



The social context moderates the relationship between neighborhood safety and adolescents' activities

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ABSTRACT

Studies of neighborhood safety and physical activity have typically neglected to consider the youth's peer context as a modifier of these relationships. This study fills this gap in testing the independent and interactive effects of perceived neighborhood safety and time spent with friends and peers on young adolescents' physical activity and sedentary behavior. Participants (N = 80; ages 13–17) completed the Pedestrian/Traffic Safety and Crime Safety subscales of the adolescent version of the Neighborhood Environment Walkability Scale (NEWS). An experience sampling methodology was used to assess sedentary behaviors/screen time and the social context in which physical activity and sedentary time/behavior occurred. Physical activity was assessed via accelerometry. Multilevel models were used to estimate the relationships between predictors (neighborhood safety and social context) and outcomes (physical activity and sedentary time/behavior). Frequency of peer/friend interactions moderated the relationships between neighborhood safety and adolescents' physical activity and sedentary behavior. Specifically, physical activity was more strongly influenced by neighborhood safety among adolescents who reported spending less time with peers and friends than among those who reported frequent peer interactions. Among youths who perceived that their neighborhoods were safer, spending more time with friends and peers was related to greater engagement in sedentary activities, whereas this was not the case among adolescents who perceived that their neighborhoods were less safe. The peer social context moderates the relationship between perceived neighborhood safety and adolescents' physical activity and sedentary behavior. Improving social interactions at the individual level within neighborhoods may decrease concerns of safety.

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1. Introduction

Regular physical activity and active play during adolescence is associated with several short- and long-term physical and psychological benefits (e.g., Janz et al., 2006). Unfortunately, many youths do not participate in recommended amounts of activity (Crespo et al., 2001) and research is needed to understand factors associated with adolescents' choices of activities. A number of studies have focused on the associations between neighborhood characteristics, including parent perceived safety, and youths' physical activity (Burdette and Whitaker, 2004, 2005; D'Haese et al., 2014; Galvez et al., 2013; Holt et al., 2009; Maddock, 2004; H. J. Moore et al., 2014; Morland and Evenson, 2009; Simmons et al., 2005; Weimann et al., 2015). Findings from this literature are mixed, with some studies showing relationships between neighborhood characteristics and youths' engagement in physically active leisure activities, and others finding no or equivocal associations

(e.g., Saelens and Handy, 2008). One explanation for the lack of consensus among studies may be that previous research has focused on the impact of parent perceived neighborhood safety on their children's physical activity and sedentary behavior, and less is known about the role of youths' perceptions of safety in relation to their own behavior (Cote-Lussier et al., 2015a; Cote-Lussier et al., 2015b). Youths' perceptions of safety may be especially important as children get older and gain increasing autonomy. Previous models of perceived neighborhood safety have also typically neglected to consider youths' peer and friend interactions as key modifiers of the relationships between perceived safety and physically active and sedentary activities. Adolescents spend the majority of their waking hours in the company of peers and friends. Consequently, limited social opportunities and aloneness can be decisive in narrowing adolescents' choices of activities (e.g., Salvy et al., 2012a). Our work clearly indicates that children and adolescents' choices of activities are strongly influenced by the presence of peers and friends. Specifically, in a series of studies we showed that spending time alone (Salvy et al., 2009; Salvy et al., 2008) and social exclusion (ostracism) decrease physical activity (Barkley et al., 2012). Conversely, co-engaging in activities with peers and friends increase youths'

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motivation to be physically active and objectively measured physical activity (Barkley et al., 2014; Dunton et al., 2007; Rittenhouse et al., 2011; Salvy et al., 2008; Salvy et al., 2009; Sanders et al., 2014).

Without minimizing the impact of neighborhood safety on adolescents' choices of activity, we hypothesize that the neighborhood environment and social factors work jointly to account for adolescents' physical activity and health. The availability of peers and friends to engage in outdoor activities likely influence youths' perception of safety whereas engaging in these activities alone may confer a greater feeling of vulnerability. This is important, as social relationships are arguably more amenable to change than neighborhood infrastructures. Improving social interactions at the individual level within neighborhoods may decrease youths' feelings of vulnerability and fear for safety through collective efficacy and social cohesion (Ball et al., 2010; Foster and Giles-Corti, 2008). Conversely, policies and interventions focused on the neighborhood environment alone may not be as effective in absence of strategies simultaneously leveraging youths' social and community relationships.

This study tests the independent and interactive effects of adolescents perceived neighborhood safety and social interactions (time alone or with peers and friends) on youth physical activity and sedentary/screen time behavior. We hypothesize that youths' social interactions with peers and friends moderate (attenuate) the relationships between perceived neighborhood safety and engagement in physically active or sedentary activities. We focused on physical activity and sedentary behavior as both are considered important and independent determinants of adolescents' health (Ekelund et al., 2007; Knaeps et al., 2016; Martinez-Gomez et al., 2010; Santos et al., 2014). There is also evidence that decreasing adolescents' screen time does not automatically result in increased physical activity (Epstein et al., 2008), suggesting that physical activity and sedentary behavior may not be interdependent and influenced by different mechanisms (O'Connor et al., 2013).

2. Method

2.1. Participants and procedure

Forty pairs of same-sex biologic siblings (ages 13–17, no >4 years apart) were originally recruited as part of a larger study evaluating putative factors contributing to differences in energy balance behaviors and adiposity among weight-discordant siblings (Fedra et al., 2015). The weight-discordant sibling design increases the innovation of this study and makes it possible to control for approximately 50% of the genetic variability between siblings, and for some degree of the variance associated with shared aspects of the home and neighborhood environments.

Families were recruited from newspaper advertisements and from a database of families who had inquired about previous studies. Parents were screened by phone for their children's height, weight, a brief medical history, and ethnic background. Children were excluded if they were below the 10th BMI percentile; had current psychopathology or developmental disability; and/or if they were on medications or had conditions that could influence their mobility or their activity level (e.g., methylphenidate). If a sibling had a cold or upper respiratory distress they were rescheduled for testing. A total of 930 families contacted the study staff regarding the study. From the original pool, 234 families did not return our call or were unable to complete the initial phone screen. A large number ($n = 652$) of contacted families were not eligible for the study (e.g., different parents, siblings were twins). The remaining 44 families were enrolled in the study and four families dropped out before completion. All study procedures were approved by the Social and Behavioral Sciences Institutional Review Board of the University at Buffalo. Parents provided written informed consent for each sibling and the siblings provided assent.

2.2. Measures

2.2.1. Covariates

2.2.1.1. Baseline participant characteristics. Siblings were asked to report their demographic information including gender, age, grade-level, school and race/ethnicity. Parents provided parents' education and household income.

2.2.1.2. BMI z-score (zBMI). Participants' height and weight were assessed using an electronic scale (Model BWB-800S, Tanita, Portage, MI) and digital stadiometer (Model PE-AIM-101, Perspective Enterprises). Body weight was measured to the nearest 0.01 kg and height to the nearest 0.1 cm. Participants were asked to remove their shoes, belts, and heavy outerwear and to empty their pockets. Height was measured in duplicate and if measurements were not within 0.5 cm, we obtained a third measurement. The weight data and mean of all height measurements were used to calculate BMI (kg/m^2) percentiles and z-scores (Centers for Disease Control and Prevention, 2000). BMI z-scores were entered as covariate in all analyses.

2.2.2. Outcomes

2.2.2.1. Physical activity. Physical activity was measured using the MTI *Actigraph* (Pensacola, FL) activity monitor. The *Actigraph* is a small ($5.1 \times 3.8 \times 1.5$ cm), lightweight accelerometer worn around the waist that collects measures of raw acceleration, activity amount and intensity. The *Actigraph* has been validated in adolescents (Robusto and Trost, 2012; Romanzini et al., 2014; Vanhelst et al., 2011). Activity was monitored and recorded for 5 weekdays and 2 weekend days. Youth received written instructions on use, including appropriate care and placement on the right iliac crest using a provided belt and had to wear the *ActiGraph* at least 10 h/day for the day to meet the criterion for a full measurement day. The *ActiGraph* was initialized for 15-second epochs. Downloaded data were cleaned of spurious lines of >16,000 counts and negative counts. Sequences of 20+ min of consecutive zero counts were scored as non-wear time. The main outcome variable is the average counts/minute, an index of average total physical activity.

2.2.2.2. Sedentary behaviors/screen time. The frequency of sedentary behaviors/screen time activities was captured using an experience sampling methodology (ESM) or ecological momentary assessment (EMA). EMA/ESM have been used to study a range of phenomena in psychology and behavioral medicine (Chen et al., 2015; Csikszentmihalyi and Larson, 1987; Davidson et al., 2016; Ebner-Priemer et al., 2009; Engel et al., 2016; Huhn et al., 2016; Linas et al., 2016; Moore et al., 2016; Schuster et al., 2016). We have used this methodology to assess the relationship between social context and physical activity in young adolescents (Salvy et al., 2008) and validated this approach using objective accelerometry (Salvy et al., unpublished manuscript). In the validation study, metabolic equivalent (MET) values estimated from participants' report of their activities based on the children's compendium of physical activity were compared to MET values estimated from accelerometer activity counts. Both methodologies (ESM and accelerometry) yielded similar conclusions with regard to the influence of social context on youth's physical activity. In the present study, each participant was given a cell phone to receive and send text messages related to the study. Text messages were sent to participants for 5 weekdays and 2 weekends, approximately every 2 h between 15:00 and 21:00 on weekdays, and between 10:00 and 22:00 on weekend days. The text message alerted participants to indicate the activity they were doing (e.g., screen time, eating, physical activity); the perceived difficulty of the activity (e.g., sitting, walking, running) and the duration of activity (<5 min, 6–10 min, 11–15 min, 16–20 min, 21+ min). We focused on the time engaged in screen-based activities (e.g., sending/receiving email or

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