

THE ROLES OF COMMUNITY RESOURCES AND PARTICIPATION IN
ORGANIZED ACTIVITIES TO PROMOTE PHYSICAL ACTIVITY AMONG LOW-
INCOME CHILDREN

A Dissertation

by

JI WON NAM

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Chair of Committee,	David Matarrita-Cascante
Committee Members,	Scott Shafer
	Jun Wang
	Xuemei Zhu
Head of Department,	Brian King

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ABSTRACT

Physical activity (PA) is important for children's physical and psychological health. Public health guidelines recommended that school-aged children should engage in at least 60 minutes of moderate to vigorous physical activity daily. However, more than half of children do not meet these guidelines, and the problem worsens with higher levels of physical inactivity for low-income children. Previous studies have shown that community resources (CRs) and organized activities (OAs) can separately enhance PA among low-income children. However, little research has examined how the combination of these factors can influence PA.

This study examines how CRs and participation in OAs are interrelated in affecting PA among low-income children. Research questions are: 1) To what extent does participation in OAs mediate the relationship between CRs and PA among low-income children? 2) Is there a conditional association between participation in OAs and PA among low-income children based on the presence of CRs?

We used data from the 2019 National Survey of Children's Health to study how physical environments and social factors such as CRs and participation in OAs (sports, clubs, and lessons) impact PA for low-income children. We conducted descriptive analysis to identify disparities in PA. Mediation analysis was performed using multivariate logistic regression analysis, GSEM analysis and bootstrapping technique to determine the indirect effect of participation in OAs. For moderation analysis, we examined the interaction term and used the AIC method.

Low-income children have limited access to CRs and lower participation in OAs. They are also more likely to be physically inactive and less regularly involved in PA. We found that participation in OAs has a mediating effect when low-income children have sidewalks, recreation/community centers or Boys & Girls Clubs, and neighborhood support to increase their PA. Additionally, parks/playgrounds, recreation/community centers or Boys & Girls Clubs and neighborhood support can interact with low-income children's participation in sports and lessons.

This study provides insights into the interrelationships between CRs and participation in OAs for promoting low-income children's PA. In conclusion, improving access to physical facilities and fostering neighborhood support can encourage participation in OAs, ultimately promoting health and well-being in low-income communities.

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NOMENCLATURE

AIC	Akaike Information Criterion
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
CRs	Community Resources
FPL	Federal Poverty Level
GIS	Geographic Information System
GSEM	Generalized Structural Equation Model
MVPA	Moderate to Vigorous Physical Activity
NSCH	National Survey of Children's Health
OAs	Organized Activities
PA	Physical Activity
SD	Standard Deviation
SE	Standard Error
SES	Socio-Economic Status
VIF	Variance Inflation Factor

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CHAPTER I

INTRODUCTION

Regular physical activity (PA) can benefit children's health both physically and psychologically (Baranowski et al., 1997; Brown et al., 2009; Davison & Lawson, 2006; Pate et al., 2003; Pender, 1998; Van Der Horst et al., 2007; Whitt-Glover et al., 2009). Physically, it can reduce the risk of chronic diseases by improving cardiovascular health, maintaining a healthy weight, and promoting bone growth. Psychologically, it can enhance motor and social skill development, cognitive function, self-esteem, and reduce anxiety and stress levels. School-aged children are encouraged to participate in 60 minutes or more of moderate to vigorous physical activity (MVPA) each day according to the US Physical Activity Guidelines for Americans (Baranowski et al., 1997; Janssen & Leblanc, 2010; Strong et al., 2005; Witt-Glover et al., 2009). Unfortunately, more than 50 percent of children and adolescents are not physically active enough despite the proven physical and psychological benefits for health enhancements (Biddle et al., 2004; Eaton et al., 2012; Pate et al., 2003). Children's physical inactivity is a problem in the United States, as 14 percent of children are not physically active at all (Davison & Lawson, 2006). The lack of physical activity (PA) at young ages sets a negative precedence as children often become increasingly less active in late childhood and adolescent years (Baranowski et al., 1997; Brown et al., 2009; Motl, 2007; Pate et al., 2006; Pender, 1998; Sallis et al., 1992; Van Der Horst et al., 2007; Whitt-Glover et al., 2009). Considering that childhood and adolescence are pivotal stages for the

development of regular healthy habits that can determine later lifestyle patterns into adulthood (Brown et al., 2009; Casey et al., 2009; Hanson et al., 2007; Hyndman et al., 2012; Pate et al., 2003; Pender, 1998; Posner & Vandell, 1999; Sallis et al., 1992), the lack of such healthy habits has consequences through the life of inactive children and youth.

This problem is exacerbated in low-income neighborhoods in the United States, where children are not physically active enough to develop a healthy lifestyle (Franzini et al., 2010; Gordon-Larsen et al., 2006; Hanson et al., 2007; Jones et al., 2015; Moore et al., 2008; Sallis et al., 1992; Santos et al., 2004; Whitt-Glover et al., 2009; Wieland et al., 2020). Several studies have noted patterns of high levels of physical inactivity and limited PA among children who live in low-income communities (Hanson et al., 2007; Wieland et al., 2020).

While individual efforts are important to increase low-income children's PA, community-level support is also critical for them to be physically active (Carter-Porkas et al., 2002; NIHCM foundation, 2007; Taylor et al., 2007; Whitt-Glover et al., 2009). This dissertation focuses on community resources (CRs) and organized activities (OAs) as factors promoting PA among low-income children. CRs include physical environments (e.g., parks, playgrounds, recreation centers, community centers) and social factors (e.g., neighborhood supports, social cohesion, perceived safety), which are known to promote healthy youth development including physical and psychological/emotional development (Davison & Lawson, 2006; Eagle et al., 2012; Witten et al., 2003). OAs refer to structured, adult-supervised extracurricular activities,

including organized sports, non-sport activities, and clubs or community organizations' activities, which are also known to help building positive social norms and sense of belonging, cognitive abilities, and health habits which are linked to positive youth development (Franzini et al., 2010; Fredricks et al., 2010; Gordon-Larsen et al., 2006; Hanson et al., 2007; Jones et al., 2015; Larson et al., 2006; Mahoney et al., 2006; Moore et al., 2008; Posner & Vandell, 1999; Sallis et al., 1992; Santos et al., 2004; Vandell et al., 2015; Whitt-Glover et al., 2009; Wieland et al., 2020).

The Knowledge Gap

While there has been well-documented evidence regarding the roles of CRs and OAs on low-income children's overall health and PA, these studies have examined the contribution of CRs and participation in OAs separately. In other words, little research has empirically tested the interrelationship between CRs and participation in OAs simultaneously as they influence low-income children's PA. However, it is important to have a comprehensive understanding of the relationship between CRs, participation in OAs, and PA among low-income children. This is because low-income families typically depend on CRs and participation in OAs to increase their children's PA instead of expensive private PA resources (Davison & Lawson, 2006; Oliveira et al., 2014; Roemmich et al., 2006).

More specifically, only a handful of studies have examined the relationship between CRs and PA among low-income children that considers participation in OAs. Such studies have generally focused on the direct relationship between CRs and

children's PA yet have not considered the role of mediating factors such as participation in OAs (Colabianchi et al., 2019; Deforche et al., 2010).

Further, little is known about the interaction between CRs and participation in OAs and its effects on PA among low-income children. Previous research has focused on exploring the interaction between participation in OAs and individual/interpersonal factors to impact children's PA, rather than examining the role of community-level factors like CRs (Lubans et al., 2008; Walters et al., 2009). However, favorable CRs (i.e., physical and social environments) can influence participation in OAs to increase PA among low-income children by providing safe places to increase social contact with others needed to adopt healthier habits as well as awareness of programs for children (Kawachi & Berkman, 2014).

Research Questions and Aims

To address the above-described knowledge gaps, this dissertation investigates the combined roles (e.g., mediating and moderating relationships) CRs and participation in OAs play in increasing low-income children's PA. This study examines different types of CRs (i.e., physical and social environments) to explore their association with OAs and low-income children's PA (see Figure 1).

Among various determinants of PA, Pate et al., (2000) noted community-based programs and community activities as potential mediating variables promoting children's PA. Further, as stated by Baranowski & Jago (2005), we can understand program-induced change through mediating analyses. Therefore, participation in OAs

will be considered as a mediating factor in this study. That is, we believe that the presence of a certain type of CRs in their neighborhood may promote PA among low-income children via participating more in OAs. Consequently, the first research question of this dissertation is “how and to what extent does participation in OAs mediate the association between CRs and low-income children’s PA?” The researcher will examine this relationship focusing on the mediating effect of participation in OAs, to examine both the direct and indirect relationship between CRs and PA among low-income children.

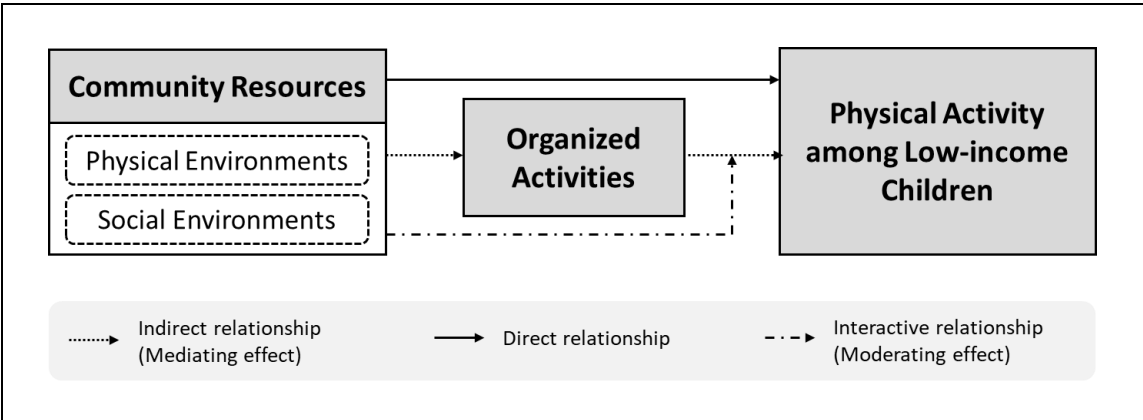


Figure 1. Research keywords and different types to understand relationships between CRs and participation in OAs on PA among low-income children.

The second research question of this dissertation includes “is there an association between participation in OAs and low-income children’s PA conditioned by the presence of CRs?” The researcher will focus on the moderating role of CRs in affecting participation in OAs to affect PA among low-income children. That is, through a moderation analysis, the researcher will seek to understand how CRs change the

direction and/or strength of the relationship between low-income children's PA and participation in OAs.

Altogether, we believe the findings of this study can help to improve our understanding of why and under what conditions CRs and participation in OAs are simultaneously associated in influencing PA among low-income children effectively through the implementation of mediating and moderating analysis.

Dissertation Organization

This study consists of 6 chapters including: 1) Introduction, 2) Literature Review, 3) Research Framework, 4) Methodology, 5) Results, and 6) Discussion and Conclusions. The introduction starts with the background and significance of PA among low-income children and uncovers the knowledge gaps in low-income children's PA studies focusing on CRs and participation in OAs. The literature review provides the literary background to support this study by investigating related significant studies including those examining the various determinants of children's PA, the characteristics of PA among low-income children, CRs (i.e., physical and social environments), and participation in OAs. Next, the research framework provides the theoretical support and conceptual model for this study. Then, the methodology chapter describes the data source, sample, variables derived from the theoretical framework, and plans for data analyses. Next, descriptive statistics explain characteristics of CRs, OAs, and PA among low-income children. Following, the researcher examines the mediating effect of participation in OAs on the relationship between CRs and low-income children's PA by

employing a series of multivariate logistic regression analyses, Generalized Structural Equation Model (GSEM) analysis, and bootstrapping analysis. To explore the moderating effect of CRs on the relationship between participation in OAs and PA among low-income children, the interaction terms between CRs and participation in OAs are included in the models through multivariate logistic regression analyses. The results section provides comprehensive analyses to explain: 1) descriptive characteristics of CRs, participation in OAs, and PA among low-income children, 2) the mediating effect of participation in OAs on the relationships between CRs and PA among low-income children, and 3) the moderating effect of CRs on the associations between participation in OAs and low-income children's PA. The discussion and conclusions emphasize the findings of the study on low-income communities, focusing on CRs and participation in OAs to promote low-income children's PA to address health disparities, while also suggesting implications and stating limitations of the study.

CHAPTER II

LITERATURE REVIEW

Children's Physical Activity

Physical activity (PA) is defined as “bodily movements produced by skeletal muscle contraction that increase energy expenditure above the basal level” (Baranowski et al., 1997; Pender, 1998). Regular PA can support children's health from a physical and psychological perspective (Baranowski et al., 1997; Brown et al., 2009; Davison & Lawson, 2006; Pate et al., 2003; Pender, 1998; Van Der Horst et al., 2007; Whitt-Glover et al., 2009). Physically, PA decreases biological cardiovascular disease, promotes a healthy weight, and encourages the development of peak bone mass to prevent chronic disease in children and adolescents (Baranowski et al., 1997; Brown et al., 2009; Van Der Horst et al., 2007). Psychologically, PA improves motor and social skill development, increases cognitive function and self-esteem, self-concept, and decreases levels of anxiety and stress during childhood (Baranowski et al., 1997; Brown et al., 2009; Pate et al., 2003; Pender, 1998; Van Der Horst et al., 2007; Whitt-Glover et al., 2009).

Although the Centers for Disease Control and Prevention (CDC) recommends that school-aged children should participate in 60 minutes a day or more of MVPA, at least half of US children and adolescents are insufficiently physically active (Biddle et al., 2004; Janssen & LeBlanc, 2010; Strong et al., 2005). Moreover, the 14 percent of children are not physically active at all in the United States (Davison & Lawson, 2006).

Furthermore, when children enter late childhood and adolescent years, their levels of PA decreases by almost 50% between ages 6 and 16 (Pate et al., 2006; Pender, 1998; Sallis et al., 1992; Van Der Horst et al., 2007). This is to a large extent the result of increasing screen time, automobile dependency, intensive academic work, part time job and/or lack of time to participate in PA (Casper et al., 2011; Sallis et al., 1992).

Given this scenario, it is important to identify the various factors contributing to children's PA and seek ways to encourage children's habitual PA to make it a regular and healthier pattern into adulthood (Pender, 1998; Sallis et al., 1992).

Determinants of Children's PA

Children's PA is associated with various elements including personal, social, and physical environmental determinants. Further, studies have suggested the importance of understanding the interrelationships among such variables (Sallis et al., 1992; Van Der Horst et al., 2007), leading to the development of the socioecological framework. Such framework allows for understanding the interaction of multi-level factors that influence PA (Bauman et al., 2002; Brennan et al., 2003; Davison & Lawson, 2006; Hyndman et al., 2012; Sallis et al., 2000; Whitt-Glover et al., 2009; Wingate et al., 2018). To find relevant studies about the determinants of children's PA, the researcher conducted an extensive search of online databases to obtain a comprehensive and thorough understanding of the research topic. Table 1 describes the determinants of children's PA according to the various categories based on the socio-ecological model: 1) demographic

factors, 2) psychological, cognitive, and emotional factors, 3) behavioral attributes and skills, 4) social and cultural factors, and 5) physical environmental factors.

Table 1. Determinants of children’s PA based on the socio-ecological model.

Categories	Items
Demographic and biological factors	Age, gender, race/ethnicity, parental education level, socio-economic status (SES)
Psychological, cognitive, and emotional factors	Personality characteristics (i.e., achievement motivation, stress tolerance, social adequacy, movement satisfaction, self-confidence, and independence), self-efficacy, perceived behavioral control, intention to exercise, value of health, appearance, achievement, exercise knowledge, enjoyment, attitudes, self-motivation
Behavioral attributes and skills	Previous PA, PA skills, sedentary time, perceived PA habits of parents and peers’ involvement in community PA organizations, involvement in community-based sports programs
Social and cultural factors	Parental supports, parental PA, parental self-efficacy, sibling PA, peer PA, rules for PA and sedentary activities, social cohesion, social capital
Physical environmental factors	Recreational facilities (i.e., parks, playgrounds, and recreation centers), sidewalks, bike paths, perceived safety, pleurability, comfort, accessibility, community-based organizations, season

(Sources: created by author using information from Baranowski et al., 1998; Beets et al., 2010; Craggs et al., 2011; Franzini et al., 2009; Griffin et al., 2008; Hanson et al., 2007; Kobel et al., 2015; Lubans et al., 2008; McNeill et al., 2006; Pender, 1998; Sallis et al., 1992; Trost et al., 1999; Tucker et al., 2009; Van Der Horst et al., 2007).

Demographic and biological factors

According to the literature, demographic factors such as age, gender, race/ethnicity, parental education level, and socio-economic status (SES) have been associated with children’s PA (Bauman et al., 2002; Craggs et al., 2011; Pender, 1998;

Sallis et al., 1992). In the case of age, participation in PA tends to increase until middle childhood and decline into adolescence (Findlay et al., 2009). In terms of gender, boys are likely to be actively involved in PA when involved with peers, as when participating in competitive sports. They also tend to participate in more PA than girls (Casper et al., 2011; Patnode et al., 2010; Sirard et al., 2006; Trost et al., 1999). In terms of race/ethnicity, parental education level, and SES, many studies have focused on the disparity issue, which notes that disadvantaged groups (i.e., non-white, low-parental educated family, and low-level SES) tend to have unequal opportunities for children's access to recreational facilities and programs in their communities that facilitate PA (Casper et al., 2011; Taylor et al., 2007; Whitt-Glover et al., 2009).

Psychological, cognitive, and emotional factors

Psychological, cognitive, and emotional factors can explain different participation patterns in PA based on individual characteristics such as personality, self-efficacy, self-motivation, self-control, intention, personal value, knowledge, and/or enjoyment (Bauman et al., 2002; Sallis et al., 2000; Van Der Horst et al., 2007).

Children's personalities may determine the different personal achievement, motivation, and stress tolerance to participate in PA (Craggs et al., 2011; Roth et al., 2010; Sallis et al., 1992). Self-efficacy, one of the most frequently studied factors in children's PA studies, is described as the ability to overcome the barriers, and is often considered as a mediator and/or moderator positively changing children's PA (Baranowski et al., 1998; Beets et al., 2007; Craggs et al., 2011; Deforche et al., 2010; Lubans et al., 2008).

Studies have reported that the higher level of self-efficacy, the more physically active children are (Baranowski et al., 1998; Beenackers et al., 2011; Craggs et al., 2011; Lubans et al., 2008; Van Der Horst et al., 2007). Similarly, the more self-motivated and self-controlled children are, the more they tend to engage in PA than others (Allender et al., 2006; Craggs et al., 2011; Pender, 1998). The personal value, intention, and knowledge of exercise that children have, can motivate them to be involved in PA (Baranowski et al., 1997; Brustad, 1993; Craggs et al., 2011; Trost et al., 1999). For example, children who understand the positive impact of PA and enjoy participating in it, are more likely to engage in PA to maintain a healthy lifestyle. In addition, previous studies examining children's psychological, cognitive, and emotional influences on PA found that health behaviors are shaped by the interplay between social environmental factors, such as modeling and social support, interpersonal factors such as self-efficacy, motivation, and enjoyment (Bandura, 1998; Pate et al., 2000).

Behavioral attributes and skills

Behavioral attributes and skills can explain children's personal behavioral capabilities to be physically active or not. Previous PA experiences, PA skills, perceived PA habits of parents and/or peers, and screen time are examples of behavioral attributes and skills for PA (Craggs et al., 2011; Pate et al., 2003; Trost et al., 1999; Van Der Horst et al., 2007). Previous positive PA experiences can encourage and/or motivate children to continue becoming involved in PA (Rees et al., 2006). In addition, PA skills are associated with an increased likelihood of participation in PA. Strong et al., (2005)

found that specialized and complex movement skills can be incorporated into a variety of individual and group activities and organized sports to increase PA. Not only personal behavioral PA characteristics but also perceived PA habits of parents and/or peers can affect the probability for children to be physically active (Fredricks et al., 2010; Kobel et al., 2015; Trost et al., 1999). In addition, recent studies have explained that screen time is a rising barrier for children to participate in PA via increased sedentary time (Beets et al., 2010; Trost et al., 1999; Van Der Horst et al., 2007; Vella et al., 2014).

Social and cultural factors

Social and cultural factors can be defined as social processes that facilitate physical activity through increased interactions among parents, peers, and neighbors (Bauman et al, 2002; Franzini et al., 2009; Sallis et al., 2000; Van Der Horst et al., 2007). Namely, social and cultural factors reflect the mutual interactions with others that influence PA behavior. Parental and/or peer support, including their encouragement and/or participation in PA, have been found to be important factors supporting children's participation in PA (Allender et al., 2006; Baranowski et al., 1997; Bauman et al., 2012; Beets et al., 2010; Brustad, 1993; Craggs et al., 2011; Eime et al., 2015; Feldman & Matjasko, 2005; Mulvihill et al., 2000; Rees et al., 2006; Rowe et al., 2013; Sallis et al., 1992; Trost et al., 1999; Van Der Horst et al., 2007; Wingate et al., 2018). Neighborhood social processes, particularly social cohesion and collective efficacy, also affect children's PA (Cohen et al., 2006; Kim et al., 2006). Neighbors can encourage children to participate in PA by sharing values, trust, connection, and helpfulness with children in

their community (Cradock et al., 2009). In other words, neighborhood social cohesion, which enhances communication and social interaction, have been found to encourage PA (Franzini et al., 2010). Related to these factors, several research studies have focused on social capital, social cohesion, and/or collective efficacy theories to explore how individuals' health and health-related behavior in a community are affected by social factors like connections, relationships, social control, trust, and shared willingness with neighbors. By understanding the influence of these social factors, we can develop strategies to improve the health of individuals and communities. (Boyd et al., 2008; Cradock et al., 2009; Sampson et al, 1999; Sampson & Graif, 2017). Even when certain physical environmental variables are not favorable, people may choose to be active in neighborhoods where social norms and social support for active living are strong (Franzini et al., 2010). Moreover, many studies stated that neighborhood support is a critical element that affects low-income children's decision to participate in community activities that increase their PA (Baranowski et al., 1997; Bauman et al., 2002; Cradock et al., 2009; Deforche et al., 2010; Franzini et al., 2010; Lenzi et al., 2012; McNeil et al., 2006; Pate et al., 2003).

Physical environmental factors

The physical environment is defined as both objective and perceived characteristics of the physical community (Davison&Lawson, 2006). The physical environment can support children's PA, for example, by providing pedestrian friendly environments (e.g., streets, bike lanes and/or trails) as well as public places (e.g., parks,

playgrounds, and/or community recreation centers) (Baranowski et al., 1997; Gordon-Larsen et al., 2006; Romero, 2004; Rowe et al., 2013; Sallis et al., 1992; Tucker et al., 2009). Davison and Lawson (2006) suggested three categories of environmental attributes associated with children's PA: 1) recreational infrastructure (e.g., parks/playgrounds), 2) transport infrastructure (e.g., sidewalks), and 3) local conditions (e.g., safety, crime, weather). Similarly, Craggs et al., (2011) noted physical environmental factors included availability of PA facilities or equipment, neighborhood safety, aesthetics in the environment, and road conditions. Unfortunately, previous studies reported less physical environmental support for children's PA in lower-income communities (Carter-Porkas et al., 2002; Sallis et al., 1992; Taylor et al., 2007; Whitt-Glover et al., 2009). More recently, children's PA studies have used the socio-ecological model to explain the interactive relationship among various factors including environmental attributes and individual and cultural factors (Griffin et al., 2008; Mahoney et al., 2005; Posner & Vandell, 1999; Rowe et al., 2013; Sallis et al., 2000; Tucker et al., 2009; Whitt-Glover et al., 2009).

PA among Low-income Children

Low-income children tend to spend less time in PA than their higher-income peers (Hanson et al., 2007; Santos et al., 2004; Wieland et al., 2020). Many studies have indicated that unequal access to PA opportunities (i.e., facilities and programs) can lead to lower PA among low-income children as it limits their exposure to resources and facilities necessary for regular PA engagement (Franzini et al., 2010; Gordon-Larsen et

al., 2006; Hanson et al., 2007; Jones et al., 2015; Moore et al., 2008; Sallis et al., 1992; Santos et al., 2004; Whitt-Glover et al., 2009; Wieland et al., 2020). These children may face barriers such as a lack of safe places to play, insufficient parks and recreation facilities, and limited access to organized sports programs in the community (Beenackers et al., 2011; Coulton & Irwin, 2009; Moore et al., 2008; Romero, 2005). These limitations can restrict their ability to engage in regular PA and negatively impact their physical health and overall well-being.

Considering that studies have found a connection between low SES and lower PA levels, it is crucial to address barriers surrounding low-income children's PA and eliminate health disparities among low-income populations (Gordon-Larsen et al., 2006; Hanson et al., 2007; Santos et al., 2004; Wieland et al., 2020). Many studies have explained such inequality in PA as the result of lacking access to facilities and programs (Carter-Porkas et al., 2002; Taylor et al., 2007; Whitt-Glover et al., 2009). In addition, several individual, intrapersonal, and social barriers to PA exist for low-income populations, including financial limitations, lack of available leisure time, lower levels of family support, social norms regarding PA (e.g., influence of family, friends, and teachers on PA behavior), and lower social capital (e.g., social network). More recently, research has increasingly considered factors that go beyond individual and interpersonal factors, acknowledging the role that organization and community-level factors play in modifying health outcomes (Baranowski et al., 1997; Biddle et al., 2004; Pate et al., 2000; Sallis et al., 1992). This line of research argues that in order to reduce childhood health disparities, it is important to provide community-based PA opportunities for

disadvantaged children by providing appropriate community sports and recreation programs to ensure their lifelong healthy and productivity in adulthood (Baranowski et al., 1997; NIHCM foundation, 2007; Taylor et al., 2007).

Community Resources Associated with Children's PA

Community resources (CRs) refer to the compositions of the physical and social environments (Witten et al., 2003). As this study primarily focuses on community-level factors, CRs associated with children's PA are derived from determinants of children's PA only at the community level. These factors, which have been previously discussed, promote personal physical health and include sport and recreational amenities, as well as neighborhoods' emotional support.

First, physical environments can be defined as the access to facilities as well as aesthetics or perceived qualities of facilities related with PA (Bauman et al., 2002; Davison & Lawson, 2006; Franzini et al., 2010; Rowe et al., 2013; Sallis et al., 1992; Van Der Horst et al., 2007; Witten et al., 2003). Multiple studies focus on how physical recreational facilities and/or amenities such as parks, recreation centers, and community centers can affect children's PA in communities (Bauman et al., 2002; D'Angelo et al., 2017; Franzini et al., 2009; Pender, 1998; Sallis et al., 1992; Tucker et al., 2009; Vella et al., 2014).

Next, social factors can be understood as social process as that favor PA including neighborhood support and perceived safety (Franzini et al., 2010). Many scholars have explored neighbor's emotional support and safe environment to encourage

children to become more physically active in their communities as social processes including neighborhood social cohesion and collective efficacy as the perceived level of connectedness among neighbors as well as informal social control, collective socialization of children, neighborhood exchange, social ties, and neighborhood satisfaction (Cradock et al., 2009; Cohen et al., 2006; Franzini et al., 2009; Kim et al., 2006; Lenzi et al., 2012). Moreover, neighborhood safety is considered one of the important factors to determine children's PA (Beenackers et al., 2011; Brennan et al., 2003; Casper et al., 2011; Franzini et al., 2009; Griffin et al., 2008; Pender, 1998; Romero, 2005). In addition, McNeill et al., (2006) defined social factors with 3 perspectives: interpersonal relationships (i.e., social support and social network), social inequalities (i.e., socioeconomic position and income inequality, racial discrimination, and neighborhood and community characteristics (i.e., social cohesion and social capital, neighborhood factors). Despite the importance of social factors in supporting children in PA, they have not been adequately studied compared to physical environments, and previous studies focused on perceived safety rather than neighborhood support (Franzini et al., 2009).

Community Resources and Reduction of Health Disparities

Many scholars have highlighted the potential of CRs in reducing health disparities at the community level by examining their accessibility (Heath et al., 2012; Pearce et al., 2006; Spengler, 2012; Witten et al., 2003). Pearce et al. (2006) examined health related accessibility of physical environments, including recreational amenities,

shopping, educational, and health facilities, to address neighborhood health disparities. Compared to high-income communities, lower-income communities tend to have less opportunities to access safe, affordable, and convenient recreational facilities in their communities (Spengler, 2012). In addition, low-income communities lack local organizations and voluntary associations which can affect collective efficacy as a part of social factors (Sampson et al., 1999). Therefore, CRs can help low-income children in being physically active by providing more accessible opportunities (i.e., facilities and programs) and fostering neighborhood support to overcome individual factors that limit PA (e.g., expenses).

Participation in Organized Activities

Organized activities (OAs) are extracurricular, afterschool, and youth organization activities that are led by adults and follow a schedule during out-of-school time (OST) (Mahoney et al, 2006; Santos et al., 2004; Vandell et al., 2015). Larson and colleagues (2006) classified different types of OAs as: 1) sports (e.g., team, individual sports), 2) performance and fine arts (e.g., musical, performances, arts clubs), 3) academic clubs and organizations (e.g., educational, student government and leadership), 4) community-oriented activities (e.g., community organizations), 5) service activities (e.g., community, peer), and 6) faith-based youth groups. Guèvremont et al., (2008) classified OAs into sports, non-sports, and clubs or community groups and found that organized sports were more frequently reported than non-sport activities or clubs or community groups. In terms of the amount of time that children are involved in OAs,

Mahoney et al., (2006) found that American youth aged 5 to 18 years old participate in OAs on average of 5 hours/week.

When it comes to the characteristics of OAs, these are voluntary, structured, regularly scheduled, and adult-supervised (Beets et al., 2010; Coulton & Irwin, 2009; Durlak et al., 2010; Feldman et al., 2005; Findlay et al., 2009; Holt et al., 2009; Kjønnsen et al., 2009; Mahoney et al., 2006; Vella et al., 2014). Posner and Vandell (1999) stated low-income children have a higher rate of unsupervised and unorganized activities compared to middle-class children. The behavioral aspect of participation in OAs should also be considered from a multidimensional perspective, including frequency of attendance during one program year, duration, frequency of attendance over multiple years, breadth (i.e., involvement in different types of programs), and efforts and interests in programs rather than just attendance. (Roth et al., 2010; Vandell et al., 2015).

Benefits of Participation in OAs for Children

Participation in OAs can support children's positive development to improve physical, psychological, and social health. Children who participate in OAs can improve their interactions with others (such as peers and staff) and sense of community by becoming a part of it, which helps them build their own community (Anderson-Butcher & Cash, 2010; Bartko, 2005; Coulton & Irwin, 2009; Kjønnsen et al., 2009; Larson et al., 2006; Mahoney et al., 2006; Vandell et al., 2015; Vella et al., 2014).

In terms of physical benefits to children, participation in OAs can increase children's regular activity and energy expenditure improving their health (Bergeron, 2007). In addition, considering the common decline in PA that happens during adolescence, many studies have focused on the importance of participation in community-based sport clubs to counter such a trend. Namely, organized youth sports can contribute to the development of PA as a habit for children and commit to form their adult PA behaviors in the long term (Kjønniksen et al., 2009; Telama et al., 2006). Baranowski et al., (1997) noted the potential of community organized programs including OAs to promote lifelong PA among children and adolescents by focusing on the social and physical environment as well as community sports and recreation programs. In other words, children's continuous participation in organized sports can predict their adult PA behavior pattern by increasing the probability of being physically active in adulthood (Kjønniksen et al., 2009; Telama et al., 2006).

Regarding the psychological effects of OAs, Roth et al., (2010) noted participation in OAs can provide children with the cognitive, behavioral, and emotional benefits including increasing sense of belonging, enjoyment, self-efficacy, and interest. Bartko (2005) stated that children can experience the warm and supportive interpersonal relationships among participants and staff by participation in OAs. In addition, Vandell and other colleagues (2015) pointed to the importance of understanding the relationship between children's experiences in OAs and the social and cultural ecology of developmental context. Moreover, considering the roles of community organizations, participation in OAs (e.g., sport and organizations) can provide an opportunity for the

minimally involved to improve their community (Lenzi et al., 2012). This is because participation in OAs may contribute to increased social network connections between residents and community (Coulton & Irwin, 2009). In addition, children's involvement in organized sports may encourage community engagement, build positive social norms and sense of belonging, promote cognitive abilities, provide opportunities to learn social skills, and improve PA (Anderson-Butcher & Cash, 2010; Bartko, 2005; Bergeron, 2007; Coulton & Irwin, 2009; Durlak et al., 2010; Feldman et al., 2005; Findlay et al., 2009; Fredricks et al., 2010; Kjønnsen et al., 2009; Kobel et al., 2015; Mahoney et al., 2006; Telama et al., 2006; Vella et al., 2014).

Factors Predicting Participation in OAs for Children

Most primary motivations for participation in OAs come from intrinsic elements including enjoyment, competencies, peers, and coaches (Mahoney et al., 2006). In addition, Marques et al., (2016) noted that the parental/ peer's social supports, SES, and costs are important factors determining children participation in OAs. According to Fredricks et al. (2010), children who participate in community-based organizations (CBOs) like Boys and Girls Clubs do so for a variety of reasons, including having fun, spending time with friends, having a working parent, and receiving academic assistance with their homework. Meanwhile, children tend to drop out of OAs because of lack of interest, coaching problems, and lack of time (Allender et al., 2006; Duffett et al., 2004; Perkins et al., 2007; Sirard et al., 2006). Considering the various factors of participation in OAs, Pate et al., (2000) suggested community recreation and sports programs need to

be more attractive and consider the needs of children and adolescents to encourage their continuous participation.

Participation in OAs among Low-income Children

OAs are becoming more important for low-income children because they help reduce health disparities and bridge the gap between socially disadvantaged people and their health. They do this by making easier and safer for children to be physically active in their communities (Campbell & Jovchelovitch, 2000; Fredricks et al., 2010; Kanters et al., 2014; Perkins et al., 2007; Wieland et al., 2020). Heath et al., (2012) found that community PA classes such as fitness and aerobics classes can enhance not only the physical health but also social supports to underserved populations including women, older adults, and low-income families. However, even though organized programs are provided in low-income communities, low-income and minority families tend to be dissatisfied with the programs' quality, affordability, and availability of options in their communities (Duffett et al., 2004). Despite federal efforts to make OAs more affordable and available to low-income children, Dynarski et al. (2004) found that participation rates were still low. Also, cost of OAs was not the only big problem for these children and their families. Moreover, quality issues should be considered to improve the physical and psychological development of children in low-income communities.

Summary

As discussed above, numerous studies have examined various determinants of children's PA and explained the health disparity problem leading to unequal access to CRs and lower levels of participation in OAs in low-income communities. These communities often lack the resources and funding necessary to establish and maintain safe and accessibility parks, recreational facilities, and organized sports programs as well as neighborhood support, which are crucial for low-income children to be physically active (Campbell & Jovchelovitch, 2000; Fredricks et al., 2010; Heath et al., 2012; Kanters et al., 2014; Pearce et al., 2006; Perkins et al., 2007; Posner & Vandell, 1999; Spengler, 2012; Wieland et al., 2020; Witten et al., 2003). Thus, interventions aimed at improving access to CRs and increasing participation in OAs are needed in promoting PA among low-income children. Such interventions can include the development and improvement of parks, recreational facilities, and neighborhood support in low-income communities. Additionally, OAs can provide children with safe and structured opportunities to engage in PA and establish a long-term perspective to ensure a regular healthy behavior pattern.

Beyond what has been done, and based on the above literature review, a need emerges for a comprehensive approach to examine the interplay between presence of CRs and participation in OAs to address disparities and improve PA among low-income children. This is the main goal of this dissertation.

CHAPTER III

RESEARCH FRAMEWORKS

Theoretical Framework

From the previous section, it was determined that PA among low-income children depends on a series of multi-level determinants that range from individual to community level. Thus, to better understand these and address PA disparities, we chose to frame our study around two frameworks that together, provide a comprehensive understanding of PA among low-income children. These include the socio-ecological model and the social determinants of health framework.

The socio-ecological model provides a holistic approach that highlights the interplay between individual, social, and physical environmental factors that influence PA. On the other hand, the social determinants of health emphasize the role of societal factors, particularly relevant to our study, which are associated with health. By considering both perspectives, we can develop a framework, and better understand multiple factors associated with health disparities in the promotion of healthy PA behaviors for low-income children.

Socio-ecological Model

The socio-ecological model is an interdisciplinary framework that explains how people and physical settings interact to influence health behavior (Brennan et al., 2003; Colabianchi et al., 2019; Eime et al., 2015; Franzini et al., 2010; Loh et al., 2019;

Wallerstein et al., 2011). Sallis et al., (2000) explained the multiple levels of factors that comprise the socio-ecological model, which include 1) demographic and biological factors; 2) psychological, cognitive, and emotional factors; 3) behavioral attributes and skills; 4) social and cultural factors; and 5) physical environment factors.

This model provides a comprehensive perspective to understand the multiple levels of factors influencing PA behavior while noting the importance of the interaction of factors that takes place across levels (Cerin et al., 2008; Colabianchi et al., 2019; Wingate et al., 2018). That is, the socio-ecological model denotes that health and well-being are influenced by multiple and interconnected factors that are necessary to be considered in a holistic and integrated way to effectively address health issues (Cerin et al., 2008; Colabianchi et al., 2019).

Based on the socio-ecological model, this study considers various factors contributing to children's health and well-being, particularly when it comes to PA. Individual factors, such as personality, skills, interests, and motivation, play a crucial role in determining whether children choose to participate in OAs to increase PA (Bartko, 2005; Biggs et al., 2020; Fredricks et al., 2010). For example, a child who is highly motivated and has an interest in sports is more likely to participate in a youth sports program (Quinn, 1999). Social and cultural factors, such as family values, peer influences, and norms, also have an impact on children's PA and participation in OAs (Bartko, 2005; Coulton & Irwin, 2009; Mulvihill et al., 2000). For instance, families that place a high value on PA and recreation are more likely to encourage their children to participate in OAs, where peers may influence on a child's participation (Allender et al.,

2006; Casey et al., 2009; Eime et al., 2015; Holt et al., 2009). Organizational and environmental factors explain rules, programs, and facilities which impact children's participation in OAs to improve PA (Eime et al., 2015). Accessibility to parks and recreational facilities can also play a role in children's PA and participation in OAs (Dwyer et al., 2008). Children who live in communities with few parks or recreational facilities and youth programs may face barriers to participate in OAs to be physically active in their communities (Finkelstein et al., 2017).

Additionally, through the socio-ecological model, we can understand mediating and moderating effects of different factors by examining the interactions between the different levels of influences on health outcomes (Wingate et al., 2018). In other words, we can understand how individuals can interact with their social and physical environments by incorporating multiple level factors that are interrelated and can have both direct and indirect effects on behavior by using the socio-ecological framework (Sallis et al., 2015). Consequently, the socio-ecological model can increase our comprehensive understanding of the multiple levels of influence on health-related behavior (Rowe et al., 2013; Wingate et al., 2018).

Social Determinants of Health

The social determinants of health construct are a way of understanding how the conditions in which people are born, grow, live, work, and age impact their health and well-being. The social determinants of health framework highlight that health is influenced by a wide range of social, economic, and environmental factors beyond

individual behavior (Viner et al., 2012). These determinants consist of income, education, employment, access to health services, housing conditions, neighborhood and built environment, the social and community context (Perez et al., 2022). While many of these coincide with the socio-ecological model, the social determinants of health construct emphasizing community-level factors relevant to positive health outcomes.

According to Schulz et al., (2005), the social determinants of health construct denote that health is not solely determined by individual behavior, but is shaped by social, economic, and environmental factors, the latter of which emphasizes community resources. Understanding the impact of these factors on health is important for developing policies and interventions aimed at reducing health disparities and improving overall health outcomes. (Braveman & Gottlieb, 2014).

Social determinants of health significantly impact health outcomes by influencing health and well-being throughout their life, beginning from childhood (World Health Organizations, 2008). Adolescent health is influenced by various social factors at the individual, family, community, and national levels (Viner et al., 2012). The social determinants of health framework are particularly important for low-income children, as they often experience significant challenges and disparities in terms of access to basic needs and opportunities at the household and community level that influence their health and well-being (Braveman & Gottlieb, 2014). They also often face physical and social environmental barriers to PA and maintain healthy eating habits, which result in higher rates of physical inactivity, obesity, and other related health problems (Viner et al., 2012; Wieland et al., 2020). By recognizing the impact of these

social determinants on the health and well-being of low-income children, the social determinants of health framework can help inform policies and interventions aimed at reducing health disparities and improving outcomes for this vulnerable population (Wall et al., 2009).

The social determinants of health can provide insights into how social and economic factors contribute to health outcome. In other words, we can understand the structural conditions including contextual and individual factors, and how these factors can mediate and/or moderate the relationship between different variables that influence health-related behavior (Schulz et al., 2005; Viner et al., 2012).

Summary

The social determinants of health and socio-ecological model are two frameworks that aim to understand the multiple levels of factors that impact health outcomes. Altogether, both frameworks offer a comprehensive understanding of the factors that influence positive health outcomes, The socio-ecological model suggests that health outcomes are influenced by factors operating at multiple levels, while the social determinants of health framework highlight the impact of community factors and socioeconomic status on health and well-being (see Figure 2).

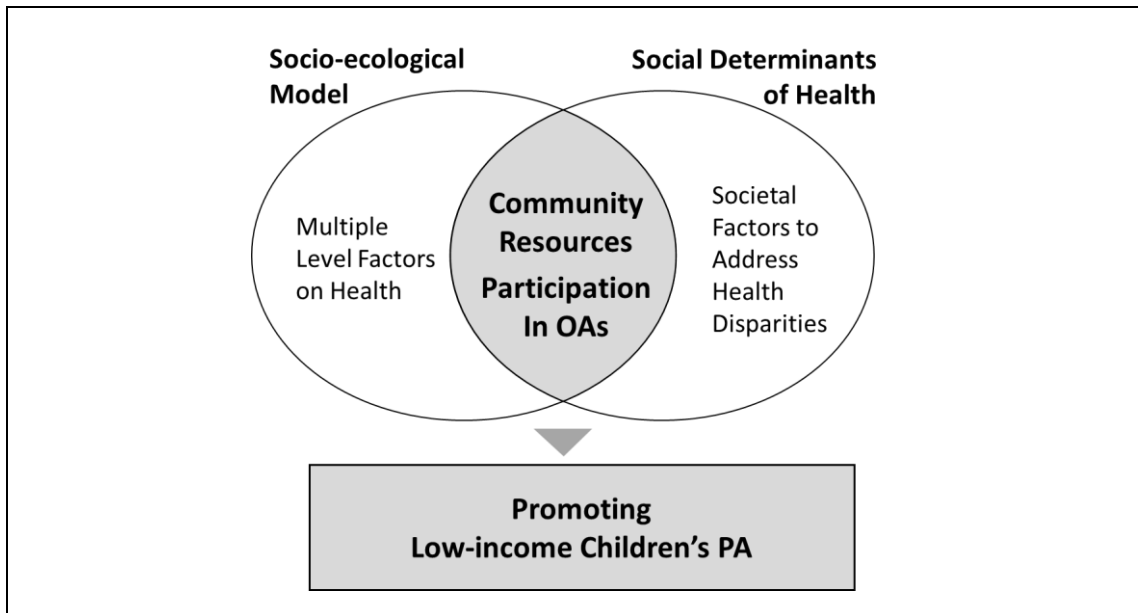


Figure 2. Theoretical framework of this study based on the socio-ecological model and the social determinants of health to understand the relationship between the presence of CRs, participation in OAs and PA among low-income children.

The information contained in both models allows for a more comprehensive examination of the interrelationships among CRs, participation in OAs, and PA, which will be emphasized here at the community level yet controlling for individual, interpersonal, and cultural factors. By referencing the socio-ecological model and the social determinants of health construct, this study takes a multi-level perspective on the interplay of individual, social, and environmental factors in shaping health outcomes, while highlighting the specific focus on CRs and participation in OAs in the context of low-income children.

In this dissertation, the relationships among CRs, participation in OAs, and low-income children's PA can be understood from the merged perspectives of the social determinants of health and the socio-ecological model. From the social determinants of

health perspective, the presence of CRs and OAs can be explained as the community-level factors including neighborhood and built environments, as well as the social and community contexts. The social determinants of health framework is widely used to explain health disparities based on individual and community socioeconomic status, making it a suitable framework for the sample group of low-income children in this study. Since low-income children often face challenges in accessing safe and healthy community environments and may lack access to quality of CRs and OAs, leading to lower levels of PA as disparities, the use of the social determinants of health framework in this context can provide insights into the implications of the findings for health disparity in the study population. At the same time, the socio-ecological model allows this study to not only focus on community factors but also consider the interplay between CRs and participation in OAs by controlling multiple factors in influencing PA among low-income children. Figure 2 shows how the presence of CRs and participation in OAs can be explained by the social determinants of health and socio-ecological model perspectives in terms of their impact on promoting PA among low-income children. This dissertation will focus on these factors at the community level.

In conclusion, the social determinants of health and the socio-ecological model can be used in conjunction to help explain the interplay of CRs, participation in OAs, and PA among low-income children by controlling for the individual and interpersonal factors and focusing on the community-level factors. This study aims to understand structural and interactional conditions that influence low-income children's PA. Specifically, we examine the mediation and moderation relationships between CRs and

participation in OAs, and their impact PA among low-income children. Combining the two frameworks provides a more holistic and integrated approach to understanding and addressing disparities of low-income children's health. This combined theoretical framework is also helpful to develop more sustainable health interventions aimed at improving health outcomes for low-income children (Braveman & Gottlieb, 2014; Viner et al., 2012; Wieland et al., 2020). Thus, this dissertation is based on the social determinants of health and the socio-ecological model as umbrella frameworks to better understand various determinants of PA among low-income children, and examine the interrelationship among CRs, participation in OAs and PA among low-income children to address health disparities.

Conceptual Framework

Based on the above discussion, this study sets to study the following relationships in a general conceptual framework depicted in Figure 3. As illustrated below, this study investigates how associations of CRs and participation in OAs can have an impact on low-income children's PA.

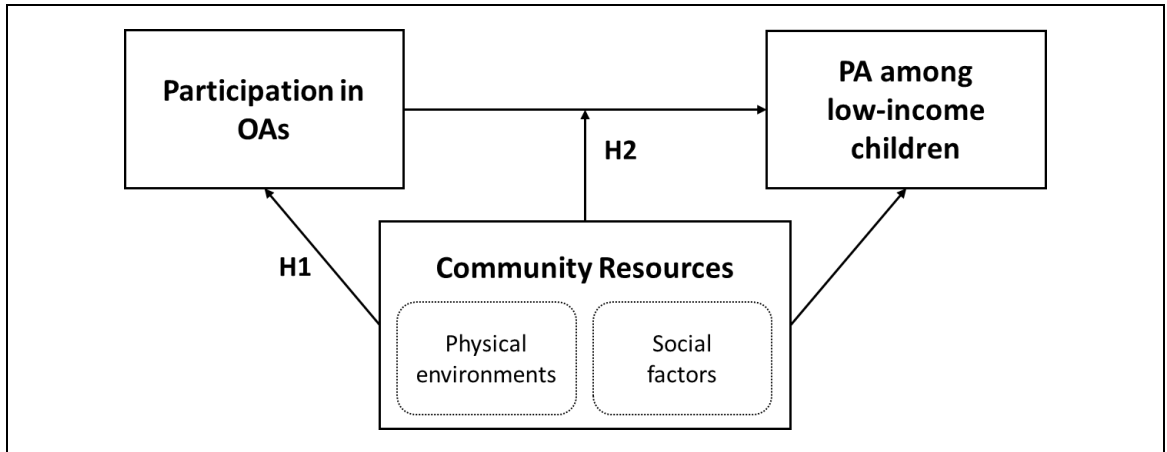


Figure 3. Conceptual framework for CRs (i.e., physical and social environments), participation in OAs, and PA among low-income children.

Based on the main features of this conceptual framework and the literature gaps described in Chapter II, the following two research hypotheses are proposed for this dissertation:

- Hypothesis 1: Participation in OAs positively mediates the relationship CRs and PA among low-income children.
- Hypothesis 2: The relationship between participation in OAs and PA among low-income children is positively moderated by the presence of CRs.

Mediating Effect of Participation in OAs between CRs and PA among Low-income Children

This study examines the mediating effect of participation in OAs to assess the link between CRs and low-income children’s PA. Specifically, as it pertains to the presence of CRs for children’s PA, many studies tend to explore the mutual “direct” relationship between CRs and children's PA (Bauman et al., 2002; Spence & Lee, 2003).

A mediating effect can create a causal pathway or link between an independent variable and an outcome variable explaining cause-and-effect pathway as an indirect effect through a mediator (Bauman et al., 2002; Lubans et al., 2008). Thus, this study examines the “indirect” relationship between the presence of CRs and low-income children’s PA through the mediating effect of participation in OAs (see Figure 4).

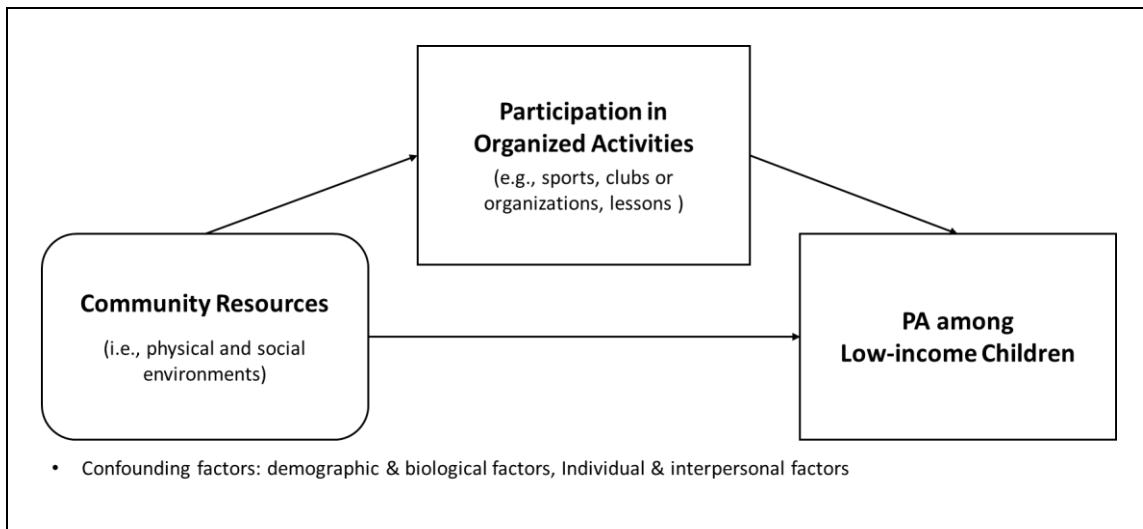


Figure 4. Mediation conceptual model of participation in OAs between CRs and PA among low-income children.

Moderating Effect of CRs on Participation in OAs and PA among Low-income Children

This study also investigates the moderating effect of CRs on the relationship between participation in OAs and PA among low-income children (see Figure 5). Although many studies explore psychological and demographic factors at the individual level to predict moderating effects of children’s PA, a few studies highlight the importance of community-level factors as moderators of children’s PA (Colaniachi et al., 2019; Spence & Lee, 2002).

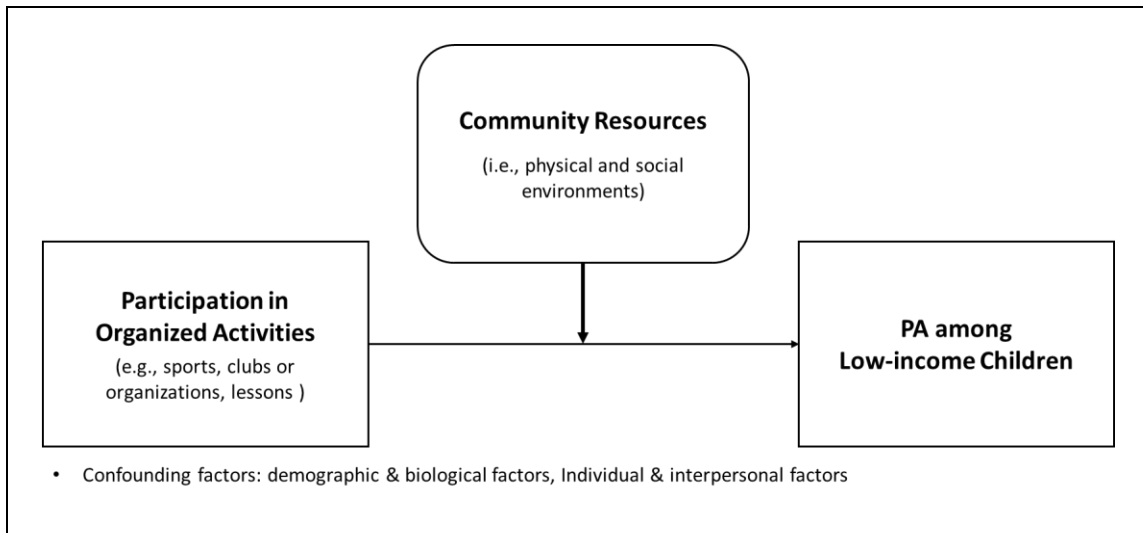


Figure 5. Moderation conceptual model of CRs on the participation in OAs and PA among low-income children.

A moderator effect can explain the stratificational change that determines the strength of an outcome variable by examining the interrelationship between the independent variable and the moderator (Bauman et al., 2002; Spence & Lee, 2003). In other words, a moderating effect can describe the change (i.e., direction and/or strength) in the relationship between the independent variable and the dependent variable according to the influence of the moderator (Bauman et al., 2002). By examining the interactive relationship between presence of CRs and participation in OAs, this study seeks to understand not only whether and how children’s PA is influenced by participation in OAs, but also how the impact of participating in OAs on PA could be influenced by CRs (i.e., physical and social environments). That is, adequate physical environments and supportive social factors could provide more opportunities for low-income children to go outside of their home and interact well with teachers, staff, and/or peers and thus, maximizing the benefits of OAs on PA.

CHAPTER IV

METHODOLOGY

Data Source¹

This study used data from the 2019 National Survey of Children’s Health (NSCH) conducted by the United States Census Bureau and funded by the United States Department of Health and Human Services, Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB). The NSCH is a national and state-level, cross-sectional, stratified, representative telephone survey that collects data of children’s health and well-being. The 2019 NSCH was conducted from June 2019 to January 2020, with the participation of randomly selected parents/caregivers. The survey results are adjusted and weighted to represent the national population of noninstitutionalized children aged 0 to 17 years from every state of the United States.

Sample

This dissertation focuses on low-income children applicable for the below 200% federal poverty level (FPL). This is because the below level of 200% FPL can be used to

¹ Child and Adolescent Health Measurement Initiative (CAHMI) (2021). “2019 National Survey of Children’s Health: Child and Family Health Measures, National Performance and Outcome Measures, and Subgroups, Stata Codebook, Version 1.0”, Data Resource Center for Child and Adolescent Health supported by Cooperative Agreement U59MC27866 from the United States Department of Health and Human Services, Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB). Retrieved [6/11/2021] from www.childhealthdata.org

measure household income level to determine eligibility for low-income benefits such as Medicaid and/or CHIP programs (Council on Community Pediatrics, 2016). The NSCH measures household poverty level using six categories from the FPL scale. This study uses dichotomized poverty level to examine low-income children (below 200% FPL, N=2,628) aged 6-11 years derived from the 2019 NSCH data sets.

Variables

The main outcome variable in this study is PA among low-income children. Based on the previously described frameworks, the researcher used various determinants of children's PA from the 2019 NSCH data including: 1) demographic and biological factors, 2) personal cognitive factors, 3) behavioral attributes, 4) social and cultural factors, and 5) physical environmental factors.

Among various determinants, this study defines CR variables as composed of physical environment and social factors. In terms of the physical environmental factors, the researcher used items of neighborhood amenities including the presence of sidewalks or walking paths, parks or playgrounds, and recreation centers, community centers, or boys' and girls' club. Regarding social factors, this study uses neighborhood support and perceived safety indicators.

In terms of participation in OAs, this study uses three different activities including sports, clubs or organizations, and lessons (e.g., music, dance, language, or other arts). Table 2 below displays the key variables examined in this study.

Table 2. Key variables of this study.

Variables		Items	
PA among low-income children	To Identify Low-income Children’s PA Behavior	Physical inactivity	1+ days/ week (0 days vs. 1-7 days)
		Regular PA	4+ days/ week (0-3 days vs. 4-7 days)
		Sufficient PA	7 days/ week (0-6 days vs. 7 days)
Community resources	Focusing on community-level factors based on socio-ecological model	Physical environments	Sidewalks
			Parks or playgrounds
		Social factors	Recreation/community centers or Boys & Girls Clubs
			Neighborhood support
Participation in organized activities	Focusing on a wider range of OAs	All	Sports + Clubs + Lessons
		Each	Sports
			Clubs
			Lessons

In the case of other variables including demographic, personal, behavioral, social, and cultural variables, they were used as control variables examining the underlying relationship between CRs, participation in OAs, and PA among low-income children. All of the above-mentioned variables are detailed below.

Outcome Variable: PA among Low-income Children

This study uses the 2019 NSCH’s PA data based on the number of days in the past week that children exercised, played sports, or engaged in PA for at least 60 minutes. Specifically, parents or guardians answered the following survey item: “During the past week, how many days did your child exercise, play a sport, or participate in physical activity for at least 60 minutes?” Responses included 0 days, 1-3 days, 4-6 days, and every day.

This study aggregated the above four-category responses into binary variables to capture the distinct characteristics of low-income children’s PA pattern including higher

level of physical inactivity and lower level of regular involvement in PA following previous studies. More specifically, this study grouped the different scales into three comparisons: 1) comparison between 0 days of physical inactivity and 1 or more days of physical activity, 2) comparison between 0-3 days of low frequency physical activity and 4-7 days of high frequency physical activity, and 3) comparison between 0-6 days of insufficient PA and 7 days of sufficient PA. This categorization reflects the approach taken by several studies that captured low-income children’s PA problems including: 1) higher level of physical inactivity and 2) less regularly involved in PA, and 3) the national criteria of meeting PA guidelines. Previous studies used different thresholds of PA days for measuring the PA variable to capture the multifaceted characteristics of children’s PA (see Table 3).

Table 3. Use of dichotomous scales measuring children’s PA with supporting literature.

PA behavior	PA scale	Variables	Supporting literature
Physical inactivity	0 vs. 1+ days	PA(1+days)	Fermino et al., 2010
Regularly involved in PA	0-3 days vs. 4+days	PA(4+days)	Baquet et al., 2003; Diaz, 2002; Fermino et al., 2010; Whitney et al., 2019
Sufficiently involved in PA	0-6 days vs. 7 days	PA(7days)	The United States Department of Health and Human Services, 2018

Note: According to the National Physical Activity Guidelines for Americans (The United States Department of Health and Human Services, 2018), 60 minutes or more of MVPA are recommended for children and adolescents aged 6 through 17 years every day.

Community Resources for Children’s PA

The Community Resources (CRs) variable consists of both physical environments and social factors derived from the community-level determinants of children’s PA from the 2019 NSCH. We used neighborhood amenities as physical environmental factors. Also,

the neighborhood support item and perceived safety features were selected as a social factor. Accordingly, this study classified CRs into physical and social factors according to the characteristics which can be explained through facilities (i.e., visible and tangible support) or social processes (i.e., invisible and emotional support) (see Table 4).

Table 4. Variable list for CRs for children’s PA used in this study.

Categories	Variables	Selected items from the 2019 NSCH	Supporting literature
Physical environments	Neighborhood amenities	Sidewalks or walking paths	Bauman et al., 2002; D'Angelo et al., 2017;
		Parks or playgrounds	Franzini et al., 2009; Pender, 1998; Sallis et al., 1992; Tucker et al., 2009; Vella et al., 2014
		A recreation center, community center, or boys’ and girls’ club	
Social factors	Neighborhood support	Willingness to help	Bauman et al., 2002; Cradock et al., 2009;
		Social cohesion/ social capital	D'Angelo et al., 2017; Franzini et al., 2010;
		Community coalition	Griffin et al., 2008; McNeill et al., 2006; Rowe et al., 2013
	Perceived safety	Neighborhood safety	Beenackers et al., 2011; Coulton & Irwin, 2009; Romero, 2005

Note: This table is created by extracting related items from the 2019 NSCH, the determinants of children’s PA at the community level factors.

Physical environments

The 2019 NSCH counted the number of available amenities including parks, recreation centers, sidewalks or libraries in the neighborhood. Our study uses the following PA related facilities as the presence of physical environments from the 2019 NSCH data: 1) sidewalks or walking paths, 2) parks or playgrounds, and 3) recreation centers, community centers, or boys’ and girls’ club. Responses for each item were coded as yes (1) or no (0).

Social environment factors

This study measured social environmental factors using two items: neighborhood support and perceived safety, which were obtained from the 2019 NSCH. These indicators have been associated with social processes as previously used by Franzini et al., (2010). The 2019 NSCH assessed the context of neighborhood including neighborhood support, neighborhood cohesion, and social capital. This question asked, “Does this child live in a supportive neighborhood?” The responses to the three statements were used to determine social factors. The statements were: “1) People in this neighborhood help each other out; 2) We watch out for each other’s children in this neighborhood; and 3) When we encounter difficulties, we know where to go for help in our community”. These statements were evaluated using a four-category scale that ranged from strongly disagree (0) to strongly agree (3). The researcher combined the three different but related items into a single variable that ranged from 0 to 9 to provide a simple and direct measure of the neighborhood support variable. A score of 0 means that three ‘strongly disagree’ responses were added together, while a score of 9 means that ‘three strongly’ agree responses were added together. This method was previously described by Singh and colleagues (2008). The researcher checked the distribution of the responses of neighborhood support to determine if it was appropriate to use a single item created from the combination of three different but related neighborhood characteristics listed earlier (see Figure 6).

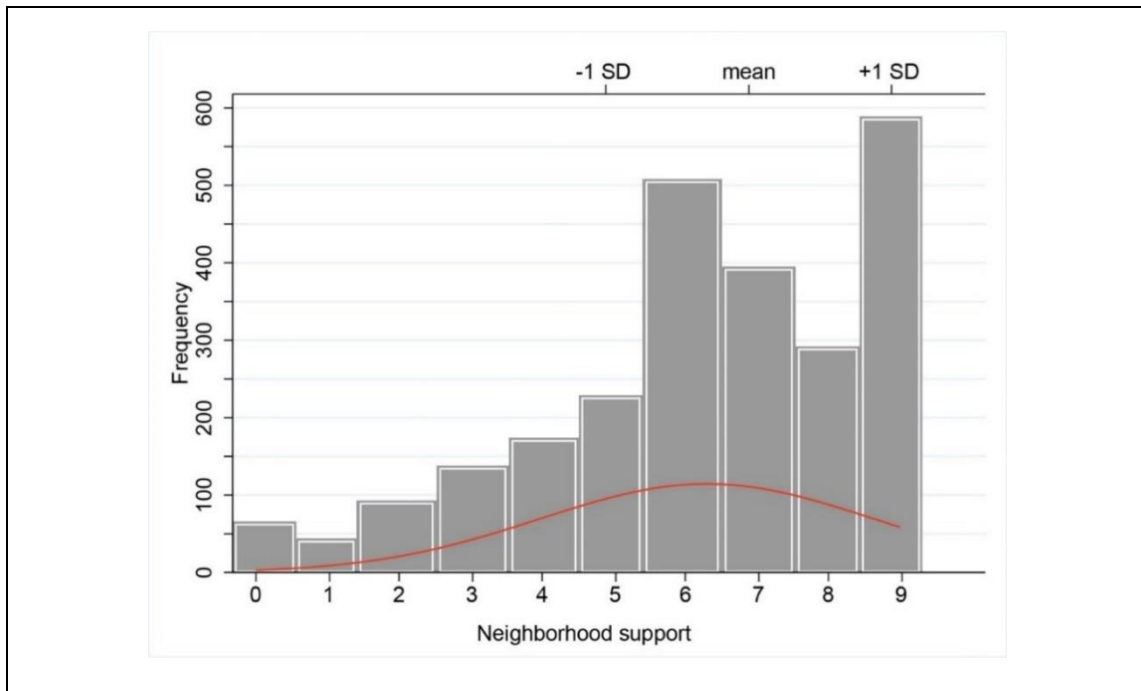


Figure 6. Distribution graph of neighborhood support for low-income children.

As shown in Figure 6, we can see how the neighborhood support variable is distributed. We calculated a mean score of 6.89 to measure the overall neighborhood support, where higher scores refer to greater neighborhood support. In this study, we also measured the reliability of the created neighborhood support variable using Cronbach’s α coefficient, which ranges from 0 to 1 and indicate internal consistency. Higher values of Cronbach’s α coefficient indicates greater internal consistency, and generally the value of 0.7 or above is considered acceptable for most research purposes (Bland & Altman, 1997; Streiner & Norman, 2008). The neighborhood support variable showed acceptable reliability with a Cronbach’s α coefficient of 0.73.

In the case of perceived safety, the 2019 NSCH asked “How much do you agree that your child is safe in your neighborhood?” using a 3-item likert scale to respond

(Definitely agree; Somewhat agree; Somewhat or definitely disagree). This study includes the perceived safety item from the physical environmental factors section of the survey. However, the perceived safety has been reclassified in this study as a social factor. This is because perceived safety is a human/social factor that is frequently studied at the community level that impacts low-income children's PA (Beenackers et al., 2011; Brennan et al., 2003; Casper et al., 2011; Franzini et al., 2009; Griffin et al., 2008; Pender, 1998; Romero, 2005).

Overall, the above selected social factors are consistent with other previous studies using the NSCH data (Burns et al., 2021; Singh et al., 2008).

Participation in OAs

This study uses the participation in OAs variable from the 2019 NSCH that asked about a child's participation in OAs, either taking place after school or on weekends. In the survey, these activities were classified into three categories: 1) sports (e.g., team sports), 2) clubs or organizations, and 3) other lessons (e.g., music, dance, language, or other arts).

In this study, the term "sports" refers to structured and organized physical activities and does not encompass all types of sports. OAs are voluntary, adult-supervised, structured, and regular programs that help children's academic, physical, and social development that occur during out-of-school time (OST) such as after school programs or during summer break. It is known that by participating in various OAs, low-income children can accomplish positive developmental outcomes (Linver et al. 2009).

Roth et al. (2010) suggested using a multidimensional scale to measure participation in OAs, encompassing dimensions such as frequency, duration, total exposure time, breadth of activities, and efforts of participants. Several studies have shown that exposing children to a wider range of activities can enhance their learning opportunities and expand their access to diverse network of mentors and peers (Bohnert et al., 2010). Because early adolescence is a critical period for exploring various interests and strengthening relationships with peers, it is important to understand the breadth of OAs, which explains the range of available activities (Bohnert et al., 2010). Additionally, there are indications that greater variety of OAs is associated with increased program attendance and positive child developmental outcomes (Smith et al., 2012; Pierce et al., 1999).

In this study, focusing on the breadth of OAs, we examined the scope of OAs to explain two different types of participation in OAs: 1) participation in *all OAs* (i.e., sports, clubs or organizations, and other lessons altogether), and 2) participation in specific OAs including either sports, clubs/organizations, or individual lessons). In other words, we have distinguished between the various types of participation in OAs as presented in Table 5.

Table 5. Two different types of participation in OAs used in this study.

Types		Binary variables
Participation in <i>all</i> OAs		Participation in <i>all</i> OAs (1) vs. partial participation in OAs (0)
Participation in <i>each of</i> OAs	Sports (e.g., sports team or sports lessons)	Participation in sports (1) vs. non-participation in sports (0)
	Clubs/organizations	Participation in clubs or organizations (1) vs. non-participation in clubs or organizations (0)
	Other lessons (e.g., music, dance, language, or other arts)	Participation in lessons (1) vs. non-participation in lessons (0)

Other Variables

Other variables in this study were employed as control factors to examine the mediating effect of participation in OAs on the relationship between CRs, as well as the moderating effect of CRs on the relationship between participation in OAs and PA among low-income children. This study captures such variables from the 2019 NSCH according to the literature review and the study framework. These variables were collapsed into two larger categories, which included 1) demographic and biological factors, and 2) individual and interpersonal factors to analyze the mediating and moderating effects as control variables. Details of them are offered below.

Demographic and biological factors

For demographic and biological factors, this study uses age, gender, race/ethnicity, education level, and family structure as control variables to analyze PA among low-income children. Table 6 details these variables.

Table 6. Variable list for demographic and biological factors with supporting literature.

Variables	Responses	Supporting literature
Age	0-5 years old (1); 6-11 years old (2); 12-17 years old (3)	Bauman et al., 2002; Mulvihill et al., 2000; Rowe et al., 2013; Trost et al., 1999; Van Der Horst et al., 2007
Gender	Male (1); Female (2)	Bauman et al., 2002; Brustad, 1993; Hanson et al., 2007; Mulvihill et al., 2000; Rowe et al., 2013; Sirard et al., 2006; Trost et al., 1999; Van Der Horst et al., 2007; Vella et al., 2014
Race/ Ethnicity	Non-Hispanic White (1); Others (0)	Bauman et al., 2002; Casper et al., 2011; Franzini et al., 2010; Hanson et al., 2007; Jones et al., 2015; McNeill et al., 2006; Moore et al., 2008; Pender, 1998; Taylor et al., 2007; Trost et al., 1999; Van Der Horst et al., 2007; Whitt-Glover et al., 2009; Wieland et al., 2020
Parent's/guardian's Education level	Less than high school (1); High school degree or GED (2); Some college or technical school (3); College degree or higher (4)	Bauman et al., 2002; Casper et al., 2011; Giles-Corti & Donovan, 2002; Gordon-Larsen et al., 2006; Hanson et al., 2007; Kobel et al., 2015; Lenzi et al., 2012; Marques et al., 2016; McNeill et al., 2006; Moore et al., 2008; NIHCM foundation, 2007; Rowe et al., 2013; Sallis et al., 1992; Santos et al., 2004; Taylor et al., 2007; Van Der Horst et al., 2007; Whitt-Glover et al., 2009
Family structure (marital status)	Two parents, currently married (1); Two parents, not currently married (2); Single parent (mother or father) (3); Grandparent Household (4); Other family (5)	Bauman et al., 2002

Individual and interpersonal factors

The individual and interpersonal factors are related to personal thoughts and feelings, abilities, as well as behaviors, and support provided by parents and peers for engagement in PA (Casey et al., 2009; Eime et al., 2015; Lubans et al., 2008; McNeil et

al., 2006). The study includes psychological, behavioral, and social and cultural factors to explain the individual and interpersonal factors that influence PA (see Table 7).

Table 7. Individual and interpersonal variable list with supporting literature.

Categories	Variables	Responses	Supporting literature
Psychological, cognitive, and emotional factors	Self-motivation	Interests and curiosity in new things	Yes (1); No (0) Bauman et al., 2002; Sallis et al., 1992
Behavioral attributes	Screen time	Time spent watching TV or playing video games	More than 2 hours (1); Less than 2 hours (0) Kobel et al., 2015; Sallis et al., 1992; Trost et al., 1999; Vella et al., 2014
Social and cultural factors	Parental supports	Parent participation in child's events	Yes (1); No (0) Bauman et al., 2012; Beets et al., 2010; Biddle & Goudas, 1996; Coulton & Irwin, 2009;
		Communication with child	Yes (1); No (0) Eime et al., 2015; Lubans et al., 2008; Marques et al., 2016; Mulvihill et al., 2000; Rees et al., 2006; Rowe et al., 2007; Rowe et al., 2013; Sallis et al., 1992; Van Der Horst et al., 2007
	Family supports	Family resilience	Yes (1) if all four behaviors were satisfied; No (0) Baranowski et al., 1998; Bauman et al., 2002; Brustad, 1993; Casper et al., 2011; Eime et al., 2015; Rowe et al., 2013; Van Der Horst et al., 2007

In the case of personal cognitive factors, we used a self-motivation variable to explain the level of children's interest and curiosity in learning new things. Additionally, this study uses screen time as a behavioral variable, which captures time spent watching TV or playing video games daily. In addition, social and cultural factors were included in this study in the form of support from others including parental and family support. In the case of parental support, this study captures two factors from the 2019 NSCH. First,

we used parent participation, which measures the extent of parent participation in child's events and activities (e.g., sports game, classroom party, etc.). Secondly, this study used communication with child to measure the degree up to which parents shared ideas and/or talked about important things with their child. We use family resilience in the context of family support by asking how often family engage in certain behaviors when facing problems. The behaviors include talking together, working together, recognizing strengths, and maintaining hope.

Analysis

This dissertation begins with a descriptive statistical analysis of the determinants of children's PA while comparing low-income children with non-low-income children to understand the different PA patterns between the two groups.

This study mainly focused on the mediating and moderating analyses. For the mediation analysis, the researcher examined how participation in OAs played a role in the relationship between the presence of CRs and PA among low-income children. First, a series of logistic regressions were conducted to check the potential mediating effect of participation in OAs on between CRs (i.e., physical and social environments) and PA among low-income children. By using multivariate analysis, this study examines how multiple variables are related to each other. We used Generalized Structural Equation Model (GSEM) analysis to see how a variable affects the outcome and the role of another variable in the relationship. By doing this, we can identify the direct and indirect effects of the predictor variable on the outcome variable as well as mediating effect of a

third variable (i.e., hypothesized mediator variable), which helps us better understand the relationships between these variables. To obtain a better understanding of the relationship between the variables, we use bootstrap repeatedly resampling the data to calculate confidence intervals for the mediation effects (Albert et al., 2016). For the moderation analysis, the researcher investigated if the presence of CRs impacted the relationship between participation in OAs and low-income children's PA. To test this, the interaction terms between the presence of CRs and participation in OAs were included in multivariate logistic regression models, which allowed the researcher to examine whether the relationship between participation in OAs and PA differed depending on the presence of CRs. To check if a model with moderating effects (i.e., an interaction term) provides a better fit to the data than a model without the interaction term, we used the Akaike information criterion (AIC), a statistical measure to compare different models and assess their relative fit to the data (Simonen et al., 2002). If the model with the moderating effect (with interaction term) has a smaller AIC value than the simple model (without interaction term), it shows that the moderating effect is significant and has improved the model fit.

The summary of the statistical analyses performed in this study can be found in Table 8. All analyses were performed in STATA SE version 17 (Stata Corp, College Station, TX). The statistical significance for the analyses was set at $p < .05$. This study has confirmed no multicollinearity issue among all variables determining PA among low-income children by checking the variance inflation factor (VIF). Results of such analysis

show that all VIF values are less than 4, which suggested that there is no multicollinearity issue among variables (see Appendix Table).

Table 8. Statistical analyses used in this study.

Analyses	Statistics	Aims	Used variables
Descriptive analysis	Chi-square test	To examine the differences between low-income children and non-low-income children	<ul style="list-style-type: none"> - Demographic and biological factors - Individual and interpersonal factors - Community resources - Participation in OAs - Physical activity
Mediating effect analysis	Multivariate logistic regression analysis	To figure out the potential mediating effect	<u>Mediating variable: Participation in OAs</u> <ul style="list-style-type: none"> - All - Each (Sports, Clubs or Lessons)
	Generalized structural equation model (GSEM) analysis	To find the mediating effect	<u>Independent variable: Presence of CRs</u> <ul style="list-style-type: none"> - Physical environments <ul style="list-style-type: none"> ▪ Sidewalks ▪ Parks or playgrounds ▪ Recreation/community centers or Boys & Girls Clubs
	Bootstrapping analysis	To confirm the mediating effect	<ul style="list-style-type: none"> - Social factors <ul style="list-style-type: none"> ▪ Neighborhood support ▪ Perceived safety <u>Outcome: PA among low-income children</u> <ul style="list-style-type: none"> - 1+ days - 4+ days - 7 days
Moderating effect analysis	Interaction term analysis	Examining the interaction term to figure out the moderating effect using logistic regressions	<u>Moderating variable: Presence of CRs</u> <ul style="list-style-type: none"> - Physical environments <ul style="list-style-type: none"> ▪ Sidewalks ▪ Parks or playgrounds ▪ Recreation/community centers or Boys & Girls Clubs - Social factors <ul style="list-style-type: none"> ▪ Neighborhood support ▪ Perceived safety
	Akaike information criterion (AIC) method	To check goodness-of-fit	<u>Independent variable: Participation in OAs</u> <ul style="list-style-type: none"> - All - Each (Sports, Clubs or Lessons) <u>Outcome: PA among low-income children</u> <ul style="list-style-type: none"> - 1+ days - 4+ days - 7 days

Mediating Effect Statistical Analysis

To investigate the indirect relationship between the presence of CRs and low-income children's PA, this study focuses on the potential mediating role of participation in OAs. Mediation analysis helps to understand the relationship between independent variable (CRs) and outcome variable (low-income children's PA) via a mediator (participation in OAs). As noted earlier, multivariate logistic regression analysis was initially examined to figure out three different direct relationship among participation in OAs (i.e., mediating variable), the presence of CRs (i.e., independent variable), and PA among low-income children (i.e., outcome variable: 1+, 4+, 7 days): 1) between the independent variable (i.e., CRs) and the outcome variable (i.e., PA among low-income children), 2) between the independent variable (i.e., CRs) and the mediating variable (i.e., participation in OAs), and finally 3) between the mediator (i.e., participation in OAs) and the outcome variable (i.e., PA among low-income children) in the presence of the independent variable (i.e., CRs). All models were adjusted for demographic, individual, and interpersonal factors. To explain the mediation model accurately, the researcher confirmed the statistical significance of the indirect relationships between independent and outcome variable through the mediating variable by focusing on the indirect paths rather than the individual paths (Hayes, 2017). Although there was not a significant relationship between any of CRs and PA among low-income children (c' : direct effect), we can confirm the indirect effect ($a1 \times b1$) of participation in OAs based on the significant relationship between some types of CRs and PA among low-income children through the mediation analysis (see Figure 7).

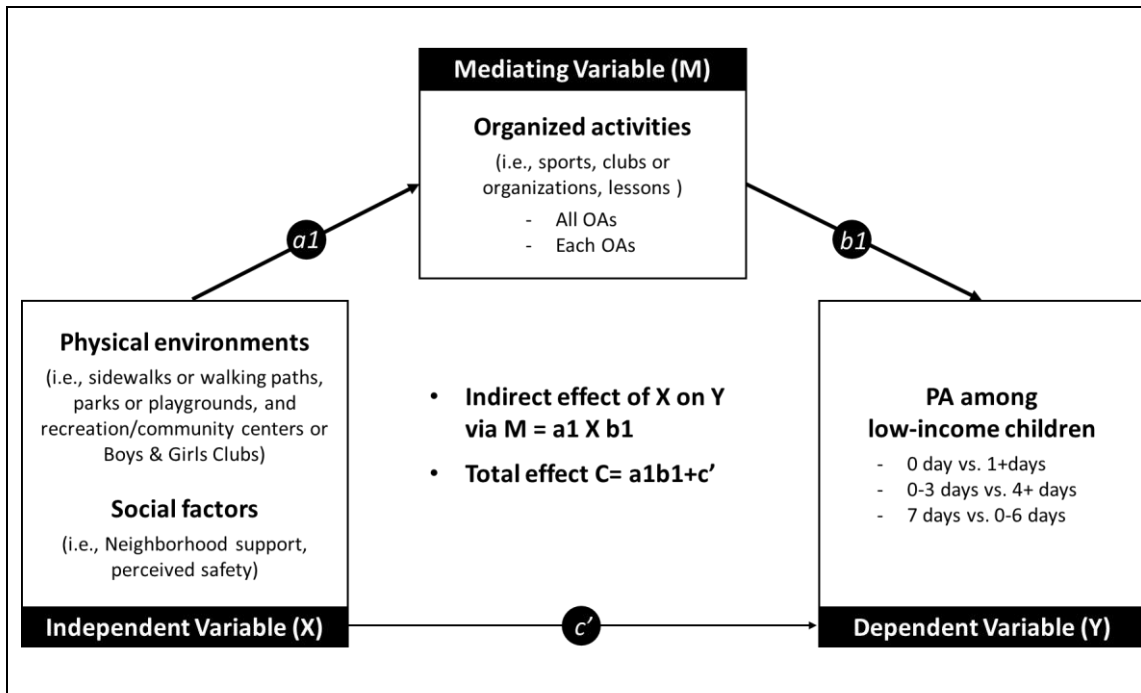


Figure 7. Mediation analysis path model of participation in OAs between CRs (i.e., physical and social environments) and PA among low-income children.

The complete mediation occurs when the effect of the independent variable (X) on the outcome (Y) is explained only through the mediator (M) without the direct effect (c') between the independent and outcome. In the case of an independent variable (X) having both direct (c') and indirect effects ($a1 \times b1$) on the dependent variable (Y), we then can say we found a partial mediation.

Furthermore, to estimate the indirect effects ($a1 \times b1$) of mediation, we used GSEM analysis to explore the pathways among independent, mediating, and outcome variables. GSEM analysis is a statistical modeling technique for analyzing the structural relationships between various variables. The researcher made the initial path models for the independent variable (i.e., CRs), the mediating variable (i.e., participation in OAs), and the outcome variable (i.e., PA among low-income children) (see Figure 7). After

controlling for other variables (i.e., demographic, individual, and interpersonal factors), the researcher made full mediation models for the binary outcome variable (i.e., low-income children's PA) following a Bernoulli distribution and using the logit link function for the binary variable. The coefficient value (β) calculated by the GSEM analysis explains how different variables are related to each other. Namely, we can use the coefficient values for the relationship between the independent variable and the mediating variable ($a1$) and for the relationship between the mediating variable and the dependent variable ($b1$) to see how strong the association is.

To confirm the mediation effect, we used a bootstrapping analysis, which supports the indirect mediating effect, even if the total effect is not found to be guaranteed (Hayes, 2009). Through the bootstrapping analysis process, the researcher can obtain standard errors (SE) for the indirect effects within 95% confidence interval (CI). This percentile bootstrap confidence interval approach is used in the Hayes Process Macro (Hayes et al., 2017). Specifically, the researcher applied a bootstrap technique with 1,000 iterations to estimate a CI of the indirect effects mediated through participation in OAs. If the 95% percentile bootstrap CI does not contain zero, it confirms the significance of the mediating effects by rejecting the null hypothesis (Efron & Tibshirani, 1985).

Moderating Effect Statistical Analysis

To explain the direction and/or strength of the relationship between participation in OAs and low-income children's PA, this study examines the moderating role of CRs

(see Figure 8). The researcher followed Hayes (2017)'s way to find the moderating effects by examining the statistical significance of the interaction term between independent variable and moderator on the outcome variable. The researcher conducted multivariate logistic regression analyses to investigate the interaction term between CRs and participation in OAs to explain how CRs can affect PA among low-income children when they participate in OAs.

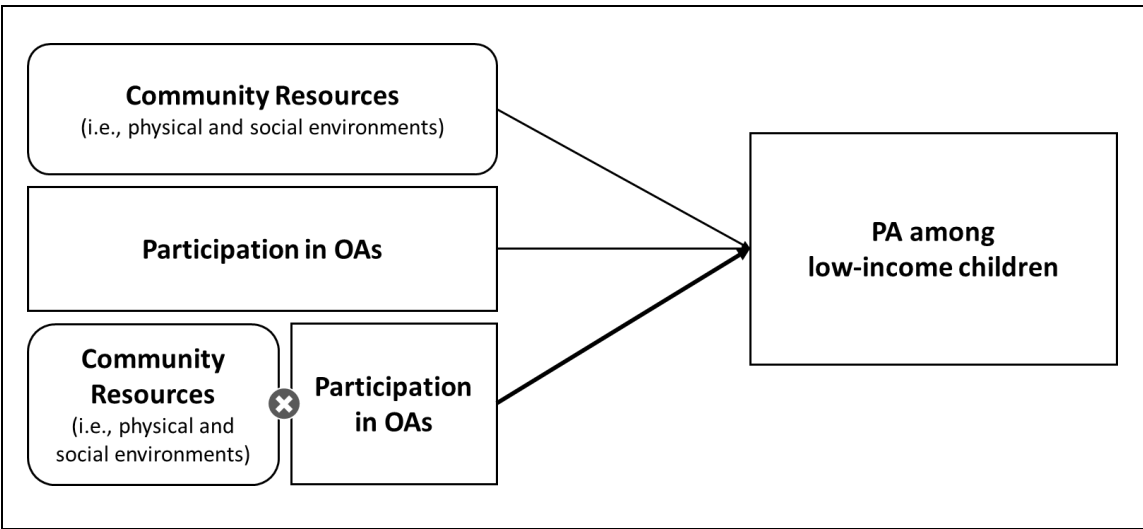


Figure 8. Moderation analytical model of CRs on the participation in OAs and PA among low-income children.

CHAPTER V

RESULTS

Comparative Descriptive Characteristics of Low-income Children's PA

This section describes the different determinants of PA of the total group surveyed (n=9,029, aged 6-11) while comparing them between low-income children (n=2,628, below 200% of FPL) and non-low-income children (n=6,401, above 200% of FPL). A chi-square test was used to examine the differences between these two groups in terms of various determinants of PA including demographics, psychological, behavioral, social and cultural, and physical factors.

Demographic and Biological Differences

Based on our descriptive analysis, ethnicity, education level, and family type were significantly different between low-income children and non-low-income children, which are shown in Table 9. Specifically, a greater number of white children were found to live in non-low-income communities, compared to the low-income communities. Additionally, the analysis showed that low-income parents tended to have lower levels of formal education than non-low-income parents. Specifically, low-income parents were found to be almost 5 times less likely to have high academic degrees compared to non-low-income parents. Finally, we also found that children from non-low-income families are more likely to have both parents living at home than low-income children.

Neither age or gender showed a statistically significant difference between children from low and non-low-income families.

Table 9. Demographic and biological factors differences between low-income and non-low-income children.

	Low-income children, n (% of “Yes”)	Non-low-income children, n (% of “Yes”)	Total, n (% of “Yes”)	P-value
Age, mean (\pm SE)	8.69 (\pm 0.03)	8.62 (\pm 0.02)	8.64 (\pm 0.02)	0.091
Female	1239 (47.15%)	3100 (48.43%)	4339 (48.06%)	0.267
White, non-Hispanic	1406 (53.5%)	4759 (74.35%)	6165 (68.28%)	<.001
High school diploma or less	941 (35.81%)	485 (7.58%)	1426 (15.79%)	<.001
Not 2-parent household	1083 (42.32%)	1008 (16.05%)	2091 (23.66%)	<.001

Note: The percent column displays the percentage of observations in each category out of the valid total number with non-missing values.

Individual and Interpersonal Differences

This study detected several individual and interpersonal differences between low-income children and non-low-income children (see Table 10). In the case of psychological, cognitive, and emotional aspects, we compared self-motivation between the two children’s groups. Results showed that economically disadvantaged children tended to have lower levels of self-motivation when compared to children from non-low-income families. In terms of behavioral attributes, we compared the screen time between low-income children and non-low-income children. Although the recommended screen time for children is less than 2 hours a day (Kobel et al., 2015), low-income children reported spending more screen time than non-low-income children. Low-income children were 1.3 times more likely to spend two hours or more on screens compared to

non-low-income children. When comparing social support from family and neighborhoods between the two groups, low-income families tended to have lower levels of parental participation in child’s events and lower levels of parental communication with children compared to non-low-income families. This means that low-income children’s parents are less involved in children’s events or activities and communicate less with their kids when compared to non-low-income children. Finally, in the case of family resilience, results showed that non-low-income families have more abilities to solve the problems of external difficulties than low-income families.

Table 10. Individual and interpersonal differences between low-income and non-low-income children.

	Low-income children, n (% of “Yes”)	Non-low-income children, n (% of “Yes”)	Total, n (% of “Yes”)	P-value
Psychological, cognitive, and emotional differences				
- Self-motivation, always and usually	2365 (90.3%)	6117 (95.74%)	8482 (94.16%)	<.001
Behavioral attributes				
- Screen time, 2+hrs	996 (38.35%)	1742 (27.41%)	2738 (30.59%)	<.001
Social and cultural differences				
- Parent participation in child’s events, always and usually	2250 (86.91%)	6063 (95.38%)	8313 (92.92%)	<.001
- Parental communication with child, very and somewhat well	2445 (94.99%)	6163 (97.24%)	8608 (96.59%)	<.001
- Family resilience, supportive	2106 (81.69%)	5424 (85.86%)	7530 (84.65%)	<.001

Note: The percent column displays the percentage of observations in each category out of the valid total number with non-missing values.

Differences of Community Resources for Children's PA

Based on our descriptive analysis, this study found that household income affects physical and social environmental inequalities (see Table 11). Low-income children were more likely to live in the neighborhoods that lacked sidewalks or walking path (67.4% vs. 72.9%), parks or playgrounds (69.8% vs. 75.6%), accessible recreation/community centers, or Boys & Girls Clubs (42.3% vs. 48.6%) when compared to their counterparts. This means that low-income children have fewer opportunities to be in PA friendly environments than non-low-income ones.

Table 11. Differences of CRs for children's PA between low-income and non-low-income children.

	Low-income children, n (% of "Yes")	Non-low-income children, n (% of "Yes")	Total, n (% of "Yes")	P-value
Physical environmental factors				
Presence of sidewalks or walking path	1730 (67.37%)	4591 (72.94%)	6321 (71.33%)	<.001
Presence of parks or playgrounds	1792 (69.84%)	4759 (75.6%)	6551 (73.93%)	<.001
Presence of recreation/community centers or Boys & Girls Clubs	1083 (42.29%)	3054 (48.6%)	4137 (46.77%)	<.001
Social environmental factors				
Neighborhood support (all yes for three items)	1660 (65.02%)	5171 (82.31%)	6831 (77.32%)	<.001
- Willingness to help	1987 (77.92%)	5791 (92.32%)	7778 (88.16%)	<.001
- Social cohesion	2056 (80.88%)	5688 (90.75%)	7744 (87.9%)	<.001
- Community coalition	2008 (79.12%)	5604 (89.45%)	7612 (86.47%)	<.001
Perceived safety, definitely agree	1442 (56.62%)	4403 (70.22%)	5845 (66.29%)	<.001

Note: The percent column displays the percentage of observations in each category out of the valid total number with non-missing values; a chi-square test was used to compare the results between the two groups.

In addition, the analysis showed that low-income children tended to live in neighborhoods with less support from their neighbors including less willingness to help, less social connections, and less community cooperation compared to non-low-income children. Low-income children were also less likely to perceive being safe in their community (56.6%) compared to non-low-income children (70.2%). This means that low-income children may not feel as secure or protected in their community as children from non-low-income families.

Participation in OAs Differences

The descriptive analysis conducted found that low-income children were fewer active participants in OAs compared to non-low-income children (see Table 12). That is, children who live in non-low-income communities participated in all previously described OAs approximately two times more frequently than other children. In the case of participation in each of the OAs, the most common type practiced by both groups of kids was sports. However, low-income children participated in sports much less (49.7%) than non-low-income children (75.7 %). In the case of other types of OAs (e.g., clubs/organizations and lessons), low-income children also participated less in them compared to non-low-income children.

Table 12. Participation in OAs differences between low-income and non-low-income children.

		Low-income children, n (% of “Yes”)	Non-low-income children, n (% of “Yes”)	Total, n (% of “Yes”)	P-value
Participation in <i>all</i> OAs		401 (15.48%)	2050 (32.21%)	2451 (27.37%)	<.001
Participation in <i>each of</i> OAs	Sports	2007 (49.67%)	3693 (75.72%)	5700 (63.92%)	<.001
	Clubs/organizations	1746 (43.45%)	2987 (61.66%)	4733 (53.41%)	<.001
	Lessons	1716 (42.68%)	2977 (61.34%)	4693 (52.88%)	<.001

PA Differences

Table 13 shows the difference in PA between low-income children and non-low-income children.

Table 13. PA differences between low-income and non-low-income children.

	Low-income children, n (% of “Yes”)	Non-low-income children, n (% of “Yes”)	Total, n (% of “Yes”)	P-value
PA days				<.001
0 days	166 (6.43%)	224 (3.53%)	390 (4.37%)	
1-3 days	954 (36.93%)	2218 (34.93%)	3172 (35.51%)	
4-6 days	646 (25.01%)	2162 (34.05%)	2808 (31.44%)	
7 days	817 (31.63%)	1745 (27.48%)	2562 (28.68%)	
1) PA comparison: Inactivity vs. at least one more day involved in PA				
PA, 1+ days	2417 (93.57%)	6125 (96.47%)	8542 (95.63%)	<.001
2) PA comparison: Less vs. often involved in PA				
PA, 4+ days	1463 (56.64%)	3907 (61.54%)	5370 (60.12%)	<.001
3) PA comparison: Insufficient vs. sufficiently involved in PA				
PA, 7 days	817 (31.63%)	1745 (27.48%)	2562 (28.68%)	<.001

Note: The percent column displays the percentage of observations in each category out of the valid total number with non-missing values; a chi-square test was used to compare the results between the two groups.

Low-income children (6.43%) were about 1.8 times more likely to be physically inactive at all compared to non-low-income children (3.53%). Further, when it comes to being regularly physically active, low-income children did it less often (56.64%) compared to non-low-income children (61.54%).

Mediating Effect Analysis

To investigate the mediating effect of participation in OAs on the presence of CRs and PA among low-income children, we conducted multivariate logistic regression analysis, generalized structural equation modeling (GSEM) analysis, and bootstrapping analysis as described in the previous chapter. We examined the data using three different scales of PA (1+, 4+, and 7 days) and approached it in two ways by considering the different participation types in two forms of OAs, either *all OAs* together or each individual OA separately.

Multivariate Logistic Regression Analysis

Participation in *All OAs*

This study conducted multivariate analysis using a series of logistic regressions to find the potential mediating effect of participation in *all OAs* between CRs and PA among low-income children (see Table 14).

Table 14. Multivariate analysis result for the associations of participation in *all OAs*, CRs, and PA among low-income children.

	Mediator						Outcome						
	Participation in <i>all OAs</i>			PA 1+ days			PA 4 days			PA 7 days			
	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		
	Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		
<i>Demographic and biological factors</i>													
Age	1.14***	1.06	1.22	0.98	0.88	1.08	0.9***	0.86	0.95	0.9***	0.86	0.95	
Female	1.34*	1.06	1.68	0.77	0.55	1.09	0.86†	0.73	1.02	0.99	0.83	1.18	
White, non-Hispanic	1.06	0.83	1.35	1.64**	1.14	2.34	1.53***	1.28	1.82	1.32**	1.1	1.6	
Education level	0.51***	0.38	0.67	0.72†	0.51	1.02	0.83*	0.7	1	1.1	0.91	1.33	
Family types	0.66**	0.51	0.84	0.96	0.68	1.35	0.97	0.82	1.16	1.06	0.88	1.27	
<i>Individual and interpersonal factors</i>													
Self-motivation	1.69†	0.99	2.9	1.04	0.63	1.73	1.44*	1.07	1.94	1.5*	1.05	2.15	
Screen time	0.6***	0.47	0.78	0.63**	0.45	0.9	0.62***	0.52	0.74	0.64***	0.53	0.77	
Parent participation in child’s events	2.22*	1.35	3.57	1.8**	1.2	2.69	1.4*	1.08	1.8	1.32†	0.99	1.77	
Parental communication with child	1.8	0.84	3.86	3.39***	1.98	5.81	1.69*	1.12	2.54	1.11	0.7	1.76	
Family resilience	0.97	0.69	1.35	1.35	0.91	2.01	1.23†	0.98	1.54	1.19	0.93	1.53	
<i>Community resources</i>													
Physical environment	Sidewalks or walking paths	1.34*	1.00	1.79	0.89	0.59	1.34	0.82†	0.67	1	0.82†	0.66	1.01
	Parks or playgrounds	1.01	0.74	1.37	1.14	0.76	1.71	1.16	0.94	1.43	1.02	0.82	1.28
	Recreation/ community centers or Boys & Girls Clubs	1.62***	1.26	2.08	1	0.69	1.46	0.97	0.81	1.17	1.02	0.84	1.25
Social factors	Neighborhood support	1.1**	1.03	1.18	1.02	0.94	1.1	1.07**	1.03	1.12	1.07**	1.02	1.12
	Perceived safety	0.88	0.67	1.16	0.95	0.64	1.41	1	0.82	1.21	1.06	0.86	1.31
[Mediating effect]													
Participation in <i>all OAs</i>				4.31**	1.74	10.73	1.43**	1.12	1.83	0.89	0.7	1.15	
# of observations		2,431		2,419		2,419		2,419		2,419			

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

In terms of the relationship between the presence of CRs and participation in *all OAs*, having recreation/community centers or Boys & Girls Clubs (OR=1.62, 95% CI 1.26-2.08) and sidewalks (OR=1.34, 95% CI 1.00-1.79) in the neighborhood were positively associated with increased participation in *all OAs* after controlling for other factors. Compared to those who don't have access to recreation/community centers or Boys & Girls Clubs in their neighborhood, the likelihood of participating in all organized activities (OAs) increases by 1.6 times in the case of those who do have access to these facilities. If the presence of sidewalks increases by one unit, the odds of participation in *all OAs* increases by 1.3 times. Additionally, neighborhood support was found to be positively associated with participation in *all OAs* (OR=1.1, 95% CI 1.03-1.18) after controlling for other factors. If there is an increase of one unit in neighborhood support, the likelihood of participating in *all OAs* increases by 1.1.

In the case of the relationship between participation in OAs and PA (1+days) among low-income children, participation in *all OAs* was significantly associated with PA (OR=4.31, 95% CI 1.74-10.73). Regarding the relationship between the presence of CRs and low-income children's PA (1+days), the presence of sidewalks or walking paths, recreation/community centers or Boys & Girls Clubs and neighborhood support were not significantly associated with PA (1+ days) among low-income children. From this analysis, we can find the potential mediating effect of participation in *all OAs* on increasing PA (1+ days) among low-income children who have access to sidewalks, recreation/community centers or Boys & Girls Clubs. Additionally, low-income children

who have available neighborhood support can increase their PA (1+ days) by participating in *all OAs* (see Figure 9).

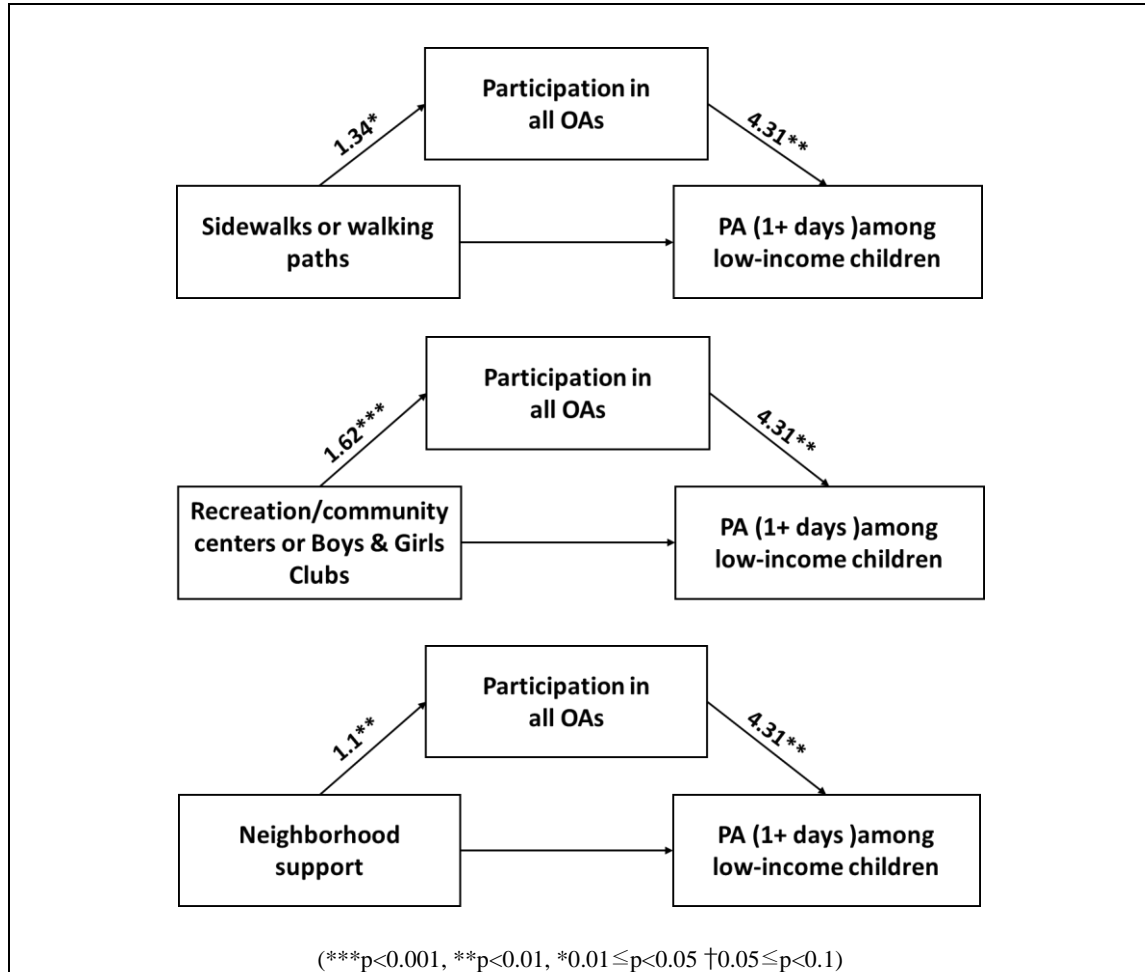


Figure 9. Path diagram explaining the relationship between CRs, participation in *all OAs*, and PA (1+ days) among low-income children.

We also found the potential mediating effect of participating in *all OAs* on increasing PA (4+ days) among low-income children who have sidewalks, community/recreation centers or Boys & Girls Clubs, and neighborhood support in their community (see Figure 10). This means that if low-income children have sidewalks or recreation/community centers or Boys & Girls clubs in their neighborhood, they are

more likely to participate in *all OAs* and therefore increase their frequency of PA (4+ days). We also found that low-income children who receive neighborhood support are more likely to participate in *all OAs* to increase their frequency of PA (4+ days).

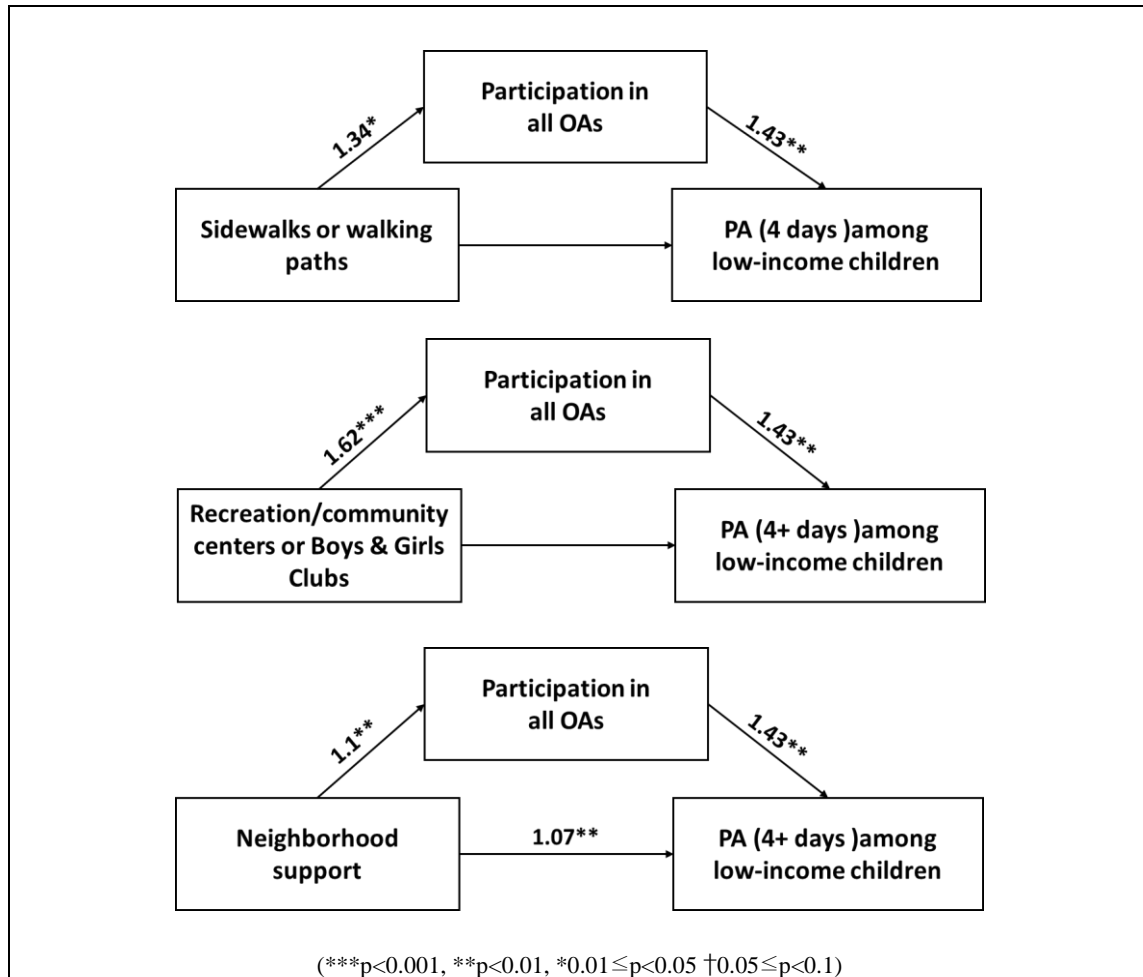


Figure 10. Path diagram explaining the relationship between CRs, participation in *all OAs*, and PA (4+ days) among low-income children.

There was not a mediating effect of participation in *all OAs* for being physically active (7 days) among low-income children.

In summary, by conducting the multivariate logistic regression analyses, we discovered the potential mediating effect of participation in *all OAs* that connects the

association between CRs (i.e., sidewalks, recreation/community centers or Boys & Girls Clubs, and neighborhood support) and low-income children's PA in the case of avoiding physical inactivity (1+ days of PA) and increasing frequency of PA (4+ days)

Participation in *each of OAs*

After examining the potential mediating effect of participation in *all OAs*, we focused on the mediating effect of participation in *each of OAs* (i.e., sports, clubs, or lessons) on the relationship between presence of CRs and PA among low-income children. For this purpose, first, we carried out a series of multivariate logistic regression analyses to investigate the relationships: 1) between the presence of CRs and participation in different OAs such as sports, clubs, or lessons (see Table 21) and 2) between the presence of CRs as well as participation in *each of OAs* and PA among low-income children (see table 15).

Our analysis showed that the presence of recreation/community centers or Boys & Girls Clubs was consistently associated with low-income children's participation in *each of OAs* (i.e., sports, clubs, or lessons). Specifically, children who lived in the neighborhood that had recreation/community centers or Boys & Girls Clubs were more likely to participate in sports, 1.21 times higher than those who did not. The odds of participating in clubs or organizations was 1.46 times higher for those who can access recreation/community centers or Boys & Girls Clubs compared to those who didn't. And the likelihood of participating in lessons was 1.35 times greater for children who had access to recreation/community centers or Boys & Girls Clubs compared to those who

did not have access. In other words, having access to recreation/community centers or Boys & Girls Clubs increased the chances of participation in *each of OAs*.

Table 15. Multivariate analysis result for the associations of CRs and participation in *each of OAs* (i.e., sports, clubs/organizations, and lessons).

		Sports			Clubs or organizations			Lessons		
		95% CI			95% CI			95% CI		
		OR	Lower	Upper	OR	Lower	Upper	OR	Lower	Upper
<i>Demographic and biological factors</i>										
Age		1.14***	1.08	1.19	1.23***	1.17	1.29	1.13***	1.08	1.19
Female		0.66***	0.55	0.78	1.15	0.97	1.36	1.94***	1.63	2.3
White, non-Hispanic		1.28**	1.07	1.53	1.15	0.96	1.38	0.87	0.73	1.04
Education level		0.5***	0.41	0.6	0.57***	0.47	0.69	0.62***	0.52	0.75
Family types		0.85†	0.71	1.01	0.8*	0.67	0.95	0.8*	0.67	0.96
<i>Individual and interpersonal factors</i>										
Self-motivation		1.24	0.9	1.71	1.54*	1.1	2.14	1.21	0.88	1.68
Screen time		0.68***	0.57	0.81	0.77**	0.64	0.92	0.88	0.74	1.06
Parent participation in child's events		2.32***	1.74	3.09	2.12***	1.59	2.85	2.26***	1.68	3.03
Parental communication with child		1.62*	1.05	2.5	1.37	0.88	2.14	1.33	0.84	2.09
Family resilience		0.91	0.72	1.15	1.06	0.84	1.35	1.24†	0.98	1.58
<i>Community resources</i>										
Physical environments	Sidewalks or walking path	1.03	0.84	1.27	1.16	0.94	1.43	1.29*	1.05	1.59
	Parks or playgrounds	1.08	0.88	1.34	1.02	0.82	1.26	1.08	0.87	1.34
	Recreation center, community center, or Boys & Girls Clubs	1.21*	1	1.46	1.46***	1.21	1.77	1.35**	1.12	1.64
Social factors	Neighborhood support	1.08**	1.03	1.13	1.06*	1.01	1.11	1.06*	1.01	1.11
	Perceived safety	0.94	0.77	1.14	0.89	0.73	1.09	0.83†	0.68	1.01
# of observations		2,419			2,406			2,407		

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05, †0.05≤p<0.1

Additionally, the odds of participation in lessons were 1.29 times higher for those who lived in areas with sidewalks or walking paths compared to those who didn't.

Neighborhood support was found to increase the odds of participation in sports 1.08 times, clubs or organizations 1.06 times, and lessons 1.06 times respectively after controlling for other factors.

Table 16 shows the results of the multivariate analyses with the associations of participation in each of OA and three different PA types (1+, 4+, and 7 days) after controlling for other factors that could affect the result. Specifically, participation in sports was positively associated with 1+ days of PA (OR=3.22, 95% CI= 1.99-5.2) and 4+days of PA (OR=1.32, 95% CI= 1.09-1.59). This means that low-income children who take part in sports are 3.2 times more likely to avoid being physical inactive compared to those who do not participate in sports. Also, participation in sports increases the likelihood of low-income children to be more frequently involved in PA (4+ days) by 1.3 times in comparison to non-participants. However, participation in clubs or organizations was not associated with PA outcomes. Participation in lessons was found to be significantly associated with 1+ days of PA outcome (OR=1.76, 95% CI= 1.15-2.68), but interestingly, it was negatively associated with 7 days of PA (OR=0.78, 95% CI= 0.64-0.95). When it comes to the direct relationship between CRs and PA among low-income children, the presence of sidewalks or walking paths was negatively associated with 7 days of PA (OR=0.8, 95% CI= 0.65-0.99). Additionally, neighborhood support had a positive relationship with 4+ days of PA (OR=1.07, 95% CI= 1.03-1.12) and 7 days of PA (OR=1.08, 95% CI= 1.03-1.13).

Table 16. Multivariate analysis result for the associations of CRs and participation in each of OAs on PA days (1+, 4+, and 7 days) among low-income children.

		PA 1+ days			PA 4+ days			PA 7 days		
		OR	95% CI		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper		Lower	Upper
<i>Demographic and biological factors</i>										
Age		0.94	0.85	1.04	0.9***	0.85	0.94	0.91***	0.86	0.96
Female		0.83	0.58	1.18	0.88	0.74	1.05	1.03	0.85	1.23
White, non-Hispanic		1.66**	1.15	2.39	1.52***	1.27	1.81	1.31***	1.08	1.58
Education level		0.81	0.57	1.15	0.85†	0.71	1.02	1.06	0.87	1.29
Family types		1	0.7	1.41	0.97	0.82	1.16	1.04	0.86	1.25
<i>Individual and interpersonal factors</i>										
Self-motivation		0.99	0.59	1.67	1.46*	1.08	1.98	1.59*	1.1	2.28
Screen time		0.64*	0.45	0.92	0.64***	0.54	0.76	0.64***	0.53	0.78
Parent participation in child's events		1.47†	0.97	2.22	1.32*	1.02	1.72	1.35*	1	1.81
Parental communication with child		2.97***	1.71	5.16	1.59*	1.05	2.4	1.08	0.68	1.72
Family resilience		1.41†	0.94	2.11	1.23†	0.98	1.55	1.18	0.92	1.52
<i>Community resources</i>										
Physical environments	Sidewalks or walking path	0.88	0.58	1.32	0.81	0.66	1	0.8*	0.65	0.99
	Parks or playgrounds	1.11	0.74	1.68	1.16	0.93	1.43	1.04	0.83	1.3
	Recreation center, community center, or Boys & Girls Clubs	0.96	0.65	1.4	0.99	0.82	1.19	1.06	0.87	1.29
Social factors	Neighborhood supports	1.01	0.93	1.09	1.07**	1.03	1.12	1.08**	1.03	1.13
	Perceived safety	1.01	0.68	1.49	0.98	0.8	1.19	1.04	0.84	1.29
[Mediating Effect] Each of OAs										
Participation in sports		3.22***	1.99	5.2	1.32**	1.09	1.59	0.95	0.78	1.15
Participation in clubs or organizations		1.14	0.74	1.75	1.04	0.86	1.27	0.99	0.81	1.22
Participation in lessons		1.76**	1.15	2.68	1.04	0.87	1.26	0.78*	0.64	0.95
# of observations		2,371			2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

Based on the result of the multivariate logistic regression analysis, the researcher made path diagrams to explain a statistically significant potential mediating effect of

participation in *each of OAs*. Below are displayed only the statistically significant relationships, including the value of the relationships between CRs, participation in *each of OAs*, and PA among low-income children (Figures 11,12, and 13).

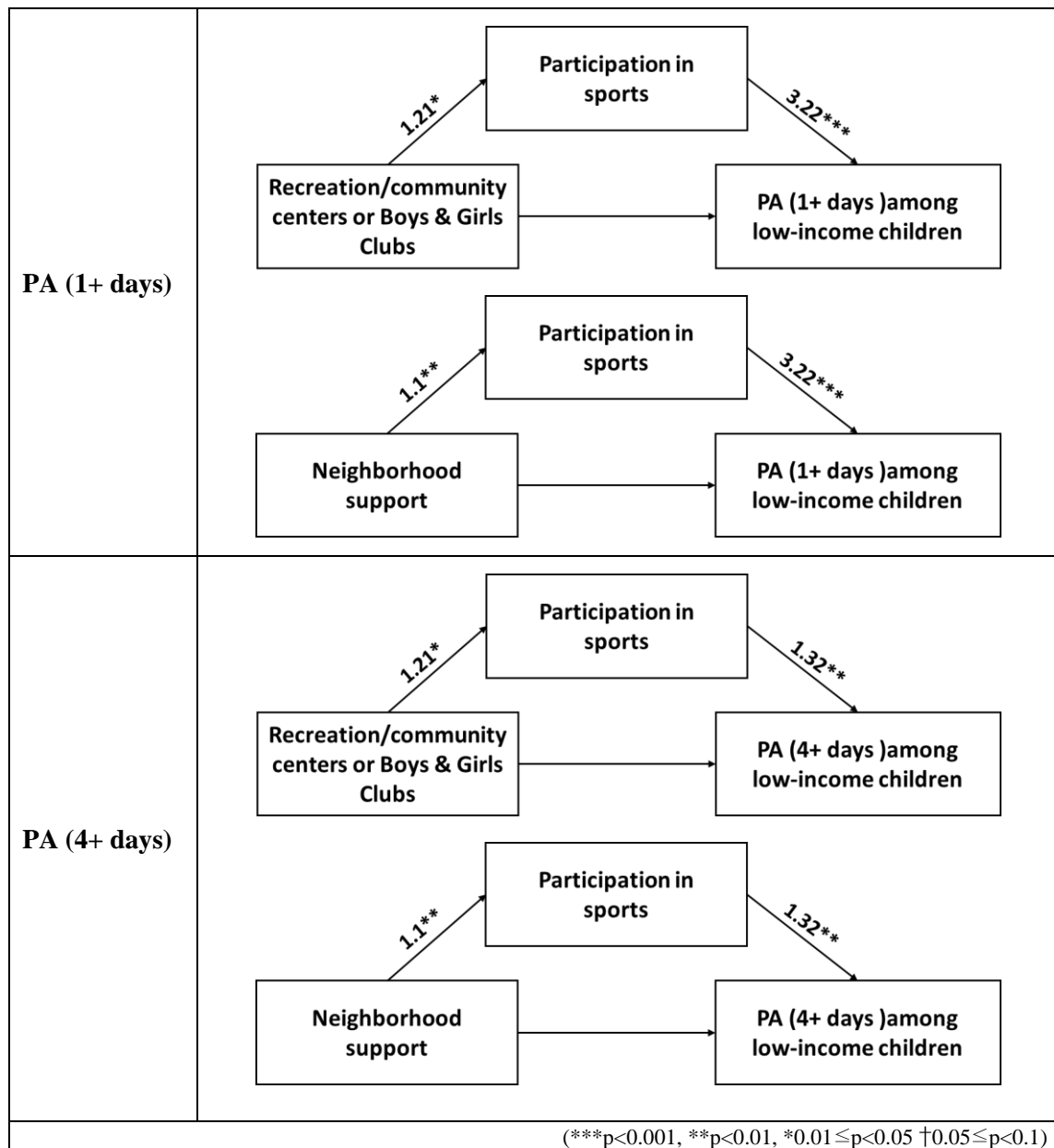


Figure 11. Path diagram to explain the relationship between CRs, participation in sports and PA (1+, 4+ days) among low-income children.

Figure 11 illustrates the mediating effect of participation in sports between CRs (i.e., recreation/community centers or Boys & Girls Clubs, neighborhood support) and PA (1+, 4+ days).

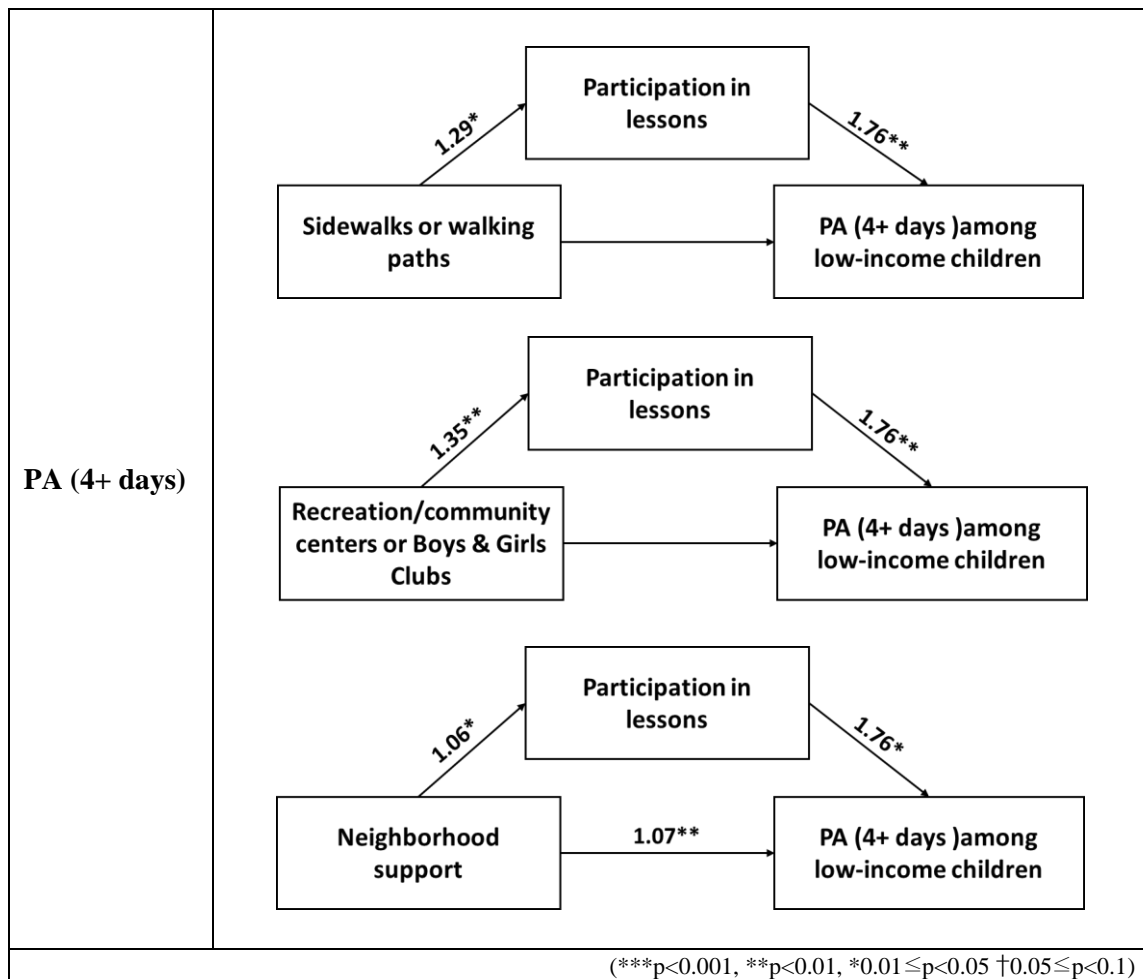


Figure 12. Path diagram to explain the relationship between CRs, participation in lessons and PA (4+ days) among low-income children.

In the case of participation in lessons, we found that such variable can mediate the presence of CRs, including sidewalks, recreation/community centers or Boys & Girls

Clubs, and neighborhood support, to promote frequency of PA (4+ days) among low-income children (see Figure 12).

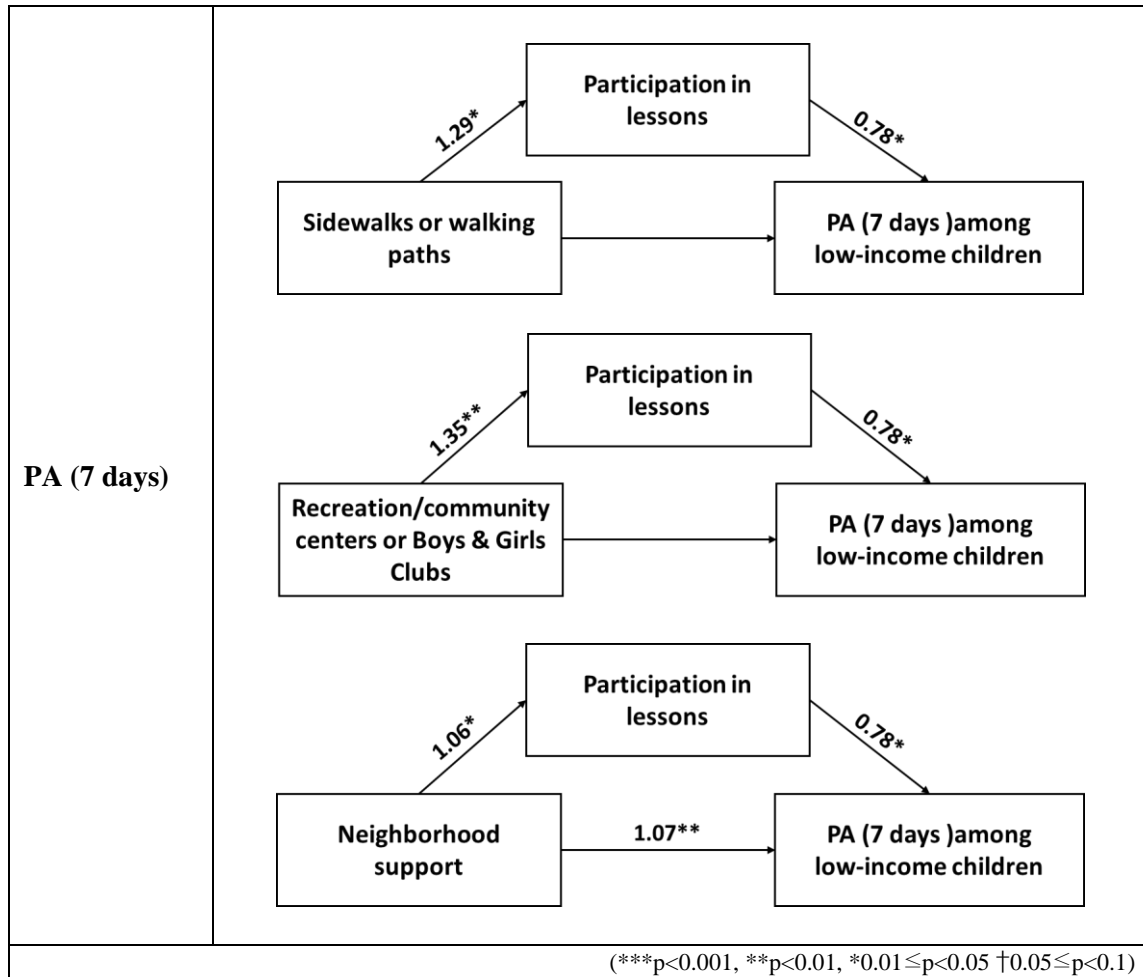


Figure 13. Path diagram explaining the relationship between CRs, participation in lessons, and PA (7 days) among low-income children.

As shown in Figure 13, we found a negative mediating effect of participation in lessons. The odds ratio between participation in lessons and PA (7+days) was 0.78, which is less than 1. This indicates that low-income children living in neighborhoods with access to sidewalks, recreation/community centers or Boys & Girls Clubs, and

neighborhood support may experience a decrease in their PA (7 days) by participating in lessons.

GSEM Analysis

Based on the previous multivariate logistic regression analysis that found a potential mediating effect of participation in OAs, we conducted a GSEM analysis that seeks to report the indirect effect of participation in OAs to see what extent participation in OAs can mediate between CRs and PA among low-income children. First, we present the results of how participation in *all OAs* can mediate the relationship between CRs and low-income children's PA (1+, 4+, and 7 days) followed by the same analysis in the case of each OAs (i.e., organized sports, clubs, and lessons).

Participation in *All OAs*

- **PA (1+ days)**

Table 17 shows the result of the GSEM analysis that corroborates the existence of a mediating effect of participation in *all OAs* on the relationship between the presence of CRs and reducing physical inactivity among low-income children by providing the value of indirect relationships between different variables to explain how much related to each other. Based on the GSEM analysis, we found indirect effects of the presence of sidewalks or walking paths ($a1: \beta=0.294$, $p\text{-value}=0.048$), recreation/community centers or Boys & Girls Clubs ($a1: \beta=0.482$, $p\text{-value}<.001$), and neighborhood support ($a1, \beta=0.099$, $p\text{-value}=0.003$) on avoiding physical inactivity via participating in *all OAs* ($b1:$

$\beta=1.462$, $p\text{-value}=0.002$). Figure 14 displays the path model that explains how the presence of CRs, participation in *all OAs* and PA among low-income, are interrelated.

Table 17. GSEM analysis result for the association of participation in *all OAs*, CRs and PA (1+ days) among low-income children.

			Coefficient (β)	SE	P-value	95% CI	
						Lower	Upper
Physical environments	Sidewalks or walking paths	(<i>al</i>)	0.294*	0.148	0.048	0.003	0.585
		(<i>c'</i>)	-0.116	0.207	0.577	-0.522	0.291
	Parks or playgrounds	(<i>al</i>)	0.008	0.156	0.960	-0.298	0.314
		(<i>c'</i>)	0.132	0.207	0.525	-0.274	0.537
	Recreation center, community center, or Boys & Girls Clubs	(<i>al</i>)	0.482***	0.129	<.001	0.229	0.735
		(<i>c'</i>)	0.004	0.193	0.985	-0.374	0.381
Social factors	Neighborhood support	(<i>al</i>)	0.099**	0.033	0.003	0.033	0.164
		(<i>c'</i>)	0.018	0.041	0.654	-0.062	0.099
	Perceived safety	(<i>al</i>)	-0.128	0.141	0.366	-0.405	0.149
		(<i>c'</i>)	-0.048	0.199	0.810	-0.439	0.343
[Mediating effect]							
Participation in all OAs		(<i>bl</i>)	1.462**	0.465	0.002	0.551	2.373
# of observations			2,431				

Note: Other variables including demographics, individual, and interpersonal factors are used as control variables to conduct the analysis to figure out the mediating role of participation in OAs on associations between community resources and PA among low-income children; *** $p<0.001$, ** $p<0.01$, * $0.01\leq p<0.05$ † $0.05\leq p<0.1$

Figure 14 illustrates how low-income children can reduce their physical inactivity when they are living in neighborhoods with access to sidewalks, recreation/community centers or Boy & Girls Clubs and supportive neighborhood for them, by participating in *all OAs*. Although there was no association between CRs and PA (1+ days) among low-income children, we found the mediating role of participation in all OAs in connecting CRs and avoiding physical inactivity.

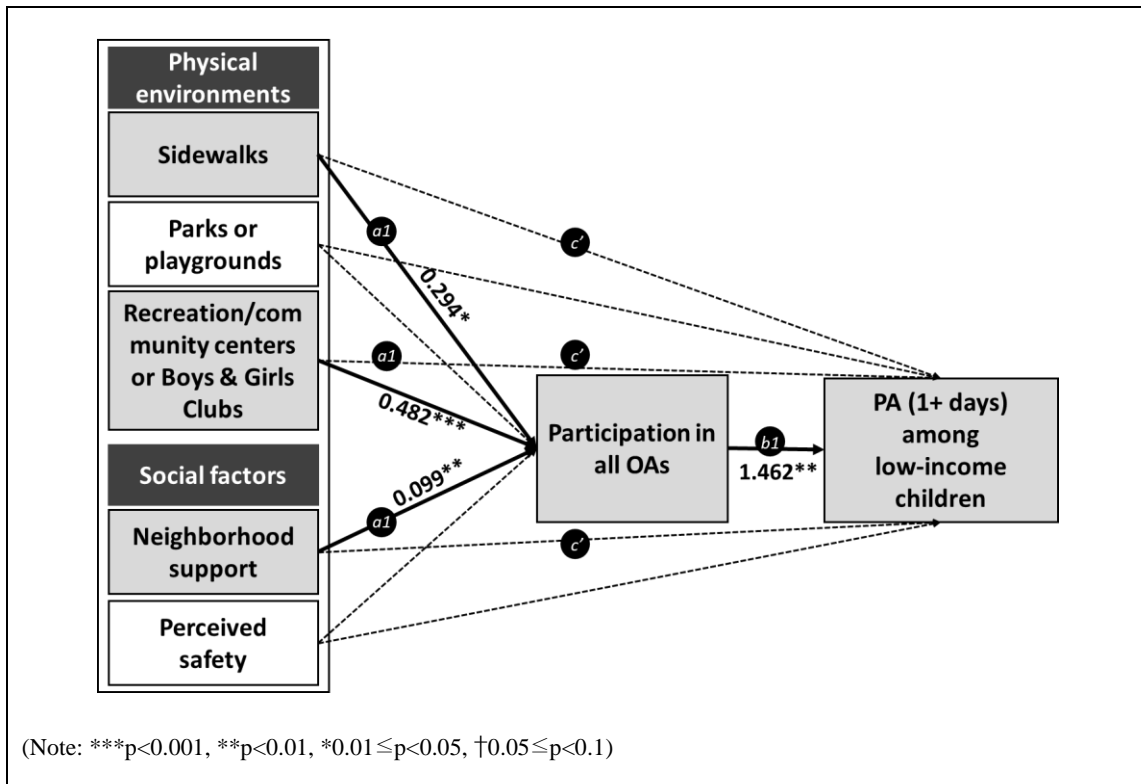


Figure 14. Mediation path model of participation in *all OAs* between CRs (i.e., physical and social environments) and PA (1+ day) among low-income children.

- **PA (4+ days)**

In the case of the second form of PA (being frequently involved in PA days), 4 or more days per week, the analysis found the mediating effect of participation in *all OAs* on the presence of sidewalks/walking paths ($a1 \times b1$, $\beta=0.106$), recreation/community centers or Boys & Girls Clubs ($a1 \times b1$, $\beta=0.173$), and neighborhood support ($a1 \times b1$, $\beta=0.036$). The result from the GSEM analysis (see Table 18) showed that the indirect effects of presence of recreation/community centers or Boys & Girls Clubs ($a1$, $\beta=0.482$, $p\text{-value} < .001$) and neighborhood support ($a1$, $\beta=0.099$, $p\text{-value}= 0.003$) on more frequent PA days (4 or more days per week) for low-income children by participating in *all OAs* ($b1$, $\beta=0.36$, $p\text{-value}= 0.004$).

Table 18. GSEM analysis result for the association of participation in *all OAs*, CRs and PA (4+ days) among low-income children.

			Coefficient (β)	SE	P-value	95% CI		
						Lower	Upper	
Physical environments	Sidewalks or walking path	(a1)	0.294*	0.148	0.048	0.003	0.585	
		(c')	-0.203	0.104	0.051	-0.407	0.001	
	Parks or playgrounds	(a1)	0.008	0.156	0.960	-0.298	0.314	
		(c')	0.147	0.108	0.172	-0.064	0.358	
	Recreation center, community center, or Boys & Girls Clubs	(a1)	0.482***	0.129	0.000	0.229	0.735	
		(c')	-0.028	0.096	0.770	-0.216	0.160	
Social factors	Neighborhood support	(a1)	0.099**	0.033	0.003	0.033	0.164	
		(c')	0.068**	0.022	0.002	0.023	0.111	
	Perceived safety	(a1)	-0.128	0.141	0.366	-0.405	0.149	
		(c')	-0.004	0.202	0.971	-0.203	0.194	
	[Mediating effect]							
	Participation in all OAs		(b1)	0.36**	0.126	0.004	0.112	0.607
# of observations			2,431					

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05, †0.05≤p<0.1

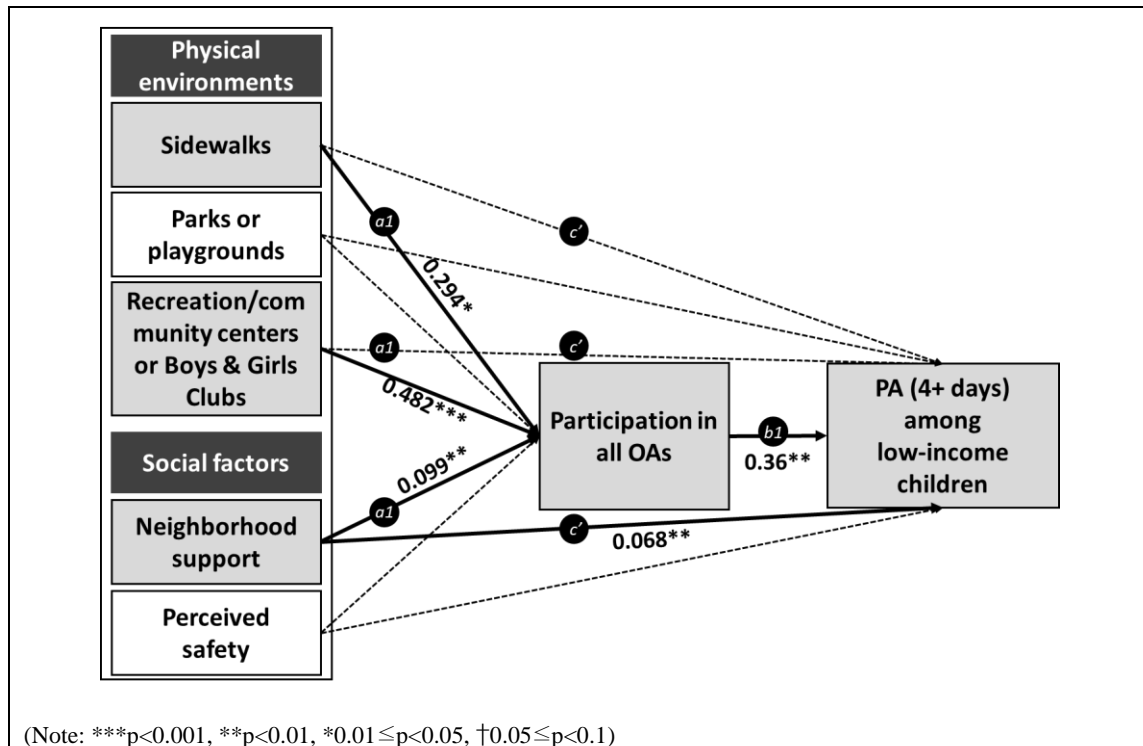


Figure 15. Mediation path model of participation in *all OAs* on between CRs (i.e., physical and social environments) and PA (4+ day) among low-income children.

Based on GSEM analysis results, the researcher made the path model that explain the interrelated relationships among participation in *all OAs*, the presence of CRs and PA among low-income children are shown in Figure 15. Low-income children who live in the neighborhood with access to sidewalks, recreation/community centers or Boys & Girls Clubs, and feel neighborhood support, can remain being frequently involved in PA (4+days) through participation in *all OAs*.

- **PA (7 days)**

In the case of children who engage in PA for 7 days a week, we did not find any significant mediating effect of participation in all OAs on between CRs and PA among low-income children (see Table 19). This means that for low-income children who are already physically active every day of the week, participating in all types of OAs did not significantly explain the relationship between CRs and PA among them.

Table 19. GSEM analysis result for the association of participation in *all OAs*, CRs and PA (7 days) among low-income children.

			Coefficient (β)	SE	P-value	95% CI	
						Lower	Upper
Physical environments	Sidewalks or walking path	(<i>al</i>)	0.294	0.148	0.048	0.003	0.585
		(<i>c'</i>)	-0.203	0.107	0.058	-0.412	0.007
	Parks or playgrounds	(<i>al</i>)	0.008	0.156	0.960	-0.298	0.314
		(<i>c'</i>)	0.023	0.113	0.840	-0.198	0.243
	Recreation/community centers or Boys & Girls Clubs	(<i>al</i>)	0.482	0.129	0.000	0.229	0.735
		(<i>c'</i>)	0.024	0.101	0.814	-0.173	0.221
Social factors	Neighborhood support	(<i>al</i>)	0.099	0.033	0.003	0.033	0.164
		(<i>c'</i>)	0.064	0.024	0.007	0.017	0.111
	Perceived safety	(<i>al</i>)	-0.128	0.141	0.366	-0.405	0.149
		(<i>c'</i>)	0.063	0.107	0.558	-0.147	0.273
[Mediating effect]							
Participation in all OAs		(<i>bl</i>)	-0.112	0.127	0.378	-0.362	0.137
# of observations			2,431				

Note: Other variables including demographics, individual, and interpersonal factors are controlled; *** $p < 0.001$, ** $p < 0.01$, * $0.01 \leq p < 0.05$, † $0.05 \leq p < 0.1$

In conclusion, from the GSEM analysis, we were able to corroborate the existence of a mediating effect of participation in *all OAs* on the relationship between the presence of sidewalks, recreation/community centers or Boys & Girls Clubs and neighborhood support to increase PA (1+ and 4+days) among low-income children but no in the case of PA (7 days). In other words, low-income children living in neighborhoods with access to sidewalks, recreation/community centers or Boys & Girls Clubs and neighborhood support can avoid physical inactivity (1+ days) and increase their frequency of physical activity (4+ days) by participating in *all OAs*.

Participation in *Each of OAs*

In the previous section, we determined the mediating effect of participation in all OAs on CRs and low-income children's PA through the GSEM analysis. In this section, we report the results of the GSEM analysis to corroborate how participating in *each of OAs* separately (i.e., participation in sports, clubs, and individual lessons), mediates the relationship between CRs and PA among low-income children.

- **PA (1+ days)**

Results showed that the presence of recreation/community centers or Boys & Girls Clubs was associated with participation in *each of OAs* including sports ($a1$, $\beta=0.19$, p-value=0.048), clubs ($a1$, $\beta=0.380$, p-value<0.001), and lessons ($a1$, $\beta=0.303$, p-value=0.002). In addition, the availability of sidewalks was associated with participation in lessons ($a1$, $\beta=0.256$, p-value=0.016) in reducing the risk of physical

inactivity among low-income children. Furthermore, the analysis found that participation in *each of OAs* including sports ($a1, \beta=0.077$, p-value=0.001), clubs ($a1, \beta=0.056$, p-value=0.015), and lessons ($a1, \beta=0.057$, p-value=0.013), had a mediating effect on the relationship between neighborhood support and avoiding physical inactivity among low-income children. The result of this analysis is presented in Table 20 and illustrated in Figure 16.

Table 20. GSEM analysis result for the association of participation in *each of OAs*, CRs, and PA (1+ days) among low-income children.

			Coefficient (β)	SE	P-value	95% CI	
						Lower	Upper
Physical environme nts	Sidewalks or walking path	(<i>a1</i> : Sports)	0.034	0.104	0.744	-0.170	0.239
		(<i>a1</i> : Clubs)	0.148	0.106	0.162	-0.060	0.355
		(<i>a1</i> : Lessons)	0.256*	0.106	0.016	0.048	0.465
		(<i>c'</i> : PA)	-0.130	0.209	0.534	-0.540	0.280
	Parks or playgrounds	(<i>a1</i> : Sports)	0.080	0.109	0.461	-0.133	0.294
		(<i>a1</i> : Clubs)	0.017	0.111	0.880	-0.200	0.234
		(<i>a1</i> : Lessons)	0.075	0.111	0.499	-0.142	0.292
		(<i>c'</i> : PA)	0.107	0.210	0.611	-0.306	0.520
	Recreation center, community center, or Boys & Girls Clubs	(<i>a1</i> : Sports)	0.190*	0.096	0.048	0.001	0.378
		(<i>a1</i> : Clubs)	0.380***	0.097	0.000	0.190	0.570
		(<i>a1</i> : Lessons)	0.303**	0.097	0.002	0.114	0.492
		(<i>c'</i> : PA)	-0.045	0.196	0.819	-0.429	0.340
Social factors	Neighborhood support	(<i>a1</i> : Sports)	0.077**	0.023	0.001	0.032	0.121
		(<i>a1</i> : Clubs)	0.056*	0.023	0.015	0.011	0.101
		(<i>a1</i> : Lessons)	0.057*	0.023	0.013	0.012	0.102
		(<i>c'</i> : PA)	0.007	0.042	0.871	-0.075	0.088
	Perceived safety	(<i>a1</i> : Sports)	-0.066	0.103	0.517	-0.267	0.135
		(<i>a1</i> : Clubs)	-0.116	0.104	0.263	-0.319	0.087
		(<i>a1</i> : Lessons)	-0.189	0.104	0.068	-0.392	0.014
		(<i>c'</i> : PA)	0.007	0.202	0.973	-0.388	0.402
[Mediating effect]							
Participation in sports		(<i>b1</i> : PA)	1.169***	0.245	0.000	0.689	1.649
Participation in clubs		(<i>b1</i> : PA)	0.129	0.220	0.557	-0.301	0.559
Participation in lessons		(<i>b1</i> : PA)	0.564**	0.216	0.009	0.141	0.987
# of observations			2,431				

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

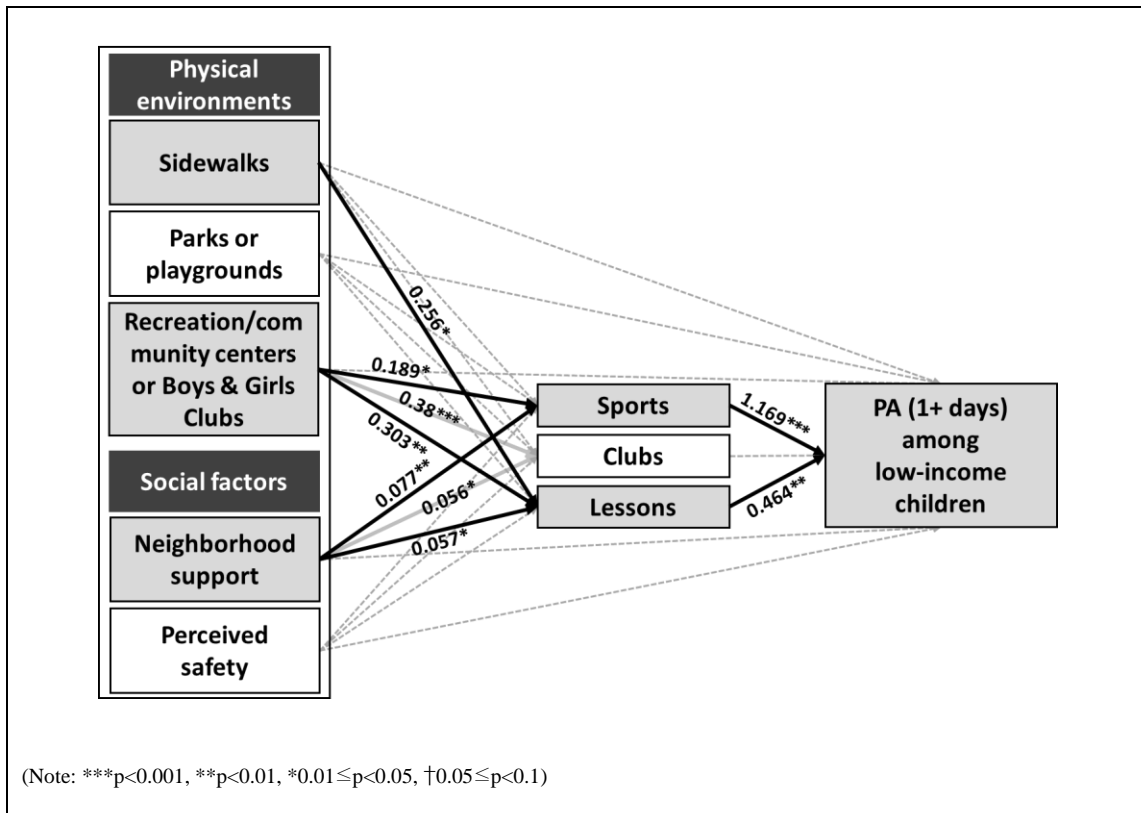


Figure 16. Mediation path model of participation in *each of OAs* on CRs and PA (1+ day) among low-income children.

Figure 16 illustrates how low-income children who live in communities with sidewalks, recreation/community centers or Boys & Girls Clubs, and a supportive neighborhood environment, can increase their PA (1+ days) by participating in sports or lessons.

- **PA (4+ days)**

As shown in Table 21, there is an existence of an indirect effect of the presence of recreation/community centers or Boys & Girls Clubs (*a1*: $\beta=0.189$, p-value=0.048) and neighborhood support (*a1*: $\beta=0.077$, p-value=0.001) on being more physically active for 4 or more days by participating in organized sports (*b1*: $\beta=0.277$, p-value=0.004). It

means that low-income children who have community centers and receive support from their neighborhood, are more likely to participate in OAs, which in turn can lead to higher levels of frequently involved PA (4+days). Although we found that participating in lessons is related to certain neighborhood resources, we did not find any association between lessons and low-income children’s PA (4+ days). It means that participating in lessons has no mediating effect on CRs and PA among low-income children.

Table 21. GSEM analysis result for the association of participation in *each of OAs*, CRs, and PA (4+ days) among low-income children.

			Coefficient (β)	SE	P-value	95% CI	
						Lower	Upper
Physical environme nts	Sidewalks or walking paths	(aI: Sports)	0.034	0.104	0.744	-0.170	0.239
		(aI: Clubs)	0.148	0.106	0.162	-0.060	0.355
		(aI: Lessons)	0.256*	0.106	0.016	0.048	0.465
		(c': PA)	-0.207	0.105	0.050	-0.413	-0.0003
	Parks or playgrounds	(aI: Sports)	0.080	0.109	0.461	-0.133	0.294
		(aI: Clubs)	0.017	0.110	0.880	-0.200	0.234
		(aI: Lessons)	0.075	0.111	0.499	-0.142	0.292
		(c': PA)	0.145	0.109	0.182	-0.068	0.359
	Recreation centers, community centers, or Boys & Girls Clubs	(aI: Sports)	0.189*	0.096	0.048	0.001	0.378
		(aI: Clubs)	0.38***	0.097	0.000	0.190	0.570
		(aI: Lessons)	0.303**	0.097	0.002	0.114	0.492
		(c': PA)	-0.014	0.097	0.886	-0.204	0.176
Social factors	Neighborhood support	(aI: Sports)	0.077**	0.023	0.001	0.032	0.121
		(aI: Clubs)	0.056*	0.023	0.015	0.011	0.101
		(aI: Lessons)	0.057*	0.023	0.013	0.012	0.102
		(c': PA)	0.072	0.022	0.001	0.028	0.115
	Perceived safety	(aI: Sports)	-0.066	0.103	0.517	-0.267	0.134
		(aI: Clubs)	-0.116	0.104	0.263	-0.319	0.087
		(aI: Lessons)	-0.189	0.104	0.068	-0.392	0.014
		(c': PA)	-0.024	0.102	0.818	-0.223	0.176
[Mediating effect]							
Participation in sports		(bI: PA)	0.277**	0.097	0.004	0.088	0.466
Participation in clubs		(bI: PA)	0.043	0.099	0.665	-0.152	0.238
Participation in lessons		(bI: PA)	0.043	0.095	0.645	-0.142	0.230
# of observations		2,431					

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

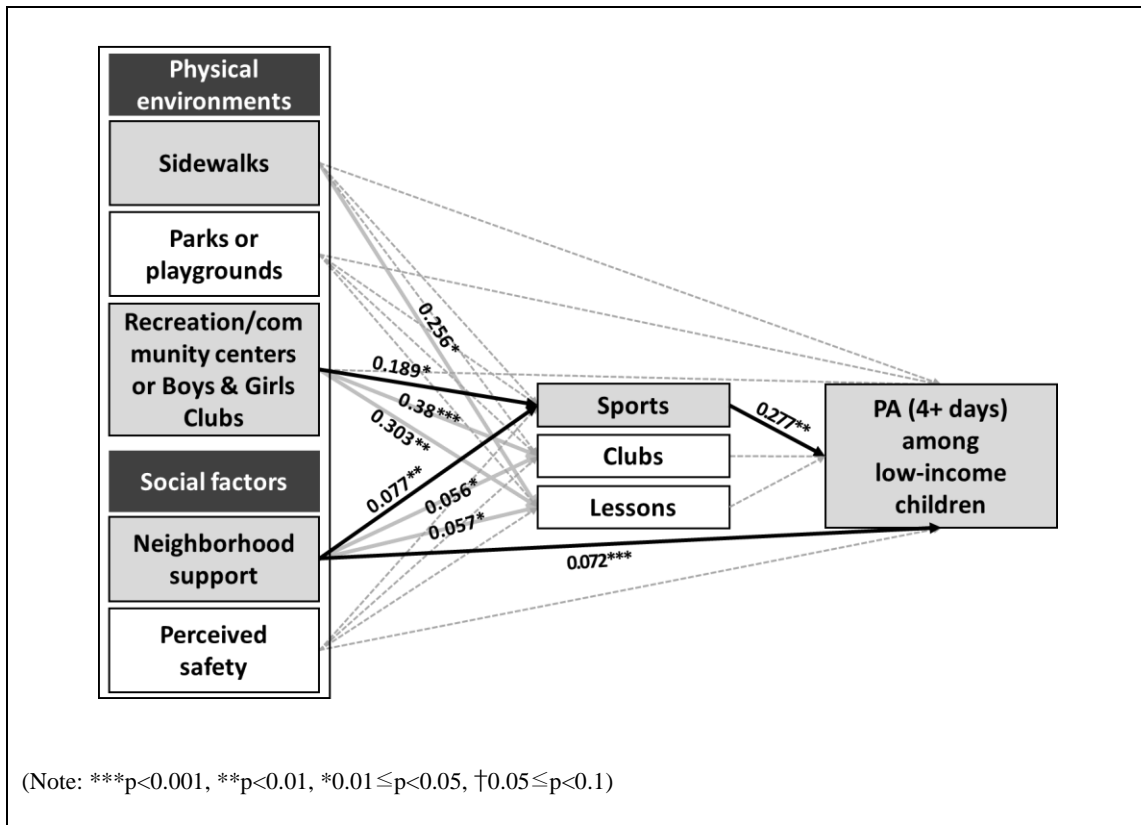


Figure 17. Mediation path model of participation in *each of OAs* on CRs and PA (4+ day) among low-income children.

As shown in Figure 17, we found that participating in sports is the only factor can mediate the relationship between CRs (i.e., recreation/community centers or Boys & Girls Clubs and neighborhood support) and increased low-income children’s PA (4+ days).

- **PA (7 days)**

Table 22 and Figure 19 explain the negative mediating effect of participation in lessons ($b1: \beta=-0.245$, p-value=0.014) on the relationship between the following factors and being sufficiently physically active daily: the presence of sidewalks ($a1: \beta=0.256$, p-

value=0.016), the availability of recreation/community centers or Boys & Girls Clubs ($a1: \beta=0.303$, p-value=0.002), and neighborhood support ($a1: \beta=0.19$, p-value=0.048).

For low-income children, increased participation in individual lessons is associated with decreased involvement in physical activity on daily basis.

Table 22. GSEM analysis result for the association of participation in *each of OAs*, CRs and PA (7 days) among low-income children.

			Coefficient (β)	SE	P-value	95% CI	
						Lower	Upper
Physical environme nts	Sidewalks or walking path	($a1$: Sports)	0.034	0.104	0.744	-0.170	0.239
		($a1$: Clubs)	0.148	0.106	0.162	-0.059	0.355
		($a1$: Lessons)	0.256*	0.106	0.016	0.048	0.465
		(c' : PA)	-0.223*	0.108	0.039	-0.435	-0.011
	Parks or playgrounds	($a1$: Sports)	0.080	0.109	0.461	-0.133	0.294
		($a1$: Clubs)	0.017	0.111	0.880	-0.200	0.234
		($a1$: Lessons)	0.075	0.111	0.499	-0.142	0.292
		(c' : PA)	0.039	0.114	0.731	-0.184	0.263
	Recreation/comm unity centers or Boys & Girls Clubs	($a1$: Sports)	0.189*	0.096	0.048	0.001	0.378
		($a1$: Clubs)	0.380***	0.097	0.000	0.190	0.570
		($a1$: Lessons)	0.303***	0.096	0.002	0.114	0.492
		(c' : PA)	0.057	0.102	0.575	-0.142	0.256
Social factors	Neighborhood support	($a1$: Sports)	0.077**	0.023	0.001	0.032	0.121
		($a1$: Clubs)	0.056*	0.023	0.015	0.011	0.101
		($a1$: Lessons)	0.057*	0.023	0.013	0.012	0.102
		(c' : PA)	0.075**	0.024	0.002	0.027	0.122
	Perceived safety	($a1$: Sports)	-0.066	0.103	0.517	-0.267	0.134
		($a1$: Clubs)	-0.116	0.104	0.263	-0.319	0.087
		($a1$: Lessons)	-0.189	0.104	0.068	-0.392	0.014
		(c' : PA)	0.039	0.108	0.716	-0.173	0.251
[Mediating effect]							
Participation in sports		($b1$: PA)	-0.055	0.102	0.587	-0.254	0.144
Participation in clubs		($b1$: PA)	-0.006	0.104	0.958	-0.209	0.198
Participation in lessons		($b1$: PA)	-0.245*	0.100	0.014	-0.441	-0.491
# of observations			2,431				

Note: Other variables including demographics, individual, and interpersonal factors are controlled; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

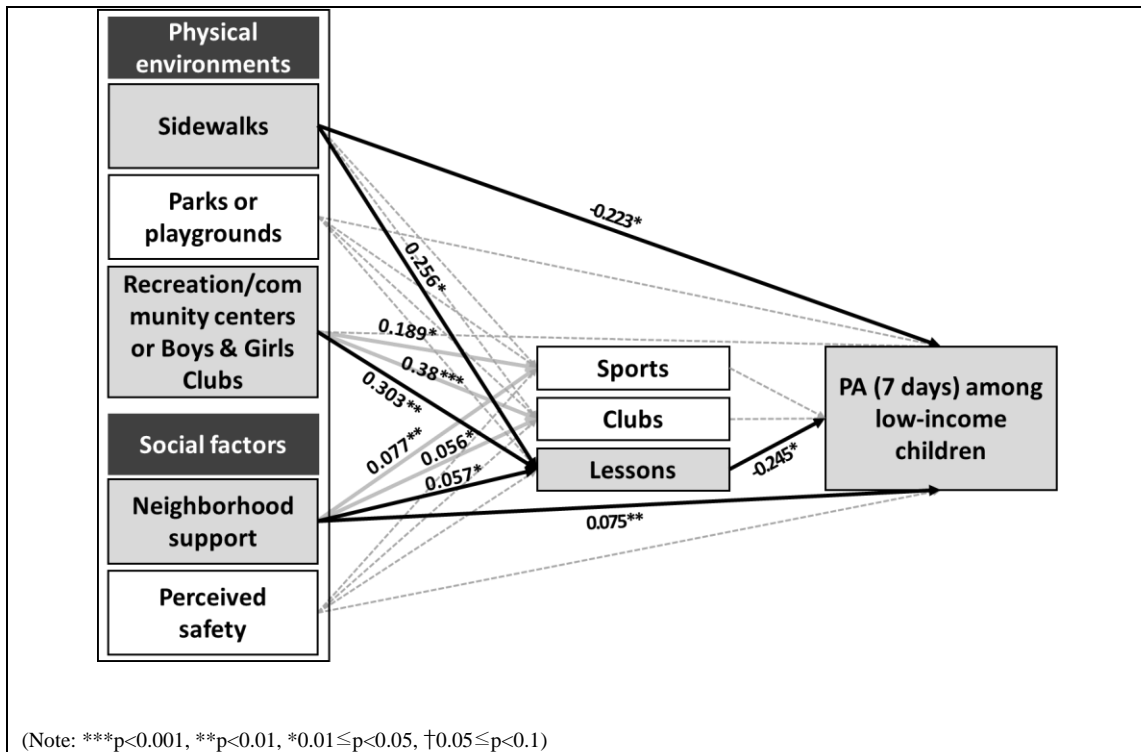


Figure 18. Mediation path model of participation in *each of OAs* on CRs and PA (7 days) among low-income children.

Although the availability of sidewalks, recreation/community centers or Boys & Girls Clubs and neighborhood support may positively impact participation in lessons, participation in lessons negatively mediates the relationship between those CRs and PA (7+ days) among low-income children (see Figure 18).

In summary, through the GSEM analysis we corroborated the existence of a mediating effect of participation in organized sports on enhancing PA (1+, 4+ days) among low-income children who have access to recreation/community centers or Boys & Girls Clubs and receive neighborhood support in their communities. Participation in individual lessons was also found to have a positive mediating effect on reducing physical inactivity (1+ days), but a negative mediation effect on PA (7 days) for low-

income children who can access to sidewalks, recreation/community centers or Boys & Girls Clubs, and feel supported in their neighborhood.

Bootstrapping Analysis

Participation in *All OAs*

Lastly, as described above, we used the bootstrapping analysis to repeatedly test our data and estimate model parameters, which allowed us to evaluate how well our model fits the data. The indirect effects can be confirmed based on the 95th percentile bootstrap confidence interval (CI), which did not contain zero. As shown in Table 23, the bootstrapping analysis found that significant mediating effects of participation in *all OAs* between CRs and PA (1+, 4+ days) among low-income children. However, there was no mediating effect on physically active (7 days) for low-income children. Specifically, in the case of recreation/community centers or Boys & Girls Clubs, we can confirm the indirect effect ($\beta = 0.704$, 95% CI = 0.267-1.711) on PA (1+ days) among low-income children through participation in *all OAs*. In other words, low-income children can reduce their physical inactivity by participating in *all OAs* while utilizing recreation/community centers or Boys & Girls Clubs. We found that for being physically active 4 or more days per week, there was a significant indirect effect of recreation/community centers or Boys & Girls Clubs ($\beta = 0.173$, 95% CI = 0.046-0.364) on explaining the mediating effect of participation in *all OAs*. What this means is that low-income children can be more frequently physically active (4+ days) by taking part in *all OAs* when they are using recreation/community centers or Boys & Girls Clubs.

The analysis also found that neighborhood support had a significant indirect effect ($\beta= 0.144$, 95% CI= 0.042-0.353) on PA (1+ days) among low-income children via participating in *all OAs*. This means that when kids from low-income families feel neighborhood support, they can decrease their physical inactivity by participating in *all OAs*, including sports, clubs, and lessons. Additionally, low-income children are more frequently physically active (4+ days) when neighborhood support is present by participating in sports, clubs and lessons altogether ($\beta= 0.036$, 95% CI= 0.006-0.08). This means that low-income children are more likely to engaged in PA regularly (4+ days) if they participate in a range of OAs including sports, clubs, and lessons when low-income children have a supportive neighborhood.

Table 23. Bootstrapping analysis results for significance of indirect effects of participation in *all OAs* between the type of CRs and PA type (1+, 4+, 7 days).

Type of CRs		Outcome (PA days)	Observed coefficient	Bootstrap SE	Bootstrap 95% CI	
					Lower	Upper
Physical environments	Sidewalks	PA 1+	0.43	0.312	-0.013	1.193
		PA 4+	0.106	0.132	-0.032	0.243
		PA 7	-0.033	0.046	-0.144	0.047
	Parks or playgrounds	PA 1+	0.011	0.246	-0.523	0.47
		PA 4+	0.003	0.62	-0.135	0.129
		PA 7	-0.001	0.028	-0.054	0.064
	Recreation/community centers or Boys & Girls Clubs	PA 1+	0.704*	0.343	0.267	1.711
		PA 4+	0.173*	0.08	0.046	0.364
		PA 7	-0.19	0.068	-0.195	0.07
Social factors	Neighborhood support	PA 1+	0.144*	0.08	0.042	0.353
		PA 4+	0.036*	0.018	0.006	0.08
		PA 7	-0.011	0.014	-0.042	0.012
	Perceived safety	PA 1+	-0.187	0.251	-0.777	0.258
		PA 4+	-0.046	0.055	-0.163	0.057
		PA 7	0.014	0.029	-0.029	0.083

Note: Estimates are based on bootstrapped standard errors with 1,000 simulations and presented with 95% CIs; *** $p<0.001$, ** $p<0.01$, * $0.01\leq p<0.05$

In summary, through the used bootstrapping analysis, we can confirm the mediating effect of participation in *all OAs* on the relationship between CRs and PA among low-income children.

Participation in *Each of OAs*

The previous bootstrapping analysis results confirmed the mediating effect of participation in all OAs on CRs and low-income children's PA. In this section, we report the result of the bootstrapping analysis to confirm how participation in *each of OAs* can mediate the relationship between the presence of CRs and PA among low-income children. The results of using bootstrapping analysis indicated that a certain types of CRs have an indirect impact on reducing physical inactivity through participation in sports among low-income children.

- **PA (1+ days)**

Specifically, participation in sport activities had a mediating effect on the relationship between the following factors and avoiding physical inactivity among low-income children: the presence of recreation/community centers or Boys & Girls Clubs (Indirect effect $\beta = 0.244$, 95% CI= 0.004-0.533) and neighborhood support (Indirect effect $\beta = 0.099$, 95% CI= 0.037-1.7). Additionally, participation in lessons was found to mediate the relations on the presence of sidewalks (Indirect effect $\beta = 0.188$, 95% CI= 0.035-0.405), recreation/community centers or Boys & Girls Clubs (Indirect effect $\beta = 0.222$, 95% CI= 0.075-0.444), and neighborhood support (Indirect effect $\beta = 0.042$, 95%

CI= 0.008-0.093) with reducing physical inactivity among low-income children (see Table 24).

Table 24. Bootstrapping analysis results for significance of indirect effects of participation in *each of OAs* between the type of CRs and PA (1+ days).

Type of CRs		Type of OAs	Observed coefficient	Bootstrap SE	Bootstrap 95% CI	
					Lower	Upper
Physical environments	Sidewalks	Sports	0.044	0.143	-0.287	0.289
		Clubs	0.08	0.663	-0.027	0.233
		Lessons	0.188*	0.095	0.035	0.405
	Parks or playgrounds	Sports	0.103	0.15	-0.165	0.405
		Clubs	0.009	0.063	-0.127	0.138
		Lessons	0.055	0.086	-0.098	0.229
	Recreation/community centers or Boys & Girls Clubs	Sports	0.244*	0.136	0.004	0.533
		Clubs	0.049	0.084	-0.113	0.224
		Lessons	0.222*	0.97	0.075	0.444
Social factors	Neighborhood support	Sports	0.099**	0.035	0.037	1.7
		Clubs	0.007	0.014	-0.018	0.038
		Lessons	0.042*	0.022	0.008	0.093
	Perceived safety	Sports	-0.086	0.139	-0.36	0.2
		Clubs	-0.063	0.063	-0.199	0.049
		Lessons	-0.139	0.089	-0.341	0.006

Note: estimates are based on bootstrapped standard errors with 1,000 simulations and presented with 95% CIs; ***p<0.001, **p<0.01, *0.01 ≤ p<0.05

- **PA (4+ days)**

Bootstrapping analysis results explained the indirect effects of CRs on low-income children's PA (4 or more days per week) through participation in sports, clubs or lessons (see Table 25). Participation in sport activities had positive mediating effects on the association between the availability of recreation/community centers or Boys & Girls Clubs (Indirect effect $\beta = 0.053$, 95% CI= 0.004-0.134) and being frequently involved in PA among low-income children. Also, children from low-income families who have

neighborhood support are more likely to be regularly physically active by participating in sports (Indirect effect $\beta= 0.022$, 95% CI= 0.005-0.043).

Table 25. Bootstrapping analysis results for significance of indirect effects of participation in *each of OAs* between the type of CRs and PA (4+ days).

Type of CRs		Type of OAs	Observed coefficient	Bootstrap SE	Bootstrap 95% CI	
					Lower	Upper
Physical environments	Sidewalks	Sports	0.01	0.322	-0.062	0.073
		Clubs	0.019	0.02	-0.012	0.063
		Lessons	0.017	0.024	-0.027	0.07
	Parks or playgrounds	Sports	0.023	0.032	-0.044	0.088
		Clubs	0.002	0.018	-0.037	0.04
		Lessons	0.005	0.014	-0.02	0.042
	Recreation/community centers or Boys & Girls Clubs	Sports	0.053*	0.034	0.004	0.134
		Clubs	0.05	0.038	-0.012	0.138
		Lessons	0.021	0.032	-0.038	0.092
Social factors	Neighborhood support	Sports	0.022*	0.01	0.005	0.043
		Clubs	0.007	0.006	-0.003	0.022
		Lessons	0.004	0.006	-0.006	0.016
	Perceived safety	Sports	-0.019	0.029	-0.084	0.037
		Clubs	-0.015	0.019	-0.058	0.019
		Lessons	-0.013	0.021	-0.062	0.023

Note: estimates are based on bootstrapped standard errors with 1,000 simulations and presented with 95% CIs; *** $p<0.001$, ** $p<0.01$, * $0.01 \leq p<0.05$

- **PA (7 days)**

We can see how low-income children’s participation in *each of OAs* affect the relationship between CRs and being sufficiently involved in PA every day. Table 26 showed that participation in lessons had negative mediating effect on the association between following factors and being physically active every day: sidewalks ($\beta= -0.065$, 95% CI= -0.156 to -0.005), recreation/community centers or Boys & Girls Clubs ($\beta= -0.077$, 95% CI= -0.163 to -0.017) and neighborhood support ($\beta= -0.014$, 95% CI= -0.034 to -0.003).

Table 26. Bootstrapping analysis results for significance of indirect effects of participation in *each of OAs* between the type of CRs and PA (7 days).

Type of CRs		Type of OAs	Observed coefficient	Bootstrap SE	Bootstrap 95% CI	
					Lower	Upper
Physical environments	Sidewalks	Sports	-0.003	0.0144	-0.032	0.029
		Clubs	-0.012	0.02	-0.063	0.024
		Lessons	-0.065*	0.039	-0.156	-0.005
	Parks or playgrounds	Sports	-0.008	0.017	-0.048	0.02
		Clubs	-0.001	0.015	-0.032	0.027
		Lessons	-0.019	0.031	-0.082	0.034
	Recreation/community centers or Boys & Girls Clubs	Sports	-0.018	0.022	-0.068	0.019
		Clubs	-0.029	0.379	-0.107	0.046
		Lessons	-0.077*	0.04	-0.163	-0.017
Social factors	Neighborhood support	Sports	-0.007	0.008	-0.023	0.008
		Clubs	-0.004	0.006	-0.018	0.005
		Lessons	-0.014*	0.008	-0.034	-0.003
	Perceived safety	Sports	0.006	0.016	-0.02	0.04
		Clubs	0.009	0.016	-0.018	0.043
		Lessons	0.048	0.035	-0.02	0.116

Note: estimates are based on bootstrapped standard errors with 1,000 simulations and presented with 95% CIs; ***p<0.001, **p<0.01, *0.01≤p<0.05

By using the bootstrapping analysis, this study can confirm that participation in *each of OAs* (i.e., sports, clubs, or lessons) played a mediating role in the connection between the presence of CRs and PA among low-income children.

Overall Summary

The summary of the overall mediating analysis conducted can be found in Table 27. Through a series of multivariate logistic regression analysis, we discovered the potential mediating effect of participation in OAs on CRs and PA among low-income children. To corroborate the existence of such mediating effect and obtain the value of the indirect effect, we conducted a GSEM analysis. Lastly, by using a bootstrapping

analysis, we confirmed the mediating effect of OAs in influencing the association between presence of CRs and PA among low-income children.

Table 27. Summary table of the mediating effects of participation in OAs on the relationship between the CRs and PA among low-income children.

Independent Variable (Community Resources)		Mediator (Participation in OAs)				Outcome (PA days)
		All OAs	Each of OAs			
			Sports	Clubs or organizations	Lessons	
Physical environments	Sidewalks	-	-	-	(+)*	1+days
		-	-	-	-	4+days
		-	-	-	(-)*	7 days
	Parks or playgrounds	-	-	-	-	1+days
		-	-	-	-	4+days
		-	-	-	-	7 days
	Recreation/community centers or Boys & Girls Clubs	(+)*	(+)*	-	(+)*	1+days
		(+)*	(+)*	-	-	4+days
		-	-	-	(-)*	7 days
Social factors	Neighborhood support	(+)*	(+)**	-	(+)*	1+days
		(+)*	(+)*	-	-	4+days
		-	-	-	(-)*	7 days
	Perceived safety	-	-	-	-	1+days
		-	-	-	-	4+days
		-	-	-	-	7 days

Note: ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

In the case of physical environments, the presence of sidewalks was positively related to avoid physical inactivity by participating in lessons. Similarly, we found that the presence of recreation/community centers or Boys & Girls Clubs also had a positive impact on avoiding low-income children’s physical inactivity through participation in *all* OAs. For participation in sports or lessons, we found similar result. Meanwhile, the

presence of recreation/community centers or Boys & Girls Clubs can encourage low-income children being more frequently involved in PA through participation in *all OAs*. The results showed that a similar pattern of mediating effect exist for participation in sports. The analyses also found a mediating effect of participation in lessons on the relationship between the presence of sidewalks and avoid physical inactivity among low-income children. However, the presence of parks or playgrounds was not found to have any significant impact on PA among low-income children by participating in OAs. We found the presence of recreation/community centers or Boys & Girls Clubs can avoid physical inactivity among low-income children by participating in *all OAs* or sports. This study found the mediating effect of participation in *all OAs* or *each of OAs* (i.e., sports and lessons) on neighborhood support to avoid physical inactivity. Additionally, neighborhood support was mediated by participation in *all OAs* or sports to encourage more frequently involved in PA. However, participation in lessons had a negative effect on sufficient PA days among low-income children who have access to recreation/community centers or Boys & Girls Clubs, and who live in supportive neighborhoods.

Moderating Effect Analysis

This section of the study examined the moderating effect of CRs on the association between participation in OAs and PA among low-income children. We conducted an interaction terms analysis to investigate the moderating effect of the relationship between CRs and participation in OAs on PA among low-income children. Additionally, we used the Akaike information criterion (AIC) method to evaluate the

moderating effect of the interaction term on the model fit compared to a model without the interaction term (Simonen et al., 2002).

Interaction Term Analysis & AIC Methods

Participation in All OAs

To examine the moderating role of CRs on PA among low-income children who participate in *all OAs*, this study examined the interaction term analysis between CRs and participation in *all OAs* on PA among low-income children using logistic regression analysis. We considered the interaction between CRs and involvement in *all OAs* to determine if PA among low-income children differs by levels of CRs availability. The researcher conducted interaction term analyses to investigate the moderating effects between participation in *all OAs* and the presence of CRs according to different PA scales (1+, 4+, and 7 days). Additionally, we checked the model fit using AIC methods. Based on the different PA scales (1+, 4+, and 7 days), the detailed results are presented below.

- **PA (1+ days)**

The findings of interaction term analysis on participation in *all OAs* and PA (1+ days) among low-income children are shown in Table 28. Based on this analysis, we found no moderating effect of any presence of CRs on the relationship between participation in *all OAs* and low-income children's PA (1+ days). What this means is that the presence of CRs did not have a significant impact on whether or not low-income children participated in *all OA* to avoid being physically inactive.

Table 28. Interaction term analysis examining the moderating role of CRs on the relationship between participation in *all OAs* and PA (1+ days) among low-income children.

CRs & participation in <i>all OAs</i>		Without interaction			Interaction with <i>all OAs</i>		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
Physical environments	Participation in <i>all OAs</i>	4.31**	1.74	10.73	1.36	0.41	4.55
	Sidewalks	0.89	0.59	1.34	0.83	0.55	1.26
	Sidewalks × participation in <i>all OAs</i>	-	-	-	6.53	1.02	41.66
	- AIC	1079.78		1077.86			
	Participation in <i>all OAs</i>	4.31**	1.74	10.73	4.78	0.64	35.52
	Parks or playgrounds	1.14	0.76	1.71	1.14	0.76	1.73
	Parks or playgrounds × participation in <i>all OAs</i>	-	-	-	0.88	0.09	8.27
	- AIC	1079.78		1081.76			
	Participation in <i>all OAs</i>	4.31**	1.74	10.73	4.68	1.13	19.38
	Recreation/community centers or Boys & Girls Clubs	1	0.69	1.46	1.01	0.69	1.48
	Recreation/community centers or Boys & Girls Clubs × participation in <i>all OAs</i>	-	-	-	0.87	0.138	5.48
	- AIC	1079.78		1081.75			
Social factors	Participation in <i>all OAs</i>	4.31**	1.74	10.73	0.94	0.1	8.48
	Neighborhood support	1.02	0.94	1.1	1.01	0.93	1.1
	Neighborhood support × participation in <i>all OAs</i>	-	-	-	1.3	0.89	1.89
	- AIC	1079.78		1080.06			
	Participation in <i>all OAs</i>	4.31**	1.74	10.73	3.18†	0.97	10.39
	Perceived safety	0.95	0.64	1.41	0.93	0.63	1.39
	Perceived safety × participation in <i>all OAs</i>	-	-	-	1.89	0.3	11.92
	- AIC	1079.78		1081.3			
# of observations		2,419		2,419			

Note: Other variables including demographics, individual, and interpersonal factors were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

- **PA (4+ days)**

Based on the analysis using the PA 4+ days outcome variable, we found there was a slightly positive relationship between participation in all OAs and the level of neighborhood support to increase PA (4+ days) among low-income children (OR=1.08, 95% CI= 1-1.16), but not with perceived safety as shown in Table 29.

Table 29. Interaction term analysis examining the moderating role of CRs on the relationship between participation in *all OAs* and PA (4+ days) among low-income children.

CRs & participation in <i>all OAs</i>		Without interaction			With interaction with <i>all OAs</i>		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
Physical environments	Participation in <i>all OAs</i>	1.43**	1.12	1.83	0.94	0.68	1.29
	Sidewalks	0.82†	0.67	1	0.74	0.53	1.02
	Sidewalks × participation in <i>all OAs</i>	-	-	-	1.19	0.81	1.75
	- AIC	3151.41			3152.61		
	Participation in <i>all OAs</i>	1.43**	1.12	1.83	1.08	0.78	1.49
	Parks or playgrounds	1.16	0.94	1.43	1.19	0.85	1.65
	Parks or playgrounds × participation in <i>all OAs</i>	-	-	-	0.96	0.65	1.42
	- AIC	3151.41			3153.37		
	Participation in <i>all OAs</i>	1.43**	1.12	1.83	1.05	0.82	1.34
	Boys & Girls Clubs recreation/community centers or Boys & Girls Clubs × participation in <i>all OAs</i>	-	-	-	0.99	0.72	1.37
- AIC	3151.41			1			
Social factors	Participation in <i>all OAs</i>	1.43**	1.12	1.83	0.67	0.41	1.11
	Neighborhood support	1.07**	1.03	1.12	1.02	0.96	1.09
	Neighborhood support × participation in <i>all OAs</i>	-	-	-	1.08†	0.99	1.16
	- AIC	3151.41			3149.77		
	Participation in <i>all OAs</i>	1.43**	1.12	1.83	1.01	0.77	1.34
	Perceived safety	1	0.82	1.21	0.95	0.69	1.3
	Perceived safety × participation in <i>all OAs</i>	-	-	-	1.07	0.74	1.55
	- AIC	3151.41			3153.27		
	# of observations	2,419			2,419		

Note: Other variables including demographics, individual, and interpersonal factors were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

However, we did not find evidence of a moderating effect of physical environments (e.g., sidewalks, parks or playgrounds, and recreation/community centers or Boys and Girls Clubs) with low-income children's participation in all OAs to promote their PA (4+ days).

- **PA (7 days)**

A weak moderating effect was found in the previous result between neighborhood support and participation in *all OAs* and PA (4+ days) among low-income children. Additionally, the study discovered a weak moderating effect of sidewalk access and neighborhood support on daily PA (7 days) for low-income children when they participated in *all OAs*. Table 30 explained the moderating effect of CRs including the presence of sidewalks (OR=1.43, 95% CI=0.97-2.13) and neighborhood support (OR=1.08, 95% CI= 1-1.17) had a weak effect on the relationship between participation in *all OAs* and being physically active everyday among low-income children. For presence of parks or playgrounds or recreation/community centers or Boys and Girls Clubs, there were no interactive relationships with participation in *all OAs* to be physically active every day for low-income children. Similarly, there was no association between perceived safety and participation in *all OAs* in the neighborhood to increase their PA (7 days).

Table 30. Interaction term analysis examining the moderating role of CRs on the relationship between participation in *all OAs* and PA (7 days) among low-income children.

CRs & participation in <i>all OAs</i>		Without interaction			With interaction with <i>all OAs</i>		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
Physical environments	Participation in <i>all OAs</i>	0.89	0.69	1.15	0.89	0.56	1.42
	Sidewalks	0.82†	0.66	1.01	0.65*	0.47	0.9
	Sidewalks × participation in <i>all OAs</i>	-	-	-	1.43†	0.97	2.13
	- AIC	2934.56			2933.35		
	Participation in <i>all OAs</i>	0.89	0.69	1.15	0.76	0.46	1.25
	Parks or playgrounds	1.02	0.82	1.28	0.97	0.69	1.37
	Parks or playgrounds × participation in <i>all OAs</i>	-	-	-	1.09	0.72	1.63
	- AIC	2934.56			2936.4		
	Participation in <i>all OAs</i>	0.89	0.69	1.15	0.77	0.53	1.09
	Recreation/community centers or Boys & Girls Clubs	1.02	0.84	1.25	1.03	0.74	1.44
Recreation/community centers or Boys & Girls Clubs × participation in <i>all OAs</i>	-	-	-	1	0.68	1.48	
- AIC	2934.56			2936.56			
Social factors	Participation in <i>all OAs</i>	0.89	0.69	1.15	0.6	0.24	1.5
	Neighborhood support	1.07**	1.02	1.12	1.02	0.95	1.09
	Neighborhood support × participation in <i>all OAs</i>	-	-	-	1.08†	1	1.17
	- AIC	2934.56			2933.08		
	Participation in <i>all OAs</i>	0.89	0.69	1.15	0.8	0.53	1.2
	Perceived safety	1.06	0.86	1.31	0.92	0.66	1.28
	Perceived safety × participation in <i>all OAs</i>	-	-	-	1.23	0.84	1.8
	- AIC	2934.56			2935.46		
# of observations		2,419			2,419		

Note: Other variables including demographics, individual, and interpersonal factors were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

Participation in *Each of OAs*

This section investigated how the relationship between having access to CRs and participation in each type of OAs (i.e., sports, clubs, or lessons) affect PA (1+, 4+, and 7 days) among low-income children by using an interaction term analysis.

Findings indicate that some moderating effects of CRs on participation in sports or lessons exist, but not with clubs to affect PA among low-income children. The results are reported below separately based on the specific type of OAs (i.e., sports, clubs, or lessons) and the different types of CRs (i.e., sidewalks, parks or playgrounds, recreation/community centers or Boys & Girls Clubs, neighborhood support and perceived safety). Following the initial analysis, we evaluated the model's goodness of fit using AIC methods.

- **Participation in Sports**

- a) **The Presence of Sidewalks**

A slightly significant interaction between participation in sports and the presence of sidewalks was found to influence PA of at least 4 or more days among low-income children (OR=1.4, 95% CI= 0.97-2.02), as indicated in Table 31. In addition, after adding the interaction term, there was a slight increase in the model's goodness-of-fit as explained by the decreased AIC value.

Table 31. Interaction term analysis examining the moderating role of sidewalks on the relationship between participation in sports and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in sports	3.22***	1.99	5.2	0.82	0.59	1.13
	Sidewalks	0.88	0.58	1.32	0.73*	0.56	0.95
	Sidewalks × participation in sports	-	-	-	1.24	0.85	1.81
	- AIC	1034.02			1035.42		
4+ days	Participation in sports	1.32**	1.09	1.59	1.05	0.76	1.44
	Sidewalks	0.81†	0.66	1	0.71**	0.55	0.92
	Sidewalks × participation in sports	-	-	-	1.4†	0.97	2.02
	- AIC	3082.42			3081.28		
7 days	Participation in sports	0.95	0.78	1.15	2.46*	1.1	5.52
	Sidewalks	0.8	0.65	0.99	0.82	0.53	1.28
	Sidewalks × participation in sports	-	-	-	1.47	0.56	3.83
	- AIC	2881.92			2882.64		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as clubs/organizations and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

b) The Presence of Parks or Playgrounds

There were no significant moderating effects of parks or playgrounds on the association between participation in sports and any of the PA types (1+, 4+, and 7 days), as shown in Table 32. When the interaction term was added, it caused a slight decrease in how well the model fit the data, which was shown by the higher AIC value.

Table 32. Interaction term analysis examining the moderating role of parks/playgrounds on the relationship between participation in sports and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in sports	3.22***	1.99	5.2	3.13**	1.36	7.22
	Parks or playgrounds	1.11	0.74	1.68	1.11	0.71	1.72
	Parks or playgrounds × participation in sports	-	-	-	1.04	0.39	2.78
	- AIC	1034.02			1036.01		
4+ days	Participation in sports	1.32**	1.09	1.59	1.58**	1.14	2.2
	Parks or playgrounds	1.16	0.93	1.43	1.28†	0.99	1.67
	Parks or playgrounds × participation in sports	-	-	-	0.77	0.53	1.13
	- AIC	3082.42			3082.63		
7 days	Participation in sports	0.95	0.78	1.15	1.05	0.74	1.47
	Parks or playgrounds	1.04	0.83	1.3	1.1	0.83	1.46
	Parks or playgrounds × participation in sports	-	-	-	0.87	0.59	1.29
	- AIC	2881.92			2883.43		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as clubs/organizations and lessons were controlled in each model; *** $p < 0.001$, ** $p < 0.01$, * $0.01 \leq p < 0.05$ † $0.05 \leq p < 0.1$; AIC: Akaike Information Criterion

c) The Presence of Recreation/Community Centers or Boys & Girls Clubs

As shown in Table 33, the presence of recreation/community centers or Boys & Girls Clubs did not have a significant moderating effect on the association between participation in sports and any of the PA types (1+, 4+, and 7 days). When the interaction term was included, it led to a slight decrease in the model fit, as explained by the increase in the AIC value.

Table 33. Interaction term analysis examining the moderating role of recreation/community centers or Boys & Girls Clubs on the relationship between participation in sports and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in sports	3.22***	1.99	5.2	3.53**	1.85	6.75
	Recreation/community centers or Boys & Girls Clubs	0.96	0.65	1.4	0.99	0.65	1.51
	Recreation/community centers or Boys & Girls Clubs × participation in sports	-	-	-	0.82	0.33	2.02
	- AIC	1034.02			1035.83		
4+ days	Participation in sports	1.32**	1.09	1.59	1.39**	1.09	1.77
	Recreation/community centers or Boys & Girls Clubs	0.99	0.82	1.19	1.04	0.81	1.32
	Recreation/community centers or Boys & Girls Clubs × participation in sports	-	-	-	0.89	0.63	1.26
	- AIC	3082.42			3083.99		
7 days	Participation in sports	0.95	0.78	1.15	0.97	0.76	1.25
	Recreation/community centers or Boys & Girls Clubs	1.06	0.87	1.29	1.09	0.84	1.41
	Recreation/community centers or Boys & Girls Clubs × participation in sports	-	-	-	0.93	0.65	1.34
	- AIC	2881.92			2883.79		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as clubs/organizations and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

d) Neighborhood Support

The analysis found a significant moderating effect between neighborhood support and low-income children's participation in sports. Specifically, when low-

income children received support from their neighborhood and participated in sports, they were 1.12 times more likely to be physically active for at least 4 days per week and 1.1 times more likely to be physically active for 7 days per week compared to those who did not receive such support and did not participate in sports. Given the AIC value, the model fit slightly increased once the interaction term was added. Thus, we can confirm the moderating effect of neighborhood support. This means that through the moderation analysis, we discovered that neighborhood support can help low-income children increase their PA more frequently (4+ days) and sufficiently (7 days) when they are participating in sport activities (see Table 34).

Table 34. Interaction term analysis examining the moderating role of neighborhood support on the relationship between participation in sports and PA among low-income children.

PA	Moderating Effect	No interaction			With interaction		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in sports	3.22***	1.99	5.2	1.34	0.44	4.06
	Neighborhood support	1.01	0.93	1.09	0.99	0.91	1.08
	Neighborhood support × participation in sports	-	-	-	1.16†	0.97	1.39
	- AIC	1034.02			1033.48		
4+ days	Participation in sports	1.32**	1.09	1.59	0.65†	0.39	1.08
	Neighborhood support	1.07**	1.03	1.12	1.03	0.98	1.09
	Neighborhood support × participation in sports	-	-	-	1.12**	1.04	1.21
	- AIC	3082.42			3075.57		
7 days	Participation in sports	0.95	0.78	1.15	0.52*	0.29	0.94
	Neighborhood support	1.08**	1.03	1.13	1.04	0.99	1.1
	Neighborhood support × participation in sports	-	-	-	1.1*	1.01	1.19
	- AIC	2881.92			2879.2		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as clubs/organizations and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

Neighborhood support serves as a robust moderator in influencing the relationship between participation in sports and PA among low-income children. This means that children who live in neighborhoods with high support tend to be more physically active when they participate in sports, compared to those who live in neighborhoods with low support. This relationship was illustrated in Figure 19, which shows that when low-income children participate in sports, there is a significant difference in the likelihood of being physically active for at least 4 days per week between those who reported high levels of neighborhood support (gray bar) and those who reported low levels of neighborhood support (white bar).

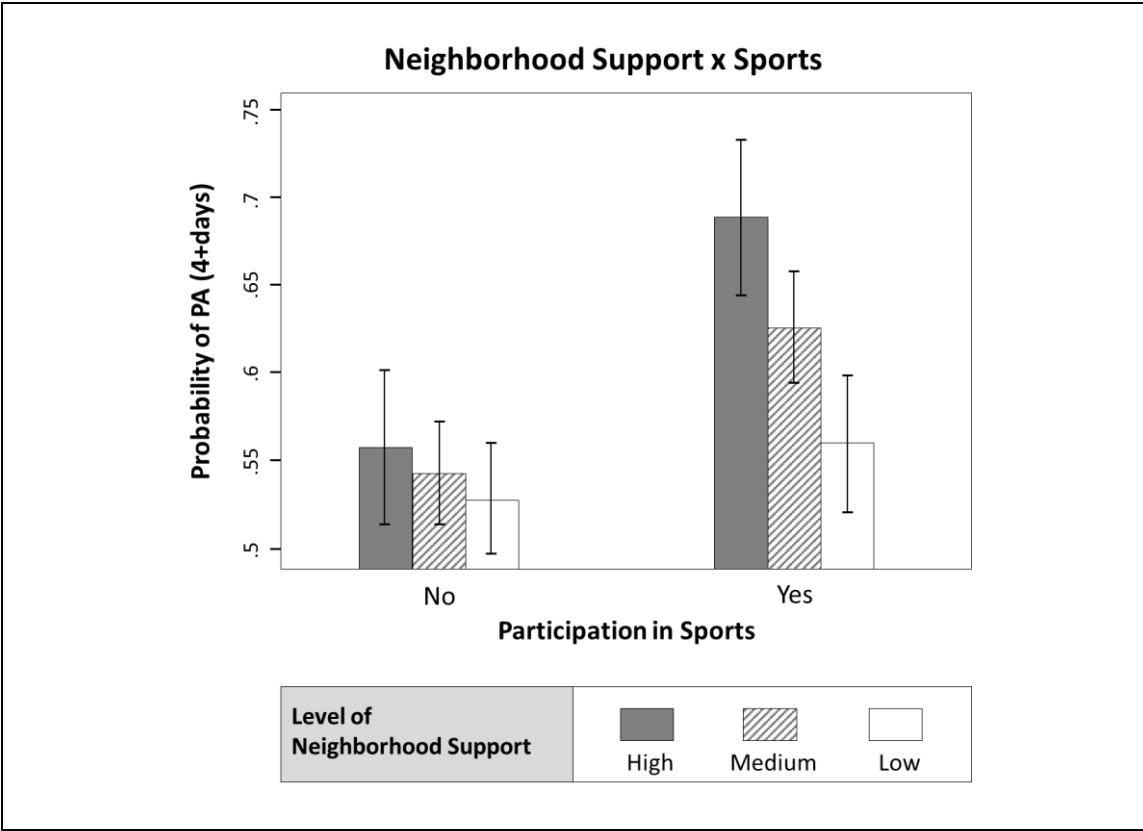


Figure 19. Interaction plot of neighborhood support and participation in sports on PA (4+ days) among low-income children.

As depicted in Figure 20, as children participate in sports, there is a significant difference in the probability of being physically active for 7 days between those who reported high neighborhood support (gray bar) and low neighborhood support (white bar). For low-income children who report high levels of neighborhood support compared to those who report low levels of neighborhood support, participation in sports has a greater effect on being physical active every day. While the probability of being physically active every day increased for low-income children who participate in sports with a high level of neighborhood support, it decreased as children participated in sports with lower levels of neighborhood support.

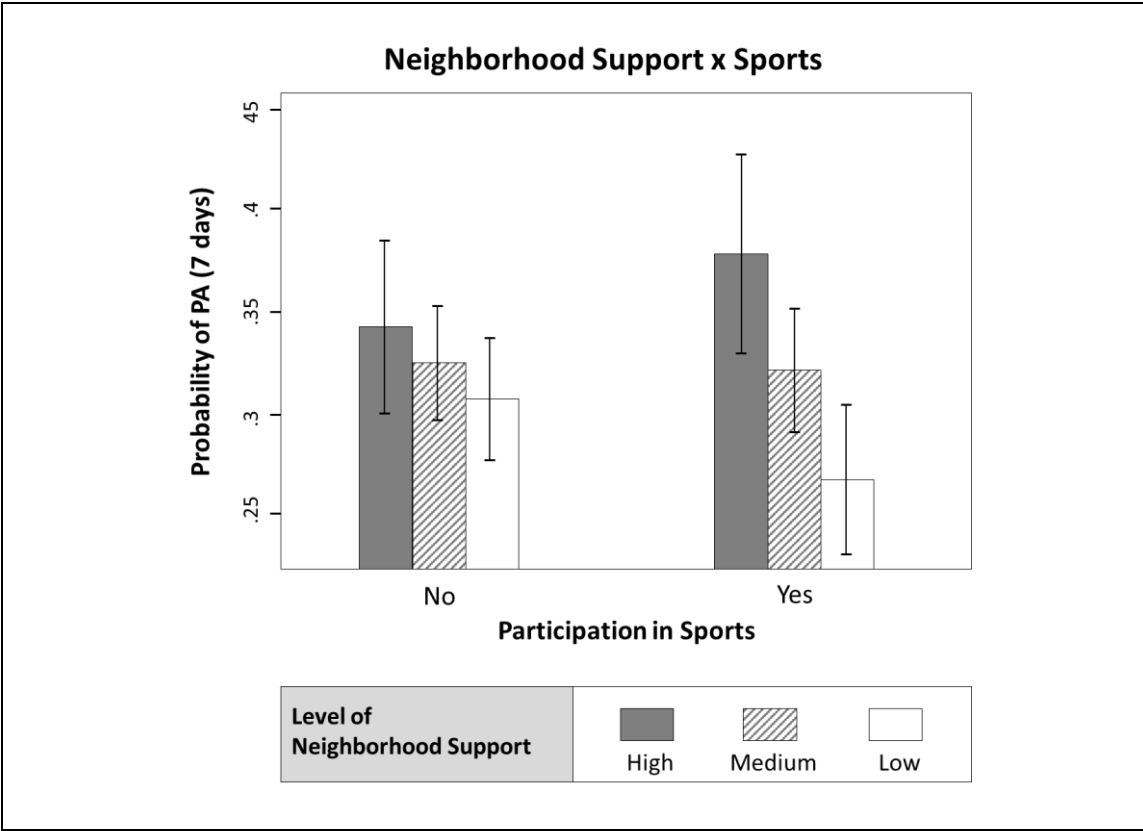


Figure 20. Interaction plot of neighborhood support and participation in sports on PA (7 days) among low-income children.

e) Perceived Safety

There were no significant moderating effects of perceived safety on the association between participation in sports and any PA types (1+, 4+, and 7 days) as shown in Table 35. According to the increased AIC value, the model fit slightly decreased after adding interaction term.

Table 35. Interaction term analysis examining the moderating role of perceived safety on the relationship between participation in sports and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in sports	3.22***	1.99	5.2	3.25**	1.65	6.42
	Perceived safety	1.01	0.68	1.49	1.01	0.66	1.54
	Perceived safety × participation in sports	-	-	-	0.98	0.4	2.42
	- AIC	1034.02			1036.02		
4+ days	Participation in sports	1.32**	1.09	1.59	1.16	0.88	1.51
	Perceived safety	0.98	0.8	1.19	0.89	0.69	1.13
	Perceived safety × participation in sports	-	-	-	1.26	0.89	1.79
	- AIC	3082.42			3082.68		
7 days	Participation in sports	0.95	0.78	1.15	0.93	0.72	1.22
	Perceived safety	1.04	0.84	1.29	0.81	0.60	1.10
	Perceived safety × participation in sports	-	-	-	1.29	0.89	1.86
	- AIC	2881.92			2882.11		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as clubs/organizations and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

- **Participation in Clubs**

a) Presence of Sidewalks

As shown in Table 36, there were no significant moderating effects of sidewalks on the association between participation in clubs and any PA types (1+, 4+, and 7 days) for

low-income children. After adding the interaction term, we found a slightly increased AIC value that explain the decreased the model fit.

Table 36. Interaction term analysis examining the moderating role of sidewalks on the relationship between participation in clubs and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in clubs	1.14	0.74	1.75	1.02	0.48	2.16
	Sidewalks	0.88	0.58	1.32	0.85	0.54	1.33
	Sidewalks × participation in clubs	-	-	-	1.17	0.49	2.81
	- AIC	1034.02			1035.9		
4+ days	Participation in clubs	1.04	0.86	1.27	0.86	0.62	1.19
	Sidewalks	0.81†	0.66	1	0.73	0.57	0.94
	Sidewalks × participation in clubs	-	-	-	1.33	0.91	1.94
	- AIC	3082.42			3082.21		
7 days	Participation in clubs	0.99	0.81	1.22	0.82	0.59	1.13
	Sidewalks	0.8	0.65	0.99	0.72*	0.56	0.93
	Sidewalks × participation in clubs	-	-	-	1.35	0.92	1.99
	- AIC	2881.92			2881.62		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

b) The Presence of Parks or Playgrounds

Our analysis showed that no significant moderating effects of parks or playgrounds on the association between participation in clubs and any PA types (1+, 4+, and 7 days) were found (see Table 37). The increased value of AIC indicates that the model fits decreased slightly after the interaction term was added.

Table 37. Interaction term analysis examining the moderating role of parks/playgrounds on the relationship between participation in clubs and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in clubs	1.14	0.74	1.75	1.21	0.58	2.54
	Parks or playgrounds	1.11	0.74	1.68	1.13	0.72	1.79
	Parks or playgrounds × participation in clubs	-	-	-	0.92	0.38	2.18
	- AIC	1034.02			1035.98		
4+ days	Participation in clubs	1.04	0.86	1.27	0.97	0.69	1.35
	Parks or playgrounds	1.16	0.93	1.43	1.11	0.86	1.43
	Parks or playgrounds × participation in clubs	-	-	-	1.11	0.76	1.64
	- AIC	3082.42			3084.11		
7 days	Participation in clubs	0.99	0.81	1.22	0.9	0.63	1.28
	Parks or playgrounds	1.04	0.83	1.3	0.99	0.76	1.29
	Parks or playgrounds × participation in clubs	-	-	-	1.15	0.77	1.72
	- AIC	2881.92			2883.45		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

c) The Presence of Recreation/Community Centers or Boys & Girls Clubs

Based in our analysis, there were no significant moderating effects of recreation/community centers or Boys & Girls Clubs on the association between participation in clubs and any PA types (1+, 4+, and 7 days) to be found (see Table 38). The model fits after including interaction term became decrease, as explained by the higher AIC value.

Table 38. Interaction term analysis examining the moderating role of recreation/community centers or Boys & Girls Clubs on the relationship between participation in clubs and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in clubs	1.14	0.74	1.75	1.49	0.82	2.72
	Recreation/community centers or Boys & Girls Clubs	0.96	0.65	1.4	1.11	0.71	1.72
	Recreation/community centers or Boys & Girls Clubs × participation in clubs	-	-	-	0.57	0.25	1.28
	- AIC	1034.02			1034.14		
4+ days	Participation in clubs	1.04	0.86	1.27	1.08	0.84	1.39
	Recreation/community centers or Boys & Girls Clubs	0.99	0.82	1.19	1.02	0.8	1.29
	Recreation/community centers or Boys & Girls Clubs × participation in clubs	-	-	-	0.92	0.65	1.31
	- AIC	3082.42			3084.22		
7 days	Participation in clubs	0.99	0.81	1.22	1.04	0.8	1.34
	Recreation/community centers or Boys & Girls Clubs	1.06	0.87	1.29	1.1	0.86	1.41
	Recreation/community centers or Boys & Girls Clubs × participation in clubs	-	-	-	0.91	0.63	1.31
	- AIC	2881.92			2883.65		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

d) Neighborhood Support

No significant moderating effects of neighborhood support on the association between participation in clubs and any PA types (1+, 4+, and 7 days) were found in the interaction term analysis result (See Table 39).

Table 39. Interaction term analysis examining the moderating role of neighborhood support on the relationship between participation in clubs and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in clubs	1.14	0.74	1.75	1.51	0.5	4.52
	Neighborhood supports	1.01	0.93	1.09	1.02	0.93	1.11
	Neighborhood supports × participation in clubs	-	-	-	0.95	0.81	1.13
	- AIC	1034.02			1035.71		
4+ days	Participation in clubs	1.04	0.86	1.27	0.67	0.4	1.13
	Neighborhood supports	1.07**	1.03	1.12	1.05	1	1.1
	Neighborhood supports × participation in clubs	-	-	-	1.07	0.99	1.16
	- AIC	3082.42			3081.22		
7 days	Participation in clubs	0.99	0.81	1.22	0.85	0.47	1.54
	Neighborhood supports	1.08**	1.03	1.13	1.07	1.01	1.13
	Neighborhood supports × participation in clubs	-	-	-	1.02	0.94	1.11
	- AIC	2881.92			2883.62		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

e) Perceived Safety

No significant moderating effects of perceived safety on the association between participation in clubs and any PA types (1+, 4+, and 7 days) were found in the interaction term analysis (see Table 40). Also, the model fits after including interaction term became slightly poorer because of the increased value of AIC.

Table 40. Interaction term analysis examining the moderating role of perceived safety on the relationship between participation in clubs and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in clubs	1.14	0.74	1.75	0.92	0.52	1.62
	Perceived safety	1.01	0.68	1.49	0.9	0.58	1.4
	Perceived safety × participation in clubs	-	-	-	1.55	0.7	3.44
	- AIC	1034.02			1034.84		
4+ days	Participation in clubs	1.04	0.86	1.27	0.93	0.71	1.23
	Perceived safety	0.98	0.8	1.19	0.9	0.71	1.15
	Perceived safety × participation in clubs	-	-	-	1.23	0.86	1.75
	- AIC	3082.42			3083.1		
7 days	Participation in clubs	0.99	0.81	1.22	0.97	0.72	1.31
	Perceived safety	1.04	0.84	1.29	1.02	0.79	1.33
	Perceived safety × participation in clubs	-	-	-	1.04	0.72	1.51
	- AIC	2881.92			2883.87		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and lessons were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

- **Participation in Lessons**

- The Presence of Sidewalks**

As shown in Table 41, no significant moderating effects of sidewalks on the association between participation in lessons and any PA types (1+, 4+, and 7 days) were found the interaction term analysis. When the interaction term was added, the AIC value increased to decrease the model fit.

Table 41. Interaction term analysis examining the moderating role of sidewalks on the relationship between participation in lessons and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in lessons	1.76**	1.15	2.68	1.59	0.74	3.44
	Sidewalks	0.88	0.58	1.32	0.85	0.55	1.34
	Sidewalks × participation in lessons	-	-	-	1.14	0.47	2.81
	- AIC	1034.02			1035.94		
4+ days	Participation in lessons	1.04	0.87	1.26	0.91	0.66	1.26
	Sidewalks	0.81†	0.66	1	0.76*	0.59	0.97
	Sidewalks × participation in lessons	-	-	-	1.22	0.83	1.79
	- AIC	3082.42			3083.39		
7 days	Participation in lessons	0.78*	0.64	0.95	0.64**	0.46	0.89
	Sidewalks	0.8	0.65	0.99	0.72*	0.56	0.93
	Sidewalks × participation in lessons	-	-	-	1.36	0.91	2.02
	- AIC	2881.92			2881.61		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and clubs were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

b) The Presence of Parks or Playgrounds

Our analysis found that a significant moderating effect of parks or playgrounds (OR=1.64, 95% CI=1.08-2.48) on the association between participation in lessons and PA (7 days) with better model fit as indicated by the decreased AIC value (see Table 42). This means that the presence of parks or playgrounds impact the connection between low-income children’s participation in lessons and being physically active for 7 days. Specifically, the presence of parks and playgrounds was found to have a positive interactive effect with participation in lessons, leading to 1.64 times increase in the likelihood of being physically active every day.

Table 42. Interaction term analysis examining the moderating role of parks/playgrounds on the relationship between participation in lessons and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in lessons	1.76**	1.15	2.68	3.65**	1.4	9.51
	Parks or playgrounds	1.11	0.74	1.68	1.31	0.84	2.05
	Parks or playgrounds × participation in lessons	-	-	-	0.38†	0.13	1.1
	- AIC	1034.02			1032.41		
4+ days	Participation in lessons	1.04	0.87	1.26	0.84	0.6	1.17
	Parks or playgrounds	1.16	0.93	1.43	1.04	0.8	1.34
	Parks or playgrounds × participation in lessons	-	-	-	1.37	0.93	2.01
	- AIC	3082.42			3081.94		
7 days	Participation in lessons	0.78*	0.64	0.95	0.55**	0.38	0.79
	Parks or playgrounds	1.04	0.83	1.3	0.88	0.68	1.15
	Parks or playgrounds × participation in lessons	-	-	-	1.64*	1.08	2.48
	- AIC	2881.92			2878.39		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and clubs were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

Figure 21 displayed the probability of being physically active everyday according to whether there are parks or playgrounds available, and how it relates to their participation in lessons among low-income children. Those low-income kids who have parks or playgrounds in their neighborhood were less influenced by the negative impact of participating in lessons on their PA, compared to those who did not have parks or playgrounds.

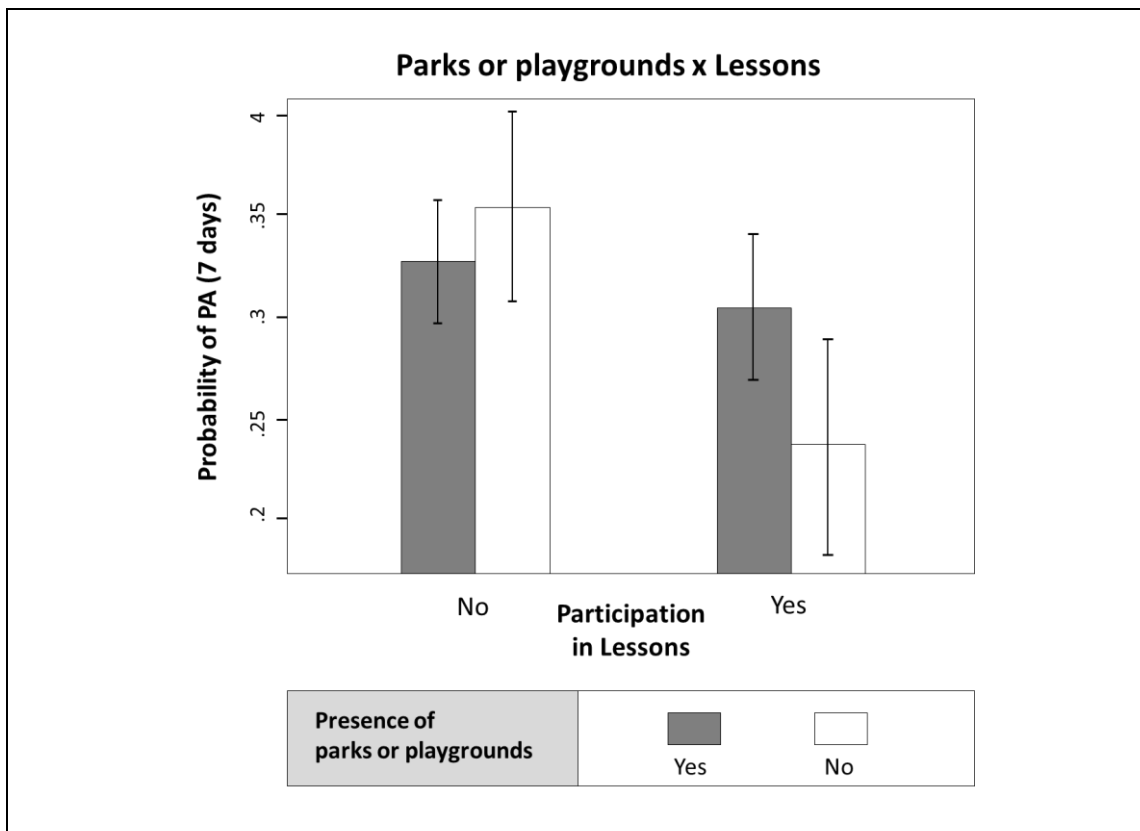


Figure 21. Interaction plot of parks/playgrounds and participation in lessons on PA (7 days) among low-income children.

c) The Presence of Recreation/Community Centers or Boys & Girls Clubs

Our analysis found a significant moderating effect of recreation/community centers or Boys & Girls Clubs (OR=1.63, 95% CI=1.13-2.37) on the association between participation in lessons and being physically active for 7 days (see Table 43). This means that when low-income children have access to recreation/community centers or Boys & Girls Clubs and they also participate in lessons, it increases the likelihood of them being physically active for 7 days by 1.63 times. In other words, they are more likely to be physically active every day when they have access to these facilities and participate in

lessons. This result also improved the model fit, as explained by the decrease in the AIC value.

Table 43. Interaction term analysis examining the moderating role of recreation/community centers or Boys & Girls Clubs on the relationship between participation in lessons and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in lessons	1.76**	1.15	2.68	1.84	1.04	3.23
	Recreation/community centers or Boys & Girls Clubs	0.96	0.65	1.4	0.98	0.63	1.51
	Recreation/community centers or Boys & Girls Clubs × participation in lessons	-	-	-	0.91	0.41	2.04
	- AIC	1034.02			1035.97		
4+ days	Participation in lessons	1.04	0.87	1.26	0.94	0.74	1.2
	Recreation/community centers or Boys & Girls Clubs	0.99	0.82	1.19	0.9	0.71	1.14
	Recreation/community centers or Boys & Girls Clubs × participation in lessons	-	-	-	1.26	0.89	1.79
	- AIC	3082.42			3082.77		
7 days	Participation in lessons	0.78*	0.64	0.95	0.63**	0.49	0.82
	Recreation/community centers or Boys & Girls Clubs	1.06	0.87	1.29	0.87	0.68	1.12
	Recreation/community centers or Boys & Girls Clubs × participation in lessons	-	-	-	1.63*	1.13	2.37
	- AIC	2881.92			2877.18		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and clubs were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

As shown in Figure 22, we found an interactive relationship between recreation/community centers or Boys & Girls Clubs and participation in lessons, which influenced PA (7+ days) among low-income children. These findings indicate that children from low-income families without access to these resources in their neighborhood are much less likely to be physically active everyday if they participate in lessons.

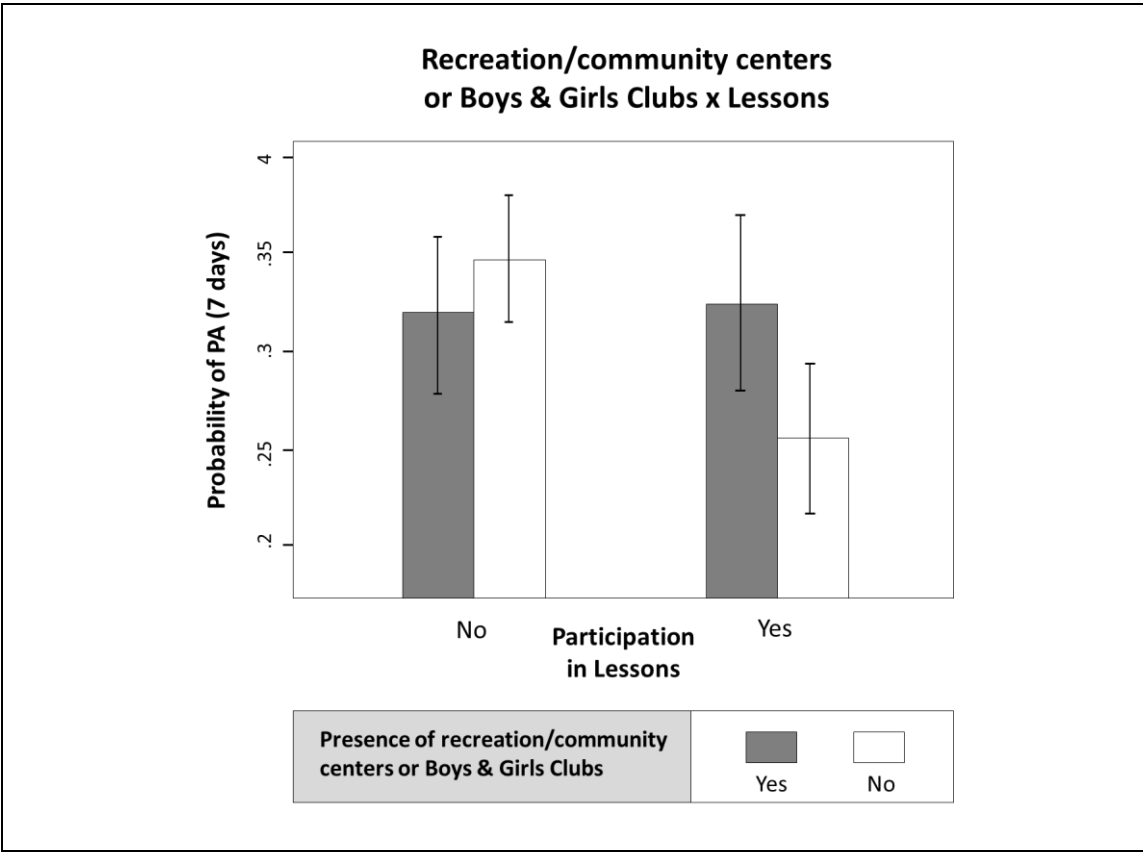


Figure 22. Interaction plot of recreation/community centers or Boys & Girls Clubs and participation in lessons on PA (7 days) among low-income children.

d) Neighborhood Support

Our analysis found a moderating effect of neighborhood support on the relationship between participation in lessons and low-income children's involvement in PA for 7 days. However, this study could not find any significant interaction effect of neighborhood support and participation in lessons on avoiding physical inactivity (1+days) and being involved in PA frequently (4+days) among low-income children (see Table 44).

Table 44. Interaction term analysis examining the moderating role of neighborhood support on the relationship between participation in lessons and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in lessons	1.76**	1.15	2.68	1.57	0.52	4.75
	Neighborhood supports	1.01	0.93	1.09	1	0.92	1.1
	Neighborhood supports × participation in lessons	-	-	-	1.02	0.86	1.21
	- AIC	1034.02			1035.98		
4+ days	Participation in lessons	1.04	0.87	1.26	0.89	0.52	1.49
	Neighborhood supports	1.07**	1.03	1.12	1.06	1.01	1.12
	Neighborhood supports × participation in lessons	-	-	-	1.03	0.95	1.11
	- AIC	3082.42			3083.97		
7 days	Participation in lessons	0.78*	0.64	0.95	0.41**	0.22	0.75
	Neighborhood supports	1.08**	1.03	1.13	1.05	0.99	1.1
	Neighborhood supports × participation in lessons	-	-	-	1.1*	1.01	1.2
	- AIC	2881.92			2878.89		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and clubs were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

As children participate in lessons, in the case of being physically of active every day, we found that there was no big difference between participants and non-participants if children are living in the higher level of neighborhood support. However, if children are living in lower level of neighborhood, they are more influenced by the negative impact of participation in lesson on PA (7 days) among low-income children. In other words, the association between low-income children's involvement in lessons and PA is moderated by neighborhood support. This means that participating in lessons has a greater impact on low-income children's PA for 7 days with high neighborhood support (gray bar) compared to low neighborhood support (white bar), as shown in Figure 23.

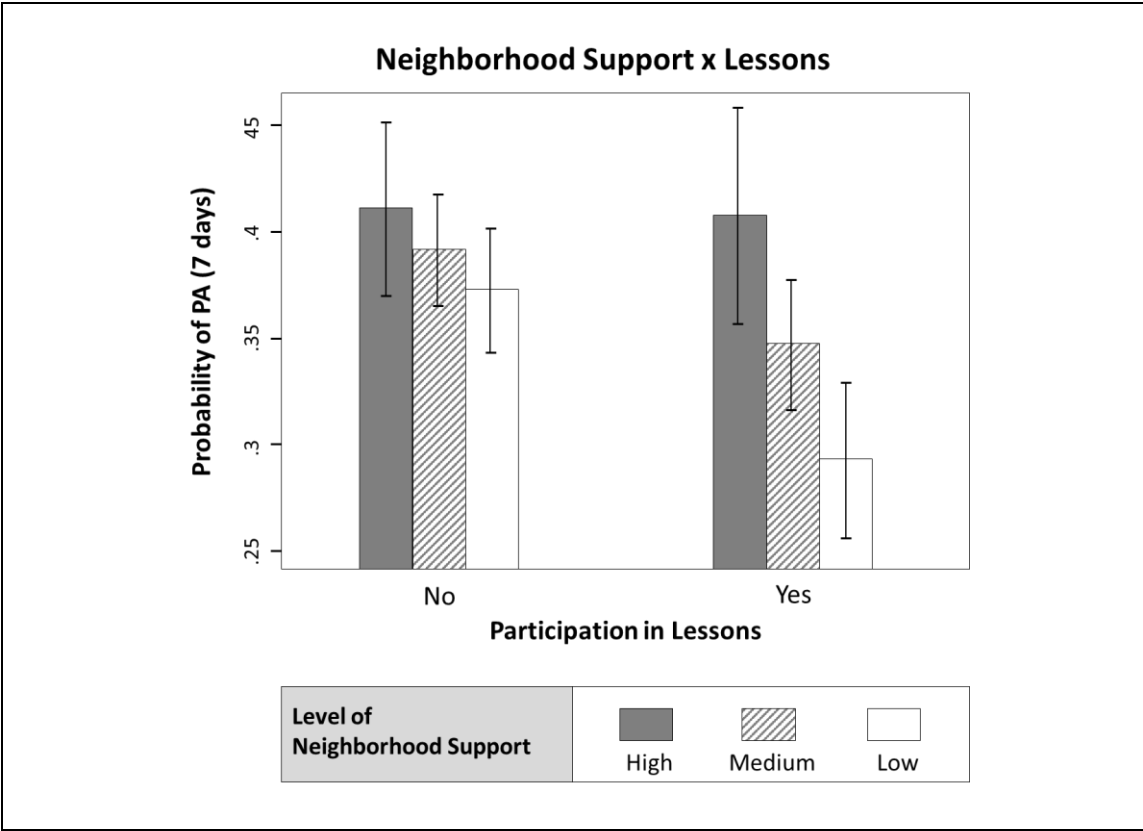


Figure 23. Interaction plot of neighborhood support and participation in lessons on PA (7 days) among low-income children.

e) Perceived Safety

As shown in Table 45, our analysis did not find any significant moderating effect of perceived safety on the association between participation in lessons and any types of PA (1+, 4+, and 7 days).

Table 45. Interaction term analysis examining the moderating role of perceived safety on the relationship between participation in lessons and PA among low-income children.

PA	Moderating Effect	without interaction			With interaction with sport		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
1+ days	Participation in lessons	1.76**	1.15	2.68	1.4	0.8	2.45
	Perceived safety	1.01	0.68	1.49	0.9	0.58	1.4
	Perceived safety × participation in lessons	-	-	-	1.61	0.72	3.62
	- AIC	1034.02			1034.68		
4+ days	Participation in lessons	1.04	0.87	1.26	1.04	0.79	1.36
	Perceived safety	0.98	0.8	1.19	0.97	0.76	1.24
	Perceived safety × participation in lessons	-	-	-	1.01	0.71	1.43
	- AIC	3082.42			3084.42		
7 days	Participation in lessons	0.78*	0.64	0.95	0.7*	0.52	0.94
	Perceived safety	1.04	0.84	1.29	0.97	0.75	1.25
	Perceived safety × participation in lessons	-	-	-	1.21	0.84	1.76
	- AIC	2881.92			2882.89		
# of observations		2,371			2,371		

Note: Other variables including demographics, individual, and interpersonal factors as well as sports and clubs were controlled in each model; ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1; AIC: Akaike Information Criterion

Overall Summary

The overall results from our analysis in this section are summarized in Table 46. The moderating effects of presence of CRs varied depending on the type of OAs (*all or each of OAs*) and the three different PA measurement scales (1+, 4+ and 7 days). In the case of physical environments, the analysis found the moderating effect of parks/playgrounds and recreation/community centers or Boys & Girls Clubs on the association between participation in lessons and being physically active for 7 days. In terms of social environment factors, we found that neighborhood support significantly moderated the relationship between participation in sports and being regularly physically active (4 or more days) and engaging in PA every day (7 days). In the case of participation in clubs or organizations, there data did not show a moderating effect of neighborhood support on PA among low-income children. Regarding participation in lessons, 'the result indicated that neighborhood support had a moderating effect on low-income children's PA (7 days). Also, there was no moderating effect of perceived safety and participation in any types of OAs affecting low-income children's PA.

Table 46. Summary table of the moderating effects of CRs on participation in OAs and PA among low-income children.

Moderator (Community Resources)		Independent Variable (Participation in OAs)				Outcome (PA days)
		All OAs	Each OAs			
			Sports	Clubs or organizations	Lessons	
Physical environments	Sidewalks	-	-	-	-	1+days
		-	(+)†	-	-	4+days
		(+)†	-	-	-	7 days
	Parks or playgrounds	-	-	-	(+)†	1+days
		-	-	-	-	4+days
		-	-	-	(+)*	7 days
	Recreation/co mmunity centers or Boys & Girls Clubs	-	-	-	-	1+days
		-	-	-	-	4+days
		-	-	-	(+)*	7 days
Social factors	Neighborhood support	-	(+)†	-	-	1+days
		(+)†	(+)**	-	-	4+days
		(+)†	(+)*	-	(+)*	7 days
	Perceived safety	-	-	-	-	1+days
		-	-	-	-	4+days
		-	-	-	-	7 days

Note: ***p<0.001, **p<0.01, *0.01≤p<0.05 †0.05≤p<0.1

CHAPTER VI

DISCUSSION AND CONCLUSIONS

Based on the socio-ecological model and the social determinants of health frameworks, this dissertation explored various determinants for low-income children's PA and identified ways to address health disparities focusing on the structural and interactional relationships between the presence of CRs and participation in OAs by promoting their PA. Specifically, we examined the mediating relationship between the presence of CRs and PA among low-income children through participation in OAs. This is because, there is limited understanding of the interrelated relationship between CRs and participation in OAs and their impact on PA among low-income children. Also, we explored the moderating effect of the presence of CRs on the relationship between participation in OAs and PA among low-income children. Thus, this study contributes to a better understanding of how and under what conditions CRs and participation in OAs simultaneously influence PA among low-income children by examining their mediation and moderation relationships.

The study provides several important findings. First, the analyses discovered a significant mediating effect of participation in *all OAs* and organized sports on the associations between CRs and low-income children's PA (1+ and 4+ days). This means that CRs, especially the presence of recreation/community centers or Boys & Girls Clubs as well as neighborhood support, may promote participation in OAs, which can subsequently help low-income children avoid physical inactivity and encourage them to

be more frequently involved in PA. More specifically, the study did not find a direct effect of recreation/community centers or Boys & Girls Clubs on PA levels, but it did find a direct relationship between neighborhood support and PA. However, recreation/community centers or Boys & Girls Clubs helped to promote PA among low-income children, particularly through participation in OAs. This finding highlights the interrelated significance of physical facilities such as recreation/community centers or Boys & Girls Clubs and participation in OAs in reducing the risk of physical inactivity and increasing frequent involvement in PA among low-income children.

Second, we found that the benefits of participation in organized sports in enhancing PA (4+ and 7 days) were dependent on the neighborhood support. In other words, low-income children who experienced higher levels of neighborhood support benefited more from organized sports engagement to increase PA. This finding provides evidence that neighborhood support can motivate participation in organized sports, which can serve as an effective way to enhance PA and foster healthy lifestyle habits for low-income children. In other words, there is a need for providing a supportive neighborhood environment with adequate supervision to maximize the benefits of participation in OAs for being more frequently involved in PA. Although participation in lessons is not directly related to PA activities, it is moderated by parks/playgrounds, recreation/community centers or Boys & Girls Clubs, and neighborhood support to be physically active every day for low-income children. This means that low-income children who live in neighborhoods with parks/playgrounds, recreation/community

centers or Boys & Girls Clubs and support from their neighborhood, are more likely to be motivated to engage in PA every day (7 days) when they participate in lessons.

Study Contributions

This dissertation makes several contributions to the literature on PA and its determinants among low-income children. Through this work, empirical evidence on the disparities in the availability of CRs, participation in OAs and PA levels between low-income and non-low-income children is provided. The findings of this study offer insights into the types of OAs that could be incorporated with CRs to increase PA levels in low-income children. In other words, low-income communities need to ensure that children have access to physical recreational facilities and a supportive neighborhood that encourages participate in OAs without any barriers, so that they can effectively engage in PA. Overall, the findings of this study highlight the importance of making more efforts to increase PA and reduce health disparities among low-income children through supportive CRs and participation in OAs. These findings are discussed below in more detail.

First, this study contributes to the body of evidence on the health disparities in several aspects of children's behavior, including participation of OAs and PA. Consistent with previous studies (Carlson et al., 2014; Gortmaker et al., 2012; McKenzie et al., 2013), our research uncovered that low-income children were less likely than their more affluent peers to participate in structured activities including OAs. Specifically,

non-low-income children were almost twice more likely to participate in *all OAs*, compared to low-income children (32.2% vs. 15.5%, $p < .001$). Children from low-income families were specifically less likely to participate in organized sports (49.7%) than non-low-income children (75.7%, $p < .001$). Unfortunately, due to reductions in physical education and recess time, children face challenges in staying physically active solely through school programs. In other words, it is difficult for children to maintain their PA levels only through the physical activities offered during school hours (Hills et al., 2015). Because of this, participation in OAs, according to our findings, is an effective way to prevent physical inactivity and promote regular PA, especially for low-income children. These findings align with previous studies conducted by Giles-Corti & Donovan (2002), Hanson et al. (2007), and Wieland et al. (2020), which also found the importance of participation in OAs to promote children's PA.

Second, our results indicate that physical environments, including available and accessible recreation, community centers or Boys & Girls Clubs within low-income communities, interrelated with the provision of programs, such as OAs, can potentially help reduce disparities in PA among low-income children. This is in line with the mission and core beliefs of the Boys & Girls Clubs of America (BGCA), whose mission is to “promote safe, positive and inclusive environments for all” (BGCA, 2019). However, it is important to note that, as we reported in our findings, the presence of recreation/community centers or Boys & Girls Clubs may not have a direct impact on low-income children's PA by itself. These facilities can indirectly promote physically active lifestyles for low-income children when participation in OAs is encouraged. This

finding evidences the important interrelation between physical facilities and programs in enhancing children's PA. Thus, it is crucial to have an integrated approach that enhances the availability and accessibility of CRs in low-income communities, as well as encouraging participating in OAs to promote PA among low-income children.

Third, this study highlights the importance of social factors, specifically neighborhood support, which when interacting with participation in OAs, can affect low-income children's PA. The results revealed a significant interaction between neighborhood support and participation in *all OAs* on PA (4+ days and 7 days). Specifically, a positive association was found among those with the highest neighborhood support when they participate in *all OAs* and organized sport activities. This denotes that the relationship between participation in organized sport activities and being physically active is highly influenced on the perceived level of neighborhood support by low-income children. While participation in organized sport activities can directly increase PA among low-income children, their participation in OAs and organized sport activities may also be influenced by the support provided in their social environment. This is because a supportive neighborhood can facilitate the development of social relationships between children and adults, leading to an increased sense of community and motivation to participate in OAs. In other words, children who feel connected to their community are more likely to participate in OAs that available in their neighborhood. Therefore, promoting activities and conditions in the community that promotes the interaction between residents (including youth and adults) that are designed to foster a positive social environment, one where children feel encouraged and

supported, can eventually lead to benefits in children's PA. What this means is that *community matters* when it comes to PA. Developing a social environment that promotes cohesion and social capital, goes beyond benefiting adults, but as found in our study, also positively influences the health of our youth.

Fourth, this dissertation provides insights into how incorporating the scope of OAs, can impact PA levels in low-income children. We assumed that participation in *all OAs* would have a greater capacity to increase PA among low-income children than participation in each of the OAs. However, the study did not find a significant difference in PA levels between low-income children who participated in *all OAs* and those who participated in *each of OAs*. This may be because of the data used in this study asked about children's participation in OAs using a simple approach which providing three options to choose from: sports, clubs, or lessons. Although there was not a big difference of participation between *all OAs* and *each of OAs*, this approach rather suggests that we need to differentiate between them in the future, considering the scope of OAs that can be meaningful for kids who participate in OAs. In addition, while participation in sports is one of the most effective ways to increase PA, we also found that participation in lessons that are not related PA programs can have an impact. There might be alternative reasons that motivate children to be more physically active when they are participating in lessons. This means that we need to provide not only PA-tailed program but also a variety of other programs for kids that emphasize other interest and abilities. This is connected to the need to carefully consider who provides those programs. From a community development perspective, instead of relying on the limited number and types

of sources often found in low-income communities, we need to encourage collaboration among diverse providers, including various community members, schools, and organizations. Namely, to achieve the overall goal of enhancing PA among low-income children through participation in OAs, a greater variety of activities should be provided through partnerships between different individuals and organizations with sharing knowledge about effective ways to support youth development. This entails a community development approach, where participation, collaboration, and capacity building are important in providing high-quality programs that should be aimed at sharing resources (i.e., time, know-how, funding) and responsibilities with others in the community (Matarrita-Cascante et al., 2020). Moreover, such approach is critical as it would allow the definition of specific needs and challenges of low-income children by own community members. Ultimately, this would provide a range of locally defined, diverse, and affordable OA options through the joint work of multiple community actors.

Finally, our analysis revealed various findings regarding different measurement scale of PA outcomes (1+, 4+ and 7 days) among low-income children. This study offers insights to better understand children's PA by considering the different phases of being physically active including: 1) the initial phase of becoming involved in PA (by comparing 0 day with 1+ days of PA), 2) the next phase of maintaining their PA (by comparing 0-3 days with 4-7 days of PA), and 3) the final stage of sustaining PA every day (by comparing 7 days or not). This is important because the strategies used to encourage low-income children to be physically active will vary depending on their current level of PA, whether the goal is to avoid physical inactivity, maintain regular PA,

or sustain daily PA. In other words, different approaches will be needed to encourage low-income children to become involved in PA, to keep up their PA levels, and to continue to be physically active every day, depending on their individual needs and neighborhood characteristics including physical environment and social factors. The findings of this study by examining the mediation and moderation analysis found that physical environments and social environmental factors are differently associated with PA levels. The physical environment of CRs, such as the presence of recreation/ community centers or Boys & Girls, can provide low-income children with opportunities to engage in OAs, which can indirectly reduce physical inactivity and increase the frequency of PA. However, these physical facilities may not necessarily encourage them to meet the recommended levels of 60 minutes of MVPA every day. This may be because some of the activities provided by recreation/community centers or Boys & Girls Clubs may not be physically demanding enough or may not be available every day. On the other hand, neighborhood support as a social factor of CRs can motivate low-income children to engage in regular PA and physically active every day. This may be because when children perceive that their neighborhood is supportive, they are more likely to engage in PA on a regular basis. Surprisingly, our results showed that low-income children were more likely to meet the PA recommendations (7 days) compared to non-low-income children, in contrast to a previous study conducted by Maglione & Hayman (2009). This finding may be influenced by methodological errors, such as low response rates among low-income populations and subjective measurements, which were reported in other studies using the same dataset (Katzmarzyk, et al., 2018). This does not

undermine the necessity of providing low-income children with safe, affordable, and accessible PA opportunities.

Theoretical Implications

This study added to the understanding of the need to address structural and interactional determinants of PA inequalities for low-income children by using a combined perspective of the socio-ecological model and the social determinants of health. The identification of underlying causes of disparities in PA and the potential impact of CRs and participation in OAs on low-income children's PA offer insights into a framework for understanding the community-level effort to integrate physical and social environmental factors, while providing various OAs programs for kids to achieve their health and well-being in the community. Moreover, these findings emphasize the importance of adopting a comprehensive approach to encourage PA among low-income children, which considers the complex interplay between individual, social, and environmental factors that affect health behaviors. In other words, by examining the mediation and moderation relationships, we can figure out that these interactive associations are supported by both the socio-ecological model and the social determinants of health perspectives. This enhances health outcomes and address health disparities by exploring the interrelated impact of CRs and participation in OAs in the low-income communities. Furthermore, this study can provide a starting point for future research that aims to identify effective strategies to reduce health disparities in PA and promote health equity by using CRs and encouraging participation in OAs for healthy

youth development in low-income communities. In other words, the findings of this study can be used as a basis for future studies that focuses on creating the community environments and implementing strategies to address health disparities that low-income children may encounter.

Practical Implications

The findings of this dissertation provide implications for stakeholders in low-income communities and youth organizations to promote PA and reduce disparities in PA resources for low-income children. We investigated how places and programs for low-income children are interrelated to improve their health. We found that low-income children are particularly vulnerable to physical inactivity due to the lack of supportive physical and social environments in their communities, such as in the case of safe and accessible spaces for physically active and less supportive neighbors, and lower participation in OAs. It is necessary to have “place to go” for youth where they can share their issues and concerns, which can direct attention to their matters among community leaders (Campbell & Erbstein, 2010). As detailed earlier, to effectively implement strategies for low-income children to address disparities in PA, it is important to involve a diverse range of stakeholders, including schools, organizations, and policymakers, to create physically and socially supportive neighborhood environments for PA among low-income children and provide various OAs programs. Through this approach, stakeholders should work together to share community resources and responsibilities and develop sustainable solutions that meet the specific needs and challenges of the

community, ultimately promoting greater healthy equity (Matarrita-Cascante et al., 2020). Furthermore, through a community development approach between community members and stakeholders, such as parents, educators, community leaders, and policymakers, trust and support within the community can be built. Also, collaboration among various community members can help to encourage shared the recognition of the interactive role of CRs, participation in OAs, and PA can play in positive youth development (Beets et al., 2010). This would lead to greater community engagement and collaboration which would create a more equitable and healthier community. In other words, it is important for all community members to actively participate in efforts to increase PA among low-income children and promote their overall health and well-being by providing supportive physical and social environment and various activities. Namely, a community development approach that leads to provide equitable access to activity-friendly environments, foster supportive neighborhood environments, and offer various programs can help achieve this goal of creating sustainable solutions to address health disparities in low-income communities. Moreover, supporting better communication and cooperation among various groups can provide youth with opportunities for community services, advocacy and personal growth (Campbell & Erbsstein, 2010).

Limitations and Future Studies

This dissertation study has several limitations in terms of the data and analysis. The limitation of this study is that it cannot explain cause and effect relationships between variables because it has a cross-sectional design, which only involves a single

measurement. Further longitudinal analysis is necessary to gain a deeper understanding of the different PA behavior of low-income children and consider the long-term perspective to figure out related factors and process to enhance low-income children's PA. In addition, there is a lack of geographic information (e.g., census block group or census tract) in the secondary data this study used. Future research may consider objective methods including geographic information system (GIS) analysis to determine why various people and communities have unequal access to PA-related resources. To learn more about the barriers and facilitators to access to CRs, participation in OAs, and PA among low-income children, qualitative research methods (e.g., interview, focus group) will be considered.

Additionally, the 2019 NSCH measured children's PA levels based on their parents' report, which may have been influenced by response and recollection bias and as a result may not have adequately reflected the prevalence of PA in children (Friel et al., 2020). This study found that, surprisingly, low-income children tended to meet the PA guideline (7 days physically active at least 1 hour a day), which is somewhat inconsistent with previous studies. Although it is difficult to determine the precise process, this may in part be a result of methodological errors (e.g., low response of low-income populations, misunderstanding of PA-related questionnaires through parental report, and subjective measurements). Friel et al (2020) also indicated that parents may not be able to adequately estimate their children's PA when the children are away from home, such as at school or an afterschool program. Moreover, it may have been challenging for parents to participate in the 2019 NSCH as it was difficult to

differentiate between leisure and transportation-based PA. Additionally, this study was unable to quantify the amount of time spent in each OA or measure the quality and maintenance of PA-related facilities. Therefore, further studies are required to assess the availability and condition of PA-related resources in a more objective approach.

Conclusions

This study was inspired by an African proverb, “It takes a village to raise a child,” which gives us lessons that the responsibilities for raising and caring for a child is shared by the entire community, not just the parents. This can be achieved through a community development approach, as noted by Matarrita-Cascante & Brennan (2012), the community can take the responsibility to provide a safe and healthy neighborhood environment for the health of all children. Despite the importance of CRs and participation in OAs, safe and affordable PA-related facilities and programs have not been equally distributed across neighborhood. Low-income children are more likely to lack of CRs and have lower participation rate of OAs to be physically active in their neighborhoods (Day, 2006). This highlights the significance of the collective responsibility of the community in ensuring equal access to CRs, including sidewalks, community/recreation centers or Boys & Girls Clubs, and supportive neighborhood environments, and opportunities for participation in OAs for all children, particularly in low-income communities. This is crucial for promoting low-income children’s PA, as it contributes to their physical and social development promoting children’s healthy lifestyle habits.

This dissertation emphasizes the importance of examining the role of CRs and participation in OAs simultaneously in promoting PA among low-income children. As a result, this study provides empirical evidence to improve PA levels in low-income children by considering the interrelationship between the presence of CRs and participation in OAs. This study focused on low-income communities to identify the underlying causes of disparities in PA-related resources as well as the role of CRs and participation in OAs in promoting regular PA. To address disparities in PA, we suggest that it is important to improve the physical and social environment by enhancing its structural and interactional conditions. Furthermore, this study suggests that low-income communities have the potential to develop a culture of PA that includes not only children but also families and other community members by connecting the local community and wider youth development networks at the regional, state, or national level. Through this approach, that reflects community development principles, PA can be improved in low-income communities and subsequently achieve a healthy and active lifestyle for their children in the long term. In conclusion, improving access to physical facilities and fostering neighborhood support could be impactful in encouraging participation in OAs to promote PA among low-income children. These efforts will expand the health and well-being benefits of communities.

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APPENDIX

Appendix Table. Multicollinearity check

	VIF	1/VIF
Age	1.07	0.94
Female	1.08	0.93
White, non-Hispanic	1.17	0.86
High school diploma or less	1.1	0.91
Not 2-parent household	1.09	0.92
Self-motivation, always and usually	1.3	0.77
Screen time, 3+hrs	1.09	0.92
Parent participation in child's events, always and usually	1.1	0.91
Parental communication with child, very and somewhat well	1.19	0.84
Family resilience, supportive	1.11	0.90
Neighborhood supports	1.42	0.71
Perceived safety	1.35	0.74
Presence of sidewalks or walking path	1.29	0.78
Presence of parks or playgrounds	1.35	0.74
Presence of recreation center, community center, or Boys & Girls Clubs	1.22	0.82
Sports	1.25	0.80
Clubs or organizations	1.26	0.79
Lessons	1.17	0.86
Mean VIF	1.24	

The researcher checked for multicollinearity based on the variance inflation factor (VIF) and found no multicollinearity issue in the study (all VIF values were less than 4).