HHS Public Access

Author manuscript

Soc Sci Med. Author manuscript; available in PMC 2016 November 01.

Published in final edited form as:

Soc Sci Med. 2015 November ; 144: 1–8. doi:10.1016/j.socscimed.2015.09.004.

Exploring ecological, emotional and social levers of self-rated health for urban gardeners and non-gardeners: A path analysis

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Abstract

Rationale—The social, emotional, and mental health benefits associated with gardening have been well documented. However, the processes underlying the relationship between garden participation and improvements in health status have not been sufficiently studied.

Methods—Using population-based survey data (n = 469 urban residents), objective street environment data, and area-level measures, this research used a path analytic framework to examine several theoretically based constructs as mediators between gardening history and self-reported health.

Results—The results showed that garden participation influenced health status indirectly through social involvement with one's community, perceived aesthetic appeal of the neighborhood, and perceived collective efficacy. Gardeners, compared to non-gardeners, reported higher ratings of neighborhood aesthetics and more involvement in social activities, whereas aesthetics and involvement were associated with higher ratings of collective efficacy and neighborhood attachment. Collective efficacy, but not neighborhood attachment, predicted self-rated health. Gardening also directly influenced improved fruit and vegetable intake. The physical and social qualities of garden participation may therefore stimulate a range of interpersonal and social responses that are supportive of positive ratings of health.

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Conclusion—This research suggests that community planners and health professionals should aim to strengthen the social and aesthetic relationships while designing environments and policies as a way to ignite intermediate processes that may lead to improved health status.

Keywords

gardening; self-rated health; built environment; collective efficacy; aesthetics; social involvement; neighborhood attachment

Introduction

Over the past decade, there has been growing interest by the public health and planning communities to better understand how modifications to the built environment and related policies influence obesity, other chronic diseases and overall health (Cummins, Curtis, Diez-Roux, & Macintyre, 2007; Diez Roux, 2003; Jackson & Kochtitzky, 2003; Northridge, Sclar, & Biswas, 2003; Sallis et al., 2006; Srinivasan, O'Fallon, & Dearry, 2003). What is largely absent from the scientific literature is empirical research that examines the underlying ecological, emotional, and social processes that help realize the community health benefits from physical and natural features of the local environment (Blacksher & Lovasi, 2012; Pereira et al., 2013; Wood, 2008).

Food producing landscapes including gardens in urban, suburban or rural settings (e.g., community or allotment gardening) (American Community Gardening Association, 2010), home gardens, and community farms represent model neighborhood environments and behavior settings through which we can explore processes that may be crucial in explaining how affordances of the built environment influence health behaviors and health status in a lasting way. Food producing landscapes, such as gardens, which support micro-social organizations within neighborhoods, may represent an important combination of physical improvements and social engagement to support healthy behaviors and healthy communities (Cattell, Dines, Gesler, & Curtis, 2008; R. Sampson, Raudenbush, & Earls, 1997). As a way to dig further into the relationships between built, social, and health environments, this research is focused upon understanding connections between ecological, emotional, and social processes, and health, in urban gardens. This is done through investigating the pathways by which gardening influences self-rated health.

The Benefits of Gardening

The social, emotional, and mental health benefits associated with gardening have been well documented. Kaplan and others pioneered the idea that gardening contributes to mental health among home and community gardeners (Kaplan, 1973). A comprehensive review of the scientific literature on recreational gardening demonstrated that gardening improves mental health status through reduced levels of stress hormones (K. H. Brown & Jameton, 2000). Milligan and others have documented therapeutic benefits of communal gardening on allotments among older adults (Milligan, Gatrell, & Bingley, 2004). Others have documented the cognitive, social, and community benefits of gardening among school-aged children through changes in children's confidence, self-esteem, attitudes and learning (Bowker & Tearle, 2007).

Moreover, several studies have demonstrated the role of gardens in shaping health behaviors. For example, Park and others showed that gardening was an effective way for adults to meet the national guidelines for moderate to vigorous physical activity (Park, Shoemaker, & Haub, 2009). In other studies, urban gardeners reported fruit and vegetable intake levels that met national guidelines for fruit and vegetable consumption (Alaimo, Packnett, Miles, & Kruger, 2008; Litt et al., 2011). The increase in fruit and vegetable consumption for all gardeners was almost two times larger than the increase seen across most other published interventions (Ammerman, Lindquist, Lohr, & Hersey, 2002; Thomson & Ravia, 2011).

While there is ample evidence to demonstrate the benefits of gardening, understanding the processes that link garden participation and improvements in health status are not well understood. We posit that gardens impact self-rated health through key ecological, emotional, and social intervening processes, specifically through aesthetics, social involvement, collective efficacy, and neighborhood attachment. Our research draws on multiple theoretical frameworks including ecological system (Bronfenbrenner, 1979; Stokols, 1996), social capital (Carpiano, 2006; Kawachi & Berkman, 2000), social cognitive (Bandura, 1986) theories and the relational nature between people and places (Carolan, 2007; Conradson, 2005; H. Frumkin, 2005; Gesler, 1992; Hartig, 2014; Kaplan & Kaplan, 2005). Together, this multi-theoretical approach recognizes the range of influences on health at intrapersonal, interpersonal, cultural, organizational, and environmental levels.

Levers of Change: Aesthetics

Aesthetic experiences help us understand the relational unfolding between people and places, such as the relationships between nearby nature (e.g., trees, green space) and neighborhood perceptions (e.g., perceived safety) (F. E. Kuo & Sullivan, 2001; Frances E. Kuo, Bacaicoa, & Sullivan, 1998) and health outcomes (e.g., obesity) (Pereira et al., 2013). These experiences occur at the individual and collective levels, are multisensory and play a key role in the development of environmental knowledge and in everyday engagement in one’s surroundings (Capaldi, 2014; Foster, 2009; Hale et al., 2011; Neves, 2009).

Gardens are spaces that foster a sense of beauty among residents and encourage direct engagement in natural and social processes over time. By providing an alternative to city noise, pollution and heat, for example, urban gardens provide hands-on learning about the biophysical system that supports plants, animals and microorganisms and a range of social and emotional processes associated with growing food in the garden (Hale et al., 2011; Neves, 2009). The tactile experience of gardening helps to embed individuals within these alternative social and natural worlds and, in turn, also helps embody a deeper awareness of others and the local environment (Carolan, 2007, 2011; Conradson, 2005; Milligan et al., 2004).

The garden experience also promotes social and civic learning as gardeners watch each other, ask questions, work together, make decisions, experiment and share results. This is rooted in a shared commitment toward the garden, and this commitment is not static. For example, it is shaped by formal workdays where aesthetics, ethics, and routines are shared, as well as regular garden-related activities and experiences, such as sharing seeds or plant

knowledge, all of which are sustained through evolving interpersonal relationships and trust (Glover, Parry, & Shinew, 2005; Hale et al., 2011; Teig et al., 2009).

We posit that the aesthetic experiences in community gardens generate meaning that encourages further engagement in garden-specific and neighborhood level activities, ignites strong emotional bonds to place (e.g., neighborhood attachment) (Arnberger & Eder, 2012; Hale et al., 2011) and develops positive social experiences (de Vries, van Dillen, Groenewegen, & Spreeuwenberg, 2013; Hale et al., 2011; Maas, van Dillen, Verheji, & Groenewegen, 2009; S. Wakefield, Yeudall, Taron, Reynolds, & Skinner, 2007). Such processes relate to attitudinal and behavioral changes (Alaimo et al., 2008; Carolan, 2007; Hale et al., 2011; Lindstrom, Hanson, Wirfalt, & Ostergren, 2001; Litt et al., 2011), overall quality of life (Foster, 2009; Hale et al., 2011; Wood, 2008), and improvements in health conditions (Cohen, Finch, Bower, & Sastry, 2006; Pereira et al., 2013).

Levers of Change: Social Involvement

Social involvement fosters access to social resources and social learning and helps define and reinforce meaningful social roles (Berkman & Glass, 2000; Hale et al., 2011; Litt et al., 2011). Behavioral settings associated with leisure activities that require active and sustained participation can lead to deeper engagement in civic life (Glover, Shinew, & Parry, 2005; Hemingway, 1999). Studies of community gardening show that the process of direct participation and social engagement promotes individual ownership of and commitment to the garden structure, enhances community engagement, and empowers residents to get involved on a variety of civic issues (Alaimo, Reischl, & Ober-Allen, 2010; Delind, 2002; Litt et al., 2011; McIvor & Hale, 2015; Teig et al., 2009; Travaline & Hunold, 2010). Glover and others found that strong social relationships formed within community gardens facilitated social organization and increased community capacity for accessing resources and social learning (Glover, Parry, et al., 2005). Such involvement seeds the formation of trust and reciprocity, which are necessary ingredients for collective action and exercising informal social control (Anselin, 1995; Subramanian, Kim, & Kawachi, 2002; Teig et al., 2009).

Levers of Change: Collective Efficacy

Defined by Sampson and others, collective efficacy is “the link between mutual trust and a shared expectations to intervene for the common good of the neighborhood (R. J. Sampson & Raudenbush, 1999; R. Sampson et al., 1997).” Social cohesion and informal social control are the two major tenets of collective efficacy (R. Sampson et al., 1997). This concept reflects the neighborhood conditions that help actualize social networks to achieve desired outcomes (Rose & Clear, 2001). That is, neighborhood collective efficacy reflects the process by which social resources, such as trust, cohesion, shared norms and values, and informal control, are translated into specific social and health outcomes such as public order, obesity, and self-rated health (Browning & Cagney, 2002; Cohen et al., 2006; Hartig, 2014; R. J. Sampson, Morenoff, & Earls, 1999; R. Sampson et al., 1997). Within the health context, collective efficacy may contribute to positive health outcomes by regulating health-compromising behaviors, increasing access to health-related facilities, managing neighborhood physical hazards and risky conditions, and strengthening social psychological

processes such as trust and neighborhood attachment (Browning & Cagney, 2002; Kawachi & Berkman, 2000).

While there is evidence to suggest the positive role collective efficacy plays in shaping health outcomes (Cohen et al., 2006), there is less clarity about the factors that generate collective efficacy. Research has shown that resident involvement in neighborhood organizations and other cooperative experiences that strengthen social networks support the development of generalized trust (Fong & Chang, 2011; Howard Frumkin, 2001; Glover, Parry, et al., 2005; Glover, Shinew, et al., 2005; Hemingway, 1999). Sampson's early conceptualization of collective efficacy has relevance to understanding the processes by which gardens generate collective efficacy (R. Sampson et al., 1997). Community gardens, as one example of a neighborhood-level social organization, tap into psychological processes that foster norms of trust, solidarity and reciprocity by creating feelings of being part of a community (Glover, Parry, et al., 2005; Sempik & Aldridge, 2005), reciprocity between individual and community (Hale et al., 2011; Teig et al., 2009), sharing history (Hale et al., 2011) and developing bonds through the relationships that develop in the community garden (Comstock et al., 2010). Gardens also help build social networks by facilitating involvement in community life (Alaimo et al., 2010; Glover, Parry, et al., 2005; Teig et al., 2009), deriving community benefits from participation in the community garden, and furthering feelings of connectedness and belonging (Knudsen & Clark, 2013; Wiles, Leibing, Guberman, Reeve, & Allen, 2012). We posit that garden-generated ecological and social processes lead to the generation of collective efficacy.

Levers of Change: Neighborhood Attachment

Understanding environment-health relationships requires consideration of place and one's emotional connection to social and physical surroundings, also referred to as neighborhood attachment (B. Brown, Perkins, & Brown, 2003, 2004). City planners, geographers, and community development planners have long been interested in attachment because of its role in promoting pro-social and environmental behaviors (Manzo & Perkins, 2006; S. L. Wakefield, Elliot, Cole, & Eyles, 2001) and its relationship with lower perceived incivilities, lower fear of crime, and greater social cohesion and control (e.g., collective efficacy) (B. Brown et al., 2003). Emotional bonds to place can be influenced by individual interactions with physical features and structures within a neighborhood (e.g., community garden) and the informal and formal social ties within a particular place (e.g., gardener to gardener) (S. Wakefield & McMullan, 2005; S. Wakefield et al., 2007). For example, studies have demonstrated that individual perceptions of quality of public green space (Arnberger & Eder, 2012) and garden participation (Comstock et al., 2010) were associated with positive attachments to place. Moreover, others have shown that individual reports of friendly relationships with neighbors were associated with higher neighborhood attachment (Mesch & Manor, 1998). Brown and others showed that individuals who had higher ratings of collective efficacy also felt stronger attachments to place (B. Brown et al., 2003).

While there are different facets of attachment, we focus on neighborhood attachment because of our interest in how neighborhood environments shape health status. Moreover, we are interested in the role of the natural environment in shaping attachment processes

(Lewicka, 2011). We postulate that garden participation may strengthen people's emotional connections to their neighborhoods through positive environmental aesthetic experiences, social involvement (Arnberger & Eder, 2012; Comstock et al., 2010; Conradson, 2005; Lewicka, 2011; Scannell & Gifford, 2010) and collective efficacy (B. Brown et al., 2003).

Model Overview

This research helps to elucidate the more proximal outcomes related to gardening and the direct and indirect pathways by which gardens influence self-rated health. We examined how gardening influences fruit and vegetable intake and self-rated health directly as well as how it influences health through neighborhood aesthetics, social involvement, collective efficacy, and neighborhood attachment. Specifically, we proposed relationships among constructs where we expected neighborhood aesthetics and social involvement to influence self-rated health through collective efficacy (de Vries et al., 2013; Teig et al., 2009) and neighborhood attachment (Arnberger & Eder, 2012); (Comstock et al., 2010). As described above, aesthetics and social involvement represent early psychosocial processes that support feelings of place attachment and social cohesion and informal social control (Arnberger & Eder, 2012; de Vries et al., 2013; Hale et al., 2011; Teig et al., 2009). Finally, in addition to examining the direct relationship between collective efficacy and self-rated health, this model examined the role of neighborhood attachment in mediating the relationship between collective efficacy and self-rated health.

Method

Study Design and Sample

We collected data for this cross-sectional study between October 2006 and November 2007 in Denver, Colorado. We used a multi-frame sampling design, which consisted of an area-based sample of the general population and a list-based census of community gardeners with a recruitment goal of 480 total households. The available sampling frame included 1,454 households. Within the area-based sample, we randomly selected 1,154 households from 40 block groups to participate in the survey. Within the list-based sample, we enumerated all gardens within the study area and randomly selected 13 community gardens to participate in the survey. From there, we selected 300 gardeners associated with these gardens to participate in the survey. One eligible respondent was randomly selected from each household to complete the survey using the "most-recent-birthday" method. Among the total 1,454 housing units within the sample, 1,437 households (99%) were visited by study employees; 799 of these housing units (56%) were physically accessible. Among homes visited, $n = 469$ households, nested within $n = 92$ block groups, participated in the study (59% response rate). The Colorado Multiple Institutional Review Board approved this study.

Data Collection

We employed two primary methods of data collection. First, we conducted a 45-minute face-to-face survey at or near the home of sampled English- or Spanish-speaking adults aged 18 years or older. Written consent was obtained from the respondent prior to survey administration. Second, we conducted neighborhood audits to objectively measure physical and social environments for each respondent. Trained data collectors assessed the street

environment by auditing both sides of the “face block” between two intersecting streets on which the study participant lived.

The survey instrument was developed using existing questions on aesthetics (Saelens et al., 2003), social cohesion, informal social control and incivilities (Sampson et al., 1997), place attachment (Bonaiuto et al., 1999), and dimensions of health (Centers for Disease Control and Prevention, 2005). The neighborhood audit included measures of respondents’ residential environments. The measures used in our audit were based on measures previously evaluated for validity and reliability (Caughy et al., 2001). For this analysis, we included a measure of objective incivilities as a proxy for neighborhood upkeep. Details about the survey methodology, survey measures, and neighborhood audit instruments are described elsewhere (Comstock et al., 2010; Litt et al., 2011). Study measures are described below.

Measures

Self-rated health—A single item from the Behavioral Risk Factor Surveillance System (BRFSS) asked respondents to rate their general health on a scale of 1 (*Poor*) to 5 (*Excellent*) (Centers for Disease Control and Prevention, 2005). This item has been shown to be a reliable and valid predictor of health status (Fayers & Sprangers, 2002).

Fruit and vegetable intake—Six survey items from the BRFSS asked respondents about frequency (per day, week, or month) of intake of green salad, non-fried potatoes, carrots, other vegetables, fruit juice and whole fruits (Blanck et al., 2007). From these responses, we created an index of fruit and vegetables consumption by summing the frequency of consumption of these six items (times/day). Participants were not given a definition of serving size.

Gardener status—Survey items asked, “Do you garden?” Respondents who answered yes to this question were then asked whether they gardened at home (n = 215) (or at a neighbor’s home) or in a community garden (n = 63). From these responses, we categorized survey respondents as gardeners (59%) or non-gardeners (41%).

Theoretical constructs—*Perceived neighborhood aesthetics* was based on six items (alpha = .76), where respondents were asked to rate (1 = strongly disagree to 4 = strongly agree) the presence of trees, shade, litter, interesting things to look at while walking, attractive natural sights, and attractive buildings in the neighborhood (Saelens, Sallis, Black, & Chen, 2003). *Social Involvement* consisted of 4 items (alpha = .73) where respondents indicated whether they participated in local activities, including communications with local elected officials regarding neighborhood problems, participation in neighborhood meetings, whether residents talked to a religious leader or minister, and whether residents participated in neighborhood meetings related to public education (RJ Sampson & Graif, 2009). The *collective efficacy* measure was based on items related to social cohesion and informal social control and included twelve items (alpha = .90), using a 4-point Likert-type scale, that rated characteristics of people in the neighborhood, such as close-knit, willing to help their neighbors, watching out for children, sharing the same values, and knowing each other (R.

Sampson et al., 1997). *Neighborhood attachment* was measured with six items (alpha = .86) that assessed degree of disagreement/agreement (scored 1 to 4) that the neighborhood is "the ideal neighborhood to live in," "is a part of me," has places "to which I am very emotionally attached," and "is hard to leave" (Bonaiuto, Aiello, Perugini, Bonnes, & Ercolani, 1999).

Covariates—Potential covariates were identified based on theoretical interest, relationship to self-reported health, and/or relationship to gardening status. Covariates modeled at the individual level included participant age, highest year of school completed, and years lived in current neighborhood (six categories from 1–2 years to 38 years or more). Income was not included in the models due to the large number of missing responses (n = 42) and its significant correlation with education level. Neighborhood level covariates were percent of college-educated persons living in the neighborhood and a measure of observed incivilities in the neighborhood. Because block-group education and poverty data were highly correlated, block-group education was selected as our proxy for block-group socioeconomic status (Comstock et al., 2010).. The neighborhood-level observed incivilities measure was derived from the neighborhood audit and represents the mean of six ratings (alpha = .61) by external observers, describing the condition of buildings and grounds and the presence of vandalism and litter (Caughy, O'Campo, & Patterson, 2001).

Data Analysis

Analyses were conducted using SAS Version 9.2 for descriptive and correlational analyses and Mplus Version 7.2 (Muthén & Muthén, 1998) for path model estimation. Prior to model estimation, the bivariate correlations among all model constructs were examined. We needed to account for the non-independence of observations because individuals were nested within block groups. Models were therefore estimated using a complex sample function that accounts for non-independence by using a sandwich estimator to adjust standard errors and chi-square (χ^2) values. Model relationships on self-reported health were estimated controlling for several individual-level (age, education, and years in neighborhood) and neighborhood-level (percent college educated in neighborhood and observed incivilities in neighborhood) covariates. Path analysis is an extension of multiple regression whereby several regression relationships can be estimated simultaneously (e.g., a variable that is an outcome of one variable may be simultaneously examined as a predictor of another). Models are evaluated in terms of how well the model as a whole fits the data, as well as in terms of the significance of each of the specific proposed relationships. This method provides a way to examine both direct and indirect predictors of self-reported health. Figure 1 depicts the estimated model, where gardening status was estimated as a direct predictor of self-reported health and fruit and vegetable intake and an indirect predictor of self-reported health through aesthetics, social involvement, collective efficacy, and neighborhood attachment. The model was evaluated in terms of the magnitude, direction, and significance of the estimated path coefficients as well as by several standard measures of overall model fit (model χ^2, comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). There was a small amount of missing data, where the sample size of model constructs ranged from n = 445 (94.9% complete) to n = 469 (100% complete). Missing data were addressed by using full information maximum

likelihood, a method that has been shown to be unbiased given the small amount of missing data experienced here (Enders & Bandalos, 2001).

Results

Participant Characteristics

Participant characteristics are shown in Table 1, distinguished by characteristics for $n = 469$ individuals versus $n = 92$ neighborhoods. The majority of individuals in the study were female and college-educated. There were also more gardeners (59.3%) than non-gardeners. The average age was 46.1 years and average time in the home was 2.5 years. In terms of neighborhood characteristics, the average percentage of those college educated was just under half, the average percentage of minority residents was around 25%, and the average percentage of those living in the neighborhood 5 or more years was 40.8%.

Bivariate Correlations

Table 2 depicts the bivariate correlations among all model variables that formed the basis of the estimated path model. All variables were significantly correlated with one another, with effect sizes ranging from small ($r = .16$) to moderate ($r = .55$). The strongest correlates of self-rated health were collective efficacy and aesthetics and the strongest correlates of garden participation were social involvement and aesthetics.

Path Model

The final model results are shown Figure 1. All path coefficients are standardized for ease of interpretation of the magnitude of the effect. Garden participation significantly predicted greater social involvement ($\beta = .36$, $p < .001$), more positive ratings of aesthetics ($\beta = .35$, $p < .001$), and increased times per day of fruit and vegetable consumption ($\beta = .21$, $p < .001$), but did not directly predict self-rated health over and above other model variables ($\beta = .04$, *ns.*). Social involvement and aesthetics both positively predicted collective efficacy ($\beta = .11$, $p < .05$ and $\beta = .46$, $p < .001$, respectively) and higher levels of collective efficacy, in turn, significantly predicted more positive reports of self-rated health ($\beta = .14$, $p < .05$). Aesthetics ($\beta = .27$, $p < .001$), social involvement ($\beta = .12$, $p < .001$), and collective efficacy ($\beta = .29$, $p < .001$) also predicted neighborhood attachment, but neighborhood attachment did not significantly predict self-rated health ($\beta = .04$, *ns.*). The impact of garden participation on self-rated health thus occurred indirectly by way of social involvement, aesthetics, and collective efficacy. This model fit the data adequately ($\chi^2(8) = 24.48$, $p < .001$; CFI = .985; RMSEA = .066 (95% CIs from .037 to .097); SRMR = .03), and accounted for 22% of the variance in self-rated health and 4% of the variance in fruit and vegetable intake. However, there was variability in the size of the effects, where some significant path coefficients represented smaller effects (e.g., the path from social involvement to collective efficacy) while others were larger (e.g., the path from aesthetics to collective efficacy).

Discussion

This study aims to elucidate the processes that may explain how garden participation influences self-rated health. Home and community gardeners, when compared to non-

gardeners, reported higher ratings of neighborhood aesthetics and more involvement in social activities. These processes, in turn, were associated with higher ratings of collective efficacy and neighborhood attachment. Further, collective efficacy was associated with self-rated health, which is consistent with past research (Browning & Cagney, 2002; Teig et al., 2009; Wen, Browning, & Cagney, 2003). The analysis illuminates how a community-level health promotion strategy may tap into the social organization of neighborhoods by way of social involvement and neighborhood aesthetics and such processes support the generation of collective efficacy and ultimately self-rated health.

Activities like gardening provide opportunities to interact with nature, reduce stress, and improve one's overall sense of well being (Hale et al., 2011; Hartig, 2014; Neves, 2009). Gardening represents a promising strategy for health promotion precisely because the primary motivation of individuals who garden is the aesthetic enjoyment of gardening—being outside in nature, helping grow things, getting their hands dirty, the smells and sights, and stress relief (Hale et al., 2011). Gardening also activates processes of learning, trust, and engagement, all of which support emotional and social processes that are fundamental to health promotion (Tidball, 2010). Gardening allows people to gain aesthetic appreciation of their neighborhoods, which may serve as a motivational factor for individuals to get more involved in community life, feel more attached to one's neighborhood, take on community challenges, and mobilize individuals to work with one another (Manzo & Perkins, 2006; Scannell & Gifford, 2010).

The tactile experience of gardening, opportunities to learn from others and contact with nature may serve as important levers in activating resident engagement in health promoting processes. These findings are consistent with broader research on the health and social benefits of nature contact and access to green space. Maas and others found that people living in areas with more green space within 1 km distance of respondent homes had better self-rated health, reported fewer health complaints and had lower propensity for psychiatric morbidity. Importantly, people living in close proximity to more green space (i.e., within a 1 km radius) felt less lonely and perceived adequate social support (Maas et al., 2009). This relationship did not hold when considering a greater distance between respondent's home and area green space (3 km radius), suggesting that green space closer to home may be important for health-promoting processes (de Vries et al., 2013; Maas et al., 2009). Gobster and colleagues refer to the scale at which humans perceive landscapes as the "perceptible realm" (Gobster, Nassauer, Daniel, & Fry, 2007). The garden represents an exemplar of a local "perceptible realm" that supports therapeutic experiences—meaning-making, tactile, emotional, spiritual, and value-driven (Hale et al., 2011). These aesthetic experiences demonstrate the way in which people relate to place and the sensory experiences that give way to health promoting processes and health promotion. In our current analysis, we find that such aesthetic experiences relate to neighborhood attachment, suggesting that the natural and physical environments play a role in shaping neighborhood attachment (Lewicka, 2011; Scannell & Gifford, 2010). Moreover, Arnberger and others show that perceived quality of green space is associated with community attachment, using measures of attachment and aesthetics similar to the measures used in our study (Arnberger & Eder, 2012). While neighborhood attachment did not predict self-rated health over and above other model constructs, the processes and experiences that support neighborhood attachment are

important for strengthening neighborhoods and community development and these processes should be considered by community planners and non-governmental organizations interested in building healthy communities (Arnberger & Eder, 2012; B. Brown et al., 2003; Comstock et al., 2010; Lewicka, 2011; Manzo & Perkins, 2006; Wen et al., 2003).

The findings from this study provide new insights about emotional and social processes that may generate collective efficacy within the garden context and reinforces previous findings about the relationship between collective efficacy and health (Browning & Cagney 2002; Browning and Cagney 2003; Cagney et al. 2005; Collins et al., 2009; Franzini et al. 2005; Poortinga 2006a).

Limitations

There are several limitations that are described below. The use of block groups as our geographic boundary for neighborhood may be incongruous with conceptual definitions of neighborhoods and thus may not accurately capture neighborhood environments and their influence on resident perceptions. However, increasingly, block group level analyses are recognized as an appropriate geography to understand neighborhood influences on health (Krieger, Williams, & Moss, 1997; Perkins, Florin, Rich, Wandersman, & Chavis, 1990).

Gardens are not uniformly distributed throughout Denver, Colorado because the goal of Denver Urban Gardens is to improve access to urban gardens for low income and minority residents. While poverty levels were shown to be higher in block groups with a community garden compared to those without (24.3% versus 17.3%), the percent minority residents was similar between neighborhoods with a community garden (15.1% African American and 32.4% Hispanic) compared to those without a community garden (14.0% African American and 30.1% Hispanic). The potential for selection effects is mitigated because all block groups chosen for the study included a community garden and thus the analyses were focused on comparing gardeners and non-gardeners specifically within neighborhoods where community gardens were present. While the results do not generalize to neighborhoods without a community garden, any systematic differences between neighborhoods with and without a community garden would not impact the observed results. The cross-sectional design of the study only captures a snapshot of attitudes, beliefs, and health and thus precludes deeper understanding about the causal relationships between the variables of interest in our analysis. The proposed relationships among constructs were driven by theory, but plausible alternative configurations of model constructs certainly exist. For example, a path from collective efficacy to aesthetics (rather than the reverse direction) is certainly plausible based on the notion that greater collective efficacy may serve to curb physical disorder; however, our rationale for the current configuration is based on prior research. Specifically, our in-depth interview data show that reasons for initiating gardening include aesthetic experiences of getting one’s hands dirty and being in nature (Hale et al., 2011; Teig et al., 2009). As gardeners engage in these tactile experiences, they report more willingness to participate in other social offerings of the garden through the process of gaining trust and investing in these common spaces (Hale et al., 2011; Sempik & Aldridge, 2005; Teig et al., 2009). Finally, this analysis did not control for prior health status, which may influence the relationships observed in this study. Future studies are warranted to

further explore the causal relationships among the elements of the physical environment, place-based social processes, and self-rated health.

While not necessarily a limitation, it is important to note variability in effect size estimates in the path model. The weaker paths from social involvement to collective efficacy, from social involvement to neighborhood attachment, and from collective efficacy to self-reported health should be interpreted in light of the relatively stronger effects observed in the model. For example, both aesthetics and social involvement significantly predicted collective efficacy, yet the effect from aesthetics was much stronger in magnitude.

This study utilized multiple data collection techniques and sources. Data used in the analysis were collected with a labor-intensive, in-person interview and neighborhood audit process that gathered detailed information about objective features of the neighborhood setting. Such diversification of data collection strategies allowed us to more thoroughly examine relationships among physical, social, and individual characteristics and self-rated health. Readily available secondary data were also incorporated to strengthen the analysis.

Conclusion

Although previous studies have examined the role of the physical attributes of the environment -- sidewalk availability and quality, parks, trails and food retail, as they relate to obesity, diabetes and other chronic diseases -- less is known about the intervening processes that link the physical attributes and the health promoting processes that lead to improved health status of individuals. This study provides empirical support for the notion that greening interventions such urban gardens can enhance health by cultivating several levers of change, including aesthetics, social involvement, collective efficacy, and neighborhood attachment. By articulating the pathways by which gardens enhances self-rated health, gardening organizations and local agency personnel who work on gardening- and greening-related interventions can plan for changes that occur in the short term (direct experience in the garden setting, participation in garden activities and neighborhood meetings), intermediate term (building relationships with fellow gardeners and neighbors), and long-term (health status) (B. Brown et al., 2003; Semenza & Krishnasamy, 2007; Semenza & March, 2009). Partner institutions such as schools, parks, libraries, hospitals, and housing authorities, can develop model strategies to incorporate community gardens into the fabric of their respective work and legitimize gardens as a permanent and valued land use in urban settings. A senior housing official in Denver stated the following:

> “When it came to incorporating urban gardens into the urban infill site redevelopment project [Hope VI], I had to think long and hard because we are dealing with valuable land… but we had to weigh all of the options as far what brings great value to the community … we are not just trying to building housing but create a community. Between resident excitement and working with schools … and bringing in some of our seniors to help buddy up with students …, it [the garden] has taken on a life of its own. When we start to list our project amenities, we are definitely listing the urban garden as one of our true community building

amenities … it's a community builder that we cannot figure out how to replicate in any other way than through this process."

Acknowledgments

The authors gratefully acknowledge the data collectors and analysts, including Wendy Peters-Moschetti, Ian Bates, Laura Diaz, Nick Gruber, Alex Harker, Bettina Haro Oliva, Rosalind May, Lenore Palumbo, Ruth Montoya-Starr, Briony Schnee, Amy Telligman, David Villareal, and Elisa Villareal. We are thankful for the support and guidance from our network of community residents (the Healthy Neighborhood Network), community partners (FrontRange Earth Force and Denver Urban Gardens), and our participatory evaluator (Joy Amulya, PhD). This study was supported by grants from the Centers for Disease Control and Prevention (K01 Award EH-000066-03), the National Institutes of Health (NIH), the National Center for Research Resources (NCRR), and the Colorado Clinical and Translational Sciences Institute (CCTSI) (grant UL1RR025780 and UL1 TR001082). Contents are the authors' sole responsibility and do not necessarily represent official NIH and other aforementioned agencies and organizations.

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Highlights

- We model the relationship between gardening participation and self-rated health.
- We examine indirect social and emotional processes that influence the relationship.
- Gardeners report higher ratings of aesthetics and more social involvement.
- In turn, these processes are associated with higher ratings of collective efficacy.
- Collective efficacy predicted self-rated health.

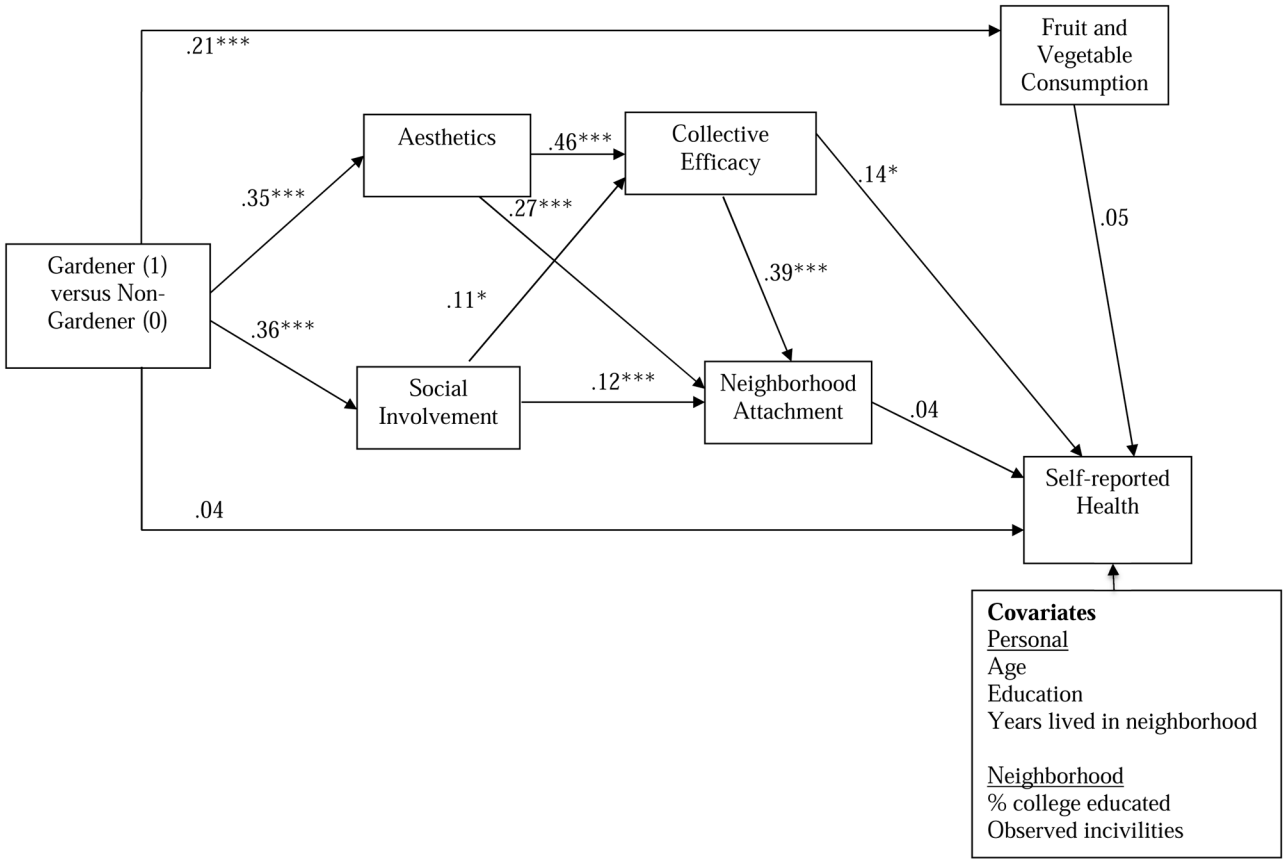

Figure 1.

Path model examining theoretical constructs as intervening variables between garden participation and self-rated health. Model Fit: Chi-square (χ^2; degrees of freedom = 8) = 24.48, $p < .001$; Comparative Fit Index (CFI) = .985; Root Mean Square Error of Approximation (RMSEA) = .066 (95% confidence intervals from .037 to .097); Standardized Root Mean Square Residual (SRMR) = .03. All parameter estimates are standardized. $p < .05$* $p < .01$** $p < .001$***

Table 1

Participant demographic characteristics at the individual- and neighborhood-levels.

Individual Characteristics (n=469)	**M (SD) or N (%)**
Age	46.1 (15.9)
Gender (% Female)	316/469 (67.4%)
Education (% College Educated)	269/469 (57.4%)
Years in Home	2.5 (1.4)
Gardening Status (% Yes)	278/469 (59.3%)
Neighborhood Characteristics (n=92)	Mean (SD)
% College Educated	49.6 (22.4)
% Minority	24.99 (23.4)
% Lived in Neighborhood >=5 Years	40.8 (16.1)
Observed Incivilities	0.59 (0.3)

Note. M=Mean, SD=Standard deviation.

Table 2

Bivariate correlations among model constructs.

	1	2	3	4	5	6	7
1. Garden Participation	-----						
2. Aesthetics	.35***	-----					
3. Social Involvement	.36***	.25***	-----				
4. Collective Efficacy	.22***	.49***	.23***	-----			
5. Neighborhood Attachment	.26***	.49***	.28***	.55***	-----		
6. Fruit and Vegetable Intake	.21***	.23***	.19***	.10*	.13**	-----	
7. Self-rated Health	.20***	.29***	.21***	.29***	.20***	.16***	-----

Note.

* p<.05,

** p<.01,

*** p<.001.

Garden Participation is a dichotomous variable, 0 = No, 1 = Yes.