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**Influence of Perceived Neighborhood Food and Physical Activity Environments on Child Weight Trajectory**

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**Introduction:**

Childhood obesity is a concerning global public health crisis (Flynn et al., 2006). According to the Centers for Disease Control and Prevention, from 2017 to 2018, 18.5% or 13.7 million children (aged 2-19 years) in the United State were obese and 16.1% or 11.9 million children were overweight (Fryar et al., n.d.; Ruopeng, 2020). This unhealthy weight status not only increases a child’s likelihood for becoming overweight or obese as an adult but also increases their likelihood of developing chronic health conditions, such as hypertension, type 2 diabetes, heart disease, stroke, osteoarthritis, and certain types of cancer throughout their lifetime (Flynn et al., 2006). To discourage the development of negative health profiles in children, researchers are giving more attention to how patterns in health behaviors during childhood relate to overall health outcomes, suggesting the need to monitor weight trajectories in children (i.e., dynamic fluctuations in weight status across childhood) rather than examining cross-sectional weight-related health patterns in youth. Specifically, Fiechtner et al. recently identified that children who were obese between the ages of 3-6 years were significantly more likely to maintain obesity into adulthood compared to healthy weight children; conversely children who were of healthy weight during early childhood (2-5 years old) were more likely to either maintain and return to a healthy BMI-for-age compared to overweight adolescence aged 13 years or older (Anderson et al., 2006; Fiechtner et al., 2017; Lattmen et al., 2018).

To address factors which may contribute to unhealthy weight profiles in youth, researchers and practitioners recommend examining the obesity epidemic through a socioecological lens, a perspective that encompasses the social, behavioral, environmental, and economic factors that contribute to individual-level health outcomes (Carroll-Scott et al., 2013; Jia, 2020; Saelens et al., 2018; Saelens et al., 2012; Sallis et al., 2006). The socioecological framework allows for the impact that built environments and social factors have on weight status to be studied within the context of a child’s home environment (Sallis et al., 2006). For example, Story et al., (2008) studied the relationship between eating habits and a child’s home environment, finding that individual-, social-, physical-, and macro-level factors (i.e., the entire neighborhood system) all directly and indirectly impacted a child’s health status and their ability to make decisions regarding their behaviors. The authors found that healthy behaviors were likely to occur in environments where they were promoted due to resource availability (Story et al., 2008). Similarly, Saelens and colleagues (2012) examined the characteristics of “obesogenic” neighborhoods, finding that children living in neighborhoods with high access to resources supporting healthy eating and physical activity had lower odds of being overweight or obese compared to children living in neighborhoods with poor access to resources supporting healthy nutrition and physical activity. Yet across the body of literature, the influence of neighborhood environments on weight status in youth is relatively unclear. Some authors demonstrate that the physical activity environment, including the prevalence and proximity of parks and outdoor spaces, crime, and walkability, has a significant impact on the predictability of youth weight status, while others demonstrate no relationship between physical activity resources and healthy weight status but report that the nutrition environment (which includes the prevalence and proximity of grocery stores and fast-food restaurants along with the affordability of food types) has a greater impact on youth weight status (Carroll-Scott et al., 2013; Jia, 2020; Penilla et al., 2017; Saelens et al., 2012; Ribeiro, 2020).

Locally, we have determined that youth weight status fluctuates as a function of Roanoke’s neighborhood environments, demonstrating a relationship between the zip code where a child resides and weight-related health status (Haden et al., 2021). While supporting the concept that neighborhood environments influence health outcomes in youth, we could not infer the factors that contributed to the marked differences we observed (Haden et al., 2021). Given the lack of consistent evidence between neighborhood environments and health outcomes in youth, it has been recommended that researchers begin to examine this relationship more subjectively (i.e., via a child’s perceived access to neighborhood resources), rather than objectively, or as a function of resource availability (Kothencz et al., 2017).

While objective measures examine the physical availability of built environmental factors, subjective accounts of neighborhood environments may better reflect socio-ecological factors that influence health behaviors and health outcomes (Lättman et al., 2018). Emerging literature recognizes that an individual’s perceptions of their lived experiences (including perceived access to health-supporting resources) may provide deeper insight into factors that spatial assessments do not measure, thus enhancing the capacity to evaluate the impact that social determinants of health may have on resource availability (Kothencz et al., 2017). Specifically, it has been suggested that perceptions of the neighborhood environment may better represent individual-level use of resources and individual-level social determinants of health as compared to assessments of the built environment (Carroll-Scott et al., 2013). Additionally, it has been observed that objective measures of the environment do not always align with residents’ perceptions of neighborhood-level resources (Jia, 2020). For example, using objective measures to examine neighborhood availability of fruit and vegetables, the presence of food stores, or land use mix, does not account for resource use (Zenk et al., 2017; Freedman and Bell, 2009; Jia., 2020). Locally, we have demonstrated that higher perceptions of access to resources promoting physical activity and healthy eating behaviors are associated with lower BMI-for-age in youth, suggesting that perceptions of the built environment may better reflect resource use (and thus the impact of social determinants of health) on youth weight status (Iyer et al., 2020). If this is true, it is possible that a child’sperceptions of their neighborhood environment may be more useful in guiding meaningful health interventions, informed by the individuals themselves, potentially resulting in health prevention strategies that residents both want and need. Given the potential to better understand an individual’s lived experiences using perceived metrics of neighborhood resource availability, a recent call to action by the National Institutes of Health described a need to explore the utility of perceived neighborhood environments as a predictor of health outcomes (Glanz, 2021). To address this call to action and respond to emergent trends in the literature suggesting a need to explore weight-trajectories in youth, the purpose of this study was to examine the role of neighborhood environments on children’s weight trajectories, from the years 2019 to 2021, as a function of perceived access to neighborhood food and physical activity resources.

**Methods**

A non-randomized prospective cohort design was used to explore the influence of perceived neighborhood food and physical activity environments on child weight trajectory. Data was gathered from the 2019 and 2021 Roanoke Valley Community Healthy Living Index (RVCHLI), an annual surveillance system that evaluates perceptions of neighborhood environments and BMI-for-age in youth to examine the effect of “place” on health within the Roanoke Valley. To gather family perceptions of neighborhood environments, surveys were sent home to all enrolled students in the Roanoke City public school system in 2019 (N = 7,357) and 2021 (N = 6,330).

*Perceptions of the built environment.* Consenting families described their neighborhood environment on a Likert scale (i.e., strongly disagree, disagree, neutral, agree, and strongly agree). Families responded to the following questions pertaining to their neighborhood food and physical activity environments: “Parks and other areas are available for people of all ages to be active in the neighborhood”, and “Food stores offering healthy foods are in walking/biking distance from home or are easy to get to by bus.” Their answers to these questions were used to code neighborhoods as (1) a high food access, high physical activity environment (High FE/High PAE); (2) a high food access, low physical activity environment (High FE/Low PAE); (3) a low food access, high physical environment (Low FE/High PAE); or (4) a low food access, low physical activity environment (Low FE/Low PAE). Specifically, those who chose “Strongly Disagree” or “Disagree” were coded as living in a low access neighborhood environment and those who chose “Agree” or “Strongly Agree” were coded as living in a high access neighborhood environment. Those who chose “Neutral” for either of the questions were not included within this study.

*Child weight trajectory.* Matched within-subject BMI-for-age data from 2019 and 2021 was collected by school Physical Education teachers so that each child could be classified according to their weight trajectory. Specifically, students were classified as having an “unhealthy weight trajectory” (UWT) if they persisted at an unhealthy BMI-for-age (above the 85th percentile for age) from 2019 to 2021 or if they regressed across years from a healthy BMI-for-age (below the 85th percentile for age) to an unhealthy BMI-for-age from 2019 to 2021. Conversely, children were classified as having a “healthy weight trajectory” (HWT) if they maintained a healthy BMI-for-age from 2019 to 2021 or returned to a healthy BMI-for-age from an unhealthy BMI-for-age over time.

*Analysis*

A flowchart illustrating complete data availability is displayed in Figure 1. In 2021, complete survey data was available for 1,146 children and BMI-for-age data was available for 5,064 children. Students with complete data in 2021 (*n* = 895) were then matched to the 5,196 students with complete BMI-for-age data in 2019. Overall, 61 students had complete data enabling weight trajectory to be determined. A 4x2 Chi Square analysis was used to explore the influence of perceived neighborhood environments (High FE/High PAE; High FE/Low PAE; Low FE/High PAE; and Low FE/Low PAE) on child weigh trajectory (UWT, HWT).

**Results**

Complete within-subjects data was obtained from 61 children (females = 26; age = 8.98 + 0.92 years). Among participants, 56% displayed a HWT and 89% of children perceived their neighborhood as a High FE/High PAE (See Figure 2). No relationship was observed between perceived neighborhood environment and weight trajectory in youth, X2(3, N = 61) = 3.43, *p* = 0.330, Cramer’s V = 0.237.

**Discussion:**

Based on previous literature, it was anticipated that children who perceive they live in a High PAE/High FE neighborhood would be less likely to display an UWT then those who perceive they live in less supportive neighborhoods (Ogden et al., 2012; Saelens et al., 2018; Saelens et al., 2012; Singh et al.). Results from the current study demonstrate that neighborhoods with favorable conditions for both healthy eating and physical activity are associated with the highest prevalence of both unhealthy and healthy weight trajectory (36% UWT; 53% HWT). This finding was not expected as previous authors have reported that less favorable neighborhoods are associated with higher rates of obesity compared to more favorable environments (Ogden et al., 2012; Saelens et al., 2018; Saelens et al., 2012; Singh et al.). However, previous studies utilizing the term “obesogenic neighborhoods”, as a way to describe built environments that are not supportive of healthy behaviors, relied on objective measures to characterize neighborhoods (Saelens et al., 2012), whereas this study utilized subjective measures to characterize the built environment.

Although no association was found between child weight trajectory and perceived access to food and physical activity resources, this is the first-known study to explore factors contributing to youth health outcomes through a socioecological lens, and the first-known study to investigate the relationship between child weight trajectory as a dynamic indicator of developing health outcomes in light of subjective measures of a child’s neighborhood environment. Finally, this is the first-known study to examine these relationships across an entire mid-sized city, rather than in targeted neighborhoods.

This study was limited by a small sample size due to the need to collate completed surveys with child weight trajectory data in a multi-year study. Moreover, given that data was collected in an urban environment, results may only be generalized across urban neighborhoods. While novel, the use of perceived neighborhood environments led to unexpected inconsistencies in how people perceive the context in which they live. In light of known infrastructure disparities across Roanoke’s diverse neighborhoods, we were surprised that the majority of respondent families described their neighborhood as a “high access” environment. It is possible that the 5-point Likert scale used in this study contributed to the lack of clarity in respondents’ ratings of neighborhood environments. As future authors seek to understand the impact of social determinants of health on individual lived experiences, more discreet prompts should be used to guide perceptions of neighborhood food and physical activity environments.

Future studies should aim to include a larger sample exploring the role of health supporting resources on BMI-for-age dynamically. Given the lack of understanding of subjective accounts of social determinants on weight-related health outcomes and the recent call to action by the National Institutes of Health acknowledging the need to identify new methods to explore social determinants as a function of an individual’s lived experiences, ongoing investigations are both needed and warranted.

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