



Racial differences in parental perceptions of the neighborhood as predictors of children's physical activity and sedentary behavior

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ARTICLE INFO

Available online 2 May 2015

Keywords:

Neighborhood
Parents
Race
Child
Sedentary lifestyle
Physical activity
Perception

ABSTRACT

Objective. Most U.S. children engage in insufficient physical activity (PA) and spend too much time in sedentary behaviors (SBs), leading to increased risk of obesity and chronic disease. Evidence remains inconsistent on relationships between parental perceptions of the neighborhood and children's PA and SB. This study examines parental neighborhood perceptions, stratified by race, as predictors of children's PA and SB.

Methods. Relationships were tested with regressions stratified by parental race. The sample included 196 parents, residing in St. Louis, Missouri with a child at home. Participants responded to a mailed survey in 2012. Parental neighborhood perceptions were examined by mean composite scores and individual items.

Results. For parents of all races, perceived barriers negatively predicted the number of days in a week children engaged in ≥ 60 min of PA. Examining parental neighborhood perceptions by individual item, the perception that drivers exceed neighborhood speed limits was a positive predictor of their children's SB only among white parents. Only among minority-race parents was perceived neighborhood crime rate a positive predictor of their children's SB.

Conclusions. While predictors of children's PA did not differ widely, several distinct predictors of children's SB by parental race lend support toward further examination of this topic.

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Introduction

Epidemiological research shows that most children (≤ 18 years) in the U.S. spend insufficient time engaged in physical activity (PA¹) and spend too much time engaged in sedentary behavior (SB²; e.g., riding in a car, watching TV) (Office of the Surgeon General, 2010; Spittaels et al., 2012; Tremblay et al., 2010). This lack of PA and abundance of SB have independent, but similarly poor effects on children's health (Ekelund et al., 2013; Fisher et al., 2011). Inactive children are at increased risk for obesity and related diseases (e.g., type 2 diabetes, cardiovascular disease, cancer) compared with children who meet national guidelines of 60 min of daily PA (Aghbuga, 2011; Ekelund et al., 2013; Schroeder, 2011). Likewise, children who spend over 2 h a day in SB have an increased risk of obesity and related chronic diseases compared with children who meet national guidelines of fewer than 2 h

of SB a day, regardless of their PA, diet, age, race, or family income (Crespo et al., 2001; Fisher et al., 2011; Owen et al., 2011). A number of factors that contribute to children's PA and SB have been identified, many of which involve parents since they tend to regulate children's behaviors (Carson et al., 2010; Davison and Lawson, 2006; Salmon et al., 2008). Evidence remains inconsistent on the relationships between parental perceptions of the neighborhood and children's PA and SB. Several studies report significant relationships between parent's perceptions of neighborhood characteristics, including safety, presence of sidewalks, and accessibility of parks to children's PA and SB (Carson et al., 2010; Davison and Lawson, 2006; Salmon et al., 2013; Veugeliers et al., 2008). Conversely, two systematic reviews found a lack of notable relationships between neighborhood characteristics and children's PA (Carver et al., 2008; Ferreira et al., 2007).

Additional research is necessary to parse the relational complexities that may be contributing to the mixed findings. Studies investigating parental perceptions of the neighborhood on children's PA or SB tend to examine differences in these relationship by individual-level characteristics of the children (e.g., age) (Cecil-Karb and Grogan-kaylor, 2009; Datar et al., 2013; Timperio et al., 2012). Little is known about these relationships by individual-level characteristics of the parents. Racial disparities in PA and SB across the life course in the U.S. are reason to appraise differences in predictors of these outcomes by race of the parents (Gordon-Larsen et al., 2004; Whitt-Glover et al., 2009).

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¹ PA: physical activity.

² SB: sedentary behavior.

Research shows that white populations have lower risk perception than populations of a minority-race (Finucane et al., 2000; Flynn et al., 1994). For example, black adults are more likely to perceive their neighborhoods to be less pleasant and less safe for PA compared with their white counterparts, despite the racial make-up of their neighborhoods (Boslaugh et al., 2004). This difference in perceived neighborhood environment is likely to have an influence on where parents allow their children to be active. This study is novel in its approach to investigating parental neighborhood perceptions as predictors of children's PA and SB by parental race.

Material and methods

This cross-sectional study analyzed data collected in St. Louis City, Missouri, between July and August 2012. Data were collected as part of a larger study examining how changes in the built environment (i.e., a new walking and biking trail) influence perceptions of the neighborhood, PA, and SB (Zwald et al., 2014). Data for the current study were collected prior to implementation of the built environment changes. Addresses were obtained through the U.S. Data Corporation and surveys were mailed to every home within one-quarter mile of the new trail (2003 addresses) and another 1537 homes in the control neighborhood (US Data Corporation, 2012). Households were mailed paper surveys soliciting one adult resident of the home (≥ 18 years of age) to complete and return the survey in exchange for a gift card. A total of 772 surveys were completed and returned (response rate of 21.9%). This study includes only respondents reporting a child living in the home between three and 18 years old ($n = 196$). Children under three were excluded to ensure that children referenced by parents in the sample could walk independently. The larger study received Institutional Review Board approval from Washington University in St. Louis.

Measures

Parental perceptions of the neighborhood

Two scales were used to measure parental perceptions of the neighborhood. The first scale, abbreviated Neighborhood Environment Walkability Scale (NEWS-A), included 9 items, each with 4-point Likert scale response options anchored with "strongly disagree" to "strongly agree" (Cerin et al., 2009). This analysis used three subscales within NEWS-A that ask about perceptions of the neighborhood Traffic Hazards (two items; e.g., Most drivers exceed the posted speed limit), Infrastructure and Safety for Walking (four items; e.g., My neighborhood streets are well lit), and Crime (three items; e.g., The crime rate in my neighborhood makes it unsafe to go on walks during the day). NEWS-A and its subscales have shown factorial and criterion validity (Cerin et al., 2009). The unabbreviated NEWS has shown concurrent validity with objective Geographic Information Systems walkability findings and moderate reliability among U.S. adults (Adams et al., 2009).

The second scale asked parents to indicate which built environment and social barriers make it difficult for their child to be active in local parks. The scale derives from a longer survey of parents and children used in the Active Where? study (Durant et al., 2009). All items in the survey showed at least moderate individual item reliability (Joe et al., 2008). This scale includes 11 items, each with 4-point Likert scale response options anchored with "strongly disagree" to "strongly agree" and has shown acceptable internal consistency and construct validity (Durant et al., 2009). All items were negatively-oriented (e.g., "There is not enough space to be active in"). The parent was directed to respond with only one child in mind: the child closest to his/her 13th birthday.

Children's sedentary behavior

Children's SB was assessed using a scale from the Active Where? study that includes six items listing behaviors that are performed sitting

or lying down (e.g., watching television/videos, riding in a car, reading a book or magazine) (Joe et al., 2008). This scale was found to be reliable and has been used in several other studies (Lake et al., 2009; Robinson and Killen, 1995; Robinson et al., 1999). Parents were asked to indicate how much time on a typical week day their child spends doing each of the six SBs. Seven categorical response options ranged from none to four or more hours per day.

Children's physical activity

Parents were asked three questions from the Active Where? study, with eight response options ranging from zero to seven days (Joe et al., 2008). These questions were found to be reliable and significantly correlated with objectively measured PA (Prochaska et al., 2001). The three items include 1) "For the past seven days, how many days was the child physically active for a total of at least 60 min per day?"; 2) "Over a usual week, on how many days was the child physically active for a total of at least 60 min per day?"; and 3) "Outside of school, how many days per week does the child play or practice team sports?" Parents were also instructed not to include school physical education or gym when considering their responses to the first three questions, though this time should have been limited due to summer survey administration.

Parent's individual characteristics

Parents reported gender, age, race, education, household income, and total PA in the past week (see Table 1 for categories). Total PA in the past week was measured using the International Physical Activity Questionnaire long-form, which was found to be reliable and valid among U.S. adults (Craig et al., 2003). PA cut-offs are informed by national guidelines for daily PA (US Department of Health and Human Services, 2008).

Statistical analyses

Using SPSS version 22.0 (IBM Corp, 2013), descriptive statistics were conducted to examine individual characteristics of the study sample of parents. Independent samples t-tests and one-way ANOVAs were conducted to examine mean differences in the main independent (parental perceptions of the neighborhood) and dependent (child's SB) variables of interest by individual parental characteristics.

Assumptions of linear regression tests were tested on the univariate and bivariate levels. To assess for racial differences in the relationships between parental perceptions of the neighborhood as predictors of children's SB and PA, data were stratified by race and linear regression tests were conducted using mean composite scores of each of the three subscales within NEWS-A and the barriers scale. Race was dichotomized by collapsing the "other" and "non-Hispanic black" categories, creating minority-race and white categories. This decision was informed by Table 1 findings indicating that parents identifying with other races (e.g., Asian, Native American, mixed race) had mean scores on parental perceptions of the neighborhood and children's SB that were closer to the mean scores of non-Hispanic black parents compared with white parents.

For a more detailed examination of racial differences in the relationships between parents' perceptions of the neighborhood as predictors of children's SB, SB was regressed on each item of the NEWS-A individually, stratified by race of the parent. Each item of the NEWS-A was dichotomized into "agree" and "disagree" categories to be consistent with other studies (Hallal et al., 2010; Zwald et al., 2014). One study found equivalent relationships regardless of dichotomizing or maintaining the 4-point ordinal response scale (Adams et al., 2009).

Table 1
Parental perceptions of the neighborhood and children's sedentary behavior by characteristics of parents residing in St. Louis City, Missouri, 2012 (N = 196).

Characteristic of parent	N (%) ^a	Parental perceptions of the neighborhood ^b		Sedentary behaviors of child	
		Mean score (SD) ^c	p-Value ^d	Mean hours/day (SD)	p-Value
Gender					
Male	49 (25.7)	2.50 (0.41)	0.78	1.25 (0.63)	0.10
Female	142 (74.3)	2.53 (0.55)		1.44 (0.69)	
Missing	5				
Age (years)					
18–29	37 (19.2)	2.43 (0.50)	0.07	1.25 (0.78)	0.43
30–39	64 (33.2)	2.45 (0.50)		1.34 (0.67)	
40–49	60 (31.1)	2.56 (0.51)		1.51 (0.63)	
50–59	24 (12.4)	2.78 (0.60)		1.47 (0.74)	
60+	8 (4.1)	2.71 (0.38)		1.51 (0.46)	
Missing	3				
Race					
Non-Hispanic Black	141 (74.2)	2.52 (0.52)	0.74	1.49 (0.70)	0.006 ^{**} , ^e
White	30 (15.8)	2.49 (0.55)		1.04 (0.47)	
Other	19 (10.0)	2.61 (0.48)		1.40 (0.73)	
Missing	6				
Education					
College graduate	137 (70.6)	2.54 (0.54)	0.75	1.42 (0.72)	0.60
Non-college graduate	57 (29.4)	2.51 (0.47)		1.36 (0.61)	
Missing	2				
Household income (dollars in past year)					
≤29,999	117 (60.9)	2.48 (0.52)	0.20	1.46 (0.71)	0.45
30,000–49,999	47 (24.5)	2.54 (0.53)		1.39 (0.70)	
50,000–70,000	28 (14.6)	2.68 (0.46)		1.27 (0.55)	
Missing	4				
Total physical activity in the past week ^f					
0–9 min	27 (13.8)	2.53 (0.63)	0.10	1.64 (0.59)	0.12
10–149 min	35 (17.9)	2.52 (0.49)		1.48 (0.76)	
≥150 min	133 (68.2)	2.53 (0.50)		1.34 (0.67)	
Missing	1				

** Significant *p*-value of <0.01.

^a Valid percentages.

^b Measured by a mean composite score of three subscales (Traffic Hazards; Infrastructure and Safety for Walking; and Crime) combined within the abbreviated Neighborhood Environment Walkability Scale (NEWS-A).

^c SD: standard deviation.

^d Independent samples *t*-tests and one-way ANOVAs were used to determine significant differences in parental perceptions of the neighborhood and sedentary activity of the child by parental demographic characteristics.

^e There is a significant difference in child sedentary activity between non-Hispanic black and white parents only.

^f Based on national physical activity recommendations of 150 min of physical activity per week.

Results

Study sample

The study sample of parents primarily consisted of non-Hispanic black mothers, between 30 and 49 years old, who were college graduates, physically active, and had yearly household incomes of less than 30,000 dollars. Parental perceptions of the neighborhood did not significantly vary by individual parental characteristics. Children's SB also did not differ by individual parental characteristics, with the exception of race. Children of non-Hispanic black parents engaged in significantly greater mean hours of SB per day compared with children of white parents. There were no significant differences in children's SB between parents of other races (e.g., Asian, Native American, mixed race) and non-Hispanic black parents or white parents (Table 1).

Parental perceptions of the neighborhood and children's sedentary behaviors and physical activity, stratified by race

Using mean composite scores for each of the three subscales within NEWS-A and a mean composite barriers scale scores as predictors, no relationships were found for white or minority-race parents between parental perceptions of the neighborhood and children's SB. Likewise, using mean composite scores for each of the three subscales within NEWS-A as predictors, no relationships were found for white or minority-race parents between parental perceptions of the neighborhood and children's PA.

Conversely, racial differences were found using the mean composite barriers scale score as a predictor of children's PA. Among white parents, the more barriers parents reported to their children being active in parks near their home, the fewer days *in the past week* their children engaged in at least 60 min of PA. Among white and minority-race parents, the more barriers parents reported for their children being active in parks near their home, the fewer days *during a usual week* their children engaged in at least 60 min of PA. Among minority-race parents, the more barriers parents reported for their children being active in parks near their home, the fewer days per week their children played or practiced team sports (Table 2).

Examining each item of the three subscales from the NEWS-A as a separate predictor, two of the 9 perceived neighborhood characteristics emerged as predictors of children's SB, and differed by race. Among white parents, the perception that people drive over the speed limit in their neighborhood positively predicted their children's SB. Among minority-race parents, the perception that crime rate in their neighborhood makes it unsafe to walk or bike outside during the day positively predicted their children's SB (Table 3).

Discussion

In this study sample, parental race was the only individual-level characteristic of parents for which children's SB differed. Children of minority-race parents spent significantly more time engaged in SB compared with children of white parents. This finding is consistent

Table 2
Children's sedentary behavior and physical activity regressed on parental neighborhood perceptions, stratified by white and minority-race parents residing in St. Louis City, Missouri, 2012.

	White parents					Minority-race parents ^b				
	F (DF) ^a	b	SE ^c	t	R	F (DF)	b	SE	t	R
<i>Children's sedentary behaviors</i>										
Parental perceptions of the Traffic Hazards ^d	1.95 (1, 27)	0.36	0.25	1.40	0.26	0.51 (1, 138)	0.11	0.15	0.71	0.06
Parental perceptions of the Infrastructure and Safety for Walking ^e	1.92 (1, 26)	0.40	0.29	1.38	0.26	0.14 (1, 136)	-0.09	0.23	-0.37**	0.03
Parental perceptions of Crime ^f	1.23 (1, 27)	0.35	0.31	1.11	0.21	0.63 (1, 134)	0.13	0.17	0.79	0.07
Parent's perceived barriers to their child being active in parks nearby their home ^g	2.87 (1, 26)	0.21	0.12	1.70	0.60	0.48 (1, 132)	0.06	0.09	0.70	0.25
<i>Days in the past week their children engaged in at least 60 min of physical activity</i>										
Parental perceptions of the Traffic Hazards	2.59 (1, 28)	-2.00	1.24	-1.61	0.29	0.37 (1, 150)	0.28	0.46	0.60	0.05
Parental perceptions of the Infrastructure and Safety for Walking	0.42 (1, 27)	0.97	1.49	0.65	0.12	0.36 (1, 147)	0.40	0.68	0.60	0.05
Parental perceptions of Crime	0.02 (1, 28)	-0.20	1.62	-0.12	0.02	0.62 (1, 146)	0.39	0.50	0.79	0.07
Parent's perceived barriers to their child being active in parks nearby their home	5.92* (1, 27)	-1.37	0.56	-2.43*	0.42	1.89 (1, 142)	-0.38	0.28	-1.38	0.12
<i>Days in a usual week their children engaged in at least 60 min of physical activity</i>										
Parental perceptions of the Traffic Hazards	1.80 (1, 28)	-1.63	1.21	-1.34	0.25	1.03 (1, 150)	0.46	0.45	1.02	0.08
Parental perceptions of the Infrastructure and Safety for Walking	0.31 (1, 27)	0.79	1.43	0.55	0.11	0.30 (1, 147)	0.36	0.67	0.55	0.05
Parental perceptions of Crime	0.26 (1, 28)	-0.79	1.55	-0.51	0.10	0.04 (1, 146)	0.09	0.49	0.19	0.02
Parent's perceived barriers to their child being active in parks nearby their home	7.41* (1, 27)	-1.43	0.53	-2.72*	0.46	4.64* (1, 142)	-0.59	0.28	-2.15*	0.18
<i>Days in the past week their children played or practiced a team sport</i>										
Parental perceptions of the Traffic Hazards	0.25 (1, 28)	0.64	1.28	0.50	0.09	0.65 (1, 150)	0.41	0.50	0.81	0.07
Parental perceptions of the Infrastructure and Safety for Walking	1.80 (1, 27)	1.85	1.38	1.34	0.25	0.02 (1, 147)	0.10	0.73	0.13	0.01
Parental perceptions of Crime	0.00 (1, 28)	0.00	1.60	0.00	0.00	0.31 (1, 146)	0.31	0.55	0.56	0.05
Parent's perceived barriers to their child being active in parks nearby their home	0.11 (1, 27)	-0.19	0.59	-0.33	.06	4.47* (1, 142)	-0.63	0.30	-2.12*	0.18

* $p < .05$.** $p < .01$.^a DF: degrees of freedom.^b Minority-race parents include all parents who do not identify as white, including non-Hispanic black, Hispanic, Asian, Native American, and mixed race.^c SE: standard error.^d Mean composite score of the Traffic Hazards subscale within the abbreviated Neighborhood Environment Walkability Scale.^e Mean composite score of the Infrastructure and Safety for Walking subscale within the abbreviated Neighborhood Environment Walkability Scale.^f Mean composite score of the Crime subscale within the abbreviated Neighborhood Environment Walkability Scale.^g Mean composite score of parent's perceived barriers to their child being active in parks nearby their home.

with the racial disparities in SB found in population studies of the U.S. (Gordon-Larsen et al., 2004; Whitt-Glover et al., 2009).

This study adds to the current literature on parental perceptions of the neighborhood and children's SB and PA by identifying several differences and similarities in these relationships by parental race. Racial differences in the relationships between parental neighborhood perceptions and their children's SB were found when each item of NEWS-A subscales was examined individually, rather than as mean composite subscale scores. This is a recommended approach because it identifies specific environmental characteristics that predict a behavior, which in turn enables more targeted strategies for change (Carson et al., 2010). Also, parents

may place more weight on certain perceptions of the neighborhood compared with others and when a number of perceptions are combined in one mean composite score, relationships between certain perceptions and children's SB and PA may be overlooked (Datar et al., 2013).

This study found that among minority-race parents, perceptions that neighborhood crime makes it unsafe to walk outside during the day was a significant, positive predictor of children's SB. Among white parents, the perception that people drive over the speed limit in their neighborhood was a positive predictor of children's SB. These results are neighborhood characteristic-specific and race-specific, and could inform highly tailored strategies for addressing disparities in children's SB.

Table 3
Children's sedentary behaviors regressed on parental perceptions of individual neighborhood characteristics, stratified by white and minority-race parents residing in St. Louis City, Missouri, 2012.

Neighborhood characteristic ^a	White parents					Minority-race parents ^b				
	F (DF) ^c	b	SE ^d	t	R	F (DF)	b	SE	t	R
Parental perception that there is so much traffic along nearby streets that it makes it difficult or unpleasant to walk	0.18 (1, 27)	0.08	0.18	0.42	0.08	0.63 (1, 139)	0.10	0.12	0.80	0.07
Parental perception that people drive over the posted speed limit	5.04* (1, 27)	0.53	0.24	2.25*	0.40	0.03 (1, 139)	0.02	0.13	0.16	0.01
Parental perception that streets are well lit at night	1.54 (1, 27)	0.23	0.18	1.24	0.23	0.00 (1, 140)	-0.01	0.12	-0.06	0.01
Parental perception that walkers and bikers on the streets are easily seen by people in their homes	0.23 (1, 26)	-0.10	0.21	-0.48	0.09	0.28 (1, 140)	-0.07	0.12	-0.53	0.04
Parental perception that there are sidewalks	2.94 (1, 27)	0.38	0.22	1.71	0.31	0.46 (1, 139)	-0.18	0.27	-0.67	0.06
Parental perception that there are crosswalks and pedestrian signals to help walkers cross busy streets	1.08 (1, 27)	0.20	0.19	1.04	0.20	0.04 (1, 137)	-0.03	0.13	-0.20	0.02
Parental perception that there is a high crime rate	0.69 (1, 27)	0.19	0.23	0.83	0.16	0.03 (1, 138)	0.02	0.13	0.19	0.02
Parental perception that the crime rate makes it unsafe to walk or bike outside during the day	0.59 (1, 27)	0.18	0.23	0.77	0.15	4.28* (1, 137)	0.25	0.12	2.07*	0.17
Parental perception that the crime rate makes it unsafe to go on walks at night	0.69 (1, 27)	0.19	0.23	0.83	0.16	0.51 (1, 139)	-0.10	0.14	-0.71	0.06

* $p < .05$.^a Items derive from three subscales (Traffic Hazards; Infrastructure and Safety for Walking; and Crime) within the abbreviated Neighborhood Environment Walkability Scale.^b Minority-race parents include all parents who do not identify as white alone, including non-Hispanic black, Hispanic, Asian, Native American, and mixed race.^c DF: degrees of freedom.^d SE: standard error.

Relationships between parents' perceived barriers to their children being active in parks and two of the three PA-related questions did vary by parental race. However, these differences were muted in part because, for parents of all races, perceived barriers and the number of days in a usual week their children engaged in at least 60 min of PA had a significant, negative relationship. Overall, these findings appear to support the literature regarding parks and children's PA; namely, the more barriers parents perceive to their children being active in parks the less active their children are (Mowen, 2010). A synthesis of studies on parks and playgrounds indicates that more can be done with parks in the U.S. to promote PA among all ages, but especially among children (Mowen, 2010). This study highlights the importance of involving parents in the design of strategies and interventions aimed at decreasing barriers to children's PA in parks.

There are several strengths and limitations to this study. The cross-sectional design does not allow for the determination of causation or temporality of variables. As is common in mail surveys, the response rate is low, which increases the likelihood of nonresponse bias (Hager et al., 2003; Kanuk and Berenson, 1975). However, a mail survey, opposed to a telephone survey or in-person interview, is considered to produce more valid responses from participants because of an increased sense of anonymity and the ability to take as long as one needs to respond to questions and verify answers (Kanuk and Berenson, 1975). Also, the sample was limited to parents and the small sample size reduces generalizability of the findings and increases the chances of type II error. In addition, the study used self-report measures, which are vulnerable to recall bias and measurement error compared with objective measures. However, a strong case has been made for studying perceptions of the environment in place of or in conjunction with objective measures. Perceptions reflect one's personal understanding or judgment of the objective environment, which influence one's behavior (McGinn et al., 2007; Muhajarine et al., 2007). In this study, parents reported their children's PA and SB, which can introduce error. Children likely engage in PA and SB throughout the day (e.g., at daycare, at school, or after school while a parent is at work), of which their parents may be unaware. However, parental reports of their children's PA and SB have been found to be more accurate than fifth grade children's reports of their own PA and SB (Sithole and Veugelaers, 2008). Also, the survey instrument lacked clear questions about the demographics of the children for which the parents reference in this study, not permitting assessment of how relationships between parental perceptions of the environment and their children's behaviors likely varied by the age and sex of the child. This oversight prevented analyses related to gender or age of the children. This study used a more comprehensive approach to examining parental perceptions of the neighborhood (9 items of the NEWS-A and a second scale related to perceived barriers to children's park use) compared with other studies (Carson et al., 2010; Datar et al., 2013). The study sample was also disproportionately female, well-educated, physically active, and non-Hispanic black compared with the population of adults in St. Louis City (United States Census Bureau, 2013). A more proportionate sample by race would allow for more equal comparisons of the racial differences for the primary relationships of interest in this study: nonetheless several differences for white and minority-race parents were identified. Lastly, this study lacked wide generalizability because it is limited to St. Louis City, Missouri, parents, however the effect of racial differences in perceptions of safety and the environment on behaviors is a timely and salient topic in the St. Louis region (Purnell et al., 2014).

Despite these limitations, this study builds on the current empirical knowledge of parental perceptions of the neighborhood as predictors of children's PA and SB, by identifying several differences and similarities in these relationships by parental race (e.g., crime rate, traffic exceeding the speed limit, barriers to children being active in nearby parks). Future studies with larger samples and longitudinal designs should further examine these racial differences, using individual characteristics of the neighborhood rather than mean composite subscale scores and examine

these relationships by demographic characteristics of the child. This approach will not only continue to unravel the complexities of the relationships, but will enable more specific recommendations for environmental changes aimed at increasing PA and decreasing SB of children.

Conflict of interest

The authors declare that there are no conflicts of interest to disclose.

Acknowledgments

The authors acknowledge and thank Nicole Kensinger for her assistance with the data analyses and Leslie Duling for data collection and management. This study was funded by the International Center for Advanced Renewable Energy and Sustainability at Washington University in St. Louis, Missouri and the Global Obesity Prevention Center at Johns Hopkins Bloomberg School of Public Health (2001656847).

References

- Adams, M., Ryan, S., Kerr, J., et al., 2009. Validation of the Neighborhood Environment Walkability Scale (NEWS) items using geographic information systems. *J. Phys. Act. Health* (Suppl. 1), S113–S123.
- Agbuga, B., 2011. Pedometer-based physical activity level and body composition among minority children in a physical activity setting. *Phys. Educ.* 68, 78–89.
- Boslaugh, S.E., Luke, D.A., Brownson, R.C., Naleid, K.S., Kreuter, M.W., 2004. Perceptions of neighborhood environment for physical activity: is it "who you are" or "where you live"? *J. Urban Health* 81, 671–681.
- Carson, V., Kuhle, S., Spence, J.C., Veugelaers, P.J., 2010. Parents' perception of neighbourhood environment as a determinant of screen time, physical activity and active transport. *Can. J. Public Health* 101, 124–127.
- Carver, A., Timperio, A., Crawford, D., 2008. Playing it safe: the influence of neighbourhood safety on children's physical activity: a review. *Health Place* 14, 217–227.
- Cecil-Karb, R., Grogan-Kaylor, A., 2009. Childhood body mass index in community context: neighborhood safety, television viewing, and growth trajectories of BMI. *Health Soc. Work* 34, 169–178.
- Cerin, E., Conway, T.L., Saelens, B.E., Frank, L.D., Sallis, J.F., 2009. Cross-validation of the factorial structure of the Neighborhood Environment Walkability Scale (NEWS) and its abbreviated form (NEWS-A). *Int. J. Behav. Nutr. Phys. Act.* 6, 32.
- Corp, I.B.M., 2013. IBM SPSS Statistics for Windows.
- Craig, C.L., Marshall, A.L., Sjöström, M., et al., 2003. International physical activity questionnaire: 12-country reliability and validity. *Med. Sci. Sports Exerc.* 35, 1381–1395.
- Crespo, C., Smit, E., Troiano, R., Bartlett, S.J., Macera, C.A., Andersen, R.E., 2001. Television watching, energy intake, and obesity in US children. *Arch. Pediatr. Adolesc. Med.* 155, 360–365.
- Datar, A., Nicosia, N., Shier, V., 2013. Parent perceptions of neighborhood safety and children's physical activity, sedentary behavior, and obesity: evidence from a national longitudinal study. *Am. J. Epidemiol.* 177, 1065–1073.
- Davison, K.K., Lawson, C.T., 2006. Do attributes in the physical environment influence children's physical activity? A Review of the Literature. *International Journal of Behavioral Nutrition and Physical Activity*. 3 pp. 1–17.
- Durant, N., Kerr, J., Harris, S., Saelens, B., Norman, G., Sallis, J., 2009. Environmental and safety barriers to youth physical activity in neighborhood parks and streets: reliability and validity. *Pediatr. Exerc. Sci.* 21, 86–99.
- Ekelund, U., Luan, J., Sherar, L.B., Esliger, D.W., Griew, P., Cooper, A., 2013. Association of moderate to vigorous physical activity and sedentary time with cardiometabolic risk factors in children and adolescents. *J. Am. Med. Assoc.* 307, 704–712.
- Ferreira, I., van der Horst, K., Wendel-Vos, W., Kremers, S., van Lenthe, F.J., Brug, J., 2007. Environmental correlates of physical activity in youth – a review and update. *Obes. Rev.* 8, 129–154.
- Finucane, M., Slovic, P., Mertz, C., Flynn, J., 2000. Gender, race, and perceived risk: the "white male" effect. *Health Risk Soc.* 2, 159–172.
- Fisher, A., Hill, C., Webber, L., Purslow, L., Wardle, J., 2011. MVPA is associated with lower weight gain in 8–10 year old children: a prospective study with 1 year follow-up. *PLoS One* 6 (e18576).
- Flynn, J., Slovic, P., Mertz, C., 1994. Gender, race, and perception of environmental health risks. *Risk Anal.* 14, 1101–1108.
- Gordon-Larsen, P., Nelson, M.C., Popkin, B.M., 2004. Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood. *Am. J. Prev. Med.* 27, 277–283.
- Hager, M. a, Wilson, S., Pollak, T.H., Rooney, P.M., 2003. Response rates for mail surveys of nonprofit organizations: a review and empirical test. *Nonprofit Volunt. Sect. Q.* 32, 252–267.
- Hallal, P.C., Reis, R.S., Parra, D.C., Hoehner, C., Brownson, R.C., Simões, E.J., 2010. Association between perceived environmental attributes and physical activity among adults in Recife, Brazil. *J. Phys. Act. Health* 7, S213–S222.
- Joe, L., Carlson, J., Sallis, J., 2008. Active where? Individual item reliability statistics parent/child survey (n = 97). San Diego, CA. http://www.drjamesallis.sdsu.edu/Documents/AW_item_reliability_ParentChild.pdf (Accessed December 10, 2014).
- Kanuk, L., Berenson, C., 1975. Mail surveys and response rates: a literature review. *J. Mark. Res.* 12, 440–453.

- Lake, A., Townshend, T., Alvanides, S., Stamp, E., Adamson, A., 2009. Diet, physical activity, sedentary behaviour and perceptions of the environment in young adults. *J. Hum. Nutr. Diet.* 22, 444–454.
- McGinn, A.P., Evenson, K.R., Herring, A.H., Huston, S.L., Rodriguez, D. a, 2007. Exploring associations between physical activity and perceived and objective measures of the built environment. *J. Urban Health* 84, 162–184.
- Mowen, A., 2010. *Parks, Playgrounds and Active Living*. San Diego, CA.
- Muhajarine, N., Labonte, R., Williams, A., Randall, J., 2007. Person, perception, and place: what matters to health and quality of life. *Soc. Indic. Res.* 85, 53–80.
- Office of the Surgeon General, 2010. The surgeon general's vision for a healthy and fit nation. Rockville, Maryland. <http://www.surgeongeneral.gov/initiatives/healthy-fit-nation/obesityvision2010.pdf> (Accessed November 20, 2014).
- Owen, N., Sugiyama, T., Eakin, E.E., Gardiner, P.A., Tremblay, M.S., Sallis, J.F., 2011. Adults' sedentary behavior determinants and interventions. *Am. J. Prev. Med.* 41, 189–196.
- Prochaska, J.J., Sallis, J.F., Long, B., 2001. A physical activity screening measure for use with adolescents in primary care. *Arch. Pediatr. Adolesc. Med.* 155, 554–559.
- Purnell, J., Camberos, G., Fields, R., 2014. For the sake of all. St. Louis, Missouri. <https://forthesakeofall.files.wordpress.com/2014/05/for-the-sake-of-all-report.pdf> (Accessed December 14, 2014).
- Robinson, T., Killen, J., 1995. Ethnic and gender differences in the relationships between television viewing and obesity, physical activity, and dietary fat intake. *J. Health Educ.* 26, S91–S98.
- Robinson, T.N., Nited, H.E.U., Has, S.T., 1999. Reducing children's television viewing to prevent obesity. *J. Am. Med. Assoc.* 282, 1561–1567.
- Salmon, J., Spence, J., Timperio, A., Cutumisu, N., 2008. Living environments. In: Smith, A., Biddle, S. (Eds.), *Youth Physical Activity and Sedentary Behaviour: Challenges and Solutions*. Champaign, IL, pp. 403–428.
- Salmon, J., Veitch, J., Abbott, G., et al., 2013. Are associations between the perceived home and neighbourhood environment and children's physical activity and sedentary behaviour moderated by urban/rural location? *Health Place* 24, 44–53.
- Schroeder, S.D., 2011. Childhood obesity and the emerging epidemic of type 2 diabetes. *Journal of the South Dakota State Medical Association. Spec No.* 75.
- Sithole, F., Veugeliers, P.J., 2008. Parent and child reports of children's activity. *Health Rep.* 19, 19–24.
- Spittaels, H., Van Cauwenberghe, E., Verbestel, V., et al., 2012. Objectively measured sedentary time and physical activity time across the lifespan: a cross-sectional study in four age groups. *Int. J. Behav. Nutr. Phys. Act.* 9, 149.
- Timperio, A., Salmon, J., Ball, K., te Velde, S.J., Brug, J., Crawford, D., 2012. Neighborhood characteristics and TV viewing in youth: nothing to do but watch TV? *J. Sci. Med. Sport* 15, 122–128.
- Tremblay, A., Perusse-Lachance, E., Brassard, P., 2010. Impact of "noncaloric" activity-related factors on the predisposition to obesity in children. *Risk Manag. Healthc. Policy* 3, 27–32.
- United States Census Bureau, 2013. St. Louis City, Missouri State and County QuickFacts Beta. <http://www.census.gov/quickfacts/table/SEX255213/29510,00> (Accessed December 23, 2014).
- US Data Corporation, 2012. <http://www.usdatacorporation.com/> (Accessed December 23, 2014).
- US Department of Health and Human Services, 2008. 2008 Physical Activity Guidelines for Americans. Washington D.C. <http://www.health.gov/paguidelines/guidelines/summary.aspx> (Accessed December 5, 2014).
- Veugeliers, P., Sithole, F., Zhang, S., Muhajarine, N., 2008. Neighborhood characteristics in relation to diet, physical activity and overweight of Canadian children. *Int. J. Pediatr. Obes.* 3, 152–159.
- Whitt-Glover, M., Taylor, W., Floyd, M., Yore, M., Yancey, A., Matthews, C., 2009. Disparities in physical activity and sedentary behaviors among US children and adolescents: prevalence, correlates, and intervention implications. *J. Public Health Policy* 30, S309–S334.
- Zwald, M.L., Hipp, J.A., Corseuil, M.W., Dodson, E.A., 2014. Correlates of walking for transportation and use of public transportation among adults in St Louis, Missouri, 2012. *Prev. Chronic Dis.* 11, 1–10.