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## Associations Between Neighborhood Characteristics and Physical Activity Among Youth Within Rural–Urban Commuting Areas in the US

**Laurin Kasehagen,**

Division of Reproductive Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS K-22, Atlanta, GA 30341, USA; Department of Pediatrics, Section on Child Health Policy and CityMatCH, University of Nebraska Medical Center, 982170 Nebraska Medical Center, Omaha, NE 68198-2170, USA

**Ashley Busacker,**

Division of Reproductive Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS K-22, Atlanta, GA 30341, USA

**Debra Kane,** and

Division of Reproductive Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS K-22, Atlanta, GA 30341, USA

**Angela Rohan**

Division of Reproductive Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS K-22, Atlanta, GA 30341, USA

Laurin Kasehagen: lkasehagen@cdc.gov

### Abstract

The association among rural–urban communities, neighborhood characteristics, and youth physical activity is inconsistent in the literature. We used data from the 2007 National Survey of Children's Health, for youth aged 10–17 years ( $n = 45,392$ ), to examine the association between physical activity and neighborhood characteristics, after adjusting for known confounders. We also examined the association between physical activity and neighborhood characteristics within seven levels of Rural–Urban Commuting Areas (RUCAs) that depict a continuum from isolated rural to dense urban communities. Attainment of a minimum physical activity level differed by RUCA ( $P = 0.0004$ ). In adjusted, RUCA-specific models, the presence of parks was associated with attaining a minimum physical activity level in only one of the seven RUCAs (adjusted odds ratio: 3.49; 95 % confidence interval: 1.55, 7.84). This analysis identified no association between youths' minimum physical activity attainment and neighborhood characteristics in unstratified models; and, RUCA-specific models showed little heterogeneity by rural–urban community type. Although this analysis found little association between youth physical activity and neighborhood characteristics, the findings could reflect the crude categorization of the neighborhood amenities (sidewalks, parks, recreation centers) and detracting elements (litter, dilapidated housing,

vandalism) and suggests that simple measurement of the presence of an amenity or detracting element is insufficient for determining potential associations with reaching minimum levels of physical activity. By exploring neighborhood characteristics and features of neighborhood amenities within the context of well-defined community types, like RUCAs, we can better understand how and why these factors contribute to different levels of youth physical activity.

## Keywords

Rural–urban commuting area; Neighborhood; Physical activity; Child; Adolescent

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## Introduction

The health benefits of physical activity and its association with maintaining a healthy weight have been well documented [1–4]. Current U.S. Department of Health and Human Services (DHHS) guidelines, adopted in 2008, recommend that youths participate in physical activity for 60 min or more daily; these recommendations are stronger than those of the 2005 Dietary Guidelines for Americans for children and adolescents in which physical activity was recommended on most, preferably all days of the week [3, 5]. However, fewer than one in three US high school students are physically active for at least 60 min per day 7 days per week (2009, 18.4 %; 2010, 15.3 %; 2011, 28.7 %) [6–8].

In a recent systematic review of research that examined the built environment and other factors potentially associated with physical activity and weight among children, Dunton et al. [9] found that, although both community and neighborhood factors contributed to obesity among youth, the association between the environmental characteristics (e.g., sidewalks or paths, lighting, trees) and obesity differed by age, sex, and socioeconomic status (see also [10]). Obesity also was associated with the population density of the area within which the child lived [11] and whether physical activity information was reported by the child or the child's parent. Among adolescents, factors such as recreation or exercise facility and equipment access [9, 11, 12] and urban/rural characteristics of a community [9, 13, 14] were associated with obesity. However, these findings have not been consistent within the literature [15–18].

Other environmental factors associated with higher levels of adolescent physical activity include warmer seasons (lower physical activity levels in winter months) [19]; trail and sidewalk characteristics conducive to exercise, presence of streetlights, and number of trees as well as mature tree height [20–22]; perceived neighborhood safety [23]; and community recreation center access [24]. Physical activity also varies by sex, age, race, education, and income level [24–28].

Little is known about the relationship between community settings (i.e., size, population density, and commuting patterns) and physical activity levels. Badland and Schofield conducted an analysis to identify differences in physical activity and environmental barriers between residents in diverse town sizes [29]. Those living in large cities (>100,000 population) were 15 % less likely to be sedentary compared to small town residents (<1,000 population). Barriers to participation in physical activity differed by town size [29]. Findings

on the relationship between community setting and physical activity level, however, are inconsistent and may be related to how community setting is defined [30].

Because barriers to physical activity have been found to differ by population size of the community, the relationship between neighborhood factors and physical activity might also differ by rural–urban community settings. If it does, failure to adequately incorporate high-quality information on the type of community setting could account for some of the inconsistencies previously observed in the relationship between neighborhood factors and physical activity. To our knowledge no study has examined the effects of neighborhood characteristics on youth physical activity within different types of rural–urban community settings. In this study, we use nationally representative data to examine whether neighborhood characteristics are associated with youth attainment of a minimum physical activity level; examine whether these associations remain when controlling for individual demographic characteristics, youth physical health, screen time, and family/household characteristics; and examine the association of neighborhood characteristics and physical activity within seven levels of Rural–Urban Commuting Areas (RUCAs) that depict a continuum from isolated rural to dense urban communities.

## Methods

We analyzed data from the 2007 National Survey of Children's Health (NSCH). The NSCH is a module of the State and Local Area Integrated Telephone Survey, conducted by the National Center for Health Statistics (NCHS) of the US Centers for Disease Control and Prevention and is sponsored by the Maternal and Child Health Bureau of the Health Resources and Services Administration. The survey was designed to provide national and state-specific prevalence estimates for a variety of validated physical and emotional health indicators among children <18 years of age. A parent or guardian who lived in the household and knew about the child's health and health care responded to survey questions about the child or adolescent [31]. Because these data included information of a restricted nature—the Rural–Urban Commuting Area (RUCA) codes—the analysis of the NSCH data was conducted via a NCHS remote access system called Analytic Data Research by Email (ANDRE), to prevent inadvertent disclosure of confidential information. This analysis was restricted to the subpopulation of NSCH youth aged 10–17 years ( $n = 45,392$ ) upon which physical activity data were collected.

The main outcome of the analysis was the intensity and number of days per week that youth participated in physical activity. Respondents were asked: “During the past week, on how many days did the child exercise, play a sport, or participate in physical activity for at least 20 min that made him/her sweat and breathe hard?” To create a physical activity variable more consistent with the most current physical activity programs [32], we created a dichotomous variable based on the number of days on which the child engaged in physical activity. However, because the survey only inquired as to the number of days of physical activity, we were not able to determine the number of minutes in excess of 20 min per day in which the child might have participated in physical activity. For this study youth were classified in two groups: youth who were reported to have participated in physical activity

for at least 20 min that made him/her sweat and breathe hard 5 or more times per week; and youth who were not reported to have met this definition.

We selected variables for inclusion in the analysis based on the literature. The main exposure variable was parental report of the youth's neighborhood characteristics (amenities and detracting elements); these questions were new to the NSCH in 2007. We dichotomized three neighborhood amenities that identified characteristics of the local built environment (sidewalks, parks, and recreation centers) as present or absent. Three neighborhood detracting elements (litter, dilapidated housing, and vandalism) were combined together into one variable that indicated whether the child was reported to have any of these detracting elements in his/her neighborhood. Rather than applying a crude 'rural' or 'urban' definition of community type or use the NSCH Metropolitan Statistical Area (MSA) variable which tends to combine urban and suburban areas, we elected to use Rural–Urban Commuting Areas (RUCAs) to characterize a child's community type. RUCAs define 'rural' and 'urban' areas using Census Bureau definitions of urbanized areas and urban clusters, which are based on a set of criteria that include population density, degree of urbanization, and population work commuting patterns [33]. In this analysis, communities were characterized using a 7-level RUCA code aggregation (*urban core, other urban area, large rural core, other large rural area, small rural core, other small rural area, and isolated rural area*) (Table 1) of the 33 primary RUCA codes [34]. Because the underlying codes are based on Census tracts, they are geographically more specific than larger county-based definitions and avoid the problems associated with the heterogeneity of large unit designations often used (i.e., problems of under and over bounding the actual boundaries of cities and towns as often happens with MSAs as well as in combining 'rural' and 'frontier' areas). This strategy of using aggregated RUCAs allowed us to look at the different types of rural–urban communities with a systematic definition and in greater depth and with more specificity—as to population density, typical services, and isolation from urban areas—than the more crude urban and rural categories often used in the literature. Thus, we examined the type of community as a modifier of the association between neighborhood characteristics and youth physical activity. Each child in the analysis resided in one of the seven different types of RUCAs.

Potential confounders identified from the literature and included in this analysis are age, sex, race/ethnicity, special health care need, body mass index (BMI), screen time, family federal poverty level (FPL), parental education, and parental physical activity. Age was dichotomized into 10–14 years and 15–17 years. Race and ethnicity were combined into a single, multilevel variable: Hispanic; non-Hispanic white; non-Hispanic African American; non-Hispanic multi-racial; and non-Hispanic other race. Based on a series of screening questions, youth also were identified as being with or without a special health care need [31]. BMI for age and sex was divided into four categories: underweight (<5th percentile); healthy weight (5th to 84th percentile); overweight (85th to 94th percentile); and obese (95th percentile or above) [35]. Youth screen time included a combined report of time spent watching television and using a computer not related to schoolwork. Screen time was categorized as 2 or more hours per day or less than 2 h per day, consistent with the recommendation of the American Academy of Pediatrics [36]. Because this variable

combines the parental report of screen time from two separate questions, it may overestimate the total screen time for youth who watched television programming and played games on the computer. The 2007 FPL was categorized as: 0–99 % of the FPL; 100–199 % of the FPL; 200–399 % of the FPL; and 400 % or greater of the FPL [31, 37]. Because, approximately 8.5 % of the 2007 NSCH national sample had missing values for household income, we used an imputed variable calculated by the NCHS for family income that is included in both the public and restricted data. A combined parental education variable incorporated both maternal and paternal education information (when available) and was dichotomized into at least one parent having more than a high school education and no parent having more than a high school education. Respondents were asked “During the past week, on how many days did you (referring to the parent respondent) exercise, play sports, or participate in physical activity for at least 20 min that made you sweat and breathe hard?” Maternal and paternal physical activity were combined to create a parental-level physical activity variable that was dichotomized into at least one parent exercising, playing a sport, or participating in physical activity for at least 20 min 5 or more days per week and no parent exercising, playing a sport, or participating in physical activity for at least 20 min 5 or more days per week.

We estimated the prevalence and 95 % confidence intervals (CI) of youth attaining the minimum physical activity level by youth, family/household, and neighborhood characteristics, and conducted Chi-square tests to evaluate bivariate associations. We used multivariable logistic regression to examine adjusted associations between neighborhood characteristics and meeting a minimum physical activity level overall. Separate models were developed for each of the seven RUCAs to explore the heterogeneity of the association between neighborhood characteristics and attaining a minimum physical activity level using multivariable logistic regression. These RUCA-specific models were created for each of the four examined neighborhood characteristics (sidewalks, parks, recreation centers, and detracting elements) regardless of whether the neighborhood characteristics were significantly associated with minimum physical activity in multivariable models before stratification, in order to examine whether any null findings were due to a differential impact of neighborhood characteristics on physical activity in each of the RUCA-defined community setting types. We conducted analyses using SAS 9.2 (SAS Institute, Inc., Cary, NC, USA) and SAS-callable SUDAAN 10 (Research Triangle Institute, Research Triangle Park, NC, USA) to appropriately weight estimates and adjust for the complex sampling design of the NSCH.

## Results

Table 2 describes the prevalence of minimum physical activity among the study population by RUCA, child demographics, health, screen time, and family/household characteristics. Minimum physical activity varies by RUCA (48.3–50.7 % in urban and rural core communities to 55.3–55.7 % in rural non-core and isolated rural communities). All of the other key variables selected a priori for inclusion based on the existing literature were bivariately associated with minimum physical activity.

Table 3 describes the prevalence of minimum physical activity by neighborhood characteristics, along with the crude and adjusted odds ratios of neighborhood amenities and detracting elements associated with minimum physical activity. Only the presence of recreation centers was significantly associated with minimum physical activity in unadjusted analyses (crude OR 1.17; 95 % CI: 1.06, 1.29). After adjusting for age, sex, race/ethnicity, special health care need, BMI for age and sex, amount of screen time, poverty level, parental education level, and parental physical activity level, neither neighborhood amenities nor neighborhood detracting elements were associated with minimum physical activity.

In Table 4, we show results for each RUCA-specific model. After adjusting for youth demographic and physical health, screen time, and family/household characteristics, presence of neighborhood parks remained a potentially important neighborhood attribute within *other small rural* community areas (i.e., non-core small towns with >10 % of their primary commuting flow to small urban clusters of 2,500–9,999 in population [34]) (adjusted OR 3.49; 95 % CI: 1.55, 7.84). No other neighborhood characteristics were significantly associated with attaining minimum physical activity levels in the adjusted, stratified models.

## Discussion

In this study, we addressed two central questions: (1) whether neighborhood characteristics were associated with youth attainment of minimum physical activity overall while controlling for individual demographic characteristics, youth physical health and screen time, and family/household characteristics; and (2) whether the associations between neighborhood characteristics and minimum physical activity differed by RUCAs.

Physical activity for at least 20 min 5 or more times per week was more prevalent among youth living in most rural areas compared to youth living in most urban areas. This finding is consistent with those of Ding and colleagues, who found that the environmental attributes of a community most strongly correlated with adolescent physical activity were land-use mix and residential density [38]. Interestingly, compared with youth from other RUCAs, a higher proportion of youth from *isolated rural* and *large* and *small rural* areas outside of rural core metropolitan areas were reported to attain minimum physical activity levels. Other researchers have found higher levels of both obesity and physical inactivity among rural youth [14, 39, 40]. Our results are consistent with Liu and colleagues [41], who reported that urban youth were less physically active than rural youth, despite more rural youth being overweight. Our findings, like Liu's, may be reflective of the age of youth in our study and the general observation from surveillance system data that reported physical activity is lower in older youth than among younger youth. In addition, other studies were limited to the publicly available data for community size using MSAs. NSCH data that are publicly available suppress geographic information for a high proportion of children who live in states where there are fewer than 500,000 individuals living in metropolitan areas or in rural areas, and, as a result, researchers may not have the ability to accurately detect differences in physical activity levels by community size, population density, and commuting pattern. Using RUCA codes—a less crude classification than MSAs, we were able to capture more



refined levels of community settings that may not have been included in studies using publicly available data.

Neighborhood amenities, such as sidewalks, parks, and recreational centers, and the absence of detracting elements were not associated with minimum physical activity as defined in this analysis. This null finding did not appear to be the result of neighborhood characteristics operating differently at the various RUCA levels. When we examined the relationship between physical activity and the presence of amenities (sidewalks, parks, recreational centers), and absence of neighborhood detracting elements within each community setting, only the presence of parks was associated with meeting the physical activity level as defined in this study, and only for youth living in the *other small rural area* community setting.

The results of our overall analysis are consistent with those of other researchers with regard to the lack of an association between the presence of neighborhood parks and youth physical activity, and may reflect the crude categorization of parks as present/absent. In our analysis, the presence of parks was not significantly associated with minimum physical activity in unadjusted analyses (crude OR 1.11; 95 % CI: 0.99, 1.24) or in the adjusted analyses (adjusted OR 1.11; 95 % CI: 0.99, 1.26; adjusted OR 1.11; 95 % CI: 0.96, 1.28) (see Table 3). Kaczynski and colleagues [42] found that park features, such as walking trails, were more important than park size and distance [43, 44]. One potential explanation for this lack of association may be that in more urban areas, neighborhood parks might not be viewed as safe locations for physical activity and perceptions of a lack of safety may present a barrier to physical activity [15, 45]. In our analysis, sidewalks also were not associated with youth attainment of minimum physical activity (crude OR 1.05; 95 % CI: 0.95, 1.16; adjusted OR 1.04; 95 % CI: 0.93, 1.15; adjusted OR 0.98; 95 % CI: 0.87, 1.11) (see Table 3). Like the presence or absence of parks, information about sidewalk characteristics may be more informative than simply the presence or absence of sidewalks to understand how sidewalk use influences youth physical activity, particularly in more urban and suburban contexts. Jago et al. [21] reported that sidewalk characteristics (sidewalk location, sidewalk material, presence of streetlights, and number and height of trees) were positively associated with light-intensity physical activity among male adolescents.

The lack of influence of neighborhood recreational centers on youth attainment of minimum physical activity in adjusted models was surprising and is not consistent with findings by Gordon-Larsen et al. [10, 24]. However, in those studies, the number of community recreational centers appears to be important for both access and as a potential means of increasing physical activity among youth [46]. In our analysis, the presence of recreation centers was significantly associated with minimum physical activity in unadjusted analyses (crude OR 1.17; 95 % CI: 1.06, 1.29). In addition, the odds ratios were elevated for the presence of recreation centers in *urban core* and *other urban* community settings (*urban core* adjusted OR 1.14; 95 % CI: 0.99, 1.32; *other urban* adjusted OR 1.23; 95 % CI: 0.92, 1.65). Simple measurement of the presence of a neighborhood recreation center may miss other more influential aspects or characteristics of recreational centers on youth physical activity.

One possible explanation for the lack of association between neighborhood characteristics and level of physical activity observed in this analysis could be the way in which physical activity was operationalized. The full benefits of physical activity are not obtained by solely engaging in any physical activity [32]. We used the level of physical activity that most programs promote: attainment of physical activity for at least 20 min 5 or more times per week. However, others have observed a relationship between neighborhood characteristics in the NSCH and physical *inactivity* [47], perhaps indicating that these neighborhood amenities and detracting elements are important for achieving any physical activity but are not sufficient for reaching recommended levels of activity. Further investigation should directly examine whether the association of these and other factors with physical activity differs for attaining any physical activity versus attaining recommended activity levels. If so, differences in the operation-alization of physical activity might account for some of the inconsistencies in the relationship between neighborhood factors and physical activity observed in the literature.

Several limitations may be present in this analysis. Data from the 2007 NSCH are cross-sectional. Thus, it is not possible to determine a causal relationship between factors that might influence youth to participate in physical activity or the myriad barriers that prevent youth from participating in physical activity and achieving a specific level of physical activity. In addition, NSCH data are parentally reported; the accuracy of parents' reports of child behaviors is unknown and may be influenced by social desirability, recall, or response bias. The survey also asks only about the presence of the neighborhood characteristics, and not their details or features. Although the sample was adjusted for families without telephones, the sample may be biased in that families with telephones may not accurately reflect the experience of families without telephones or those with cellular telephones only [31, 48, 49].

Another limitation of this study is the definition of physical activity. The U.S. Department of Health and Human Services and many national organizations, such as the National Association for Sport and Physical Education and the American Academy of Pediatrics, currently recommend that youth participate in at least 60 min of moderate to vigorous physical activity on most days of the week [3, 4, 50]. The physical activity question on this survey was based on the number of days a child exercised, played a sport, or participated in physical activity for at least 20 min that made him/her sweat and breathe hard. To create a variable more consistent with the current 2008 recommendation, we created a dichotomous variable based on the number of days of physical activity, but were not able to determine whether the child participated in physical activity in excess of 20 min per day. Therefore, we are not able to determine the level to which youth in this survey met current recommendations.

Despite the limitations, this analysis has several strengths. In this study, we conducted an analysis of a large, nationally representative sample of US youth and an examination of youth attainment of minimum physical activity taking into account both neighborhood amenities and detracting elements, as well as community setting. By using the RUCA taxonomy to specify community setting, we were able to apply a uniform and consistent definition of community size, population density, commuting patterns, and geographic



proximity to urban areas. Few researchers have focused on community setting in this manner. The restricted nature of this type of information in national studies may have contributed to previous research detecting no differences in physical activity levels between urban and rural youth.

This study identified very little association between neighborhood characteristics and minimum physical activity, and virtually no heterogeneity in the association between neighborhood characteristics and attainment of minimum physical activity by RUCAs. Although neighborhood factors may be relevant for achieving a basic level of physical activity, they appear to be less important influences on children reaching the recommended minimum physical activity levels. By exploring neighborhood characteristics in more meaningful ways—not just the presence or absence of an amenity or detracting element, but features of the amenity or element that provide contextual information—the ability to answer public health questions that involve neighborhood characteristics will be improved. Neighborhoods also could be characterized by how they are perceived by both parents and youth [51–53]. Existing surveillance systems, such as the NSCH, could be expanded to include questions about amenity features. By exploring neighborhood characteristics and features of neighborhood amenities within the context of well-defined community types, like RUCAs, we can better understand how and why these factors contribute to different levels of youth physical activity.

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**Table 1**  
**7-Level RUCA code aggregation description**

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The purpose of the RUCA 7-level code aggregation is to highlight the distinction between core areas and their peripheries, with the exception of the isolated areas, which are not defined by a core area. This classification method is useful for understanding the hierarchies within different levels of urbanity (i.e. large urban, large rural, small rural). The RUCA codes are classified as follows:

Urban core—metropolitan areas in which most of the commuting is within the urbanized area with a population of 50,000 or more or its peripheral areas

Other urban—metropolitan areas with primary commuting patterns to another urbanized area, and micropolitan, small towns, and rural areas in which the commuting is to another, larger urbanized area

Large rural core—micropolitan areas in which primary commuting patterns are within a large urban cluster with a population of 10,000–49,999

Other large rural—micropolitan areas in which primary commuting patterns are to large urban clusters with populations of 10,000–49,999

Small rural core—small towns in which primary commuting patterns are within a small urban cluster with a population of 2,500–9,999 and secondary commuting patterns are to larger urbanized areas or large urban clusters with populations of 10,000–49,999

Other small rural—small towns in which primary commuting patterns are to small urban clusters with a population of 2,500–9,999 and secondary commuting patterns are to larger urbanized areas or large urban clusters with populations of 10,000–49,999; and

Isolated rural—rural areas in which the primary commuting patterns are to areas that lie outside an urbanized area or urban clusters and secondary commuting patterns are to larger urbanized areas, large urban clusters with populations of 10,000–49,999 or small urban clusters with a population of 2,500–9,999

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**Table 2**  
**Characteristics of youth, 10–17 years of age, participating in minimum physical activity,**  
**2007 National Survey of Children's Health ( $N = 45,392^a$ )**

Characteristics	Participated in physical activity 5 or more days/week for at least 20 min at a time ( $n = 23,015^a$ )		
	Weighted % 49.4	95 % confidence interval 48.2, 50.6	Cochran Mantel–Haenszel $\chi^2$ $P$ value
Rural–urban commuting area (RUCA) (community type)			
Urban core ( $n = 27,642$ )	48.6	<i>b</i>	0.0004
Other urban ( $n = 4,846$ )	50.2		
Large rural core ( $n = 4,460$ )	48.3		
Other large rural ( $n = 1,439$ )	55.3		
Small rural core ( $n = 2,689$ )	50.7		
Other small rural ( $n = 716$ )	57.7		
Isolated rural ( $n = 3,594$ )	57.1		
Youth demographics			
Age (years)			
10–14	53.1	51.6, 54.7	<0.0001
15–17	43.1	41.3, 44.9	
Sex			
Male	55.9	54.3, 57.6	<0.0001
Female	42.8	41.1, 44.5	
Race/ethnicity			
Hispanic	38.2	34.5, 42.0	<0.0001
White, non-Hispanic	52.9	51.5, 54.2	
African American, non-Hispanic	49.8	46.9, 52.8	
Multi-racial, non-Hispanic	57.8	52.6, 62.9	
Other, non-Hispanic	45.8	38.9, 52.9	
Youth health and activities			
Body mass index (BMI)	53.3	47.9, 58.6	<0.0001
Underweight (<5th percentile)	52.4	50.8, 53.9	
Healthy weight (5th–84th percentile)	46.2	43.2, 49.3	
Overweight (85th–94th percentile)	43.7	40.6, 46.9	
Obese (95th percentile or above)			
Child with special health care need			
No	50.5	49.2, 51.9	0.0004
Yes	45.6	43.3, 48.0	
Amount of screen time			
Less than 2 h/day	56.7	54.8, 58.5	<0.0001
2 h or more/day	44.5	43.0, 46.1	
Family and household characteristics			
Parental education			



Characteristics	Participated in physical activity 5 or more days/week for at least 20 min at a time ( <i>n</i> = 23,015 <sup>a</sup> )		
	Weighted % 49.4	95 % confidence interval 48.2, 50.6	Cochran Mantel– Haenszel $\chi^2$ <i>P</i> value
No parent has more than a high school education	43.5	41.1, 45.8	<0.0001
At least one parent has more than a high school education	52.6	51.2, 54.0	
Federal poverty level of family (derived)			
0–99 FPL	40.6	37.7, 43.6	<0.0001
100–199 FPL	46.7	43.9, 49.6	
200–399 FPL	50.3	48.1, 52.4	
400 FPL	54.9	53.0, 56.7	
Parental physical activity level			
No parent exercises 5 or more days/week	43.6	42.1, 45.2	<0.0001
At least 1 parent exercises 5 or more days/week	58.6	56.6, 60.5	

<sup>a</sup>Unweighted

<sup>b</sup>The calculation of 95 % CI is not an allowed function in ANDRE within SUDAAN's proc crosstab

**Table 3**  
**Neighborhood characteristics associated with minimum physical activity, among youth aged 10–17 years, 2007 National Survey of Children's Health**

Neighborhood characteristics	Participated in physical activity 5 or more days/week for at least 20 min at a time					
	Weighted %	95 % CI	CMH $\chi^2$ P value	Crude OR (95 % CI)	Adjusted <sup>a</sup> OR (95 % CI)	Adjusted <sup>b</sup> OR (95 % CI)
Neighborhood amenities						
Sidewalks present	49.8	48.3, 51.3	0.3507	1.05 (0.95, 1.16)	1.04 (0.93, 1.15)	0.98 (0.87, 1.11)
Sidewalks absent	48.6	46.6, 50.6		Referent	Referent	Referent
Parks present	50.0	48.6, 51.4	0.0739	1.11 (0.99, 1.24)	1.11 (0.99, 1.26)	1.11 (0.96, 1.28)
Parks absent	47.4	45.0, 49.8		Referent	Referent	Referent
Recreation centers present	51.0	49.5, 52.5	<b>0.0026</b>	<b>1.17 (1.06, 1.29)</b>	1.09 (0.98, 1.21)	1.07 (0.95, 1.19)
Recreation centers absent	47.2	45.2, 49.2		Referent	Referent	Referent
Neighborhood detracting elements						
Presence of 1 or more detracting elements	47.5	45.2, 49.9	0.0509	Referent	Referent	Referent
Absence of detracting elements	50.3	48.9, 51.7		1.11 (1.00, 1.24)	0.98 (0.87, 1.11)	0.99 (0.88, 1.12)

Bold values indicate statistically significant

<sup>a</sup> Adjusted model includes child's age group, sex, race/ethnicity, special health care need, body mass index for age and sex, amount of screen time, poverty level, parental education level, parental physical activity

<sup>b</sup> Adjusted model includes all variables described above, as well as all of the neighborhood amenities and detracting elements

**Table 4**  
**Adjusted odds ratios of neighborhood characteristics associated with minimum physical activity, among youth aged 10–17 years, by Rural–Urban Commuting Areas (RUCAs), 2007 National Survey of Children’s Health (N = 45,386<sup>a</sup>)**

Neighborhood characteristics	RUCA designation <sup>b</sup>						
	Urban core (n = 24,632) Adjusted odds ratio (95 % CI)	Other urban (n = 4,414) Adjusted odds ratio (95 % CI)	Large rural core (n = 4,016) Adjusted odds ratio (95 % CI)	Other large rural (n = 1,303) Adjusted odds ratio (95 % CI)	Small rural core (n = 2,401) Adjusted odds ratio (95 % CI)	Other small rural (n = 637) Adjusted odds ratio (95 % CI)	Isolated rural (n = 3,268) Adjusted odds ratio (95 % CI)
Presence of sidewalks in the neighborhood	1.00 (0.85, 1.17)	1.08 (0.79, 1.49)	0.96 (0.63, 1.46)	0.97 (0.59, 1.58)	1.18 (0.70, 1.99)	0.56 (0.27, 1.18)	1.12 (0.81, 1.54)
Presence of neighborhood parks	1.12 (0.93, 1.36)	1.19 (0.84, 1.67)	0.97 (0.61, 1.52)	1.28 (0.79, 2.07)	1.00 (0.57, 1.78)	<b>3.49 (1.55, 7.84)</b>	1.11 (0.78, 1.59)
Presence of neighborhood recreation centers	1.14 (0.99, 1.32)	1.23 (0.92, 1.65)	0.96 (0.65, 1.40)	0.82 (0.52, 1.30)	0.98 (0.67, 1.42)	0.78 (0.40, 1.51)	0.85 (0.61, 1.19)
Absence of detracting neighborhood elements <sup>c</sup>	1.02 (0.87, 1.19)	1.04 (0.75, 1.45)	1.01 (0.73, 1.41)	0.69 (0.43, 1.12)	0.82 (0.55, 1.21)	1.04 (0.54, 2.01)	1.15 (0.83, 1.59)

Bold values indicate statistically significant

Models of minimum physical activity within each RUCA designation for the community type also controlled for the following characteristics and factors: child’s age group, sex, race/ethnicity, special health care need, body mass index for age and sex, screen time, poverty level, parental education level, parental physical activity level

<sup>a</sup>Unweighted

<sup>b</sup>Table 1 describes the 7-level RUCA code aggregation

<sup>c</sup>Detracting neighborhood elements included litter, garbage, poorly kept, rundown or dilapidated housing, broken windows, graffiti, or other signs of vandalism