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Where are children active and does it matter for physical activity?: A latent transition analysis

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Abstract

Background—Numerous studies have focused on the role of environments in promoting physical activity, but few studies have examined the specific locations where children are active and whether being active in these locations is associated with physical activity levels over time.

Methods—Self-reported locations of where physical activity occurred and physical activity measured via accelerometry were obtained for a cohort of 520 children in 5th and 6th grades. Latent class analysis was used to generate classes of children defined by the variety of locations where they were active (i.e., home, school grounds, gyms, recreational centers, parks or playgrounds, neighborhood, and church). Latent transition analyses were used to characterize how these latent classes change over time and to determine whether the latent transitions were associated with changes in physical activity levels.

Results—Two latent classes were identified at baseline with the majority of children in the class labeled as 'limited variety'. Most children maintained their latent status over time. Physical activity levels declined for all groups, but significantly less so for children who maintained their membership in the 'greater variety' latent status.

Conclusions—Supporting and encouraging physical activity in a variety of locations may improve physical activity levels in children.

Keywords

exercise; accelerometry; environment; pediatrics; physical activity

Introduction

Physical activity offers many physical and mental health benefits to children and adolescents, including lower adiposity, improved markers of cardiovascular health, increased bone mineral density, and reduced depression and anxiety[1–5]; however, the majority of adolescents in the US are not sufficiently physically active. Only 42% of US children (aged 6–11) meet the US physical activity guidelines,[6] which recommend physical activity for at

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least 60 minutes every day for children and adolescents.[7] Furthermore, physical activity levels decline significantly from childhood into adolescence, with only 8% of adolescents aged 12–19 meeting physical activity recommendations.[6] Identifying the reasons for this decline is critically important for developing approaches to increase physical activity levels among youth.

Environmental features of communities have been identified as important targets for addressing physical inactivity. In particular, having access to places to play has been associated with increased physical activity levels in children and adolescents.[8,9] For example, each additional park in a half-mile radius around a girl's home was associated with an increase of 17 minutes of moderate-to-vigorous activity (MVPA) over six days.[10] Similarly, the number of private recreational facilities in a one-mile buffer around a girl's home was associated with higher levels of physical activity.[11] Most of these studies did not, however, examine whether the children were physically active in these specific locations; rather, they found that children with these features near their home were more physically active than those children without these features near their home.

Studies that have examined where children are physically active have found that children utilize multiple locations for physical activity.[12,13] The most commonly used locations for physical activity are at home[12,13], at school[12,13] and at parks.[12] The locations where children are physical active differ by age. For example, children aged 9–11 spend more time and have higher MVPA in schools and neighborhoods compared to children aged 6–8.[13] To date, the majority of studies have been cross-sectional studies; thus, little is known about individual transitions in where children play. Furthermore, most of these studies examine each location separately or as a summed index rather than determining whether there are classes of children who utilize different numbers or types of locations.

A handful of studies have examined whether adolescents who utilize specific locations for physical activity are more physically active than those who do not use these locations. For example, Kneeshaw-Price et al. found the highest *proportion* of time in MVPA occurred when children were active in their neighborhood.[13] However, children did not spend much time in their neighborhoods and total *amounts* of MVPA were highest at home and school. In a different study, Corder et al. found that a greater variety of locations, defined by summing the number of different types of locations that children went to, was associated with vigorous activity as measured by accelerometry in a subsample of 178 children aged 5–8.[12] Thus, while there is initial evidence that physical activity in specific locations and in a greater number of locations is associated with greater physical activity levels, evidence to date has been based on cross-sectional studies. Understanding where children are physically active and its association with physical activity levels is important for health practitioners, planners, and policy makers in that it can help determine how to allocate funds in order to implement interventions in the most relevant settings.

This study aimed to address the gaps in the existing literature by examining: 1) whether there were latent classes of children defined by the locations where they were physically active; 2) whether the latent classes were associated with physical activity cross-sectionally;

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3) how these latent statuses changed over time (latent transition analysis); and 4) whether the latent transitions were associated with changes in physical activity over time.

Methods

Study Population

Children were part of the Transitions and Activity Changes in Kids (TRACK) study, a longitudinal multi-level study of predictors of change in physical activity behavior beginning in the 5th grade (N=1098). Children in the TRACK study were recruited from 21 elementary schools in two school districts in South Carolina (24 schools were invited to participate). The two school districts were multi-ethnic (40% white; 54% African American, 3% Hispanic, 2% other and 53% white, 35% African American, 7% Hispanic, and 5% other, respectively) and lower-income (82% and 54% of 5th grade students, respectively, qualified for free and reduced price lunch).

At both baseline and follow-up, data collection was completed at the schools. On the first visit, children were provided an accelerometer and given instructions for its use. They also completed a self-administered questionnaire on a laptop. During the second visit, which occurred about a week later, children returned the accelerometer and completed a physical activity recall questionnaire (i.e., the Physical Activity Choices questionnaire). This timing of administration allowed for overlap in the timeframe referenced in the Physical Activity Choices (PAC) questionnaire and the timeframe when the accelerometer was worn. Data were collected in small groups (≤24 students) throughout the 2010–2011 school year. Follow-up data on 896 children (83%) were collected one year later (2011–2012) when the children were in sixth grade. Data were collected throughout the school year; however, for any single child, data collection occurred around the same time each year. As a result, the effect of seasonal variation on the main outcome of interest (i.e., change in individual level physical activity over time) was limited. Parental/guardian informed consent and child assent were obtained. The Institutional Review Board at the University of South Carolina approved all study procedures. Potential participants were to be excluded if they had limited English-language skills or an inability to complete study protocol because of a medical condition or disability; however, no students met these exclusion criteria.

Measures

Physical Activity—Physical activity was measured using GT1M and GT3X ActiGraph accelerometers (Pensacola, FL). Only the vertical axis was utilized from the GT3X ActiGraph model in order to be comparable to the GT1M ActiGraph model.[14] Children were asked to wear the accelerometer on their right hip for seven full days during waking hours and to remove the device when bathing, engaging in water activities, or sleeping. Data were collected and stored in 60-second epochs. Non-wear was defined as any period of 60 minutes or more of consecutive zeros, and was set to missing.[6] Data from Sundays were excluded due to low wear rates and poor reliability. The vast majority of children (80% in 5th grade) wore their accelerometer for at least four days and at least 8 hours per day. Missing values were imputed using PROC MI in SAS (Version 9.0, SAS Institute, Inc., Rockville, MD) for children who wore their accelerometer at least 2 days for at least 8 hours each day.

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Five imputed data sets were created and the mean value of these data sets was used for this analysis. MVPA was calculated using an age-specific prediction equation generalized to the mean age of the TRACK cohort.[15]

Physical Activity Locations—The use of a location for physical activity during the past 5 days was assessed using the PAC questionnaire. The PAC questionnaire asks children whether they completed any of 48 physical activities in the previous 5 days. Based on the administration protocol, this timeframe would always include at least one weekend day. For each activity that children indicated they performed, a number of follow-up questions are asked, including where they did the activity. The current analysis includes reports of physical activities at the following locations: school grounds, recreation centers, parks or playgrounds, gyms, neighborhood, home, and church. If children reported completing any of the 48 physical activities at a location, they were defined as having been physically active at that location.

Demographic Information—Demographic information was assessed from a self-report questionnaire. Children were asked to report their gender as male or female; to self-identify their race as one or more of the following: American Indian or Alaskan Native, Black/African American, Native Hawaiian or other Pacific Islander, White, or Asian and to report whether they were Hispanic or Latino. For the purposes of this study, race/ethnicity categories included Hispanic, non-Hispanic white, non-Hispanic African American, and non-Hispanic other, the latter of which includes all other classifications (i.e., Native American, Asian, Pacific Islander, other, and those indicating multiple races). School district was defined as either school district A or school district B.

Just under 900 students were retained in 6th grade (83%). There were no differences in gender or baseline total physical activity in those lost to follow up although participants who reported their race/ethnicity as Hispanic were more likely to be lost to follow-up. In this paper, the analytic sample was restricted to children who had complete data on all analytic variables (N=520 in 15 elementary schools). Of those dropped in this analysis, 197 were dropped because of a change in the PAC questionnaire during the study. A more user-friendly interface was developed and implemented with the last 16 schools. Thus participants from the first 5 schools enrolled were excluded from these analyses because they did not utilize the same PAC questionnaire format and the responses from the two versions were not considered comparable. An additional 52 children were missing PAC data because they either chose not to fill it out or did not fully complete the second visit and 127 did not have sufficient physical activity outcome data at both time points. There were no differences by gender or race/ethnicity in those excluded from the analysis due to missing variables. In addition there were no differences in physical activity levels by exclusion status.

Statistical Analysis

The statistical analyses were completed in four steps. First, to characterize children according to the variety of locations in which they reported being physically active, a latent variable model, specifically latent class analysis, was used. The purpose of a latent variable

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model is to define unobserved variable(s) such that the relationship among observed items is locally independent. A latent class model is one such latent variable model used when the latent and observed variables are categorical.[16] Latent class models estimate two key parameters: item response probabilities and latent class probabilities. An *item response probability* is the probability that a child in class *t* of the latent variable provides a given response. The pattern of item response probabilities is used to interpret the latent class. *Latent class probabilities* describe the proportion of children estimated to be in a particular latent class. The latent class analysis took into account clustering within schools. Grade-specific models and a multiple group latent class model for each grade by gender were estimated.

Second, within each grade, it was determined whether physical activity location latent classes were associated with objectively-measured physical activity. This was achieved by using the manual three-step approach, a method for incorporating the measurement error associated with the estimated latent class assignment in the regression of physical activity on latent class.[17] This approach is preferable to the one-step approach (in which the most likely latent class membership is treated as an observed variable in subsequent analyses) because it incorporates the uncertainty of latent class assignment. The equality of the class-specific mean MVPA values was evaluated using the Wald test.

Third, latent transition analysis was used to characterize whether and how physical activity latent classes changed over time. To reflect the potential transitory nature of latent classes over time, such classes are called latent statuses. Latent transition analysis permits the study of changes in latent status membership over time.[18] Specifically, three key parameters are estimated: latent status probabilities at time 1, item response probabilities at each time point, and transition probabilities between time points. *Transition probabilities* describe the probability that a child in status *t* at time 1 will transition to status *t* at time 2. Longitudinal changes in latent status membership are called *latent transitions.* In such models, it is advantageous to constrain item response probabilities to be equal across time points[18]; doing so ensures that the latent status interpretations will remain the same at each time point. The effect of this constraint on model fit was evaluated.

Fourth, it was determined whether changes in physical activity location latent statuses were associated with changes in objectively-measured physical activity. Again, the manual three-step approach was used so that the measurement error associated with the estimated latent status assignment would be incorporated. The equality of the transition-specific mean MVPA values was evaluated using the Wald test.

Generally speaking, all model selection decisions prioritized model interpretability and the principle of parsimony (see Collins and Lanza (2010) p. 82). Among the various model fit statistics available, the BIC was prioritized because Nylund, Asparouhov, and Muthén (2007) have determined it to be superior to the AIC.[19] A similarly acceptable statistic, the bootstrap likelihood ratio test (BLRT), is not available for the analysis of clustered data. All analyses were conducted in M*plus* v. 7.11.[20]

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Results

Descriptive characteristics of the sample

Sample characteristics are presented in Table 1. The sample included slightly more girls than boys (55% and 45%, respectively) and nearly equal proportions of children self-identifying as white and African American (38% and 37%, respectively) along with 8% who self-identified as Hispanic and 17% as some other race/ethnicity. There were similar proportions of participants from the two school districts (51% and 49%). Descriptive statistics of physical activity locations and MVPA are presented in Table 2. The majority of children reported engaging in at least one of the 48 physical activities at home (92%), at school (84%), or in the neighborhood (61%). About half (48%) reported engaging in physical activity at a park or playground; the least frequently used locations were gyms (36%), recreation centers (21%) and churches (17%). The mean number of minutes of MVPA was 36 minutes, with boys accruing more MVPA relative to girls (46 and 27 minutes, respectively).

Latent class analysis

Grade-specific latent class models were estimated. As indicated by various model fit statistics (see Table 3) and model interpretability, a two-class model best fit data from both grades. Specifically, children in both grades belonged to one of two classes defined by physical activity in the following locations: (1) school and home ("limited variety"); and (2) school, home, gym, park or playground, and neighborhood ("greater variety"). Grade-specific item response probabilities and latent class membership probabilities are presented in Table 4. Latent class membership is similarly distributed in both grades. Specifically, around 65% of children in each grade were in the limited variety class (i.e., physically active at school or home); while about 35% were in the greater variety class (i.e., physically active at school, home, parks or playgrounds, gyms, and neighborhoods).

Because of well-established differences between genders in physical activity behavior and predictors of activity [21,22], a multiple group latent class model for each grade was estimated. Specifically, a model was estimated in which the item response probabilities (i.e., the probability that a child would endorse a specific physical activity location given membership in a particular latent class) were constrained to be equal for boys and girls. Nested model comparisons using the likelihood ratio test [18] were used to evaluate whether the constrained models resulted in worse model fit compared to the unconstrained model in which the item response probabilities were freely estimated. The constrained model did not result in significantly worse fit for either grade (5^{th} grade: Δ likelihood ratio chi-square = 22.76, Δ df = 14, p = 0.064; 6^{th} grade: Δ likelihood ratio chi-square = 18.80, Δ df = 14, p = 0.173); thus, for each grade, a two-class model in which measurement equivalence between genders was used.

Distal outcomes—To examine whether grade-specific physical activity location latent classes were associated with physical activity cross-sectionally, the manual three-step approach was used. In both grades, being physically active in a greater variety of locations was associated with being more physically active; this difference was statistically significant

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in Grade 6 ($p < .001$) but marginally significant in the 5th grade ($p = .053$). Parameter estimates are presented in Table 5. Models controlling for gender, race, and school district (not presented) showed the same result.

Latent transition analysis

To examine whether and how the variety of physical activity locations changed between 5th and 6th grades, a latent transition model was estimated. First, to evaluate whether constraining the item response probabilities to be equal in both 5th and 6th grades resulted in worse model fit than not constraining them in this way, a nested model comparison using the likelihood ratio test was conducted. Although the comparison revealed that the two models differed significantly (Δ likelihood ratio chi-square = 62.52, $\Delta df = 16$, $p = <.001$), there was no meaningful difference in item response probabilities by grade (i.e., status definitions remained the same despite differences in item response probabilities).[18] Thus, item response probabilities were constrained to be equal across time. Constrained item response probabilities are presented in Table 4.

The majority (76.5%) of children stayed in the same physical activity status. Specifically, 48.5% stayed physically active in only a few locations (school and home) and 28.0% stayed physically active in a greater variety of locations (school, home, park or playground, gym, and neighborhood). Just less than one quarter (23.5%) of students changed physical activity location status. Specifically, 17.9% of all children decreased the variety of their physical activity locations and 5.6% increased the variety of their physical activity locations.

Distal outcome—To examine the effect of changes in the variety of physical activity locations on changes in physical activity, the manual three-step approach was used whereby change in minutes of MVPA from 5th to 6th grade was the distal outcome. Given the need to examine the effect of multiple covariates (i.e., gender, race, and school district) on the relationship between latent transition and changes in physical activity, it was important to ensure that latent transition cell sizes were sufficiently large for the consideration of multiple covariates. Due to the low prevalence of the latent status characterized by an increase in the variety of physical activity locations [n=29 (5.6%)], children active in few locations in 5th grade were constrained to remain active in few locations in 6th grade; doing so permitted the consideration of multiple covariates. Thus, three latent transitions were considered: maintained limited variety in physical activity locations (51.9%), maintained greater variety in physical activity (31.3%) and decreased variety of physical activity locations (16.8%). Note that the size of the latent transition cells change slightly to account for the constraint on the estimated number of latent transitions.

Parameter estimates are presented in Table 5. Regardless of the latent transition experienced, all children experienced a statistically significant decline in MVPA. As hypothesized, latent transitions were ordered such that a decrease in the variety of physical activity locations was associated with the greatest decline in MVPA and the maintenance of a greater variety of physical activity locations was associated with the smallest decline in MVPA. Specifically, children who decreased the variety of their physical activity locations experienced a significantly larger decline than did children who maintained greater variety in their physical

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activity locations ($p = .03$). In models controlling for gender, race, and school district (not presented), the same finding was significant (i.e., children who decreased the variety of their physical activity locations experienced a significantly larger decline than did children who maintained greater variety in their physical activity locations).

Discussion

This study has a number of important findings that both replicate and extend previous studies. To our knowledge, this is the first study to examine whether there are latent classes of children defined by where they are physically active. Two classes of children were identified: those who are physically active primarily at home and school and those who were active at these locations and others (e.g., parks, gyms, neighborhoods). Most children were in the first class, consistent with other research that has found most physical activity occurs at home and at school.[12,13] Consistent with other studies that have examined use of locations by gender, this study did not find gender differences in the structure of physical activity location classes.[12,13]

This is the one of the first studies to examine how the locations where children are physically active changes over time. The majority of children did not change their status membership between 5th and 6th grade. Those whose membership changed were most likely to move from being physically active in a variety of locations to being physically active just at home and school. Previous research has suggested that, as children age, they become more independent and are able (i.e., allowed) to be physically active in more places; [23] however, this study found only a small subset of children who increased the variety of their physical activity locations over time. It is possible that the transition to being physically active in a greater variety of locations takes place at an earlier age; thus, it would be valuable for future research to examine use of various locations for physical activity at earlier ages.

Importantly, those who maintained activity in a variety of locations had smaller declines in their MVPA over time relative to those who maintained their membership in the low variety class. This suggests that promoting activity in multiple locations may help to address declines in physical activity levels in children, adding to a growing body of research that suggests that environments are important for physical activity behavior.[24–26] This study found only two classes suggesting no further differentiation in children amongst those who utilize non-home and non-school locations (e.g., park and gym).

This study has important implications for interventions and policies to promote physical activity in children. First, since those who maintained activity in a variety of locations had smaller declines in their MVPA over time it is critical to assure that children have opportunities to be active in multiple locations. Opportunity requires both availability (i.e., the resources are within a reasonable distance) and accessibility (e.g., reasonable costs, hours of operation). Second, it is critical to promote these opportunities and to make them attractive and safe spaces for children to play. Providing sufficient opportunities for children to be active in multiple places and helping to expose children to these opportunities in order to encourage their use will require the participation of partners from multiple sectors (e.g., planning, recreation, community groups, schools, parents).

Further, most of the children were classified within the limited variety class (i.e., active at home and school). Thus, an additional strategy for improving physical activity levels is to increase the opportunities within the places where most kids are currently getting their physical activity, namely at home and at school. Reaching out to children in school is an efficient means of reaching a majority of children. There is significant room for improvement in terms of enhancing the physical activity opportunities available to children through schools. For example, a national study found that, on average, middle school students attend schools that implemented only 4 out of the 6 physical activity policies and practices that were examined (i.e., shared use, intramural sports, interscholastic sports, active transport, activity breaks, recommended amounts of PE).[27] Importantly, middle school students who attended schools that implemented more physical activity practices and policies were physically active for at least 60 minutes on more days compared to students who attended schools with fewer physical activity practices and policies in place .[27]

This study had a number of strengths. Physical activity was measured using accelerometry, which offers a valid measure of physical activity levels.[28,29] Numerous studies have documented a large decline in physical activity as people age [30] and this study took place during a critical development period for physical activity.[31] The study examined change over time in both where children were physically active and their physical activity levels. Finally, a novel analytic technique (i.e., latent transition analysis) was employed that permits the classification of children and changes in their classifications over time.

This study was subject to a number of limitations. Although this study advanced previous studies by specifically considering use of specific types of locations (rather than just the proximity of those locations to a child's home), the proportion of physical activity that occurred at each location cannot be quantified. Studies that take advantage of simultaneous use of GPS and accelerometry can address this limitation. Several studies have utilized this dual methodology to examine the association between environments and activity.[32–34] Further, although the data are longitudinal in nature, reverse causation cannot be ruled out. Namely that those who decrease their physical activity subsequently decrease the number of places in which they are active. The PAC questionnaire, used in this study to assess where the kids engaged in physical activity, was based on the Three Day Physical Activity Recall (3dPAR), which has been shown to be reliable and valid.[35] To assess the context in which physical activity occurred (including where), the PAC questionnaire included modifications to the 3dPAR which were first used in the TAAG study.[36] The current PAC questionnaire further expanded the number of locations where a participant could report engaging in physical activity. However the reliability and validity of the specific wording and format of the PAC questionnaire used in our study has not been examined. Importantly, we did not examine the availability of places to be active, thus the lack of physical activity at a particular location may be because the resource (e.g., parks, gyms) was not accessible to the child or it may have been accessible but the child did not use it. Our study chose to use a 60 minute interval for its non-wear algorithm. A number of different time intervals are used in the literature and the use of a different time interval may have resulted in slightly different estimates than those generated for this study. Finally, the study results may not be generalizable to children of a different age or in other regions of the country.

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This study found that children who continued to use a variety of locations for physical activity over time maintained higher physical activity levels than those who decreased the number of locations in which they were physically active. Thus, exposing children to a variety of places to be active and encouraging them to be physically active in more locations may led to improvements in physical activity levels over time. Multiple stakeholders including planners, schools, community groups and parents should work together to ensure these environments are both available and accessible as well as safe and attractive to children.

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Table 1

Sample characteristics (*N*=520)

	Frequency (%)
Gender	
Male	233 (44.8)
Female	287 (55.2)
Race/Ethnicity	
White	197 (37.9)
African American	194 (37.3)
Hispanic	43 (8.3)
Other	86 (16.5)
School District	
District A	253 (48.6)
District B	267 (51.4)

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Table 2

Descriptive statistics of physical activity locations and MVPA

	Frequency (%)					
	Grade 5			Grade 6		
	Overall (*N*=520)	**Boys (*N*=233)**	**Girls (*N*=287)**	**Overall (*N*=520)**	**Boys (*N*=233)**	**Girls (*N*=287)**
Physical activity locations						
School grounds	438 (84.2)	190 (81.6)	248 (86.4)	382 (73.5)	172 (73.8)	210 (73.2)
Recreation center	109 (21.0)	52 (22.3)	57 (19.9)	118 (22.7)	65 (27.9)	53 (18.5)
Park or playground	251 (48.3)	117 (50.2)	134 (46.7)	194 (37.3)	94 (40.3)	100 (34.8)
Gym	189 (36.4)	96 (41.2)	93 (32.4)	190 (36.5)	93 (39.9)	97 (33.8)
Neighborhood	319 (61.4)	147 (63.1)	172 (59.9)	268 (51.5)	125 (53.7)	143 (49.8)
Home	477 (91.7)	214 (91.9)	263 (91.6)	442 (85.0)	187 (80.3)	255 (88.9)
Church	86 (16.5)	26 (11.2)	60 (20.9)	87 (16.7)	31 (13.3)	56 (19.5)
Minutes of MVPA, mean (se)	35.5 (22.9)	46.1 (27.1)	26.9 (13.9)	29.3 (19.8)	39.1 (22.7)	21.4 (12.4)
Hours of wear time, mean (se)	12.5 (0.9)	12.6 (0.9)	12.4 (0.9)	11.8 (1.0)	11.8 (1.0)	11.8 (1.0)

MVPA: Moderate to vigorous activity

Se: Standard error

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Table 3

Model fit information for Latent Class Analysis models (N=520)

Model	Log-likelihood	*df*	AIC[a]	BIC[a]	Entropy[b]
Grade 5					
1 class	−1923.0	120	3860.1	3889.9	
2 classes	−1846.6	112	3723.2	3787.0	0.59
3 classes	−1834.3	104	3714.6	3812.4	0.73
4 classes	−1829.1	96	3720.2	3852.0	0.73
Grade 6					
1 class	−2079.0	120	4172.1	4201.8	
2 classes	−1976.3	112	3982.6	4046.4	0.62
3 classes	−1966.0	104	3978.1	4075.9	0.52
4 classes	−1960.7	96	3983.5	4115.4	0.58

df degrees of freedom, *AIC* Akaike information criterion, *BIC* Bayesian information criterion

[a] Smaller values indicate better fit

[b] Measure of classification uncertainty bounded between 0 and 1 where larger values reflect greater certainty

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Table 4

Parameter estimates for Latent Class Analysis (LCA) and Latent Transition Analysis (LTA) (N=520)

	LCA				LTA	
	Grade 5		Grade 6			
	Limited Variety	**Greater Variety**	**Limited Variety**	**Greater Variety**	**Limited Variety**	**Greater Variety**
			Item Response Probabilities			
School grounds	0.786	0.941	0.644	0.896	0.701	0.921
Recreation center	0.133	0.343	0.156	0.355	0.143	0.332
Park or playground	0.240	0.905	0.194	0.694	0.201	0.772
Gym	0.203	0.642	0.149	0.753	0.166	0.666
Neighborhood	0.480	0.846	0.367	0.781	0.406	0.804
Home	0.886	0.972	0.768	0.997	0.818	0.983
Church	0.070	0.331	0.069	0.343	0.063	0.323
			Latent Class Membership Probabilities			
Grade 5	0.635	0.365			0.541	0.459
Grade 6			0.642	0.358	0.664	0.336
					Transition Probabilities	
					Grade 6	
					Limited Variety	Greater Variety
			Grade 5	Limited Variety	0.897	0.103
				Greater Variety	0.389	0.611

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Table 5

Parameter estimates for Latent Class Analysis (LCA) and Latent Transition Analysis (LTA) with distal outcome (N=520)

	LCA	
	Minutes of MVPA, mean (SE)	
	Grade 5	**Grade 6**
Greater Variety	33.02 (1.07)	30.06 (1.07)
Limited Variety	28.31 (1.05)	21.29 (1.06)
Difference	4.71	8.78
p-value	0.053	<.001
	LTA	
	Δ Minutes of MVPA	
	Mean (SE)	*p-value*
Transition		
(1) Decrease Variety (16.8%)	−9.68 (1.97)	<.001
(2) Maintain Limited Variety (51.9%)	−5.37 (2.53)	0.034
(3) Maintain Greater Variety (31.3%)	−4.51 (1.72)	0.009
Differences		
1 vs. 2		0.183
1 vs. 3		0.030
2 vs. 3		0.741