Childhood Overweight/Obesity and the Physical Activity Environment in Rhode Island

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ABSTRACT

OBJECTIVE: This study seeks to better understand the relationship between the physical activity environment and child overweight/obesity in Rhode Island.

METHODS: Using geographic information systems (GIS), this study calculated distances from residences to physical activity resources to assess the relationship distance has with childhood overweight/obesity.

RESULTS: Mean distances in high-risk towns ranged from 0.61 to 3.15 miles compared to physical activity resources in low-risk towns, where distances ranged from 1.25 to 7.43 miles. For each additional mile to reach the closest indoor facility, there is a 0.41 (95% CI: –0.78, –0.03) percentage point decrease in the child overweight/obesity rate.

CONCLUSION: High-risk block groups and towns have higher rates of child overweight/obesity and show shorter distances to physical activity resources. This study demonstrates that simply having physical activity structures in place is not enough to reduce child overweight/obesity and further research should examine the quality and usage patterns of these resources.

KEYWORDS: children, overweight/obesity, physical activity resources

INTRODUCTION

Considered by the Centers for Disease Control and Prevention (CDC) to be a serious public health issue, childhood obesity currently affects 18.5% of children in the United States.[1] Children who are racial/ethnic minorities, of lower socioeconomic status, and live in households where the head of household has low educational attainment are disproportionately affected by childhood overweight/obesity.[2,3] In Rhode Island, the prevalence of children who are classified as overweight/obese (at or above the 85th percentile of the CDC sex-specific BMI-for-age growth charts) is 31%; however, the problem is greater in the core cities of Pawtucket, Woonsocket, Central Falls, and Providence, with more than 43% of children affected.[4]

Children who are overweight/obese are at an increased risk not only for the development of psychosocial consequences, sleep disorders, lower educational attainment, and bullying, but are also at an increased risk for the development of multiple chronic diseases such as cardiovascular disease and type II diabetes.[5,6] Obesity also carries a financial burden. It is estimated that, on average, obese children will experience $19,000 more in direct medical costs over the course of their life when compared to children who are not obese.[7]

In addition to diet, genetics, family environment, and psychological factors, research has shown the important role that physical activity environments play in a child's development of overweight and obesity.[8,9] However, a systematic review showed that study results are inconsistent, with some studies showing a relationship between the physical activity environment and child overweight and obesity and others not showing a relationship.[10] In this study, we examined the physical activity environment in Rhode Island with the following research questions: (1) Do physical activity environments vary by neighborhood risk at the town and block group level? (2) Do Rhode Island towns have differential access to physical activity resources? (3) Is a town's proximity to physical activity resources predictive of the town's level of overweight/obesity in children?

METHODS

Physical Activity Environment

In order to assess the physical activity environment in Rhode Island, we used a number of different resources. To understand outdoor physical activity space, we obtained the 2018 State Comprehensive Outdoor Recreational Plan (SCORP) geospatial data from the Rhode Island Department of Environmental Management (RIDEM), which included the geographic locations of all public basketball courts, tennis courts, fields, pools, ice rinks, skate parks, playgrounds, and tracks (https://www.rigis.org/datasets/state-comprehensive-outdoor-recreation-plan-scorp-inventory-of-facilities). In an attempt to create a more comprehensive picture of the physical activity environment, we obtained the locations of afterschool and summer programs with a physical activity component, which were obtained from the United Way of Rhode Island. We also included Girls on the Run of Rhode Island meeting locations, which is where girls can meet to have structured running activities. These were

obtained via its website (https://www.gotrri.org/Our-Locations). In addition, indoor recreational facilities were found via a Google search (facilities included indoor recreational spaces that were not included in SCORP; e.g., indoor trampoline parks, pools, ice hockey rinks). All data not already in a geospatial datafile were then geocoded using ESRI's World Geocoder (https://www.esri.com/en-us/arcgis/products/world-geocoder-for-arcgis) in ArcGIS 10.7.1 and exported to a geodatabase.

Demographics

For each town and for each block group, a risk index was constructed using eight highly-correlated measures obtained from the 2014–2018 American Community Survey (ACS): % adults without high school education, % single-parent households, % household crowding (>1 person per room), % renter-occupied housing units, % vacant homes (excluding vacation homes), % families below the federal poverty limit, % non-white, and % housing units built before 1950.[11] Quintiles were computed for each of the eight measures and summed, resulting in a scale ranging from 8–40, with higher scores indicating greater risk. The risk index was categorized into high- (≥75th percentile) and low-risk (<75th percentile) towns and block groups, a dichotomization used previously.[11] While only town-level associations of physical activity resources with child overweight/obesity rates can be examined, we felt it was also important to understand the distance to physical activity resources in the smaller geographic unit of block groups, which can better approximate a child's neighborhood.

BMI

Town-level overweight/obesity prevalence for children between the ages of 2–17 years was obtained from a published statewide assessment of clinical and billing records.[4]

Analysis

We calculated the distance from every residence in the state to the closest physical activity resource. Locations of each RI residence were obtained as a pre-existing geospatial datafile (http://www.rigis.org/datasets/e-911-sites), which includes all known buildings and structures in the state. We limited the structures to those identified as primary residences, multifamily, mobile homes, other residential, and seasonal homes. We used ESRI's Closest Facility Network Analyst (NA) tool to calculate the distance from each RI residence to each physical activity variable, using the RIGIS E911 spatial datafile of roads as the basis for the travel network. The Closest Facility analysis identified the shortest walking route to each physical activity variable for 99% of RI residences. All distance calculations were summarized to the block group and town level and combined with sociodemographic and BMI data. Analyses were completed in Stata 16 and SAS 9.4. Descriptive statistics were calculated for variables included in the neighborhood and town risk indices, as well as for the mean distances to physical activity resources at the block group and town level. Distances were weighted by the total number of residences in each block group or town. Unadjusted and adjusted weighted linear regression analyses were conducted to assess the association between mean travel distance to a physical activity resource in each town and the prevalence of child overweight and obesity.

As only aggregate and non-human subject data were utilized, no approval was needed from the Institutional Review board.

RESULTS

Demographic characteristics of towns and block groups are displayed in **Table 1**. As expected, the mean percentage of each demographic characteristic which comprises the risk index is greater in high-risk towns and block groups compared to low-risk towns and block groups.

The mean distances from residences to each physical activity resource were significantly shorter in high-risk block groups than in low-risk block groups (**Table 2**). Mean distances in the high-risk block groups ranged from 0.39 to 2.70 miles compared to physical activity resources in low-risk towns, where the distances ranged from 1.09 to

Table 1. Demographic characteristics of Rhode Island towns and block groups by socio-economic risk classification

Demographic characteristics (%)	Low-Risk Block Groups (N=609)		High-Risk Block Groups (N=199)		Low-Risk Towns (N=29)		High-Risk Towns (N=10)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Non-White	15.53	15.17	63.82	25.04	8.49	3.55	35.27	23.16
Single-Parent Households	10.58	11.19	31.25	15.23	9.05	3.88	19.81	7.24
Adults 25+ with No High School Education	8.27	6.73	24.40	11.44	6.57	2.94	16.01	8.89
Families below 100% FPL	4.93	7.46	24.92	15.11	4.23	2.47	13.05	7.80
Renter-Occupied Households	30.05	22.19	70.32	15.62	23.39	9.35	52.26	15.10
Vacant Homes	6.50	6.23	14.88	10.10	5.97	2.03	9.45	3.09
Household Crowding	0.90	2.22	4.71	5.58	0.85	0.72	2.67	1.93
Housing Units Built before 1950	34.79	24.15	62.12	17.92	24.98	9.00	47.25	16.06

Table 2. Weighted average distances by block group-level socioeconomic risk

Weighted average distance (miles) to:	Low-Risk Block Groups (N=609)	High-Risk Block Groups (N=199)	
	Mean (95% CI)	Mean (95% CI)	p-value
Afterschool programs	1.92 (1.75, 2.10)	0.44 (0.41, 0.48)	<0.0001
Basketball courts	1.49 (1.38, 1.60)	0.52 (0.48, 0.56)	<0.0001
Fields	1.09 (1.02, 1.16)	0.49 (0.46, 0.52)	<0.0001
Girls on the Run meeting locations	5.90 (5.54, 6.27)	2.70 (2.26, 3.14)	<0.0001
Indoor facilities	4.51 (4.15, 4.87)	1.72 (1.38, 2.06)	<0.0001
Playgrounds	1.21 (1.13, 1.30)	0.39 (0.36, 0.42)	<0.0001
Summer programs	4.19 (3.96, 4.43)	1.83 (1.54, 2.11)	<0.0001
Tennis courts	1.68 (1.58, 1,77)	0.91 (0.85, 0.96)	<0.0001
Tracks	3.18 (2.98, 3.38)	1.75 (1.63, 1.87)	<0.0001
YMCA/Boys and Girls Clubs	3.58 (3.27, 3.89)	0.90 (0.77, 1.03)	<0.0001

Table 3. Weighted average distances by town-level socioeconomic risk

Weighted average distance (miles) to:	Low-Risk Towns (N=29)	High-Risk Towns (N=10)	
	Mean (95% CI)	Mean (95% CI)	p-value
Afterschool programs	2.38 (1.51, 3.25)	0.81 (0.32, 1.30)	0.0022
Basketball courts	1.81 (1.31, 2.31)	0.74 (0.52, 0.96)	0.0003
Fields	1.25 (1.03, 1.47)	0.67 (0.37, 0.96)	0.0010
Girls on the Run meeting locations	7.43 (5.77, 9.09)	2.82 (0.93, 4.71)	0.0004
Indoor facilities	4.77 (3.49, 6.05)	3.15 (0.00, 6.88)	0.3758
Playgrounds	1.46 (1.14, 1.77)	0.61 (0.42, 0.80)	<0.0001
Summer programs	4.59 (3.63, 5.55)	2.82 (0.80, 4.83)	0.1003
Tennis courts	1.97 (1.67, 2,28)	1.02 (0.80, 1.25)	<0.0001
Tracks	3.81 (2.89, 4.73)	1.86 (1.49, 2.24)	0.0003
YMCA/Boys and Girls Clubs	4.17 (2.77, 5.56)	1.86 (0.00, 4.01)	0.0407

5.90 miles. Playgrounds were the closest physical activity resource in high-risk block groups (0.39 miles), while fields were the closest resource in low-risk block groups (1.09 miles). Girls on the Run meeting locations were the most remote resource in both high-risk (2.70 miles) and low-risk block groups (5.90 miles).

For all of the physical activity resources examined, the mean distance was closer to residences in high-risk towns than in low-risk towns (**Table 3**); however, the differences were not statistically significant for indoor facilities and summer programs. Mean distances in the high-risk towns ranged from 0.61 to 3.15 miles compared to physical activity resources in low-risk towns where the distances ranges from 1.25 to 7.43 miles. The closest physical activity resources in both high- and low-risk towns were playgrounds (high-risk: 0.61 miles; low-risk: 1.46 miles) and fields (high-risk: 0.67 miles; low-risk: 1.25 miles). The most remote physical activity resources in high-risk towns were indoor facilities (3.15 miles), while Girls on the Run meeting locations were the most remote for low-risk towns (7.43 miles).

Overall, the rate of childhood overweight/obesity in RI is 31%;[3] 24% of children living in low-risk towns and 35% of children living in high-risk towns are classified as overweight or obese. **Table 4** shows the relationship between the mean distance from RI residences to each physical activity resource and the prevalence of child overweight/obesity. Unadjusted models showed that the mean distance to physical activity resources had a significant inverse relationship with child overweight/obesity rates. However, after adjusting for the town-level risk index, only indoor facilities remained statistically significant associated with the town-level rate of child overweight/obesity. For each additional mile to reach the closest indoor facility, there was a 0.41 (95% CI: –0.78, –0.03) percentage point decrease in the child overweight/obesity rate.

Table 4. Unadjusted and adjusted weighted regression models of town-level overweight/obesity rates among Rhode Island youth ages 2–17

Distance (in miles) to:	Unadjusted			Adjusted*		
	Param Est	95% Confidence Interval	p-value	Param Est	95% Confidence Interval	p-value
Afterschool programs	-1.09	(-2.13, -0.05)	0.0399	-0.29	(-1.23, 0.66)	0.5434
Basketball courts	-2.60	(-4.26, -0.95)	0.0029	-1.20	(-2.83, 0.43)	0.1450
Fields	-5.64	(-8.73, -2.56)	0.0007	-2.95	(-6.10, 0.20)	0.0659
Girls on the Run meeting locations	-0.56	(-1.01, -0.11)	0.0158	-0.10	(-0.55, 0.36)	0.6728
Indoor facilities	-0.57	(-1.03, -0.12)	0.0155	-0.41	(-0.78, -0.03)	0.0333
Playgrounds	-4.51	(-6.83, -2.18)	0.0004	-2.31	(-4.82, 0.21)	0.0714
Summer programs	-0.72	(-1.44, 0.01)	0.0539	-0.28	(-0.91, 0.36)	0.3801
Tennis courts	-3.92	(-6.24, -1.61)	0.0015	-1.41	(-4.00, 1.19)	0.2783
Tracks	-1.52	(-2.40, -0.64)	0.0013	-0.80	(-1.66, 0.08)	0.0742
YMCA/Boys and Girls Clubs	-0.65	(-1.21, -0.09)	0.0233	-0.31	(-0.80, 0.18)	0.2017

*Adjusted for town-level risk index
Param Est = parameter estimate

DISCUSSION

Physical activity environments were found to vary by neighborhood risk at both the town and block group level. The shortest distance was found for playgrounds and fields at both the town and block group levels, regardless of whether these areas had high or low levels of socioeconomic resources. The most remote physical activity resource for both high- and low-risk block groups and towns was Girls on the Run meeting locations and indoor facilities. It is important to keep in mind that previously published studies determine "walkable" to be less than half a mile for children[8], suggesting that, on average, most of the resources examined in this study are not easily reached by walking. The distance to physical activity resources was shorter in high-risk towns and block groups than in low-risk towns and block groups showing differential access to physical activity resources; however, the mean distances were still not considered "walkable" in either the high- or low-risk block groups or towns.

High-risk block groups and towns in the current study are characterized by high rates of poverty and higher proportions of nonwhite individuals. In these areas, we found residences were in closer proximity to physical activity resources. Previous research has shown an inconsistent relationship, with some finding increased physical activity resources in neighborhoods with low socioeconomic status[12] and in racial minority neighborhoods,[13] while others studies report decreased physical activity resources in lower socioeconomic status neighborhoods and racial minority neighborhoods.[14] Our study further contributes to inconsistencies within the literature.

Finally, when investigating the association between the proximity to physical activity resources and town-level overweight/obesity rates in children, we found a counter-intuitive relationship, where towns that had higher rates of child overweight/obesity also had closer proximity to physical activity resources. This inverse relationship between distance to any physical activity resource and child overweight/obesity is consistent with a previous study of the built environment (i.e., the man-made structures, features, and facilities where people live) and its relationship with childhood overweight/obesity.[15] These results suggest that proximity alone to physical activity resources is not a significant predictor of child overweight/obesity at the town level, after adjusting for the socioeconomic characteristics of a town's population. Further, these results suggest that access to physical activity resources is a multidimensional issue, and factors beyond proximity (e.g. genetics, family environment, and nutrition) may play an important role.

To our knowledge, this is the first proximity analysis conducted for physical activity resources in the state of Rhode Island which examines differences in proximity to physical activity resources by neighborhood and town-level socioeconomic environments. It also examines the town-level relationship of proximity to physical activity resources with the prevalence of childhood overweight/obesity. There are a few limitations of our study. First, this study did not take into consideration all of the various modes of space which could be used for child play and physical activity. One of the main resources missing from this analysis is resources available to students within their schools. This limitation could therefore underestimate the physical activity resources that children have access to. Second, the Closest Network Analyst tool utilized roads as the mode of travel when calculating the distance that would be needed to be traveled in order to reach each physical activity resource. Roads were used as the mode of travel under the assumption that sidewalks are typically located next to them and would therefore be the best estimation of how children may reach each resource. Under this assumption, the analysis does not take into consideration that children may cross yards or reach physical activity resources by means that are not sidewalks. Finally, there were no qualitative assessments completed for any of the physical activity structures in this study. While there may be a physical activity structure present, the structure may not be of great quality, which has been shown to impact child utilization.[16]

CONCLUSIONS

This study demonstrates that living in closer proximity to physical activity structures does not necessarily mean that children are going to utilize them enough to reduce overweight/obesity. Additional research should examine the quality of physical activity environments and resources, as well as actual usage patterns by children living in the community. Future studies should also consider assessing crime data as well as traffic patterns due to previous research showing these are both barriers in physical activity among children.[17,18] Furthermore, a database identifying all available physical activity resources should be made available to all families to improve knowledge of available physical activity resources.

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Disclaimer

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