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Physical Education Resources, Class Management, and Student Physical Activity Levels: A Structure-Process-Outcome Approach to Evaluating Physical Education Effectiveness

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Abstract

BACKGROUND—This study was conducted to empirically evaluate specific human, curricular, and material resources that maximize student opportunities for physical activity during physical education (PE) class time. A structure-process-outcome model was proposed to identify the resources that influence the frequency of PE and intensity of physical activity during PE. The proportion of class time devoted to management was evaluated as a potential mediator of the relations between resource availability and student activity levels.

METHODS—Data for this cross-sectional study were collected from interviews conducted with 46 physical educators and the systematic observation of 184 PE sessions in 34 schools. Regression analyses were conducted to test for the main effects of resource availability and the mediating role of class management.

RESULTS—Students who attended schools with a low student-to-physical educator ratio had more PE time and engaged in higher levels of physical activity during class time. Access to adequate PE equipment and facilities was positively associated with student activity levels. The availability of a greater number of physical educators per student was found to impact student activity levels by reducing the amount of session time devoted to class management.

CONCLUSION—The identification of structure and process predictors of student activity levels in PE will support the allocation of resources and encourage instructional practices that best

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support increased student activity levels in the most cost-effective way possible. Implications for PE policies and programs are discussed.

Keywords

physical activity; physical education; human resources; equipment; physical education facilities; class management

School-based physical education (PE) programs face numerous challenges including pervasive inactivity among children and families,[1] competing academic priorities,[2,3] and budget cuts.[4] Despite recent progress in the implementation of policies that support PE programs,[5-7] schools are struggling to provide the frequency and intensity of PE and physical activity opportunities recommended in *Healthy People 2010*. These objectives prescribe an increase in adolescents' participation in daily PE, with at least 50% of class time devoted to being physically active.[8] Yet only 3.8% of elementary, 7.9% of middle, and 2.1% of high schools provide daily PE for students in all grades for the entire school year,[4,5] and students spend large amounts of PE class time being inactive.[9] Because a primary function of PE is to provide opportunities for physical activity,[9] it is important to identify resources that increase both PE opportunities and levels of student activity during PE class. Exposure to an adequate amount of PE class time during which physical activity is maximized increases students' energy expenditure, which is a key contributor to the maintenance of healthy weight and fitness. It is important to understand the mechanisms though which resource availability exerts its effects.

The purpose of this study is to empirically evaluate a proposed model of PE quality rooted in the Donabedian (2003) structure-process-outcome approach to performance monitoring.[10] This framework was selected because it is useful for identifying barriers and facilitators of program quality, thereby suggesting targets for program-enhancing interventions. As depicted in Figure 1, structural indicators of quality include human (eg, student-to-teacher ratio, availability of instructors exclusively focused on PE), curricular (eg, availability of curricula and lesson planning resources aligned with best practices in PE), and material (eg, access to facilities and equipment) resources that comprise the conditions under which PE is provided. These resources are expected to influence process indicators of quality, the activities that constitute PE implementation. In the proposed model, an indicator of process quality is the content of PE lessons, specifically the proportion of class time devoted to class management activities. The amount of PE provided per day and student activity levels during PE sessions (eg, % of class time during which students engage in MVPA) are outcomes, which are attributable to the availability of PE resources both directly and through the effects of some resources on class content.

Hypotheses regarding relations among the structure, process, and outcome components of the model are evaluated in this study.

Access to adequate human resources, as indicated by low student-to-physical educator ratio and the availability of teachers exclusively focused on PE, is expected to directly influence the amount of time that students participate in PE per day. Relative to schools with high student-to-teacher ratios, those with lower ratios can maximize the amount of time that each student participates in PE while maintaining class sizes that enhance student safety, learning, and activity levels.[11] Indeed, prior research indicates that students who attend schools with an adequate number of teachers who exclusively provide PE instruction (eg, do not teach other subjects) receive more PE per week.[4,12-15]

In addition to increasing overall exposure to PE lesson time, the availability of qualified PE instructors is associated with increased student knowledge of physical fitness and activity levels during class.[12-15] High student-to-physical educator ratios and large class sizes are associated with reduced student physical activity.[3,11] Further, when physical educators are required to teach other subjects, they teach shorter lessons during which children are less active.[4] Like human resources, access to adequate curricular and material resources are expected to directly influence the proportion of PE class time during which students engage in moderate to vigorous physical activity (MVPA). There is growing consensus about the positive impact of using standard-based PE curricula.[7,16] PE programs that implement a curriculum based on national standards increase student physical activity levels.[17] Likewise, physical activity levels are increased by access to well-maintained, appropriate, and aesthetically inviting facilities and safe environments in which to be active.[18,19] Having an adequate amount of sport and exercise equipment that is in good condition and appropriate for children's sizes is also likely to increase physical activity opportunities during PE class sessions.

Although prior research has illustrated the positive effects of resource availability on lesson length and student activity levels, few studies have explored the mechanisms through which these resources exert their effects. The proportion of class time devoted to management during which administrative tasks are accomplished and students are not expected to be physically active is one such mechanism (indicated by dashed lines in Figure 1). Physical educators may spend as much as 21% of class time on administrative/class management tasks.[20,21] Adequate resources may reduce the proportion of class time needed for management and thereby increase opportunities for children to be physically active. For example, large class sizes resulting from high student-to-physical educator ratios may require that more time be devoted to activities such as taking attendance and transitioning from one activity to the next. Likewise, insufficient access to appropriate equipment or facilities could increase time devoted to activities such as selecting equipment and transitioning from one space to another.[22] Conversely, organized and focused lesson planning enhanced by access to curricular resources that are consistent with best practices in PE should maximize opportunities for students to participate in physically demanding activities. Thus, we hypothesized that time devoted to class management would mediate the relations between human, curricular, and material resource availability and student activity levels during PE sessions. That is, high levels of class management activities will be an outcome of inadequate resource availability and a contributor to reduced MVPA time.

METHOD

Subjects

Resources, daily PE class time, and student activity levels were assessed for 46 physical educators in 34 schools. Participating schools include all elementary schools (n = 26) and middle schools (n = 8) in 3 school districts (2 in Maryland and 1 in West Virginia). Schools serve families living in rural or small town communities who are otherwise sociodemographically diverse (17% African American, 81% White, 2% of another race, 3% Hispanic). Based on the US Census Bureau poverty thresholds for 2006, 23% of families served by the schools live below the poverty line and 58% of students are eligible to participate in a free and reduced meal program. All PE teachers in the 34 schools agreed to take part in the study and provided written consent for their participation. On average, teachers had 10.2 (SD = 9.5) years of experience teaching PE. All teachers had at least a bachelor's degree and 35% had a master's degree. All middle school physical educators were certified by their state to teach PE at the secondary level. Among elementary school physical educators, 93% were certified to teach PE at the primary level. Almost two thirds of teachers

(63%) taught other subjects in addition to PE. Of these, 66% taught health education, 7% taught art or music, and 45% taught other subjects, most commonly reading.

Instruments

Interview questions were adapted from the Centers for Disease Control and Prevention School Health Policies and Programs Survey (SHPPS), a national survey periodically conducted to assess school health policies and practices at state, district, school, and classroom levels.[6] This survey has been previously tested for reliability and validity through a data quality substudy conducted in conjunction with the SHPPS 2000.[23]

Human Resources

Physical educator full-time equivalent (FTE) and the number of students were obtained for each school for the academic year in which the assessments were conducted. An FTE of 1.0 means that there is 1 full-time physical educator at the school, while an FTE of 0.5 signals that there is 1 half-time physical educator at the school. The number of students per physical educator was calculated for each school (number of students/physical educator FTE). Teachers provided information about subjects they taught in addition to PE. Because health topics are commonly presented during PE class time, educators who taught physical and health education, but no other subjects, were classified as teaching no other subjects.

Curricular Resources

Teachers responded to 3 questions adapted from the 2006 SHPPS Physical Education School Questionnaire pertaining to the availability of curricular and lesson planning resources. Teachers who positively endorsed all of the following questions were identified as having access to a required PE curriculum that is consistent with best practices in PE: (1) “Have you been provided with a written physical education curriculum?”; (2) “Are all physical education teachers at this school required to use this curriculum?”; and (3) “When planning to teach, do you use the National Standards for Physical Education from the National Association for Sport and Physical Education?”

Equipment Resources

Teachers responded to 6 questions pertaining to their satisfaction with the sport and exercise equipment available at their school (eg, “How much of your school's exercise equipment is in adequate condition?”). All items had 5-point Likert response options with higher values indicating greater satisfaction with equipment. Scale scores were calculated by averaging item responses. The equipment resource scale had adequate internal consistency reliability (α = .87).

Facility Resources

Teachers responded to questions about the presence of and their satisfaction with facilities used during PE at their school. If teachers reported that they had access to a particular type of facility, they were asked to rate their level of satisfaction with the facility on a 5-point Likert scale for which higher response options indicated greater satisfaction. Both middle and elementary school teachers were asked to rate their satisfaction with 6 facility types: gymnasium, outdoor track, outdoor basketball court, baseball and softball diamonds, and playing fields. In addition, elementary school teachers were asked to rate their satisfaction with playgrounds and hard surface areas used for PE instruction. Each item was coded as 0 if the facility was unavailable, 1 if a facility was available and teachers expressed extreme to moderate dissatisfaction, and 2 if a facility was available and teachers expressed satisfaction or extreme satisfaction. Scale scores were calculated by averaging item responses. The facility resource scale had adequate internal consistency reliability (α = .83).

System for Observing Fitness Instruction Time

The System for Observing Fitness Instruction Time (SOFIT), a reliable and valid observational tool, was used to assess lesson length, student activity levels, and the percent of session time devoted to class management.[7,24,25] Consistent with the training methods used by SOFIT developers, 11 observers completed 8 hours of classroom-based SOFIT training and 4 hours of field practice with a trainer. Classroom training included a review of code definitions and administration conventions as well as practice coding exercises using videotape vignettes obtained from the instrument's developers. Observers were SOFIT "certified" by reaching an interobserver reliability level of 85% on all variables for 2 consecutive class periods during a field practice day.[26]

Procedure

From January to May 2008, trained research assistants administered interviews to study PE teachers. The SOFIT was administered during 4 randomly selected PE class sessions for each teacher between March and May 2008. Class sessions were eligible for selection if the majority of participating students were in first to eighth grade. For each lesson, trained observers calculated lesson length by subtracting start time (time at which the teacher and 51% of students in the class reached the instructional area) from end time (time at which 51% of the class departed from the area). Teachers reported the number of PE class sessions that observed students received per week. Daily PE time was determined by multiplying lesson length by teacher reports of the number of PE class sessions that observed students received per week. This product was then divided by 5. Daily PE time was averaged across the teacher's 4 observation periods.

During each class session, observers coded the activity levels of 4 randomly selected students using a momentary time sampling procedure (10-second observe, 10-second record intervals). The selected students were observed for 4-minute intervals on a rotational basis for the entire class session. Physical activity levels were assessed by observing students' body positions, which were coded as *lying down*, *sitting*, *standing*, or *walking*. *Very active* was coded if students appeared to be expending energy beyond what is needed for walking, regardless of body position.[20,24,27] The percentage of intervals during which students engaged in each level of activity was calculated for each class session. Time devoted to MVPA was determined by summing the percent of intervals during which students were walking or very active and averaging these proportions across the teacher's 4 observed class sessions.

Curricular lesson content was coded for each 10-second observation interval.[28,29] Intervals were coded as *management* when students were not intended to be involved in PE content such as during transitioning (eg, team selection, selecting equipment, moving from one space to another), when dealing with class business unrelated to instructional activity (eg, taking attendance), or during breaks (eg, getting a drink of water). Alternatively, intervals could be coded as *knowledge acquisition* (focus is on student knowledge acquisition related to PE, not their active engagement), *physical fitness* (activities whose major purpose is to alter the physical state of the individual in terms of cardiovascular endurance, strength, or flexibility), *skill practice* (practice of skills with the primary goal of skill development), *game play* (application of skills in a game or competitive setting), or *free play/other* (free play time during which PE instruction is not intended). The percentage of intervals devoted to management was calculated for each class session and averaged across each teacher's 4 observed class sessions. Thirty-one of the 184 SOFIT observations were conducted simultaneously by 2 independent observers yielding an interrater reliability of .93 which exceeds the recommended level.[13]

Data Analysis

Primary outcome variables were daily PE minutes, the proportion of lesson time devoted to MVPA (%), and the proportion of lesson time devoted to class management. Separate generalized linear models were fit to the data to assess relations between PE resources and each outcome variable as indicated in Figure 1. Analyses were conducted using SAS 9.2 proc GENMOD (SAS Institute Inc., Cary, NC) because the procedure can handle general linear models as well as those appropriate for count or proportion data. General linear models were fit for daily PE minutes (a continuous outcome variable) and MVPA data, which despite being a proportion score was normally distributed and fell within the range . 20 to .80. A Poisson distribution and log link function was specified for the prediction of the proportion of class time devoted to management.

Following the identification of resources that significantly predicted MVPA, the mediating role of class management was evaluated (Table 2). Only resource variables that significantly predicted MVPA were included in the mediation analyses. Four criteria were used to test for mediation: resources significantly affect class management (Table 1), resources significantly affect MVPA (model 1, Table 2), management significantly affects MVPA (model 2, Table 2), and the effect of resources on MVPA is less in the mediation model than in the main effects model (Table 2).[30] Mediation analyses were conducted using SAS 9.2 proc GENMOD.

RESULTS

On average, there were 331.1 students (SD = 236.9) per physical educator FTE in participating schools (range = 134 to 1558 per FTE). Approximately one third of physical educators (33%) taught a subject other than physical and health education. Consistent with national trends, about one third (34%) of teachers had access to a required PE curriculum and used the National Standards for Physical Education when developing lesson plans. Physical educators rated their sport and exercise equipment positively, rating equipment resources an average of 3.96 (SD = 0.73) on the 5-point scale. Although the vast majority of schools (93.1%) had access to a gymnasium for use during PE, fewer schools had access to a playing field (66%), an outdoor basketball court (44%), a baseball or softball diamond (38%), or an outdoor track (29%). Among elementary schools, 56% had a playground and 47% had a hard surface area, which were used during PE instruction. The average rating of facility resources was 0.58 (SD = 0.35) on the 0 to 2 scale.

Students received an average of 23.1 (SD = 12.0) minutes of PE per day and only 17.4% of schools offered PE to students 5 days per week. Average lesson length was 46.7 (SD = 13.6) minutes, and the mean number of days per week that students had PE was 2.47 (SD = 1.3). Students spent 0.9% of lesson time lying down, 20.2% sitting, 33.5% standing, 20.3% walking, and 25.0% being very active. Thus, students engaged in MVPA for 45.3% of lesson time, an average of 21.2 minutes per lesson or 10.4 minutes per school day. On average, 23.1% of class time was devoted to class management.

Results of the main effect regression analyses including all hypothesized predictors are presented in Table 1. Compared with elementary school students, middle school students received a greater number of PE minutes per day. Middle school teachers spent significantly less class time on management than elementary school teachers. Access to more dedicated human resources was associated with greater daily exposure to PE. In particular, having fewer students per physical educator FTE at the school and physical educators exclusively charged with teaching physical and health education were associated with more minutes of daily PE exposure. Low student-to-physical educator ratio was also associated with a greater proportion of class time during which children engaged in MVPA and a lesser proportion of

class time devoted to management. Access to adequate sport and exercise equipment and physical activity facilities predicted increased MVPA and decreased class management time. As shown in Table 2, the proportion of class time devoted to management significantly mediated the relation between student-to-physical educator ratio and MVPA.

DISCUSSION

In the present sample, fewer than 1 in 5 schools offered PE to students 5 days per week. On average, children received about 23 minutes of PE per day and engaged in MVPA for less than half of class time. Therefore, they were moderately to vigorously active for about 10 minutes per day during PE, which is approximately one sixth of the Institute of Medicine's (2005) recommended 60 minutes of MVPA per day.[31] Undoubtedly, children must be active outside of the PE context to achieve recommended MVPA levels. However, to help children achieve these goals, schools must maximize the amount of time devoted to PE during which children are physically active.

This study suggests that human resources, particularly having a low number of students per physical educator FTE, significantly increase class time and student activity levels during PE. School districts must allocate adequate resources to recruit and retain highly skilled physical educators to permit longer PE class sessions and maximize student physical activity during PE.[3] Reduced time spent on class management is one mechanism through which student-to-physical educator ratio influences student activity levels. Teachers in schools with fewer students per physical educator FTE spend less class time on activities during which students are not engaged in PE content, thereby increasing physical activity opportunities for their students. Like human resources, access to adequate equipment and facilities is associated with increased student activity levels and decreased class management time. Thus, by increasing accessing to human and material resources in support of PE, educational agencies will enhance students' potential to engage in the recommended amount and intensity of physical activity.

Limitations

Several limitations of this study merit discussion. First, this study focused exclusively on students' physical activity levels during PE class time, but there are many other desirable PE outcomes including frequency and intensity of physical activity outside of the PE context (eg, during recess/free time, in the community), competency in movement forms, understanding the benefits of physical activity, and enjoying physical activities.[32] Further work is needed to identify characteristics of PE programs that maximize these and other positive outcomes. Second, this study was conducted in elementary and middle schools serving rural and small town communities, which may pose a challenge to the generalizability of study findings. Future research of this type should be conducted in high schools and urban school environments. Third, additional research is needed to further explore the impact of curricular resources on student outcomes. Access to a required curriculum and lesson planning resources that are consistent with best practices in PE was unrelated to lesson time, student activity levels, and the proportion of class time devoted to management. However, it is notable that this study did not include an assessment of curricular content (a structure variable) or the fidelity with which curricula were implemented (a process variable). Past intervention programs utilizing standard-based curricula (eg, Trial of Activity for Adolescent Girls[12] and Sports, Play, and Active Recreation for Kids[33]) have demonstrated that high-fidelity implementation of specific curricula with key content standards increase student physical activity levels during class time.[15,34] More research is needed to identify the specific components of PE curricula and other instructional support tools that when used with high fidelity enhance student activity both in and out of class.

Conclusions

Undoubtedly, adequate exposure to high-intensity PE is an effective contributor to healthy lifestyle among children and across the life span. Yet, many PE programs fall short of national recommendations in terms of both class time and intensity of physical activity. This study suggests that PE quality can be enhanced by establishing, protecting, and improving both activity-promoting resources and instructional practices. In particular, access to an adequate number of physical educators per student as well as well-maintained, safe, and appropriate facilities and sport and exercise equipment will enhance students' opportunities for adequate physical activity. In addition, the frequency and intensity of student physical activity are enhanced by minimizing the proportion of class time devoted to classroom management.

IMPLICATIONS FOR SCHOOL HEALTH

This study provides an organizing framework of PE quality that distinguishes between structure and process predictors of student activity levels. Comprehensive approaches to improve PE effectiveness and ultimately the health and well-being of children must address both type of factors, but the distinction is important because approaches that enhance structure quality may differ from those that enhance process quality. For example, improving access to physical activity-promoting resources (structure factors) requires the implementation of federal-, state-, and district-level policies that mandate appropriate physical educator-to-student ratios and allocate adequate funds for equipment and facility maintenance. In contrast, PE process quality, which includes instructional practices, should be enhanced by providing teachers with professional development opportunities that emphasize techniques to reduce the amount of class time devoted to management.

Human Subjects Approval Statement

This study was approved by the institutional review boards at the Children's Hospital of Philadelphia and the Johns Hopkins Bloomberg School of Public Health.

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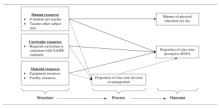

Figure 1.
A Structure-Process-Outcome Framework of PE Quality

Table 1

Regression Analyses Evaluating Relations Between Resources and Physical Activity Indicators

	Daily Physical Education Minutes†	MVPA (% Class Time)†	Class Management (% Class Time)‡
Intercept	33.04**** (4.98)	33.71**** (5.69)	2.91**** (0.14)
School type§	17.14**** (1.91)	1.34 (2.18)	–0.18*** (0.05)
Number of students per teacher FTE	–0.01**** (0.01)	–0.01* (0.00)	0.01** (0.00)
Teaches other subject area‖	–5.38* (2.45)	–1.36 (2.05)	0.05 (0.05)
Curriculum required/consistent with best practices‖		0.73 (2.02)	0.01 (0.05)
Equipment resources	—	2.94* (1.36)	–0.09** (0.09)
Facility resources	—	7.91** (2.77)	–0.19** (0.07)
Model fit statistics			
AIC	653.79	678.24	847.25
BIC	673.96	698.42	864.91

*$p < .05$

**$p < .01$

***$p < .001$

****$p < .0001$.

†Estimates (standard errors) from linear regression models are reported.

‡Estimates (standard errors) from Poisson regression model are reported.

§Coded 0 = elementary schools; 1 = middle schools.

‖Coded 0 = no; 1 = yes.

Table 2

The Mediating Role of Time Spent on Class Management in Relations Between PE Resources and the Proportion of Class Time Devoted to MVPA

	Model 1: Main Effects†	Model 2: Mediation†
Intercept	34.77**** (5.17)	41.00**** (4.79)
Number of students per teacher	–0.01** (0.00)	-5.20×10^{-3} (0.00)
Equipment resources	2.57* (1.35)	3.33** (1.22)
Facility resources	7.74** (2.75)	5.82* (2.49)
%time managing class	—	–0.39**** (0.08)
Model fit statistics		
AIC	673.14	654.25
BIC	685.75	669.38

* $p < .05$

** $p < .01$

**** $p < .0001$.

† Estimates (standard errors) from linear regression models are reported.