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School environments predict Hispanic children's physical education related outcomes through basic psychological need satisfaction☆

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ABSTRACT

School physical activity environments including physical environment (e.g., facilities, equipment) and social environment (e.g., teachers and peers support) provide a foundational support for children's physical activities in school. Guided by self-determination theory, this study aimed to test three mediation models between school physical activity environments and PE related outcomes (i.e., effort in PE and physical fitness) through basic psychological need satisfaction (BPNS) among Hispanic children in the U.S. Participants included 215 fourth- and fifth-grade Hispanic children (M_{age} = 10.66 years), who completed (a) a survey measuring perceived school physical activity environments, BPNS, and effort in PE, and (b) the FITNESSGRAM® test battery assessing their cardiorespiratory fitness, muscular fitness, and body composition. Structural equation modeling revealed that, controlling for age, school physical activity environments positively predicted effort in PE through partial mediation of BPNS and physical fitness through full mediation of BPNS. These findings highlight the potential roles of school environments in predicting Hispanic children's health and fitness. Accordingly, building adequate physical activity facilities and providing culturally relevant activities is recommended for enhancing Hispanic children's learning in PE.

1. Introduction

The high prevalence of childhood overweight and obesity is a worldwide concern, which has heightened exponentially in the last three decades. In the U.S., the percentage of obese children aged 6–11 years increased from 7.0% in 1980 to 18.4% in 2015 (Hales, Carroll, Fryar, & Ogden, 2017). This obesity epidemic is even more severe among Hispanic children. As one of the fastest-growing ethnic groups in the U.S. (Colby & Ortman, 2015), Hispanic children are more vulnerable to obesity (Hales et al., 2017) and subsequent chronic diseases (Mayer-Davis et al., 2017), such as diabetes, than non-Hispanic children. Moreover, research has shown that Hispanic children are less likely to be physically active and more likely to be sedentary than their Caucasians and African American peers (Fakhouri, Hughes, Brody, Kit, & Ogden, 2013). To reduce these health disparities, it is necessary to examine Hispanic children's health-related outcomes and the underlying motivational mechanisms stemmed from school environments in which school-aged children spend almost 50% (7–8 h) of their awake time. Recent research has begun to investigate and indicate the predictive role of adaptive school environments in motivation for PE (Rutten, Boen, & Seghers, 2012, 2015). This study, therefore, examined these mechanisms, particularly the associations among school physical activity environments, basic psychological need satisfaction [BPNS], and physical education (PE) related outcomes such as effort in PE and physical fitness in Hispanic children.

1.1. School physical activity environments

Whereas school PE is an important channel for school-aged children to promote physical activity during school days, children's intrinsic motivation and enjoyment toward PE gradually decline at late elementary years (Cairney et al., 2012). Empirical evidence indicates that both school environments (i.e., physical and social environments) and children's BPNS are significant correlates of children's motivation (or

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lack thereof) toward PE (Rutten et al., 2012). Because motivation influences PE related outcomes, and in turn, physical activity behaviors outside of school (Hagger & Chatzisarantis, 2016), it is imperative to investigate the roles of school physical activity environments in these underlying mechanisms, especially among Hispanic children who suffer from low physical activity participation. Hispanic children are faced with less physically active lifestyle than non-Hispanic children, contributing to disparities in PE and health related outcomes (Gu, Chen, & Zhang, 2019).

The school physical activity environment includes physical environment and social environment that provides a foundational support for children's physical activities in school (Rutten et al., 2012). *School physical environment* refers to the indoor and outdoor facilities and equipment to support children physical activity and skill practice, such as the size, number, quality, and availability of playground, gym, and other sport equipment (Rutten et al., 2012). An optimal school physical environment may support children's ability and desire to engage in a variety of activities that they like and feel competent and to become physically fit as a result. Research has shown that school physical environment, especially the equipment availability and safety, contributes to a small, but significant, proportion of variances in physical activity participation among adolescents (Motl et al., 2005; Zhang, Solmon, Gao, & Kosma, 2012). Motl et al. (2005) further found that adolescent girls' self-efficacy for overcoming barriers mediated the association between perceived physical environment and physical activity. On the other hand, *school social environment* includes teacher support and peer support for physical activities in schools (Rutten et al., 2012). For instance, a positive school social environment, along with senses of belonging and accomplishment, can form when teachers and peers encourage students to try out different sports to promote physical activity participation.

1.2. Basic psychological need satisfaction

Self-determination theory (SDT; Deci & Ryan, 1985) has been widely applied to understanding individuals' motivational processes in learning contexts. Basic psychological need theory (BPNT), a mini-theory of SDT, proposes that fulfillment of an individual's needs for autonomy, competence, and relatedness is associated with positive PE related outcomes, including greater effort in PE and general well-being (Chu, Zhang, Thomas, Zhang, & Gu, 2019; Taylor & Lonsdale, 2010). According to Deci and Ryan (1985), *autonomy* concerns with having choices and experiencing volition, such as making own decisions on what activities to engage during PE. *Competence* reflects desires and needs to feel a sense of mastery in a social context. For example, children feel competent in PE and may try harder when they successfully demonstrate skills and accomplish tasks that are optimally challenging. *Relatedness* corresponds to the feeling of belongingness—being emotionally connected to and cared for by significant others. For instance, children can feel related to classmates and become more engaged in PE if they are involved and cooperate in group activities and team sports. The BPNS of all three needs is essential for optimal learning in PE, especially in the physical and cognitive domains. Children who report greater satisfaction of competence, autonomy, and relatedness needs demonstrate higher levels of physical activity and physical fitness (Taylor & Lonsdale, 2010), as well as greater effort and vitality in PE (Hein et al., 2018). Based on the theory and empirical evidence, BPNS also mediates the relationships between social environment and PE related outcomes (Ntoumanis, 2001, 2005).

While ample research has examined the roles of teaching climates in motivation toward PE across various races/ethnicities and age groups (Chu, Zhang, & Cheung, 2019; Taylor & Lonsdale, 2010), investigating how the broader school physical activity environments interact with BPNS may provide further understandings of what infludneces PE related outcomes (Rutten et al., 2012; Rutten, Boen, Vissers, & Seghers, 2015). Rutten et al. (2012) found that perceived school physical environment and social environment were positively associated with all three BPNS (*r*s ranged from 0.12 to 0.48) among sixth graders. More specifically, physical environment significantly predicted children's autonomous motivation in PE through autonomy, and social environment significantly predicted autonomous motivation toward PE through autonomy and competence. Therefore, sufficient facilities and equipment may support children' BPNS by offering them various activity choices and opportunities, while social support from teachers and peers may support children's BPNS by providing them with a sense of control, connection, and effectiveness for better motivation toward PE. However, a longitudinal study showed that neither physical nor social environment predicted physical activity and sedentary behavior (Rutten, Boen, Vissers, & Seghers, 2015). Research on underserved middle school students revealed that school physical environment was positively associated with cardiorespiratory fitness, and that school social environment, particularly classmate support, was positively associated with muscular fitness (J. J. Martin, McCaughtry, Flory, Murphy, & Wisdom, 2011). Given the mixed findings, examining both the physical and social components of school physical activity environment in relation to different PE related outcomes is needed to provide more comprehensive understanding of their relationships.

1.3. PE related outcomes

It is well established that regular physical activity and good physical fitness are beneficial to children's physical and mental health (Nightingale et al., 2018). Physical fitness, particularly high levels of cardiorespiratory fitness and muscular fitness along with low adiposity, are associated with lower health risks for chronic diseases, such as high cholesterol and high blood pressure (Nightingale et al., 2018). While physical fitness is an important physical outcome in PE, effort is an important cognitive leaning outcome in PE (SHAPE America, 2013)—representing conscious interpretation of afferent sensations of an expected outcome—such as the perceived time and energy to master physical skills (Hampson, St Clair Gibson, Lambert, & Noakes, 2001; St Clair Gibson et al., 2006). Children who put forth more effort in PE are more likely to engage in physical activity, which in turn, show more activity time and better motor skill performance (Hein et al., 2018).

Empirical evidence further suggests that children with greater BPNS generally put forth higher levels of effort in PE. Specifically, Taylor and Lonsdale (2010) revealed the mediating role of BPNS between autonomy support and perceived effort in PE among 715 middle school students from the U.K. and Hong Kong. Gillison, Standage, and Skevington (2013) manipulated the social environment in a middle school PE fitness class, indicating that students who were supported with autonomy exerted greater effort than those in the control group. To date, there is little, if any, evidence regarding the associations between children's perceived physical environment in school and their effort in PE, although Solmon (2015) necessitates the consideration of school physical environment for promoting children's physical activity and fitness. Thus, investigating both school physical and social environments that can contribute to children's effort in PE and physical fitness is warranted.

1.4. The current study

Racial/ethnic background plays a role in the relationships between school environments and, students' BPNS and physical activity participation (Taylor & Lonsdale, 2010). Research shows that children from schools with predominantly ethnic minorities, particularly Hispanics, are less physically active than those from schools with predominantly Caucasians (Kwon, Mason, & Welch, 2015). It implies that the relations of school physical activity environments with effort in PE and physical fitness may be different between Hispanic children and their Caucasian counterparts, who constituted the majority of the samples in this line of research. For instance, most Hispanic children go to schools

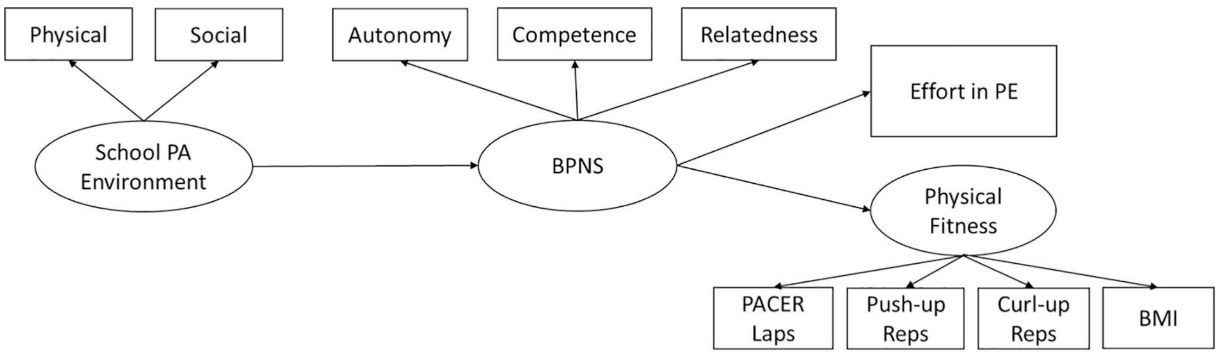

Fig. 1. Hypothesized mediation model using basic psychology need satisfaction as a latent variable. PA = physical activity; BPNS = basic psychology need satisfaction, PE = physical education; PACER = Progressive Aerobic Cardiovascular Endurance Run; BMI = body mass index.

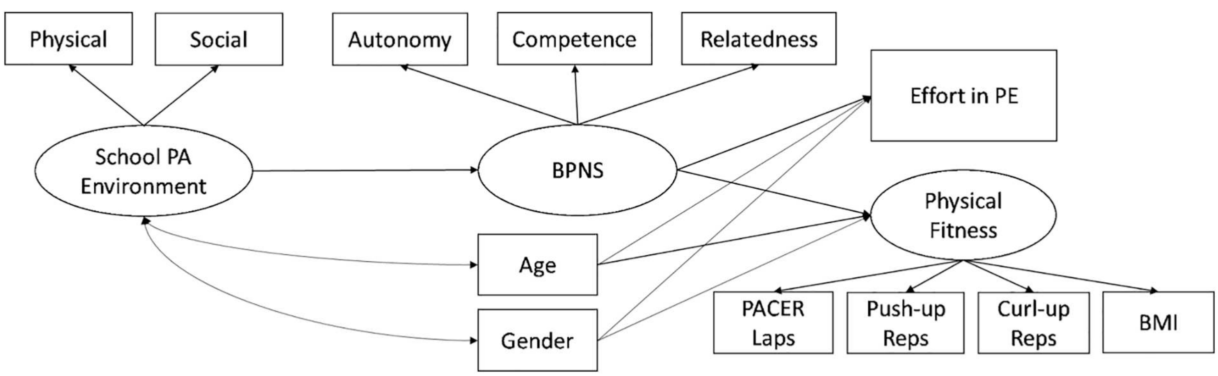

Fig. 2. Modified hypothesized mediation model with age and gender control variables. PA = physical activity; BPNS = basic psychology need satisfaction, PE = physical education; PACER = Progressive Aerobic Cardiovascular Endurance Run; BMI = body mass index.

surrounding low-income families who are primarily ethnic minorities (Amin et al., 2017; Gu et al., 2019). Hispanic children also tend to report less favorable experience of safety, connectedness, and relationships with teachers and other adults in school than do their Caucasian peers (Voight, Hanson, O'Malley, & Adekanye, 2015). To fill the aforementioned research gaps, the current study focused on school environments that lacked sufficient evidence in elementary children, particularly among Hispanics who are understudied (Chu, Zhang, Thomas et al., 2019).

The aim of this study was to examine the relationships between school physical activity environments and PE related outcomes (i.e., effort in PE and physical fitness), as well as the mediating roles of BPNS, among fourth- and fifth-grade Hispanic children. Specifically, this study tested three mediation models: (1) a hypothesized model using BPNS as the mediating variable (Model 1; see Fig. 1); (2) a modified hypothesized model with an addition of age and gender as potential control variables (Model 2; see Fig. 2) given that children's effort in PE and physical fitness achievement decline with age and that these relationships vary by gender (Chu, Zhang, Thomas et al., 2019; Bai et al., 2015); and (3) a further modified hypothesized model (based on Model 1 or 2) with an addition of direct paths from school physical activity environments to effort in PE and/or physical fitness (Model 3; model specification determined upon fit indices and modification indices) due to some evidence supporting school environments' direct effect on effort in PE (Gillison et al., 2013).

The sample of this study was from a larger study and overlapped with that of Chu, Zhang, Thomas et al. (2019), although the aims of these two studies were substantially different. Chu, Zhang, Thomas et al. (2019) examined gender differences in the relative importance of BPNS in PE in predicting physical, cognitive, and psychological outcomes, indicating that (a) competence was the most important BPNS in predicting effort and well-being among both boys and girls; (b) relatedness predicted only well-being among boys, but both effort and well-being among girls; and (c) autonomy did not predict any outcomes. The unique contribution of Chu, Zhang, Thomas et al. (2019) was on examining the predictive strengths of autonomy, competence, and relatedness on Hispanic boys' and girls' PE related outcomes, which could inform PE teaching strategies by taking gender into account. The current study differs in the following ways: (a) focusing on the direct and indirect effects of physical activity environments as the exogenous variable guided by SDT; (b) testing BPNS for their mediating roles using structural equation modeling (SEM); and (c) examining all of the fitness components as a latent variable instead of focusing on only one—-cardiorespiratory fitness. The unique contribution of this study pertains to the understanding of both school physical and social environments in relation to effort in PE and physical fitness through BPNS, which could inform school-level intervention endeavors beyond existing student-level ones (Cheon, Reeve, & Ntoumanis, 2018).[1]

2. Methods

2.1. Participants

Two hundred and fifteen fourth- and fifth-grade Hispanic children (M_{age} = 10.66 years, SD = 0.58 years; 111 boys, 104 girls) from four elementary schools in the southwestern U.S. participated in this study. In the student population of these four schools, about 47% were Hispanic and 78% were from low-income families with free or reduced

[1] In addition to different focuses of these two studies, school physical activity environments could not have been included due to the small sample size for testing gender invariance. Also, while there is evidence that gender influences the contribution of autonomy, competence, and relatedness in the motivational processes, no such support is provided to test gender differences in the role of school physical activity environments.

lunch status. Each school had two PE class sections; students from each grade were assigned to one of them for a 45-minute class period on alternate days of the week: Monday, Wednesday, and Friday in one week and Tuesday and Thursday in the next. The two PE class sections received the same lessons in the same week using both indoor gymnasium and outdoor playground areas unless the weather conditions did not allow. These four elementary schools have similar sizes of indoor gymnasium and outdoor playground areas, but the available physical activity equipment and green field spaces are different.

Eight state-certified PE teachers with at least five years of teaching experience, including two male dyads, a female dyad, and a mixed-gender dyad, co-taught all of the PE classes in the four corresponding schools. These teachers typically taught motor skills via a direct instruction approach at the beginning of the class, followed by providing opportunities for student practice for most of the class time and then a lesson summary at the end. Students in all four schools performed similar sports and physical activities by following the curriculum calendar of the same school district and corresponding teacher directions.

2.2. Measures

2.2.1. School physical activity environment

The perceived school physical and social environments were measured using the 20-item Questionnaire Assessing School Physical Activity Environment (Q–SPACE; Robertson-Wilson, Lévesque, & Holden, 2007). Twelve items assess the physical environment (e.g., "My school has good quality sport and physical activity equipment for students to use") and eight items assess the social environment (e.g., "Teachers usually encourage me to be physically active at school"). Participants rated the items on a 5-point Likert scale of 1 (*strongly disagree*) to 5 (*strongly agree*). Good construct validity was shown across countries and age groups, including elementary school-aged children (Robertson-Wilson et al., 2007; Rutten, Boen, Vissers, & Seghers, 2015).

2.2.2. Basic psychological need satisfaction in PE

Autonomy was assessed with Standage, Duda, and Ntoumanis' (2005) 6-item scale beginning with "In my PE class…" (e.g., "I have some choice in what I want to do"), including one reverse-scored item "I have to force myself to do the activities." Competence was assessed with the 5-item Competence subscale of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) adapted to PE settings (Standage et al., 2005). Each item begins with "In my PE class…" (e.g., "I think I am pretty good at PE"); there is one reverse-scored item "I cannot do PE very well." Relatedness was assessed with the 5-item Acceptance subscale of the Need for Relatedness Scale (NRS; Richer & Vallerand, 1998) adapted to PE settings (Standage et al., 2005). Each item begins with "With the other students in my PE class, I feel…" (e.g., "supported"). Participants rated the items of the three measures on a 7-point Likert scale of 1 (*strongly disagree*) to 7 (*strongly agree*). All three measures demonstrated good construct validity across countries and age groups, including elementary school-aged children (Standage et al., 2005).

2.2.3. Effort in PE

Perceived effort in PE was assessed with the 4-item Effort subscale of the IMI (McAuley et al., 1989) adapted to PE settings (Ntoumanis, 2001), such as "I put a lot of effort when I play in this PE class" and one reverse-scored item "I don't try very hard in this PE class." Participants rated the items on a 7-point Likert scale of 1 (*strongly disagree*) to 7 (*strongly agree*). Past research revealed good construct validity of the measure across countries and age groups, including elementary school-aged children (Ntoumanis, 2001).

2.2.4. Physical fitness

The FITNESSGRAM® test battery (Meredith & Welk, 2014) was used to assess participants' physical fitness, including cardiorespiratory fitness, muscular fitness, and body composition. Cardiorespiratory fitness was assessed with the number of 20-meter lap completion in the PACER (Progressive Aerobic Cardiovascular Endurance Run) test, a 20-meter multistage shuttle run test in which participants followed the running speed that started slow and increased gradually each minute based on an audio sound track. When participants failed to reach the end lines on two occasions or stopped due to fatigue, the number of laps was recorded. Muscular fitness was assessed with a push-up and a curl-up tests that indicated both muscular strength and endurance. For the push-up test, participants were instructed to perform the maximal number of push-ups by following the audio cadence of "up" and "down" with their arms bent to a 90 degree angle. For the curl-up test, participants were instructed to perform the maximal number of curl-ups by following the audio cadence of "up" and "down" to curl up and down and slide their fingers across the 3-inch measurement strip on a standard curl-up mat. When participants failed to perform push-ups and curl-ups in correct form on two occasions or stopped due to fatigue, the number of reps for the respective test was recorded. Body composition was assessed with body mass index (BMI), which was calculated using objective height and weight (weight (kg)/[height (m)]^2) measured on the Health-O-Meter 500KL Digital Scale. These four measures, which have been validated and used in statewide fitness assessments from elementary to high school (Bai et al., 2015; Meredith & Welk, 2014), were used to form the physical fitness latent variable.

2.3. Procedure

After the study was approved by the university's institutional review board (IRB) and the school district, Hispanic children were invited to participate in this study based on the demographic information (race/ethnicity, gender, and date of birth) provided by the four schools. Upon collection of parental consents and student assents, data were collected from each PE section of each grade over three PE class periods: (1) the first author instructed the participants to complete paper-and-pencil surveys containing the study measures; (2) the first author and two trained research assistants measured participants' height and weight and then administered the PACER test; (3) the first author and two trained research assistants administered the push-up and curl-up tests. To ensure non-Hispanic children were not isolated, they were asked to perform physical activities with the PE teachers at the gymnasium during survey data collection and complete fitness tests with the Hispanic participants, though their test results were not recorded.

2.4. Data analysis

Prior to data analysis, all of the missing and invalid values were identified. The total missing values consisted of $<5\%$ of the data, and thus expectation-maximization (EM) algorithm was performed for missing data imputation (Tabachnick & Fidell, 2007). Then, all of the survey items for each subscale were averaged to form an observed variable for data analysis. Each observed variable was screened for outliers ($|z| > 3$; significant Mahalanobis D^2) and normality (|skewness and kurtosis| < 2) to remove their potential influence on the results (Tabachnick & Fidell, 2007). Next, descriptive statistics and bivariate correlations were computed for each survey variable and fitness component. Finally, SEM was conducted to test three hypothesized mediation models with consideration of age and gender as control variable. Prior to testing the proposed structural models, confirmatory factor analyses were conducted to test the fit of measurement models. After the adequacy of the measurement model was confirmed, a structural equation model was tested to examine the hypothesized structural relations among the latent variables. School physical activity environments and physical fitness were treated as latent variables, BPNS was treated as latent variable, and effort in PE and control variables were treated as observed variables.

In line with the recommendation of Hu and Bentler (1999), various indices of fit were examined in the current study to evaluate the adequate fit of the model to the data. Specifically, chi-square statistic (χ^2) was used to test whether there was a statistically significant difference between the model and the sample data based on the degrees of freedom (*df*) for each estimation. Given that χ^2 can be heavily influenced by the sample size, the χ^2/df ratio was reported (between 2 and 5 is appropriate). Further, acceptable and excellent model fits, respectively, were determined using goodness-of-fit indices—comparative fit index (CFI) > 0.90 and 0.95, Tucker–Lewis index (TLI) > 0.90 or 0.95, root mean square error of approximation (RMSEA) with its 90% confidence interval (90% CI) < 0.08 or 0.06 (Hu & Bentler, 1999). At the same time, the factor loadings, standard errors, residual variances, the Aikaike information criterion (AIC), and the Bayesian information criterion (BIC) were examined for further model testing, comparisons, and interpretation. In addition, chi-square difference tests ($\Delta\chi^2$) were employed to compare nested models to investigate any significant alterations in the model fit. If a χ^2 difference ($\Delta\chi^2$) score for adding parameters to a model is significantly larger than zero, it indicates that the newer model has improved fit to the data than the original model (Kline, 2016). Finally, to test for the statistical significance of the indirect effect in the SEM models, a bootstrapping technique with 5000 resamples and bias-corrected 95%CI was utilized (Preacher & Hayes, 2008). An indirect effect is significant when the bias-corrected 95%CI does not include zero.

3. Results

The results of data screening revealed normally distributed data without univariate or multivariate outliers among the study variables, except for BMI that typically has high kurtosis (Ng, Liu, Thomson, & Murray, 2016). Table 1 presents the descriptive statistics and bivariate correlations for each observed variable. In general, there was an expected pattern of positive correlations among school physical activity environment, BPNS, effort in PE, and physical fitness to justify further SEM analysis. Additionally, the scores for the observed variables indicated acceptable internal consistency ($\alpha > 0.70$), and multicollinearity issues did not exist based on the values of variance inflation factors (VIF < 10), tolerance (>0.10), and condition numbers ($\kappa < 30$).

SEM was conducted to examine the relationships between school physical activity environments and PE related outcomes (i.e., effort in PE and physical fitness) through BPNS among Hispanic children. The goodness-of-fit statistics indicated an acceptable measurement model, $\chi^2/df = 2.054$; CFI = 0.948; TLI = 0.910; RMSEA (90% CI) = 0.071 (0.046, 0.095). Moreover, the standardized factor loadings of all observed variables on their respective latent variables were larger than 0.40 and statistically significant (see Supplementary Table), indicating that each variable was appropriately supported by valid constructs of the measurement models. Thus, the subsequent structural models could be tested, and their results are reported in Table 2. Based on the goodness-of-fit statistics, the hypothesized model without control variables (Model 1) exhibited an acceptable fit. Therefore, modified hypothesized models were further tested by adding control variables. Regarding the modified hypothesized model with age as a control variable (Model 2), the goodness-of-fit statistics revealed an acceptable fit only when age predicted physical fitness, but not effort in PE. Because age was a significant control variable in line with previous research evidence, the modified hypothesized model was chosen as a more theoretically appropriate model than the original hypothesized model. To determine the fit of more potential models, theoretically justifiable modifications were tested.

The modification indices of the hypothesized model suggested an addition of a direct path from school physical activity environments to effort in PE; thus, this modified hypothesized model (Model 3) was evaluated. The goodness-of-fit statistics (see Table 2) indicated that this modification resulted in a significantly better fit ($\Delta\chi^2 = 6.907$, $p = .009$) than Model 2 without the direct path (Kline, 2016), and all CFI, TLI, and RMSEA 90% CI met the acceptable standards. When an addition of a direct path from school physical activity environments to physical fitness was evaluated, the goodness-of-fit statistics indicated that this modification did not result in a better fit ($\Delta\chi^2 = 0.942$, $p = .33$). Therefore, model comparisons revealed that Model 3 with a direct path from school physical activity environments to effort in PE was the most theoretically appropriate and parsimonious model (see Fig. 3) for interpretation.

In the final model, all standardized factor loadings were moderate to strong (ranging from 0.40 to 0.93), and all parameter estimates were statistically significant with appropriate magnitude and direction. The variance explained in each endogenous variable within the model was as follows: $R^2 = 12.5\%$ for BPNS, $R^2 = 52.2\%$ for effort in PE, and $R^2 = 20.6\%$ for physical fitness. As a control variable, age negatively predicted physical fitness and was negatively associated with school physical activity environments. School physical activity environments positively predicted BPNS with a small effect, which in turn positively predicted effort in PE with a large effect and physical fitness with a medium effect. School physical activity environments also directly and positively predicted effort in PE with a small effect. Results of the bootstrapping technique indicated that the indirect effects of school physical activity environments on effort in PE ($\alpha\beta = 0.23$, 95%CI = 0.144–0.341) and fitness ($\alpha\beta = 0.10$, 95%CI = 0.053–0.173) were both statistically significant. Therefore, BPNS fully mediated the relationship between school physical activity environments and fitness, but partially mediated that between physical activity environments and effort in PE.

Table 1
Descriptive statistics and bivariate correlations among study variables ($N = 215$).

		M	*SD*	γ	Kurt	1	2	3	4	5	6	7	8	9	10
1.	Physical environment	3.05	0.54	−0.34	−0.01	**0.78**									
2.	Social environment	3.10	0.62	−0.65	−0.11	0.71***	**0.76**								
3.	Autonomy	4.36	1.41	−0.21	−0.76	0.18**	0.15	**0.69**							
4.	Competence	5.10	1.50	−0.55	−0.29	0.26***	0.22**	0.58***	**0.89**						
5.	Relatedness	4.98	1.43	−0.68	−0.39	0.30***	0.29***	0.59***	0.65***	**0.82**					
6.	Effort	5.55	1.49	−0.91	−0.14	0.36***	0.29***	0.42***	0.63***	0.55***	**0.86**				
7.	PACER laps	19.62	8.62	0.66	−0.15	−0.03	−0.01	0.17*	0.19**	0.03	0.04	–			
8.	Pushups reps	8.19	6.85	0.97	0.57	0.21**	0.17*	0.07	0.18**	0.16*	0.14	0.26**	–		
9.	Curl-ups reps	20.23	13.34	0.80	0.34	0.17*	0.15*	0.02	0.21**	0.16*	0.23**	0.19**	0.42**	—	
10.	BMI	21.45	5.21	1.47	5.32	−0.02	−0.04	−0.05	−0.20**	−0.01	−0.09	−0.38**	−0.27**	−0.27**	—
11.	Age	10.66	0.58	0.09	−1.35	−0.21**	−0.20**	−0.10	−0.16*	−0.16*	−0.22**	0.03	−0.38**	−0.12	0.19**

Note. *M* = mean; *SD* = standard deviation; γ = skewness; Kurt = kurtosis; BMI = body mass index. Cronbach's αs are in **bold** on the diagonal.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 2
Comparison among the hypothesized and the alternative models (N = 215).

Model	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA (90%CI)	AIC	BIC	$\Delta\chi^2$	Δdf
1. Hypothesized model without control variables	71.042*	33	2.153	0.941	0.920	0.073 (0.050–0.097)	115.042	189.197		
2. Modified hypothesized model with age control variable	89.304*	41	2.178	0.929	0.905	0.074 (0.053–0.095)	139.304	223.570		
3. Modified hypothesized model with age control variable and an added direct path from school PA environment to effort in PE	82.397*	40	2.060	0.938	0.914	0.070 (0.049–0.092)	134.397	222.034	6.907*	1

Note. χ^2 = chi-square; *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker–Lewis Index; RMSEA = root mean square error of approximation; CI = confidence interval; AIC = Aikaike Information Criterion; BIC = Bayesian Information Criterion; $\Delta\chi^2$ = chi-square difference; PA = physical activity; PE = physical education.
* $p < .05$. $\Delta\chi^2$ and Δdf compare Model 3 to Model 2.

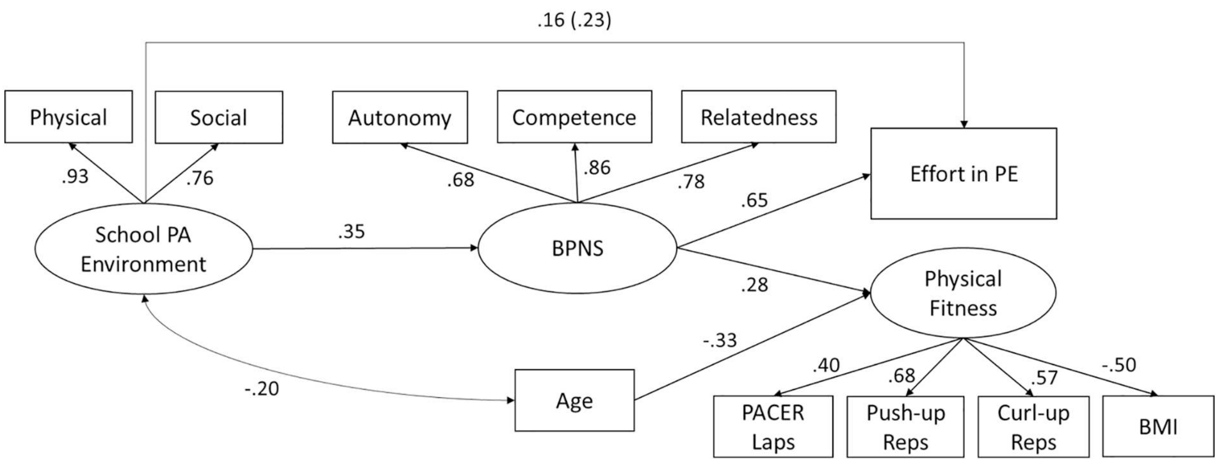

Fig. 3. Final mediation model with age as a control variable. PA = physical activity; BPNS = basic psychology need satisfaction, PE = physical education; PACER = Progressive Aerobic Cardiovascular Endurance Run; BMI = body mass index. All paths contain statistically significant ($p < .05$) standardized coefficients. The parenthesis in the path from School PA Environment to Effort in PE represents the standardized indirect effect.

4. Discussion

This study examined the relationships between school physical activity environments and PE related outcomes, and whether they were mediated by BPNS among Hispanic fourth- and fifth-grade children. The findings extended the current literature (Rutten et al., 2012; Rutten, Boen, Vissers, & Seghers, 2015) by testing the potential contribution of school physical activity environments, consisting of physical and social dimensions, among Hispanic children. This was also the first study to date that employed SEM to test three hypothesized models with direct and indirect effects of school physical activity environments on effort in PE and physical fitness. The final model indicated that school environments positively predicted BPNS, which in turn positively predicted effort in PE and physical fitness when controlling for age. Further, school physical activity environments directly and positively predicted effort in PE.

These findings suggest that, consistent with the hypothesis and previous research, school physical activity environments play a crucial role in Hispanic children's motivational processes, and in turn, physical and cognitive outcomes in PE (K. Martin, Bremner, Salmon, Rosenberg, & Giles-Corti, 2014; Rutten et al., 2012; Rutten, Boen, & Seghers, 2015; Rutten, Boen, Vissers, & Seghers, 2015).

Expanding on Rutten and colleagues' (Rutten et al., 2012; Rutten, Boen, Vissers, & Seghers, 2015) findings that school physical environment positively predicted autonomous motivation in PE through the mediating role of BPNS, this study added that school physical and social environments together positively predicted PE related outcomes through the mediating role of BPNS. Aligned with the goals of the Comprehensive School Physical Activity Program (CSPAP; Centers for Disease Control and Prevention, 2013) that emphasizes physical activity opportunities outside of PE, this study highlights the importance of enhancing the quality of physical activity facility and equipment and providing optimal teacher and peer support through additional organized physical activities during recess and after school. With quality school physical and social environments, Hispanic children are more likely to put forth effort in PE and promote physical fitness, which can in turn promote their physical activity participation both in and outside of school (Hein et al. Chu, & Zhang, 2018; Martin et al., 2014). This result further supports previous evidence that underserved children might benefit more from conducive school physical activity environments than non-underserved children might (Martin et al., 2011). The direct and indirect effects of school environment on effort and physical fitness are worth considering when implementing physical activity interventions given the increasing number of overweight or obese children in the U.S., among which Hispanic children with low SES have the highest rate (about 50%; National Physical Activity Plan Alliance, 2016).

Beyond the main relationships in the SEM models, several patterns concerning the observed and control variables are worthy of note. Consistent with past studies, physical environment contributed to a larger portion of school physical activity environment than did social environment (Robertson-Wilson et al., 2007), and competence contributed more to a large portion of BPNs than did autonomy and relatedness (Brunet, Gunnell, Teixeira, Sabiston, & Bélanger, 2016). Thus, while enhancing social environment, autonomy, and relatedness is important, prioritizing improvement of physical activity facility and equipment and supporting Hispanic children's competence may result in better school environments and greater BPNS. For instance, schools may invest in more grassed surface and sports equipment, which many schools with ethnic minorities lack, in order to maximize physical activity opportunities for large groups of children (Martin et al., 2014). Further, teachers should consider culturally relevant activities (e.g., soccer, baseball) when purchasing equipment with adequate quantity and quality to encourage Hispanic children's participation and promote their competence and relatedness satisfaction. In an effort to further support Hispanic children's competence, teachers ought to create a climate that focuses on self-reference (i.e., self-improvement) instead of social comparison for their goals and success in PE (Chu, Zhang, & Cheung, 2019). Introducing various sports and roles (e.g., officials) via a Sport Education curriculum in PE is also recommended for developing Hispanic children's competence (Chu, & Zhang, 2018).

Another emerging pattern found in the SEM model was the unexpected negative relationships between age and, school physical activity environment and physical fitness. The finding of lower physical fitness in the older participants might be explained by their greater BMI and less effort in PE than the younger participants. Effort is one of the two most vital potential threats to internal validity in fitness testing, and the lack thereof among some older participants in this study might have also contributed to some undetectable inaccurate fitness test results, not only for those participants but also for other classmates due to the contagion effect (Taylor & Lonsdale, 2010). In order to improve effort among older children, future research may follow Wiersma and Sherman's (2008) guidelines regarding fitness test administration, such as emphasizing attention and maximal effort, or spreading out the tests over few days for small group testing.

Because we did not personally know the participants, with a limited number of personnel in data collection, we unfortunately could not have identified the participants who might have exerted less effort for us to individualize instruction to them. Spreading out the fitness tests was also not an option due to the interference that would cause delays in the schools' PE curriculum. Nevertheless, employing not only a subjective measure of cognitive outcome (i.e., effort), but also several objective tests of physical fitness, enhanced the internal validity of our results. Additionally, our study finding may indeed better reflect the real situation that those participants who had lower BPNS would exert less effort and perform worse in PE, and over time, would suffer from lower BPNS. Further longitudinal and experimental studies are needed to test these reciprocal relationships and the casual inference in the SEM models tested in this study.

Other limitations are present in this study in addition to the abovementioned ones. Despite the theoretically and practically important investigation of school physical activity environment's relationships with BPNS and PE related outcomes, we were not able to determine which specific components of the physical and social environments were more important than the others. Future intervention and qualitative research is needed to examine what facility, equipment, and physical activity opportunities are effective and practical in enhancing students' BPNS in PE.

Due to an insufficient sample for multigroup or multilevel SEM (Preacher, Zyphur, & Zhang, 2010) and our statistical software choice, we were not able to investigate gender invariance and variation at the classroom level that could influence the results of this study. Further studies with larger and diverse samples are needed to examine how similar or different school environments predict BPNS and PE related outcomes across different school-level variables, such as scheduled physical activity time, geographic regions, enrollment sizes, and teacher qualifications. Examining both the Hispanic and non-Hispanic samples within a study is also needed in order to explore similarities and differences in the role of school physical activity environments across racial/ethnic groups.

Some of the Hispanic children in the current study might participate in sports outside of school, which might be a confounding variable that influenced their levels of physical fitness. Future studies on Hispanic children and adolescents need to take into account their sport participation and several sociodemographic factors, including family background, country of origin, and levels of acculturation, that could cause individual differences within the Hispanic population (Amin et al., 2017). Despite these limitations, this initial investigation on an ethnic minority in PE encourages more research comparing various races/ethnicities, levels of acculturation, and different learning environments.

5. Conclusions

As one of the first PE studies focused on Hispanic children, a population experiencing more health issues than their counterparts in the U.S., our study adds to the current knowledge base for practical implications in PE and school environments that could potentially mitigate some of the negative health trends. Consistent with previous studies that a SDT framework can be implemented for creating PE programs conducive to health and well-being, our findings revealed the importance of examining school physical and social environments beyond PE teachers' support for BPN. Furthermore, the results of this study shed light on the potential roles of school physical activity environments in predicting other PE related outcomes. With increasingly diverse student populations in the U.S., this line of research is essential to inform policy regarding the development of physically fit and healthy children across schools and races/ethnicities.

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