, in which well-being is predicted by various individual-level variables (e.g. age, gender, race, education, marital status, income) at Level 1, and the adjusted mean well-being (that is, mean well-being adjusted for age, gender, race, education, etc. from Level 1) was predicted by walkability at Level 2. Whereas the simple multilevel analysis that did not include any individual-level variables showed no association between walkability and life satisfaction, once various individual-level variables were statistically controlled for, residents of more walkable areas reported *lower* levels of life satisfaction than those of less walkable areas (d = $-.459$). These results

TABLE 3
Individual Predictors of Well-Being in Multilevel Analyses

	Life Satisfaction			*General Health*			*BMI*		
	b	(SE)	t-*value*	*b*	(SE)	t-*value*	*b*	(SE)	t-*value*
Age	.00265	(.00009)	29.435**	.01179	(.00015)	−80.152**	.00329	(.00086)	3.816**
Gender	−.04177	(.00293)	−14.239**	−.06690	(.00479)	−13.964**	.80668	(.02810)	28.708**
Marriage	.015780	(.00326)	48.372**	−.04193	(.00534)	−7.859**	.39033	(.03127)	12.482**
Black	.01514	(.00591)	2.562*	−.12346	(.00985)	−12.53**	2.26575	(.05713)	39.658**
Hispanic	.04605	(.00659)	6.988**	−.13994	(.01106)	−12.655**	.38543	(.06393)	6.029**
Asian	−.04966	(.01322)	−3.757**	−.11883	(.02193)	−5.444**	−2.45237	(.12746)	−19.240**
Hawaiian	.07308	(.03214)	2.273*	.01059	(.05253)	.0202	1.05978	(.30809)	3.440**
Indian	−.02530	(.01302)	−1.943	−.23784	(.02147)	−11.077**	1.27815	(.12532)	10.200**
Other Race	−.05708	(.00961)	−5.939**	−.15411	(.01574)	−9.793**	.42718	(.09220)	4.633**
Education	.03215	(.00156)	20.609**	.14904	(.00255)	58.134**	−.28010	(.01494)	−18.747**
Unemploy	−.21343	(.00761)	−28.036**	−.10752	(.01244)	−8.646**	.30841	(.07293)	4.229**
Income	.06393	(.00090)	71.329**	.14518	(.00146)	99.144**	−.17292	(.00859)	−20.137**

Note: * $p < .05$; ** $p < .01$. Age, education, and income are grand-centered. Gender (0 = female; 1 = male). Marriage (0 = not married; 1 = married). Race dummies (reference group is European American). Unemployment (0 = not unemployed, 1 = unemployed). Household Income is rated on the 8-point scale (1 = less than \$10,000, 2 = \$10,000 to less than \$15,000, 3 = \$15,000 to less than \$20,000, 4 = \$20,000 to less than \$25,000, 5 = \$25,000 to less than \$35,000, 6 = \$35,000 to less than \$50,000, 7 = \$50,000 to less than \$75,000, 8 = \$75,000 or more). Education was rated on the 4-point scale (1 = did not graduate high school, 2 = graduated high school, 3 = attended college or technical school, 4 = graduated from college or technical school).

TABLE 4
Predicting Well-Being from MSA-Level Variables, while Controlling for Individual-Level Variables in Simple and Simultaneous Multilevel Analyses

Simple Model	*Individual-Level Variables Adjusted*								
	Life Satisfaction			*General Health*			*BMI*		
	γ	(SE)	t-*value*	γ	(SE)	t-*value*	γ	(SE)	t-*value*
Walkability	−.00135	(.00022)	−6.071**	.003552	(.00045)	7.881**	−.00421	(.00268)	−1.570
Mobility	.00242	(.00052)	4.641**	.001800	(.00103)	1.751	−.02365	(.00594)	−3.979**
Long Commute	−.05319	(.02665)	−1.996*	−.13822	(.05374)	−2.572*	−.69378	(.31040)	−2.235**
Median Income	−.00171	(.00023)	−7.480**	.00366	(.00046)	7.890**	−.01608	(.00270)	−5.962**
	Individual-Level Variables Adjusted								
Simultaneous Model	*Life Satisfaction*			*General Health*			*BMI*		
	γ	(SE)	t-*value*	γ	(SE)	t-*value*	γ	(SE)	t-*value*
Walkability	−.00080	(.00023)	−3.508**	.00231	(.00046)	5.073**	.00087	(.00273)	.318
Mobility	.00205	(.00051)	3.993**	.00158	(.00099)	1.597	−.03088	(.00593)	−5.210**
Long Commute	.03817	(.02710)	1.409	−.27615	(.05470)	−5.048**	−.49913	(.32792)	−1.522
Median Income	−.00139	(.00026)	−5.401**	.00373	(.00051)	7.315**	−.01674	(.00305)	−5.487**

Note: * $p < .05$; ** $p < .01$. Each outcome measure was predicted by one city-level variable, one at a time, either individual-level variables not adjusted, or individual-level variables adjusted. Individual-level variables included were age (grand-centered), gender (female = 0; male = 1), marriage (not married = 0; married = 1), education (grand-centered), unemployment (employed = 0; unemployed = 1), income (grand-centered), and race-dummy codes (European American = reference; Hispanic, Black, Asian, Hawaiian or Pacific Islander, American Indian or Alaskan Native, or other).

remained essentially the same when we entered all four MSA-level predictors simultaneously (see Table 4). We repeated the above analyses with self-reported health. The results were largely the same as the multilevel analyses without controlling for individual variables. Namely, residents of areas that are more walkable (d = +.383) reported better health than those living in areas that are less walkable. However, the analyses with BMI showed that residents of more walkable areas did not have lower BMI than those of less walkable areas.

DISCUSSION

Using a multi level, ecological framework (Oishi & Graham, 2010; Sallis et al., 2006), we examined the role of walkability of metropolitan areas in residents' well-being—here, life satisfaction and health. As predicted, those living in walkable areas self-reported better health and lower BMIs than those living in less walkable areas. Likewise, those living in wealthy areas reported better health and had lower BMIs than those living in less walkable areas.

Whereas area-level correlates of physical health (e.g. median income, walkability, commute time) were largely consistent with our expectations and previous research (e.g. Sallis et al., 2009), area-level correlates of life satisfaction were somewhat surprising. Once individual-level characteristics (i.e. age, gender, race, education, household income, marital status) were statistically controlled for, participants living in wealthy cities were *less* satisfied with their lives than those living in less wealthy cities. While perhaps surprising, it should be noted that this finding is consistent with previous research (e.g. Luttmer, 2005), and simply means that if two individuals' annual incomes were equal, the person living in a low median income (perhaps cheaper) area would be more satisfied with her life than the person living in a high median income (perhaps more expensive) area. Our supplementary analyses (see Supplementary Materials) using a group centering method also clarified this finding (see also Lucas, Cheung, & Lawless, 2014, for a relevant discussion). Specifically, after controlling for exactly the same individual-level variables, the group-centered analysis showed that when we compared the residents whose household income is about the median income in their respective area (e.g. $40k in Mobile, AL, $100K in Los Amos, NM), residents living in high median income areas were more satisfied with their lives than those living in low median income areas.

Contrary to our expectations, participants living in more walkable areas were *less* satisfied with their lives than those living in less walkable areas. Because physical activities such as walking are positively associated with life satisfaction in general (Maher et al., 2013), this finding was counterintuitive. It is possible that because walkable areas have more choices (e.g. restaurants, cultural activities) than less walkable areas, people living in walkable areas might be more prone to the paradox of choices (Schwartz, 2004), or routinely regretting their own decisions. Similarly, walkable areas have more temptations (e.g. restaurants, bars), which might intensify residents' desires and widen the gap between their desires and reality (Oishi, Westgate, Tucker, & Komiya, 2015).

However, this finding could also be driven by third, unmeasured variables. For instance, walkable cities such as New York and San Francisco may have higher inequality than less walkable cities such as Charlotte, NC. Previous research has shown that higher levels of income inequality are associated with lower levels of life satisfaction (Oishi, Kesebir, & Diener, 2011). In addition, there are numerous variables that might be associated with walkability, ranging from unemployment and crime rate, to the quality of education, to social capital. In order to address many of these potential third-variable issues, we gathered city-level variables from Chetty, Hendren, Kline, and Saez (2014): the unemployment rate, income inequality, percentage African Americans, per capita local government expenditure, teacher–student ratio, percentage of manufacturing employment, the violent crime rate, and social capital, and conducted supplementary multilevel analyses in which these additional variables were entered in Level 2 (see Supplementary Materials). Controlling for these important social indicators did not change our main findings.

The contrasting findings between life satisfaction and health have important theoretical implications, particularly considering that life satisfaction and general health are positively correlated (Okun et al., 1984). The somewhat striking findings we obtained could potentially be explained by differences in judgment processes. For instance, life satisfaction judgments are perhaps more subjective than health judgments. While life satisfaction judgments are complex, involving objective and subjective factors ranging from social comparisons, past comparisons, or comparisons to one's ideal conditions (Michalos, 1985), health judgments may be narrower in scope than life satisfaction judgments. This narrower scope suggests that health judgments may be more concrete than life satisfaction judgments (Schwarz & Strack, 1999), which in turn make health judgments reflect objective macro-conditions more faithfully than broader judgments such as life satisfaction. In a related vein, the current findings suggest that physical health is more sensitive to one's objective physical environment, such as walkability, compared to subjective well-being.

Although the current research has several notable strengths (e.g. a large representative sample, both self-report and a behavioral index of health), there are also several potential issues. We address some of these issues below. First, although the above analyses provide important information regarding macro-contextual effects on life satisfaction and physical health, MSAs cover a major city *and* its surrounding areas (e.g. DC plus Alexandria, Arlington), whereas Walk Scores used were at the city level (e.g. DC). We thus repeated the analyses above, in which only city residents were included in the analysis. As seen in the Supplementary Material, the supplementary analyses showed that the results were essentially identical when restricted to city residents only.

Second, BMI is not linearly associated with general health, as extremely low BMI also indicates poor health. In our current sample, self-reported general health was highest for individuals with a BMI of 22. Those who were below a BMI of 22, in particular those with a BMI less than 18, reported feeling less healthy than those with a BMI of 22. Previous research also indicates that mortality risk is lowest among those with a BMI between 20 and 25 (Calle, Thun, Petrelli, Rodriguez, & Heath, 1999). Thus, our linear analyses with BMI might not be optimal. To account for this issue, we calculated a new BMI index using the absolute difference from 22. This index equates those who have a BMI that is too low with those who have a BMI that is too high. We repeated the above analyses with the absolute difference BMI index as a dependent variable. The results, however, were nearly identical to the original. Likewise, because a recent study showed that mortality risk was particularly high among obese individuals (BMI of 30 or more, Flegal et al., 2013), we repeated the analyses above to see if walkable cities had less obese individuals (i.e. individuals with a BMI of 30 or more). The correlation between the percentage of obese individuals and walkability was nearly identical, r [701] = $-.162$, $p < .001$, to the correlation between mean BMI and walkability, r [701] = $-.160$, $p < .001$. Likewise, the results from the HLM analyses were essentially the same whether we used percentage of BMI over 30 or the original BMI.

Third, life satisfaction and general health were assessed with single items. Although both single-item life satisfaction and single-item general health have a reasonable degree of reliability (reliability coefficient of .62 to .74 for life satisfaction, Lucas & Donnellan, 2012; reliability coefficient of .74 for general health, DeSalvo et al., 2006), it is desirable to measure subjective well-being and health with multiple items.

Fourth, the research design was cross-sectional. Thus, there was a possible selection effect such that healthy people were more likely to choose to live in a walkable city than less healthy people (see Zick et al., 2013, for suggestive evidence). It is critical to conduct a longitudinal study to disentangle this possible selection effect and the macro-societal effects on one's physical and psychological well-being in the future.

Fifth, the geographic information was at the level of Metropolitan Statistical Area and the city as a whole. Clearly, some neighborhoods are far more walkable than other neighborhoods in the same city. Thus, walkability measures in smaller units, such as for a zipcode or neighborhood, are more ideal than the walkability of MSAs and cities. It is important to conduct future studies at a smaller unit of analysis.

Finally, the effect sizes we observed were in general small to medium. For instance, Table 4 showed that the difference between a walk score of 38 (e.g. Charlotte, NC) and 78 (e.g. Boston) corresponds to a 0.14 change in general health on a 5-point scale. Although it should also be noted that this difference between a walk score of 38 and 78 corresponds roughly to the effect of median income difference between $40,000 and $80,000, our findings should be interpreted with modest effect sizes in mind.

Conclusion

The present research shows that people living in walkable areas reported having better general health and more ideal BMIs than those living in less walkable areas. Yet those living in walkable areas were not happier than those living in unwalkable areas. As the current findings are correlational, it is important to examine in the future whether making a city more walkable (e.g. by creating sidewalks) might improve the city residents' health using a longitudinal design. As enhancing physical health and subjective well-being are important goals of society (Diener, 2000; Stiglitz, Sen, & Fitoussi, 2009), it is critical to continue accumulating more solid longitudinal evidence regarding the role of walkability and other built environmental factors in individuals' physical and psychological well-being.

REFERENCES

Berke, E.M., Gottlieb, L.M., Moudon, A.V., & Larson, E.B. (2007a). Protective association between neighborhood walkability and depression in older men. *Journal of the American Geriatrics Society*, *55* (4), 526–533.

Berke, E.M., Koepsell, T.D., Moudon, A.V., Hoskins, R.E., & Larson, E.B. (2007b). Association of the built environment with physical activity and obesity in older persons. *American Journal of Public Health*, *97*, 486–492.

Calle, E.E., Thun, M.J., Petrelli, J.M., Rodriguez, C., & Heath, C.W. Jr. (1999). Body-mass index and mortality in a prospective cohort of US adults. *New England Journal of Medicine*, *341* (15), 1097–1105.

Carlson, J.A., Saelens, B.E., Kerr, J., Schipperijn, J., Conway, T.L., Frank, L.D., et al. (2015). Association between neighborhood walkability and GPS-measured walking, bicycling and vehicle time in adolescents. *Health & Place*, *32*, 1–7.

Carr, L.J., Dunsiger, S.I., & Marcus, B.H. (2011). Validation of Walk Score for estimating access to walkable amenities. *British Journal of Sports Medicine*, *45*, 1144–1148.

Chetty, R., Hendren, N., Kline, P., & Saez, E. (2014). The economic impacts of tax expenditures: Evidence from spatial variation across the US. Working paper. Cambridge, Bureau of Economic Research. Available online: http://obs.rc.fas.harvard.edu/chetty/tax_expenditure_soi_whitepaper.pdf.

Christian, H., Zubrick, S.R., Foster, S., Giles-Corti, B., Bull, F., Wood, L., et al. (2015). The influence of the neighborhood physical environment on early child health and development: A review and call for research. *Health & Place*, *33*, 25–36.

Costa, P.T. Jr. & McCrae, R.R. (1987). Neuroticism, somatic complaints, and disease: Is the bark worse than the bite? *Journal of Personality*, *55* (2), 299–316. doi:10.1111/1467-6494.ep8970749

DeSalvo, K.B., Fisher, W.P., Tran, K., Bloser, N., Merrill, W., & Peabody, J. (2006). Assessing measurement properties of two single-item general health measures. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care & Rehabilitation*, *15*, 191–201.

Diener, E. (2000). Subjective well-being: The science of happiness and a proposal for a national index. *American Psychologist*, *55*, 34–43.

Diener, E., Oishi, S., & Lucas, R.E. (2003). Personality, culture, and subjective well-being: Emotional and cognitive evaluations of life. *Annual Review of Psychology*, *54*, 403–425.

Diener, E., Suh, E.M., Lucas, R.E., & Smith, H.L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, *125*, 276–302.

Diener, E., Tay, L., & Oishi, S. (2013). Rising income and the subjective well-being of nations. *Journal of Personality and Social Psychology*, *104*, 267–276.

Duncan, D.T., Aldstadt, J., Whalen, J., Melly, S.J., & Gortmaker, S.L. (2011). Validation of Walk Score for estimating neighborhood walkability: An analysis of four US metropolitan areas. *International Journal of Environmental Research and Public Health*, *8*, 4160–4179.

Ferdinand, A.O., Sen, B., Rahurkar, S., Engler, S., & Menachemi, N. (2012). The relationship between built environments and physical activity: A systematic review. *American Journal of Public Health*, *102*, 7–13.

Flegal, K.M., Kit, B.K., Orpana, H., & Graubard, B.I. (2013). Association of all-cause mortality with overweight and obesity using standard Body Mass Index categories: A systematic review and meta-analysis. *Journal of the American Medical Association*, *309*, 71–82.

Frank, L.D., Sallis, J.F., Saelens, B.E., Leary, L., Cain, K., Conway, T.L., et al. (2009). The development of a walkability index: Application to the neighborhood quality of life study. *British Journal of Sports Medicine*, *44*, 924–933.

Haselwandter, E.M., Corcoran, M.P., Folta, S.C., Hyatt, R., Fenton, M., & Nelson, M.E. (2015). The built environment, physical activity, and aging in the United States: A state of the science review. *Journal of Aging and Physical Activity*, *23*, 323–329.

Helliwell, J.F., & Putnam, R.D. (2004). The social context of well-being. *Philosophical Transactions of the Royal Society: Biological Sciences*, *359*, 1435–1446.

Hirsch, J.A., Moore, K.A., Evenson, K.R., Rodriquez, D.A., & Roux, A.V.D. (2013). Walk Score® and Transit Score® and walking in the multi-ethnic study of atherosclerosis. *American Journal of Preventive Medicine*, *45*, 158–166.

Kawachi, I., Kennedy, B.P., Lochner, K., & Prothrow-Stith, D. (1997). Social capital, income inequality, and mortality. *American Journal of Public Health*, *87*, 1491–1498.

Lawless, N.M., & Lucas, R.E. (2011). Predictors of regional well-being: A county-level analysis. *Social Indicators Research*, *101*, 341–357.

Leyden, K.M. (2003). Social capital and the built environment: The importance of walkable neighborhoods. *American Journal of Public Health*, *93* (9), 1546–1551.

Lucas, R.E., Cheung, F., & Lawless, N.M. (2014). Investigating the subjective well-being of United States regions. In P.J. Rentfrow (Ed.), *Geographical psychology* (pp. 161–177). Washington, DC: American Psychological Association.

Lucas, R.E., Clark, A.E., Georgellis, Y., & Diener, E. (2004). Unemployment alters the set-point for life satisfaction. *Psychological Science*, *15*, 8–13.

Lucas, R.E., & Donnellan, M.B. (2012). Estimating the reliability of single-item life satisfaction measures: Results from four national panel studies. *Social Indicators Research*, *105*, 323–331.

Luttmer, E.F. (2005). Neighbors as negatives: Relative earnings and well-being. *Quarterly Journal of Economics*, *120* (3), 963–1002.

McGrath, L.J., Hopkins, W.G., & Hinckson, E.A. (2015). Associations of objectively measured built-environment attributes with youth moderate-vigorous physical activity: A systematic review and meta-analysis. *Sports Medicine*, *45*, 841–865.

Maher, J.P., Doerksen, S.E., Elavsky, S., Hyde, A.L., Pincus, A.L., Ram, N., et al. (2013). A daily analysis of physical activity and satisfaction with life in emerging adults. *Health Psychology*, *32*, 647–656.

Michalos, A.C. (1985). Multiple discrepancies theory (MDT). *Social Indicators Research*, *16* (4), 347–413.

Must, A., Spadano, J., Coakley, E.H., Field, A.E., Colditz, G., & Dietz, W.H. (1999). The disease burden associated with overweight and obesity. *Journal of the American Medical Association*, *282* (16), 1523–1529.

Norman, G.J., Carlson, J.A., O'Mara, S., Sallis, J.F., Patrick, K., Frank, L.D., et al. (2013). Neighborhood preference, walkability, and walking in overweight/obese men. *American Journal of Health Behavior*, *37*, 277–282.

Oishi, S. (2012). *The psychological wealth of nations: Do happy people make a happy society?* Malden, MA: Wiley-Blackwell.

Oishi, S. (2014). Socio-ecological psychology. *Annual Review of Psychology*, *65*, 581–609.

Oishi, S., & Graham, J. (2010). Social ecology: Lost and found in psychological science. *Perspectives on Psychological Science*, *5*, 356–377.

Oishi, S., Kesebir, S., & Diener, E. (2011). Income inequality and happiness. *Psychological Science*, *22*, 1095–1100.

Oishi, S., Schimmack, U., & Diener, E. (2012). Progressive taxation and the subjective well-being of nations. *Psychological Science*, *23*, 86–92.

Oishi, S., Westgate, E., Tucker, J., & Komiya, A. (2015). Desires and happiness: Aristotelian, Puritan, and Buddhist approaches. In W. Hofmann & L. Nordgren (Eds.), *The psychology of desire* (pp. 286–306). New York: Guilford Press.

Okun, M.A., Stock, W.A., Haring, M.J., & Witter, R.A. (1984). Health and subjective well-being: A meta-analysis. *International Journal of Aging and Human Development*, *19* (2), 111–132.

Oswald, A.J., & Wu, S. (2010). Objective confirmation of subjective measures of human well-being: Evidence from the USA. *Science*, *327*, 576–579.

Patterson, P.K., & Chapman, N.J. (2004). Urban form and older residents' service use, walking, driving, quality of life, and neighborhood satisfaction. *American Journal of Health Promotion*, *19* (1), 45–52.

Powell, K.E., Martin, L.M., & Chowdhury, P.P. (2003). Places to walk: Convenience and regular physical activity. *American Journal of Public Health*, *93*, 1519–1521.

Renalds, A., Smith, T.H., & Hale, P.J. (2010). A systematic review of built environment and health. *Family & Community Health: The Journal of Health Promotion and Maintenance*, *33*, 68–78.

Rentfrow, P.J., Mellander, C., & Florida, R. (2009). Happy States of America: A state-level analysis of psychological, economic, and social well-being. *Journal of Research in Personality*, *43* (6), 1073–1082. doi:10.1016/j.jrp.2009.08.005

Rogers, S.H., Halstead, J.M., Gardner, K.H., & Carlson, C.H. (2011). Examining walkability and social capital as indicators of quality of life at the municipal and neighborhood scales. *Applied Research in Quality of Life*, *6*, 201–213.

Sallis, J.F., Cervero, R.B., Ascher, W., Henderson, K.A., Kraft, M.K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health*, *27*, 297–322.

Sallis, J.F., Owen, N., & Fisher, E.B. (2008). Ecological models of health behavior. *Health Behavior & Health Education: Theory, Research, and Practice*, *4*, 465–486.

Sallis, J.F., Saelens, B.E., Frank, L.D., Conway, T.L., Slymen, D.J., Cain, K.L., et al. (2009). Neighborhood built environment and income: Examining multiple health outcomes. *Social Science & Medicine*, *68* (7), 1285–1293.

Sampson, R.J., Raudenbush, S.W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*, *277* (5328), 918–924.

Schwartz, B. (2004). *The paradox of choice: Why more is less*. New York: HarperCollins.

Schwarz, N., & Strack, F. (1999). Reports of subjective well-being: Judgmental processes and their methodological implications. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 61–84). New York: Russell Sage Foundation.

Siedlecki, K.L., Tucker-Drob, E.M., Oishi, S., & Salthouse, T.A. (2008). Life satisfaction across adulthood: Different determinants at different ages? *Journal of Positive Psychology*, *3*, 153–164.

Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin*, *134* (1), 138–161.

Stevens, J., Cai, J., Pamuk, E.R., Williamson, D.F., Thun, M.J., & Wood, J.L. (1998). The effect of age on the association between body-mass index and mortality. *New England Journal of Medicine*, *338* (1), 1–7.

Stiglitz, J.E., Sen, A., & Fitoussi, J.-P. (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress. Available at: http://www.stiglitz-sen-fitoussi.fr/en/documents.htm.

Stokols, D. (1992). Establishing and maintaining health environments: Toward a social ecology of health promotion. *American Psychologist*, *47*, 6–22.

Stommel, M., & Schoenborn, C.A. (2010). Variations in BMI and prevalence of health risks in diverse racial and ethnic populations. *Obesity*, *18*, 1821–1826. doi:10.1038/oby.2009.472

Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise*, *40* (1), 181–188.

United States. Public Health Service. Office of the Surgeon General, National Center for Chronic Disease Prevention, Health Promotion (US), President's Council on Physical Fitness, & Sports (US) (1996). *Physical Activity and Health: A Report of the Surgeon*. Burlington, MA: Jones & Bartlett Learning.

Zick, C.D., Hanson, H., Fan, J.X., Smith, K.R., Kowaleski-Jones, L., Brown, B.B., et al. (2013). Re-visiting the relationship between neighborhood environment and BMI: An instrumental variables approach to correcting for residential selection bias. *International Journal of Behavioral Nutrition and Physical Activity*, *10*, 27.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Supplementary Material.

1. Supplementary analysis with group-centered income.
2. Multilevel analysis with full individual level and community level controls.
3. Multilevel analysis with city residents only.
4. Analyses with different measures of BMI.