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Associations of neighborhood social environment attributes and physical activity among 9–11 year old children from 12 countries

Samaah M. Sullivan[a,b,c], Stephanie T. Broyles[b], Tiago V. Barreira[b,d], Jean-Philippe Chaput[e], Mikael Fogelholm[f], Gang Hu[b], Rebecca Kuriyan[g], Anura Kurpad[g], Estelle V. Lambert[h], Carol Maher[i], Jose Maia[j], Victor Matsudo[k], Tim Olds[i], Vincent Onywera[l], Olga L. Sarmiento[m], Martyn Standage[n], Mark S. Tremblay[e], Catrine Tudor-Locke[b,o], Pei Zhao[p], Peter T. Katzmarzyk[b,*], for the ISCOLE Research Group

[a] Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA, United States
[b] Pennington Biomedical Research Center, 6400 Perkins Road, Baton Rouge, LA 70808-4124, United States
[c] College of Humanities & Social Sciences, Louisiana State University, Baton Rouge, LA, United States
[d] Department of Exercise Science, Syracuse University, Syracuse, NY, United States
[e] Children's Hospital of Eastern Ontario Research Institute, Ottawa, Canada
[f] Department of Food and Environmental Sciences, University of Helsinki, Helsinki, Finland
[g] St. Johns Research Institute, Bangalore, India
[h] Division of Exercise Science and Sports Medicine, Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa
[i] Alliance for Research in Exercise Nutrition and Activity (ARENA), School of Health Sciences, University of South Australia, Adelaide, Australia
[j] CIFI2D, Faculdade de Desporto, University of Porto, Porto, Portugal
[k] Centro de Estudos do Laboratório de Aptidão Física de São Caetano do Sul, Sao Paulo, Brazil
[l] Department of Recreation Management and Exercise Science, Kenyatta University, Nairobi, Kenya
[m] School of Medicine, Universidad de los Andes, Bogota, Colombia
[n] Department for Health, University of Bath, Bath, United Kingdom
[o] Department of Kinesiology, University of Massachusetts Amherst, Amherst, United States
[p] Tianjin Women's and Children's Health Center, Tianjin, China

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ABSTRACT

We investigated whether associations of neighborhood social environment attributes and physical activity differed among 12 countries and levels of economic development using World Bank classification (low/lower-middle-, upper-middle- and high- income countries) among 9–11 year old children (N=6161) from the International Study of Childhood Obesity, Lifestyle, and the Environment (ISCOLE). Collective efficacy and perceived crime were obtained via parental/guardian report. Moderate-to-vigorous physical activity (MVPA) was assessed with waist-worn Actigraph accelerometers. Neighborhood environment by country interactions were tested using multi-level statistical models, adjusted for covariates. Effect estimates were reported by country and pooled estimates calculated across World Bank classifications for economic development using meta-analyses and forest plots. Associations between social environment attributes and MVPA varied among countries and levels of economic development. Associations were more consistent and in the hypothesized directions among countries with higher levels economic development, but less so among countries with lower levels of economic development.

1. Introduction

Physical inactivity is the fourth leading cause of death worldwide, and is recognized as a global pandemic (Kohl et al., 2012). For school-aged children, global physical activity guidelines as well as those for the United States (US) call for a minimum of 60 min per day of moderate-

Abbreviations: BMI, Body Mass Index; CI, confidence interval; HDI, Human Development Index; ISCOLE, International Study of Childhood Obesity, Lifestyle and the Environment; MVPA, moderate-to-vigorous physical activity; OR, odds ratio; SD, standard deviation; UK, United Kingdom; US, United States

* Corresponding author.
E-mail address: Peter.Katzmarzyk@pbrc.edu (P.T. Katzmarzyk).

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Table 1
Descriptive Characteristics of Participants by Study Site, ISCOLE (N=6161).

	N (%)					
	HDI	N	Males	Females	Highest Parental Education, ≤ High School)	Age, y (mean, SD)
All Sites	–	6161	2812 (45.6)	3349 (54.4)	2612 (42.4)	10.4 (0.6)
Low/Lower-Middle Income Countries		1033	473 (45.8)	560 (54.2)	271 (26.2)	10.5 (0.5)
Kenya (Nairobi)	0.509	491	226 (46.0)	265 (54.1)	179 (36.5)	10.2 (0.7)
India (Bangalore)	0.547	542	247 (45.6)	295 (54.4)	92 (17.0)	10.4 (0.5)
Upper-Middle Income Countries		2168	1047 (48.3)	1121 (51.7)	1345 (62.0)	10.3 (0.6)
South Africa (Cape Town)	0.619	371	148 (39.9)	223 (60.1)	268 (72.2)	10.2 (0.7)
China (Tianjin)	0.687	497	260 (52.3)	237 (47.7)	251 (50.1)	9.9 (0.5)
Colombia (Bogota)	0.710	856	422 (49.3)	434 (50.7)	565 (66.0)	10.5 (0.6)
Brazil (São Paulo)	0.718	444	217 (48.9)	227 (51.1)	261 (58.8)	10.5 (0.5)
High Income Countries		2960	1292 (43.7)	1668 (56.4)	996 (33.7)	10.3 (0.6)
Portugal (Porto)	0.809	603	261 (43.3)	342 (56.7)	476 (78.9)	10.4 (0.3)
UK (Bath & North East Somerset)	0.863	427	185 (43.3)	242 (56.7)	122 (28.6)	10.9 (0.5)
Finland (Helsinki, Espoo & Vantaa)	0.882	462	216 (46.8)	246 (53.3)	125 (27.1)	10.5 (0.4)
Canada (Ottawa)	0.908	514	213 (41.4)	301 (58.6)	46 (9.0)	10.5 (0.4)
US (Baton Rouge)	0.910	476	197 (41.4)	279 (58.6)	128 (26.9)	9.9 (0.6)
Australia (Adelaide)	0.929	478	220 (46.0)	258 (54.0)	122 (28.6)	10.7 (0.4)

Abbreviations: SD, standard deviation; HDI, human development index; ISCOLE, International Study of Childhood Obesity, Lifestyle and the Environment.

to-vigorous physical activity (MVPA) to achieve health benefits (World Health Organization, 2010). However, globally, 80% of adolescents do not achieve physical activity recommendations (Hallal et al., 2012). The lack of adequate levels of physical activity among children around the world is concerning, even in middle- and low- income countries where domestic and transport-related physical activities might contribute more to overall energy expenditure than leisure or recreational physical activities (Kohl et al., 2012; Hallal et al., 2012; Katzmarzyk and Mason, 2009; Dumith et al., 2011; Tremblay et al., 2016). Effective global promotion efforts for children's physical activity are dependent on understanding correlates and determinants across different social-cultural and environmental settings. With transitions in economic and social development, lifestyle behaviors such as physical activity also transition with increasing urbanization, availability of alternative modes of transportation, and increasing sedentary behaviors, referred to as the "Physical Activity Transition" (Katzmarzyk and Mason, 2009).

Theoretical frameworks such as ecological models have included environmental determinants of physical activity, which propose that physical activity is affected at multiple levels of influence including individual factors, the inter-personal/social environment, physical environment, and policy-level factors (Sallis et al., 2002a). Only a few studies have investigated associations between attributes of the neighborhood environment and physical activity (Ding et al., 2013; Sallis et al., 2009; Adams et al., 2013; Cerin et al., 2014) using multi-country samples; however, these studies focused on characteristics of the physical environment and were conducted only among adults. Further, these studies only included upper-middle and high-income countries (Adams et al., 2013; Cerin et al., 2014; Ding et al., 2013; Sallis et al., 2009). The existing research; however, does not provide a comprehensive examination of the association between aspects of the neighborhood social environment and children's physical activity globally or provide an examination of differences across multiple countries with varying levels of economic development.

Aspects of the social environment include dimensions such as interpersonal relationships (e.g., social support and social networks), social inequalities (e.g., socioeconomic position, income inequality, racial discrimination), and neighborhood characteristics (e.g., social cohesion and social capital). The neighborhood social environment may be an important setting to understand variations in children's physical activity levels. Single country studies, which have been mostly limited to North America, have shown that attributes of the neighborhood social environment such as crime and poor neighborhood safety are inversely associated with children's physical activity (Molnar et al., 2004; Gomez et al., 2004; Janssen, 2014; Datar et al., 2013) while collective efficacy has been associated with higher levels of physical activity (Franzini et al., 2009; Kimbro et al., 2011). Collective efficacy, the willingness of people to intervene for the common good, is a form of social capital which measures individual perceptions of social cohesion and social control (Sampson et al., 1997). Neighborhoods with higher levels of collective efficacy are able to reinforce positive social norms such as physical activity and enforce ordinances and laws restricting negative behaviors (i.e., selling of illegal drugs or engaging in other illicit behaviors) increasing a sense of neighborhood safety which also promotes physical activity (Kawachi and Berkman, 2003; McNeill et al., 2006). Thus, through the collective neighborhood response of residents to do good deeds for others, intervene, and to achieve common goals for the neighborhood, collective efficacy is hypothesized to mediate public order and violence. Conversely, low levels of collective efficacy and perceived neighborhood safety may discourage and constrain physical activity behavior (Molnar et al., 2004; Burdette et al., 2006).

Given the lack of multi-country studies that focus on characteristics of the social environment among children, the main objective of this paper was to investigate whether associations of the neighborhood social environment (collective efficacy and perceived crime) and physical activity differed among 12 countries. A secondary objective of this study was to examine heterogeneity of associations among countries with different World Bank classifications of economic development divided into low/lower-middle-, upper-middle-, and high-income groups (World Bank, 2012) and ranked by the Human Development Index (HDI), which is a composite score based on life expectancy, gross national income, literacy and school participation (Table 1) (United Nations Development Programme, 2011).

We hypothesized that neighborhood-by-country interactions would be significant, indicating differences in the associations between neighborhood social environment attributes and physical activity. We expected variations among countries by World bank classification of economic development such that higher levels of collective efficacy would be associated with higher levels of physical activity while higher levels of perceived crime would be associated with lower levels of physical activity among children living in high- income countries. We did not expect to observe these associations among children living in countries with lower levels of economic development. In high- income countries with higher levels of development, physical activity has become largely optional (based on choice for leisure and recreational activities rather than need) (Sarmiento et al., 2015), and hence barriers such as perceived crime and facilitators such as collective efficacy