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# The role of parental support for youth physical activity transportation and community-level poverty in the healthy communities study

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**Abstract** This study evaluates whether parental provision of transportation for physical activity is associated with child/adolescent moderate-to-vigorous physical activity, while also evaluating community-level poverty. Self- and parental-reported surveys were administered with parents/caregivers and children in the Healthy Communities Study ($N = 5138$). Associations between individual-level demographics, community-level poverty, parental provision of transportation for physical activity, and moderate-to-vigorous physical activity were examined in multi-level models. Even when accounting for community-level poverty, which was significantly associated with lower moderate-to-vigorous physical activity, parental provision of transportation for physical activity was positively associated with greater moderate-to-vigorous physical activity. This study provides evidence for the importance of considering multiple systems of influence (e.g., community and individual factors) and considering how gaps in physical activity transportation for youth can be addressed in future health policies.

**Keywords** Social support · Neighborhood poverty · Moderate to vigorous physical activity

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## Introduction

Physical activity (PA) in childhood is associated with a variety of health benefits, including cardiovascular fitness, strong bones and muscles, a healthy weight, and reduced risk of developing chronic diseases (Janssen & LeBlanc, 2010). Only one in five children meet the U.S. national recommendations for moderate-to-vigorous physical activity (MVPA) (National Physical Activity Plan Alliance, 2016), highlighting the need to understand the critical factors that promote greater youth MVPA. Social Cognitive Theory (Bandura, 1986, 2004) proposes that the self-regulation of health behaviors is guided by individual level factors, and by social and structural impediments to change. Relatedly, a bioecological model, highlights the importance of considering multiple systems of influence, including, individual, interpersonal, and community-level factors (Bronfenbrenner, 2005; Sallis et al., 2015). Supporting these frameworks, an abundance of studies have identified individual, interpersonal, and community-level factors related to youth MVPA (Bauman et al., 2012; Sallis et al., 2000; Van Der Horst et al., 2007). The majority of such studies, however, have focused on relatively small sample sizes, with few studies evaluating these factors in

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a large national sample. We argue that to develop effective community-level policies it is critical to understand which individual and community-level factors are important correlates of youth MVPA.

Efforts to implement policies to promote greater youth MVPA have increased in U.S. communities. Such community-wide campaigns have been guided by a relatively small base of scientific evidence (Baker et al., 2011), with many questions remaining about when and why these policies are most effective. A 5-year, large-scale observational investigation, the Healthy Communities Study (HCS) (Arteaga et al., 2015), sought to address these questions by examining whether socio-demographic factors at the individual- and community-levels moderate the influence of community policies/programs on child/adolescent PA. The HCS revealed that an index reflecting the six-year history of the number of behavior change strategies used in community programs and policies was positively associated with children and adolescents' MVPA, but the effect was attenuated when adjusting for demographics (Pate et al., 2018). The relationship between community policies and youth MVPA was moderated by ethnicity, such that community polices had a negative impact on MVPA for Hispanic youth. These results suggest that efforts to develop effective community-level policies for promoting youth PA are falling short, especially for ethnic minority children. To develop community policies that meet the needs of communities across the United States, further research is needed to identify the individual and community factors related to youth MVPA at a national level.

Youth PA is shaped by the broader social environment. One major social-environmental impediment to youth PA is having transportation to places to be active, including parks, playgrounds, and sports practices or competitions. Cross-sectional studies using self-report (Beets et al., 2006; Heitzler et al., 2006; Hoefer et al., 2001) and objective measures of PA (Sallis et al., 1992) have shown that parent provision of transportation is a robust correlate of youth PA. Providing longitudinal support for the relationship between parent transportation and youth PA, results from the Active by Choice Today trial (Wilson et al., 2008) demonstrated that changes in tangible support for PA among middle school students, including transportation to places to be active, predicted increases in accelerometry-assessed MVPA across a 17-week period (Siceloff et al., 2014). Another study found that over a 20-month period, transportation was the only supportive parenting behavior that predicted changes in child PA (Sallis et al., 1999). Overall, past studies have focused on specific regions and populations, thus there is a critical need to extend our understanding of the role of parent support (social and structural) in national samples that include a broad range of children and adolescents, including low income groups, and ethnic and racial minorities.

Drawing from a bioecological model, which emphasizes the importance of considering broader community-level factors, numerous studies have found that health outcomes across the lifespan, including PA, obesity, and longevity, are strongly associated with community-level social and economic conditions (Braveman et al., 2011; Kaplan, 2019; Shih et al., 2013). Poor neighborhood conditions, including low walkability and low perceived safety, impede adolescent PA and tend to be more prominent among low income communities (Boone-Heinonen et al., 2011; Franzini et al., 2010; Singh et al., 2010). Increasingly, researchers are recognizing the utility of evaluating impediments to change that cut across multiple systems, including socioeconomic factors (Sallis et al., 2015). Although both parent support for PA transportation and community-level socioeconomic factors have both been found to relate to childhood PA, these factors have rarely been evaluated simultaneously, thereby limiting understanding of their relative importance. Supportive parenting practices, including providing transportation for PA, may be especially impactful for youth who cannot easily or safely walk to places to be active. Drawing from previous studies which have found that social support is a more robust predictor of walking and MVPA than environmental barriers in adults (Burton et al., 2005), the present study evaluates whether this pattern extends to children/adolescents in regard to parent support. To the best of the authors' knowledge, while previous studies with children have evaluated aspects of neighborhood design related to social and economic conditions (e.g., safety), no previous study has evaluated the role of parent support for PA, while also taking into account community-level poverty as an additional system of influence.

The majority of previous studies on parental support in youth have focused on middle class and White youth (Hoefer et al., 2001; Saelens et al., 2002; Sallis et al., 1992). Given recent findings from the HCS that responses to community policies vary across different ethnic minority communities (Pate et al., 2018), the next step for advancing this area of research is to evaluate the generalizability of parent support for PA transportation as a meaningful correlate of child/adolescent PA in a national sample. Previous studies evaluating parent support for PA transportation have focused primarily on a single system of influence (e.g., individual or interpersonal) and have rarely considered the simultaneous impact of broader community-level factors, including community-level poverty. Thus, the present study aims to evaluate whether parent support for PA transportation predicts child/adolescent MVPA, while also accounting for community-level poverty and other demographics factors in a national sample of ethnically and racially diverse youth.

## Methods

### Study design

The HCS was an observational study of 130 communities with cross-sectional and retrospective longitudinal measurements. Communities were selected based on efforts to implement programs and policies targeting childhood obesity ($N = 28$) and from a probability sample based on race and ethnicity, income, and regional distributions ($N = 102$). The sampling process has been described elsewhere (Strauss et al., 2015). Children and adolescents were recruited from two elementary and two middle schools that were associated with a defined high school in each community (Arteaga et al., 2015). Up to 81 children per community were enrolled (John et al., 2015). Participants were excluded if they were unable to walk, institutionalized, or had lived at their home address for less than 1 year. Data collection occurred between November 2013 and July 2015, year-round and simultaneously in several communities throughout this period.

### Home visit procedures

Trained data collectors conducted in-home visits with parents and children/adolescents. For the child-report sections of the survey, children and adolescents ages 9 to 15 were the primary respondents. For children 4 to 8, parents and guardians responded to the questions, which comprised 37.7% of the study sample. Parents assisted children ages 9 to 11 as needed. Child and adolescent height, weight, and waist circumference were measured according to standardized procedures and body mass index (BMI) was calculated for each participant (Arteaga et al. 2015; John et al. 2015).

### Individual-level demographics

Parents completed a survey to report on individual-level demographics, including the child/adolescent's age, sex, grade in school, race, and ethnicity, as well as family income, parent education, and parent employment status.

### Community demographics

The American Community Survey was used to create community-level characteristics using three-year estimates from 2011–2013. Communities was characterized based on weighted census tract minority status (> 30% African-American, > 30% Hispanic, or Other), income (High or Low), urbanicity (Urban, Suburban, or Rural) and region (Northeast, West, Midwest, or South). Several other community-level demographic variables were created using census tract data, including: percentage of persons living below the poverty line; percentage of high school graduates; percentage unemployed; percentages of housing units that were renter-occupied or vacant; and percentage of population with health insurance.

### Parent support for PA

PA transportation was assessed as the weekly frequency with which a member of the child's household provided transportation so the child could participate in PA, with higher numbers indicating higher levels of parent support. This item was adapted from a previous study on youth PA by Sallis and colleagues (1999). Other large-scale studies have found a single-item assessment of parent support for transportation to have predictive validity for youth PA (Hoefer et al., 2001; Sallis et al., 1992, 1999).

### Measurement of children and adolescent's PA

PA was measured using self- or parental-report of participation in selected forms of PA. The 7-Day PA Behavior Recall assessed the child/adolescent's participation in 14 physical activities over the past 7 days. Examples include Physical Education, walking or biking to/from school, and school sports teams. This measure was based on previous self-report questionnaires that been used and validated in other large-scale studies (Gordon-Larsen et al., 2004; Hayden-Wade et al., 2003). Respondents reported whether the child participated in each activity during the past week, the days on which (s)he did the activity, and the intensity of the activity. A MVPA index was calculated using the subset of 11 activities that are typically performed at MVPA intensity (for further description of this measure, see Pate et al., (2015).

### Data analysis

Multilevel modeling was used to account for the non-independence in outcomes for youth within the same community. Model 1 included only the effects of individual-level covariates and contextual factors, including child/adolescent age, sex, race, BMI, ethnicity, family income, parent employment, parent education, season, urbanicity, and region. Consistent with studies showing that PA tends to be lower in winter, season was dummy coded, such that winter = 1, and all other seasons = 0 (Tucker & Gilliland, 2007). Additionally, dummy codes were created to compare rural communities (vs. all others) and communities in the Southern region of the U.S. based (versus all other regions) based on studies showing these areas tend to have the lowest levels of PA (Joens-Matre et al., 2008; Center for Disease Control and Prevention, 2014). Model 2 added parent support for PA transportation. Finally, Model 3 added community-level

poverty. Using mixed effects notation, the full statistical model is below:

$$\begin{aligned} MVPA =& \beta_0 + \beta_1 age_{ij} + \beta_2 male_{ij} + \beta_3 BMI + \beta_4 black_{ij} + \beta_5 white_{ij} + \beta_6 hispanic_{ij} \\ &+ \beta_7 parent\ income_{ij} + \beta_8 parent\ full-time\ employed_{ij} + \beta_9 parent\ college\ graduate_{ij} \\ &+ \beta_{10} winter_j + \beta_{11} rural_j + \beta_{12} south_j + \beta_{13} parent\ support\ for\ PA\ transportation_{ij} \\ &+ \beta_{14} community\ percent\ poverty_{ij} + b_i + \epsilon_{ij} \end{aligned}$$

where MVPA is predicted for the individual *i* in the *j*th community, $\beta_0$ is the intercept across all communities, $\beta_1 - \beta_{12}$ are the effects of individual-level covariates and contextual factors, and $\beta_{13}$—$\beta_{14}$ is the increase in MVPA associated with a one-unit increase in parent support for PA transportation and community-level poverty holding the covariates constant. The random effect $b_i$ allows for intercepts to differ among communities, thus accounting for any non-independence of the outcome within communities. The outcome variable, child/adolescent MVPA was square root transformed prior to analysis to achieve a normal distribution.

Intraclass correlation coefficients revealed that approximately 9.6% (ICC = 0.096) of the variance in MVPA in the full model was due to clustering at the community level, supporting the utility of a multi-level statistical approach. Multiple imputation techniques were used to address missing data. Results were averaged across 20 imputed datasets using the mitml package in R (Grund et al., 2018).

## Results

### Sample characteristics

Demographic characteristics are depicted in Table 1. Complete demographics and baseline characteristics of the HCS sample are described elsewhere (Author et al., 2018). Participants ($N = 5138$) were, on average, 9.28 years old ($SD = 2.65$). A similar number of boys and girls participated (49.1% male), with 18.7% identifying as African American and 43.3% as Hispanic.

### Modeling analyses

Model 1 tested the relationship between individual-level covariates and contextual factors predicting MVPA (Table 2). Participant sex, BMI, ethnicity, and season predicted MVPA, such that being female, higher in BMI, or Hispanic (versus non-Hispanic or unreported ethnicity) was associated with lower MVPA. Additionally, season was associated with MVPA, such that winter was associated with lower MVPA. Model 2 included the addition of parent support for PA transportation, in addition to the individual-level covariates and contextual factors, which significantly improved model fit ($F = 217.447$, $p < 0.001$) and revealed that parent support was positively associated with MVPA ($p < 0.001$). Model 3 included the addition of community-level poverty, which further improved model fit ($F = 4.863$, $p = 0.027$). The final model demonstrated that although

**Table 1** Family and child/adolescent demographics ($N = 5138$)

| | *N* | % |
|---|---|---|
| *Sex* | | |
| Males | 2524 | 49.1 |
| Females | 2614 | 50.9 |
| *Grade* | | |
| K-2 | 1935 | 37.7 |
| 3–5 | 1637 | 31.9 |
| 6–8 | 1566 | 30.5 |
| *Family income* | | |
| < $20 k | 1261 | 24.5 |
| $20-35 k | 1109 | 21.6 |
| $35-50 k | 602 | 11.7 |
| $50-75 k | 517 | 10.1 |
| $75-100 k | 383 | 7.5 |
| > $100 k | 840 | 16.4 |
| Don't know, refused or missing | 426 | 8.2 |
| *Child race* | | |
| White | 2924 | 56.9 |
| African-American (AA) | 960 | 18.7 |
| Other Only | 234 | 4.6 |
| More than 1 race | 227 | 4.4 |
| Don't know, refused or missing | 793 | 15.5 |
| *Child ethnicity* | | |
| Not Hispanic | 2767 | 53.9 |
| Hispanic | 2225 | 43.3 |
| Don't know, refused or missing | 146 | 2.9 |
| *Max parent education* | | |
| No high school | 434 | 8.5 |
| Some high school | 713 | 13.9 |
| High school | 979 | 19.1 |
| Some college | 646 | 12.6 |
| Associates degree | 591 | 11.5 |
| Bachelors degree | 756 | 14.7 |
| Masters and above | 844 | 16 |
| Missing | 175 | 3.4 |
| *Max parent employment* | | |
| Full time | 3424 | 66.6 |
| Part time | 510 | 9.9 |
| Temp lay off, sick leave, maternity leave | 41 | 0.8 |
| Unemployed | 268 | 5.2 |
| Disabled | 148 | 2.9 |
| Keeping house | 310 | 6 |
| Retired/student/other | 99 | 1.9 |
| Missing | 338 | 6.6 |

**Table 2** Results of the multi-level model describing the relationship between MVPA and individual-level demographics and contextual variables (Model 1), parent support for PA transportation (Model 2), and community-level poverty (Model 3)

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | *Estimate* | *SE* | *Estimate* | *SE* | *Estimate* | *SE* |
| *Fixed Effects* | | | | | | |
| Intercept | **3.525**** | **0.087** | **3.486**** | **0.086** | **3.651**** | **0.113** |
| Child age | − 0.014 | 0.007 | − 0.012 | 0.007 | − 0.011 | 0.007 |
| Male | **0.099**** | **0.033** | **0.088**** | **0.032** | **0.088**** | **0.032** |
| BMI | **− 0.007*** | **0.003** | − 0.006 | 0.003 | − 0.006 | 0.003 |
| Black | − 0.08 | 0.074 | − 0.032 | 0.072 | − 0.016 | 0.073 |
| White | − 0.07 | 0.061 | − 0.068 | 0.06 | − 0.068 | 0.06 |
| Hispanic | **− 0.152**** | **0.05** | **− 0.099*** | **0.049** | **− 0.098*** | **0.049** |
| Family income | 0.014 | 0.014 | − 0.001 | 0.013 | − 0.004 | 0.013 |
| Parent college educated | 0.042 | 0.042 | 0.018 | 0.041 | 0.013 | 0.041 |
| Parent full-time employed | 0.011 | 0.041 | 0.006 | 0.04 | 0.004 | 0.04 |
| Winter | **− 0.213**** | **0.043** | **− 0.178**** | **0.042** | **− 0.182**** | **0.042** |
| Rural | 0.113 | 0.091 | 0.139 | 0.091 | 0.154 | 0.091 |
| South | 0.00 | 0.078 | 0.026 | 0.078 | 0.029 | 0.077 |
| Parent support for PA transportation | | | **0.255**** | **0.017** | **0.255**** | **0.017** |
| Community percent poverty | | | | | **− 0.795*** | **0.361** |
| *Random effect* | | | | | | |
| Intercept | 0.375 | | 0.377 | | 0.371 | |
| ε ij | 1.328 | | 1.271 | | 1.270 | |

Significant effects are bolded, such that $^{**}p < .01$, $^{*}p < .05$; Model 2 fit the data significantly better than Model 1 ($p < .001$) and Model 3 fit the data better than Model 2 ($p = .027$)

community-level poverty was negatively associated with MVPA ($p = 0.027$), the positive association between parent support for PA transportation and MVPA remained significant ($p < 0.001$). Additional analyses were conducted to test moderation and found that parent support for PA transportation was not moderated by race, ethnicity, parent income, or parent education.

## Discussion

The present study found that parent support for PA transportation was associated with greater MVPA, whereas community-level poverty was associated with lower MVPA in children/adolescents. By using a stepped approach, the present study demonstrated that parent support for PA transportation remained significant even after accounting for community-level poverty, suggesting that parent support accounts for unique variance above and beyond community-level social and economic conditions. However, given that there were significant effects of both community-level poverty and parent support in the final model, these results also highlight the importance of evaluating sources of support and impediments to change across multiple systems of influence (i.e., individual and community levels). Whereas many previous studies have focused primarily on White and middle class children, by demonstrating that parent support for PA transportation was associated with child and adolescent MVPA across a range of communities, the present findings underscore the generalizability of this factor as a meaningful correlate of child/adolescent PA at a national level. PA has been associated with numerous physical and mental health outcomes for children, including adiposity, cardiometabolic biomarkers related to chronic disease (e.g., fasting glucose, insulin resistance), bone health, quality of life, and motor skill development (Joan Poitras et al., 2016). Thus, there remains a critical need to identify modifiable social-environmental barriers to engaging children and adolescents in greater PA in order to inform future interventions and health policies.

The present research adds to the growing literature on the importance of tangible forms of social support (i.e., provision of financial assistance, material goods, or services). Several studies have demonstrated the importance of parental social support for youth PA (Spinrad et al., 2007), but the majority of studies have focused on emotional social support (e.g., providing encouragement for PA), with fewer studies examining tangible forms of social support (Beets et al., 2010). Many previous studies have combined social support types and respondents into a composite measures, making

it challenging to determine the unique effects of parents and the type of support provided (Beets et al., 2010). Recently, however, researchers have begun to disentangle the unique effects of parental tangible and emotional social support on adolescent MVPA (Siceloff et al., 2014). By focusing specifically on the role of parents in providing transportation for PA, the present study adds to the growing literature on child and adolescent PA by demonstrating that across a diverse range of communities providing transportation for PA is a significant correlate of child/adolescent PA.

The present results suggest that enhancing transportation and access to places for children and adolescents to be active may be a critical target for future community-level programs and policies, but there are several challenges and opportunities that warrant further consideration. For families with limited time or resources for facilitating child transportation, there may be opportunities to draw from one's broader social network (e.g., eliciting help from teammates' parents, family friends, neighbors, extended family), which could be promoted through community-based programs or campaigns. Additionally, afterschool programs have become increasingly recognized as an important context to support youth PA (Trost et al., 2008; Zarrett & Bell, 2014), and often include district-provided transportation. Such programs may help to reduce some of the transportation burden for parents, especially for families with limited resources. Finally, future policies may also consider the role of neighborhood design as another approach for increasing access. Neighborhood walkability, for example, is a robust predictor of adolescents' objectively-measured PA among both low and high income communities (Sallis et al., 2018). Parents are more likely to encourage their children to walk or bike as active transportation if they perceive their neighborhood to be safe in terms of traffic, crime, and stranger danger (Esteban-Cornejo et al. 2016). Taken together, developing programs and policies that target improved transportation opportunities, prioritize access and transportation to afterschool programming, and improve neighborhood design (e.g., walkability) may help to address gaps in parent-provided transportation for PA.

Another finding from the present study was that community-level poverty was a stronger predictor of child/adolescent MVPA than individual-level family income. This finding is consistent with previous studies, which have found that childhood health outcomes are strongly associated with community-level social and economic conditions (Shih et al., 2013), and that addressing poverty at the community level (e.g., moving from a high poverty to low poverty neighborhood) has a stronger impact on childhood health outcomes than individual-level approaches (e.g., cash vouchers) (Ludwig et al., 2011, 2013). A child's income is strongly associated with their parent's income, such that those with experience poverty as a child tend to remain living in disadvantaged neighborhoods as adults (Council on Community Pediatrics, 2016; Mitnik & Grusky, 2015). The present study, by drawing from a national sample of communities, further strengthens the evidence-base for the need to target economic hardship at the community-level in order to reduce inequities in morbidity and mortality.

One challenge with identifying correlates of child/adolescent PA at a national level is that to achieve a large and representative sample, it is not always possible for studies like the HCS to include numerous time-intensive measures. To minimize participant burden and because it was not feasible to assess PA objectively in this large of a sample, the HCS included a single self-report item for assessing parent support for PA transportation, which is consistent with previous large-scale studies assessing parent support for transportation (Hoefer et al., 2001; Sallis et al., 1992, 1999). The present study used a self-reported measure of PA, which is prone to self-report bias (Loney et al., 2011; Prince et al., 2008). However, other large-scale studies using a similar approach have shown it to be a valid approach for assessing PA changes. (Gordon-Larsen et al., 2004; Hayden-Wade et al., 2003). Future research is needed to evaluate the relationship between parent support for PA transportation and community-level factors with objective measures of PA. Furthermore, given the cross-sectional design of this study, these results leave unanswered questions about the direction of the relationship between parent provision of transportation for PA and MVPA. Future longitudinal research is needed to clarify whether children who are active (for other reasons) results in greater parent provision of transportation for PA or whether parent support elicits increases in PA.

Despite these limitations, the HCS offered a unique opportunity to examine the generalizability of the relationship between parent support and child and adolescent PA across a national sample and while accounting for multiple systems of influence, including community-level poverty. This study contributes to a growing literature by demonstrating that parent support for PA transportation is associated with youth MVPA across a diverse range of communities, even when accounting for multiple systems of influence, including community-level poverty. These results provide evidence for the importance of continuing to think critically about how to enhance tangible and community-level support for communities through effective community programs and policies.

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**Compliance with Ethical Standards**

**Human and Animal Rights and Informed Consent** The study was approved by the Battelle Memorial Institute IRB and all procedures

were in accordance with ethical standards. Parents and children over the age of 8 provided written consent or assent.

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