


Food Access and Its Relationship to Perceived Walkability, Safety, and Social Cohesion

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Understanding social inequalities in terms of neighborhood characteristics and the context to which individuals belong is important for reducing disparities. This article describes how perceptions of food access are related to three physical and social environmental factors: perceived neighborhood walkability, safety, and social cohesion. A cross-sectional survey was conducted with a random sample of 1,500 households in Springfield, Missouri. The main outcome measures were ease of purchase; availability of a large selection and quality; and affordability of fresh fruits and vegetables (FVs) and low-fat products (LFPs). Overall, 63% of respondents reported consuming <5 servings of FVs daily in the past month. Most agreed it was easy to purchase FVs (70%) and LFPs (76%) in their neighborhood and felt there was a large selection available (70% and 71%, respectively). High walkability (odds ratio [OR]: 1.8), low crime (OR: 1.6), and high social cohesion (OR: 1.7) were significantly associated with having greater selection of FVs. High walkability (OR: 1.6) and low crime (OR: 1.6) were associated with greater access to FVs. Given that healthy food access is an important component to improving health outcomes, understanding how to alter environmental features that influence behaviors like eating is important.

Keywords: chronic disease; nutrition; surveys; program planning and evaluation; social determinants of health

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► INTRODUCTION

Access to healthy food is critical for improving the physical and economic well-being of communities. Evidence further suggests that healthy food access is an important component to promoting health and improving individual-level health outcomes such as obesity, diabetes, and other diet-related chronic diseases (Bell, Mora, Hagan, Rubin, & Karpyn, 2013). While recognition of the importance of healthy food access is growing, over 800 million people worldwide lack sufficient access to food (Food and Agriculture Organization of the United Nations, UNICEF, International Fund for Agricultural Development, World Food Programme, & World Health Organization, 2017) and 12.3% (15.6 million) of U.S. households are food insecure (U.S. Department of Agriculture, Economic Research Service, 2017), thereby underscoring the ongoing challenge. Research and policy have focused on the physical neighborhood food environment and the variety of features that may support or impede healthy behaviors and overall health (Diez Roux, 2008; Myers, Denstel, & Broyles, 2016). Across the world, increasing urbanization is now

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recognized as a key driver of poor health due to inadequate neighborhood environments and limited access to healthy food. Of particular emphasis have been links between health and retail mix, proximity of food outlets, and types and price of foods available (Lovasi, Hutson, Guerra, & Neckerman, 2009; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008; Webber, Sobal, & Dollahite, 2010). However, there have been inconsistent findings (Morland, Wing, & Diez Roux, 2002; Pearson, Russell, Campbell, & Barker, 2005), which may be explained by research suggesting that neighborhoods may not be wholly "healthy" or "unhealthy" but rather contain a varied distribution of both features (Myers et al., 2016). Globally, few studies have investigated the impact of neighborhood food environment on health, and existing research is limited to fast-food outlets, with mixed results (Mason, Pearce, & Cummins, 2018).

Individual- and household-level factors have been shown to exert important influences on food purchases and consumption behaviors (Story et al., 2008). Yet, to be effective in reducing disparities in access to healthy food, a focus should be placed on the contextual factors of the local community environment as well as characteristics of the groups, or context to which individuals belong, that may affect individual access (Lovasi et al., 2009). A theoretical framework of food access suggests that food choice and healthful eating are influenced by characteristics of potential customers (e.g., vehicle/transit options, their neighborhood, financial resources) and characteristics of the food environment (e.g., number, type, size, and location of food stores; food availability and variety; price and quality of food items; Sharkey, Horel, & Dean, 2010). Research has shown that people living in walkable neighborhoods are less likely to be overweight or obese than those in less walkable neighborhoods. This may be in part due to better access to healthy food, which facilitates a healthier diet (Sallis & Glanz, 2009). One study of older adults found that neighborhood walkability was an important correlate of food insecurity (Chung et al., 2012); however, outcome measures were related to individual-level food insecurity factors as opposed to environmental factors. Perceived neighborhood safety can also affect access to healthy food. For example, if an individual feels unsafe due to crime, he or she may be less likely to frequent nearby food retailers, and may in fact adapt his or her shopping routines to avoid unsafe places (Cannuscio, Hillier, Karpyn, & Glanz, 2014). Additionally, retailers may deem it less desirable to reside in an unsafe neighborhood, thereby further limiting access. The social environment also exerts important influences on food-related behaviors through mechanisms like social support,

trust, and social norms. One study found that social capital was positively associated with household food security (Martin, Rogers, Cook, & Joseph, 2004) as measured by household hunger; however, neighborhood food access was not explored.

A body of research has shown that neighborhoods may contain a varied distribution of healthy and unhealthy features that can affect their individual behaviors (Leal, Bean, Thomas, & Chaix, 2012; Matthews & Yang, 2013; Myers et al., 2016). However, much of this work has focused on objectively defined characteristics (e.g., physical location of grocery store, police-reported crime rates) rather than subjective or perceived characteristics. Perceptions of the environment reflect an individual's interaction with the environment, and therefore suggest the value in using respondents' own assessments of environmental quality (Carter, Williams, Paterson, & Iusitini, 2009; Echeverria, Diez-Roux, & Link, 2004). Furthermore, studies looking at the food environment often use a simple presence of a store as a proxy for the availability of healthy foods (Bell et al., 2013), which does not take into account the quality and price of the food. This study investigates how perceptions of food access defined as ease of purchase, selection and quality, and affordability are related to three physical and social environmental factors—perceived neighborhood walkability, safety, and social cohesion. Findings may be used to garner cross-sectoral support for policies to improve food access as a way to enhance physical and social environmental factors within communities and vice versa.

► METHOD

This study was reviewed by John Snow Inc. Institutional Review Board (OHRP IRB00009069) and deemed exempt. A cross-sectional survey was conducted with a randomized, citywide sample of households to examine the relationship between neighborhood and individual/household characteristics and food access.

Study Setting

This study took place in Springfield, Missouri, the third-largest city in the state, with a population of 165,399 (Missouri Census Data Center, 2014). Springfield faces a number of significant health and social problems. Data indicate that 32% of adults are obese and 7% have diabetes (Husney, 2014). Over one quarter (29%) of households are below the poverty level; 39% have incomes under \$25,000/year and 20%

are on government assistance (Missouri Census Data Center, 2014). Fifty-four percent of Springfield's public school students are eligible for free or reduced-price lunches, with some schools reaching 95% student eligibility (Missouri Student Information System Reporting, Missouri Department of Elementary and Secondary Education, 2017). Although known as a regional hub with small town hospitality, Springfield has one of the highest crime rates (92 per 1,000) in the United States; 1 in 11 people becomes a victim of either violent or property crime (Neighborhood Scout, 2015).

Sample and Procedures

A sample of 1,500 households were randomly selected (1,200 citywide and 300 in select low-income areas), with 136 extra households as replacements for undeliverable addresses, from Genesys Sampling of the Marketing Systems Group. Prenotifications were sent to inform households of their selection. Two weeks later, a packet containing an information letter, eligibility criteria, a survey, \$5 incentive, and a stamped return envelope was mailed. The adult (≥ 18 years) with an upcoming birthday in the household was invited to complete the survey. A reminder postcard was sent 2 weeks after the initial mailing, followed by a second copy of the survey mailed to nonresponders and a last reminder, both 2 weeks apart. Households could opt out, and a Spanish version was available on request. Data collection took place between August and September 2014.

Measures

Dependent Variables. Three food access indicators were measured: (1) ease of purchase of fresh fruits and vegetables (FVs) and low-fat products (LFPs), (2) availability of a large selection and quality of FVs and LFPs, and (3) affordability of FVs and LFPs in the neighborhood. Respondents indicated on a 5-point scale their level of agreement on seven statements (*ease of purchase*: "It is easy to purchase fresh FVs in my neighborhood" and "It is easy to purchase LFPs in my neighborhood"; *selection and quality*: "There is a large selection of FVs available in my neighborhood," "There is a large selection of LFPs available in my neighborhood," and "The FVs in my neighborhood are of high quality"; *affordability*: "The fresh FVs and LFPs (2 statements) in my neighborhood are reasonably priced." Questions were adapted from the Perceived Nutrition Environment Survey (Green & Glanz, 2015; test-retest reliability. Respondents with positive responses (*somewhat/strongly agree*) on all items within a subscale

were coded as having high ease of purchase, selection and quality, and affordability, respectively, while all others were coded as having low food access characteristics. Those who responded positively to all seven statements were coded as having high overall food access and all others were coded as not.

Independent Variables. Demographic characteristics included sex, age, race, ethnicity, educational attainment, height and weight, daily FV intake, annual household income, Supplemental Nutrition Assistance Program (SNAP) participation, home ownership, household size, number of children (<18 years) at home, and number of household vehicles. Residents also reported their perceptions on three physical and social attributes of their neighborhood—social cohesion, walkability, and crime—by indicating their level of agreement on a series of statements. The *social cohesion* scale (Sampson, Raudenbush, & Earls, 1997; intraclass correlation = .76; Cronbach's α = .83) consisted of five items (i.e., "People around my neighborhood are willing to help their neighbors"; "People in this neighborhood can be trusted"). The 10-item *infrastructure and safety for walking* scale (hereafter referred to as "walkability"), adapted from the Physical Activity Neighborhood Environment Scale (intraclass correlation range = .52-.88; Cohen's kappa range = 0.35-0.70; Sallis et al., 2010), included items such as "Sidewalks are on most streets in my neighborhood," "My neighborhood streets are well lit at night," "The crosswalks in my neighborhood help walkers feel safe when crossing busy streets." A four-item *crime* subscale (Saelens, Sallis, Black, & Chen, 2003; test-retest reliability = .80) assessed walkability and crime and included items such as "There is a high crime rate in my neighborhood" and "The crime rate in my neighborhood makes it unsafe to go on walks during the day." Three items on the crime scale were reverse coded whereby a higher score indicated greater safety or lower crime. Composite scores for social cohesion, walkability, and crime were calculated by averaging across the individual items, with a range of 1 to 5 where higher scores indicated a more positive neighborhood environment. Respondents with composite scores greater than or equal to the sample average were categorized as living in areas with high social cohesion, high walkability, or low crime.

Data Analysis. All data analyses were conducted using SAS 9.4 (SAS Institute Inc., Cary, NC), and results were considered statistically significant at the $p < .05$ level. Overall descriptive analyses were conducted to describe respondent/household characteristics, FVs intake, and

perceived food access and neighborhood physical and social attributes. Chi-square tests were used to compare differences in perceptions of food access by demographics—sex, age group, household income, own versus renting home, SNAP benefits in past 12 months, children under 18 in household, and body mass index (BMI, kg/m²)—and by each of the four food access measures. To identify demographic and neighborhood characteristics independently associated with each of the four food access measures, multivariate logistic regression models were used. The dependent variables were overall food access, ease of purchase, selection and quality, and affordability, and the covariates in the final model included sex, age, household income, and the perceived neighborhood characteristics of social cohesion, walkability, and crime. Odds ratios and their corresponding 95% confidence intervals are reported, with significance indicated by 95% confidence intervals that do not include 1.

► RESULTS

Among the 1,392 households with valid addresses, 586 surveys were completed (42% response rate). Two percent opted out ($n = 25$) and 244 were excluded due to vacant addresses. The demographic characteristics are presented in Table 1. In summary, the majority of respondents self-reported as White, as female, and with at least some college or vocational training. Almost a quarter (22.0%) had children living at home, 48.0% had an annual household income of less than \$40,000, and 18.0% received SNAP benefits. Approximately 59.0% of respondents were overweight (BMI 25.0 to <30) or obese (BMI 30.0 or higher) and 63.0% reported consuming less than five servings of FVs daily in the past month.

The mean “walkability” composite score was 3.3 (SD = 0.8, range: 1-5), crime score was 3.5 (SD = 1.0, range: 1-5), and social cohesion score was 3.5 (SD = 0.8, range: 1-5). Over half (53.6%) of respondents perceived their neighborhood as having high walkability, 48.3% low crime, and 51.6% high social cohesion.

Table 2 presents data on food access. Overall, 36.9% of respondents had high food access, positively responding to all seven food access–related statements. The majority agreed that it was easy to purchase fresh FVs (69.7%) and LFPs (76.3%) in their neighborhood (67.2% agreed to both). Over two thirds agreed that there was a large selection of fresh FVs (70.0%) and LFPs (71.0%) available, and 57.9% agreed fresh FVs were of high quality (54.3% agreed to all three items). About half agreed that fresh FVs (51.2%) and LFPs (47.2%) were reasonably priced (42.8% agreed to both

affordability items). However, older individuals (65+), homeowners, respondents from households with higher incomes ($\geq \$40,000$) and those who did not receive SNAP benefits reported overall greater food access. Specifically, 73.3% of those with household incomes of $\geq \$40,000$ indicated having ease of purchase (vs. 57.6% with income under \$20,000), as did 75.7% of those age 65+ (vs. 63.2 under age 45), and 72.9% of homeowners (vs. 58.1% renters). For food selection and quality, 71.5% of those age 65+ (vs. 39.8% under age 45), 65.4% of homeowners (vs. 36.2% renters), 64.7% of those with income $\geq \$40,000$ (vs. 37.1% under \$20,000), and 57.6% of non-SNAP recipients (vs. 39.0% SNAP recipients) indicated having access to large selection of quality foods. Similarly, some groups were more likely to agree that foods were reasonably priced than others, including 54.6% of those age 65+ (vs. 37.2% under age 45), 50.9% of home owners (vs. 30.7 renters), 53.4% of $\geq \$40,000$ income (vs. 31.2% under \$20,000), and 46.4% non-SNAP recipients (vs. 26.3% SNAP recipients).

Positive neighborhood perceptions were associated with higher perceived food access. Overall, 45.3% of respondents who felt their neighborhood was walkable, 47.4% who perceived low crime, and 47.9% who rated high social cohesion had overall high food access, compared to 27.1%, 26.8%, and 25.2% of those living in areas perceived to have low walkability, high crime, and low social cohesion. This pattern was observed for each of the three food access measures, with respondents living in neighborhoods with more perceived positive characteristics being more likely to report ease of purchase, selection and quality, and affordability. Between 74.7% and 77.9% of those living in neighborhoods with more positive features reported ease of purchase compared to between 57.1% and 58.7% of those with less favorable characteristics. About 63.0% to 66.1% also reported selection of high-quality foods compared to 42.1% to 44.1% of respondents from neighborhoods with less favorable characteristics. Between 50.8% and 53.3% of those living in more favorable areas had access to affordable foods compared to about 33% of others.

Perceived high walkability (odds ratio [OR]: 1.6), low crime (OR: 1.7), and high social cohesion (OR: 1.7) were associated with ease of purchase of FVs and LFPs (Table 3). Positive neighborhood characteristics were also significantly associated with having greater selection of high-quality foods (high walkability OR: 1.8; low crime OR: 1.6; high social cohesion OR: 1.7), while controlling for age and income, which remained significant factors (age 65+ OR: 3.7; age 45-64 OR: 2.0; income \$40,000+ OR: 2.7). Similarly, high walkability (OR: 1.6) and low crime (OR:

TABLE 1
Characteristics of 2014 Survey Respondents and Springfield, Missouri, 2010 U.S. Census Data

<i>Characteristic</i>	<i>Survey Respondents, N = 586</i>		<i>Springfield, Missouri, N = 159,621</i>	
	n	%	n	%
Total	586	100	159,621	100
Sex				
Male	180	31.5	77,326	48.5
Female	392	68.5	82,172	51.5
Mean age in years (range)	53 (19-96)			
Age, years				
18-45	193	34.7	107,201 ^d	67.2 ^d
45-64s	399	37.0		
≥65	158	28.4	23,127	14.5
Hispanic/Latino				
Yes	11	2.0	5,851	3.7
Race				
White	542	92.5	146,257	91.7
Non-White	50	8.5	15,141	9.6
Highest degree or level of school completed				
High school	141	24.7	42,385	42.2
Some college or vocational training	223	39.0	26,183	26.0
Completed college or graduate school	208	36.4	25,863	25.7
Approximate annual household income, \$ ^a				
<20,000	132	22.5		
20,000-39,999	151	25.8		
≥40,000	193	32.9		
I would prefer not to say	110	18.8		
SNAP recipient household	103	18.1	10,416	14.9
Home ownership	341	60.7	34,729	49.6
Average no. of people in household	2.2		2.1	
Households with > 1 child under 18	130	22.2	25,311	15.9
Households with >1 drivable motor vehicle	530	90.4	63,830	91.0
Body mass index category ^b				
<18.5 (underweight)	14	2.6	111	1.9
18.5-24.9 (normal weight)	204	38.5	1998	32.6
25.0-29.9 (overweight)	142	26.8	2319	35.1
≥30.0 (obese)	170	32.1	2018	30.4
Fruit and vegetable intake, servings/day ^c				
<5	345	62.6		
≥5	206	37.4		

NOTE: SNAP = Supplemental Nutrition Assistance Program.

^aMedian household income for Springfield per the U.S. Census is \$33,379. ^bBody mass index data in Springfield column is for the state: Behavioral Risk Factor Surveillance System prevalence and trends data, Missouri 2013, overweight and obesity (body mass index). Retrieved from <http://apps.nccd.cdc.gov/BRFSS/display.asp?cat=OB&yr=2012&qkey=8261&state=MO>. ^cMeasure was created from two questions: (1) On average, how many servings of vegetables did you eat per day (not including potatoes) and (2) How many servings of fruit (including 6 ounces of 100% fruit juice) did you eat per day? ^dCensus data combine age-groups to include 18 to 64 years

TABLE 2
Comparisons of Positive food Access Scores by Respondent Characteristics and Perceived Neighborhood Walkability, Crime, and Social Cohesion

<i>Characteristic</i>	<i>% With Ease of Purchase</i>	<i>% With Large Selection and Quality</i>	<i>% With Affordability</i>	<i>% With Overall High Food Access Items</i>
Overall	67.2	54.3	42.8	36.9
Respondent/household characteristics				
Gender				
Male	64.8	53.4	44.6	37.4
Female	68.2	54.2	41.8	36.3
Age-group (years)				
<45	63.2	39.8	37.2	27
45-64	64	53.3	38	34.2
65+	75.7*	71.5***	54.6**	50***
Own/rent home				
Own	72.9	65.4	50.9	46.7
Rent	58.1**	36.2***	30.7***	21.3***
Annual household income, \$				
<20,000	57.6	37.1	31.2	21.9
20,000-39,999	67.1	54.1	37.9	31.3
≥40,000	73.3	64.7	53.4	49
Unreported	67.6*	55.8***	43.9**	39.8***
SNAP benefits in the past 12 months				
No	68.7	57.6	46.4	40.1
Yes	60.4	39**	26.3**	22.9**
Body mass index overweight/obese				
No	70.7	50.7	43.1	35.4
Yes	65.0	55.6	42.7	37.7
Household with children age < 18 years				
No	68.0	55.7	44.4	37.8
Yes	64.3	49.2	37	33.6
5 or more servings fruits and vegetables consumed daily				
No	65.8	51.2	37.2	32.2
Yes	68.6	58.3	51.7**	43.6**
Perceived neighborhood characteristics				
High walkability				
No	58.7	44.1	33.5	27.1
Yes	74.7***	63***	50.8***	45.3***
Low crime				
No	57.1	43.1	32.9	26.8
Yes	77.9***	66.1***	53.3***	47.4***
High social cohesion				
No	57.8	42.1	32.7	25.2
Yes	76.3***	65.7***	52.4***	47.9***

NOTE: SNAP = Supplemental Nutrition Assistance Program.

* $p < .05$. ** $p < .01$. *** $p < .0001$.

TABLE 3
Adjusted Odds Ratios From Multivariate Regression Modeling: Respondent and Perceived Neighborhood Characteristics Associated With Food Access

<i>Characteristic</i>	<i>Ease of Purchase</i>	<i>Large Selection and Quality</i>	<i>Affordability</i>	<i>Overall Food Access</i>
Respondent/household characteristics				
Gender				
Female (reference: male)	1.42 [0.94, 2.13]	1.42 [0.95, 2.14]	1.01 [0.68, 1.5]	1.19 [0.78, 1.80]
Age, years (reference: <45)				
45-64	1.1 [0.71, 1.7]	1.95 [1.26, 3.02]*	0.99 [0.64, 1.54]	1.42 [0.89, 2.27]
65+	1.62 [0.97, 2.68]	3.73 [2.27, 6.14]***	1.76 [1.1, 2.8]*	2.44 [1.48, 4.00]**
Annual household income, \$ (reference: <20,000)				
20,000-39,999	1.37 [0.81, 2.32]	1.93 [1.12, 3.3]*	1.17 [0.68, 2.00]	1.47 [0.8, 2.7]
≥40,000	1.56 [0.93, 2.62]	2.65 [1.57, 4.48]**	2.00 [1.19, 3.35]**	2.89 [1.63, 5.12]**
Unreported	1.14 [0.62, 2.09]	1.37 [0.75, 2.53]	1.36 [0.74, 2.49]	1.72 [0.89, 3.33]
Perceived neighborhood characteristics				
High walkability (reference: low)	1.62 [1.11, 2.37]*	1.8 [1.24, 2.63]**	1.62 [1.12, 2.34]*	1.78 [1.2, 2.64]**
Low crime (reference: high)	1.73 [1.15, 2.61]**	1.55 [1.04, 2.3]*	1.55 [1.05, 2.29]*	1.47 [0.97, 2.21]
High social cohesion (reference: low)	1.68 [1.12, 2.5]*	1.65 [1.11, 2.43]*	1.45 [0.99, 2.14]	1.69 [1.12, 2.54]*

NOTE: Adjusted odds ratios from multivariate regression modeling reported along with corresponding 95% confidence intervals.

* $p < .05$. ** $p < .01$. *** $p < .0001$.

1.6) were associated with having greater perceived affordability of foods, as was being age 65+ (OR: 1.8) or having an income of ≥\$40,000 (OR: 2.0). Overall, high walkability (OR: 1.8) and high social cohesion (OR: 1.7) were significantly associated with having high food access, as were being age 65+ and having an income of ≥\$40,000.

► DISCUSSION

Compelling evidence suggests that healthy food access is an important component to promoting health and improving health outcomes. Independent of income and age, which influence ability to purchase healthy foods, adjusted odds ratios showed that neighborhood characteristics remained strongly associated with food access scores. Understanding how to alter the environmental features that influence behaviors like eating is important and supports policy makers and practitioners in applying best practice strategies. In this study, high walkability, low crime, and high social cohesion were associated with reported ease of purchase,

having a large selection and quality, and affordability of FVs. Moreover, this study found that respondents with higher household incomes had overall greater food access, thus underscoring the importance of income and resources when considering food access.

Researchers have posited that proximity to food outlets might increase FV consumption since it not only enhances healthy food options but also makes it easier to purchase perishable food more frequently (Zick et al., 2009). In particular, research has shown that supermarkets provide access to a greater variety of and higher quality healthy foods than other retailers, and that there is increased consumption of healthy foods such as FVs in areas with more supermarkets (Morland et al., 2002). Thus, many studies of food access have focused on area-based measures such as distance to the closest grocery store (Food Research and Action Center, 2011). For this study, respondents generally reported high levels of access to grocery stores—about 90% said they shopped at a supermarket at least twice a month. However, nearly two thirds of respondents reported consuming less than five servings of FVs daily

over the past month. These findings are consistent with other studies that claim that geographic access to food is only one element of consumption (Sadler, Gilliland, & Arku, 2013) and that purchasing decisions are often made in a context of competing demands (e.g., housing, transportation), especially when resources are scarce (Kirkpatrick & Tarasuk, 2011).

Even when FVs are seemingly easy to purchase and individuals report having access to a large selection of high-quality foods, price and affordability strongly influence food purchase and consumption patterns (DiSantis et al., 2013). Less than half of respondents reported that fresh FVs were affordable and reasonably priced in their neighborhood. Research has shown that households with limited resources often try to maximize their calories per dollar to avoid hunger (DiSantis et al., 2013). In the present study, those reporting less affordability of FVs were less likely to meet the FV recommendation as compared to those reporting high access to affordable foods. These findings suggest that in addition to supplemental assistance to those with lower incomes, structural changes to the neighborhood environment that improve walkability and lower crime can support access to and consumption of healthy foods.

Our data found differences in food access depending on respondents perceived neighborhood walkability (greater access associated with greater walkability). Neighborhoods designed to encourage walking may promote accessibility to affordable food outlets. However, when communities lack features that promote walking and biking, residents must rely on a car, spend significant amount of time traveling, or shop locally (with limited choice) to purchase food (Clifton, 2004). Studies have found that neighborhoods with greater walkability have a lower prevalence of overweight and obesity (Creatore et al., 2016; Smith et al., 2008), thereby underscoring the importance of the built environment, particularly walkability.

High crime rates are a growing threat to public safety and wellbeing (Husney, 2014). Almost half of study respondents reported a sense of unease about neighborhood safety. Our data found significant differences in crime and food access such that those with low perceptions of neighborhood crime reported higher access to healthy food than those with high perceptions of crime. Neighborhood safety can affect the affordability of foods in several ways. Crime, or perceptions of crime, may deter supermarkets or grocery stores from establishing or remaining in an area or may increase operation costs that are translated into higher prices and less affordability for residents (Bell & Rubin, 2007). Higher prices, in addition to perceived or real crime near grocery stores, can deter shoppers, reduce sales revenues, and make it difficult for store owners to stock perishable, healthy

foods at affordable prices (Bell et al., 2013). From a consumer perspective, concerns about personal safety along the shopping route can influence decisions about whether or not to shop at certain stores. Cannuscio et al. (2014) found that participants avoided areas they perceived as dangerous due to fear and a sense of vulnerability. When pedestrians feel unsafe, they may patronize more distant stores. From a societal point of view, when customers shop outside of their neighborhoods, they are not supporting local businesses and generating taxes to support social services and community infrastructure (Bell et al., 2013). Moreover, higher crime rates may result in a diversion of tax revenue from government services that support food access to fund law enforcement and correctional facilities (Husney, 2014). Reduced pedestrian traffic near a store and/or overall poor social cohesion may also weaken informal social controls and the way people experience the food environment.

Fear of safety can result from physical signs of neighborhood disorder such as litter, graffiti, and broken lighting/fences. Infrastructure is more difficult to repair in areas with diminished tax revenue. Moreover, these attributes are uninviting and discourage outdoor activities, thus limiting the number of people and “eyes” on the streets (Cohen, Davis, Lee, & Valdovinos, 2010). Community-wide fear resulting from violence can lead to feelings of distrust, suspicion, seclusion, minimal social interactions (Cohen et al., 2010), and a consequent underutilization of local health promoting assets. Our findings suggest that these social cohesion-type factors may be related to food access in Springfield. A greater proportion of respondents with perceived high social cohesion had high food access as compared to those who reported low social cohesion.

This study has limitations. It is a cross-sectional study that provides a snapshot of the targeted community at one point in time and therefore findings may not be generalizable to areas outside of Springfield, Missouri. Furthermore, respondents were more likely to be female, older, more educated and home owners as compared to the overall population of Springfield, thereby potentially limiting generalizability to the city at large. Food access and neighborhood characteristics are based on respondent perception and may or may not reflect actual access, availability, or affordability and characteristics of the environment. These findings help further understand contextual factors that may affect individual access.

► IMPLICATIONS FOR RESEARCH AND PRACTICE

Improved access to healthy foods is the target of current initiatives and policies intended to promote

individual and community health and well-being. Findings from this study suggest that broader measures of food access be used, and support the inclusion of food access in broader community efforts. As it relates to healthy community design, advocating for zoning laws that support mixed land use creates opportunity for food retailers and residents to be in close proximity, thereby increasing food access and theoretically driving down the cost of healthy food. In addition, policy makers could impose moratoriums on the number of fast-food restaurants, which largely provide unhealthy food, and increase fresh food options by providing funding to grocers to locate in low-income neighborhoods and food deserts.

Low-income people are more likely to face challenges accessing food, and particularly in less walkable communities, vehicle ownership and its associated costs may be one competing factor (U.S. Department of Agriculture, 2010). Associated transportation costs can cut into the limited budget and resources of low-income households (Food Research and Action Center, 2011). To date there have not been studies aimed at reducing transportation costs competing with the food budget, such as a transportation benefit for working SNAP participants, improved public transit on routes to supermarkets, and carpooling campaigns. These efforts in combination with interventions such as bonuses and vouchers for healthy food warrant investigation.

Efforts to increase access to affordable, healthy foods have the potential to reduce crime and increase neighborhood safety, improve walkability, and promote social and community cohesion. For example, crime and vandalism rates have dropped in areas where community gardens have been built (U.S. Department of Agriculture, Economic Research Service, 2017). Moreover, community gardens bring people out into the community and encourage social cohesion and positive interactions. Similarly, infrastructure maintenance like sidewalk improvements and lighting along roads where food retailers are located as well as new bus routes from areas with low access to food retailers could improve access and increase traffic, including by foot, to these stores. Generating revenue within the community can result in commercial revitalization, local job creation, and improved economic and community development.

Our findings demonstrate the importance of defining food access beyond physical location to include the availability of high-quality healthy foods that are affordable. While levels of social cohesion, walkability, and crime may vary across communities, our study shows their association to healthy food access. Across the United States, advocacy and policy efforts to ensure

equitable access healthy, affordable foods should address social cohesion, walkability, and crime, especially in neighborhoods where these factors seem problematic. An increased awareness of the linkage between food access and social cohesion, walkability, and crime will help build the necessary cross-sectoral community engagement and support needed to address the complex problems communities across the United States are facing. Although these findings strengthen the knowledge around food access, additional research looking at social cohesion, walkability, and crime in other cities and towns is warranted.

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