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Restricting Play During the School Day:  
The Negative Impact on Physical Activity Patterns in Children

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**Abstract**

**Restricting Play During the School Day:  
The Negative Impact on Physical Activity Patterns in Children**

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**Purpose:** Outlets for physical activity in the form of recess and physical education are being cut from our public-school curricula at the same time obesity and chronic disease are on the rise in our children. The purpose of this study was to compare children's physical activity level with and without structured opportunities for movement throughout the school day. We hypothesized that children's total physical activity during a school day would be significantly higher on days that included recess, physical education or music and that their physical activity would be significantly diminished on days they stayed in the classroom with no access to self-selected physical activity or structured physical activity in their course work. In addition, we hypothesized that gender and children's BMI would be associated with physical activity levels.

**Methods:** Twenty-four kindergarten students were fitted with waist worn accelerometers. Three school day interventions were implemented: 1) Typical classroom time with the addition of physical education and recess, 2) Typical classroom time with the addition of music and recess

and 3) Classroom time only for the duration of the school day. Using a crossover design, each subject was his or her own control. Each structured school day was repeated twice for a total of six days.

**Results:** Physical activity as measured by the accelerometer was significantly greater on days when children had both physical education and recess and on days when children had music and recess when compared to an inactive day ( $p < 0.0001$ ). There was not a statistically significant effect of gender or BMI on physical activity in this sample.

**Conclusion:** This study highlights how recess, physical education and music can significantly add to kindergarten children's accumulation of necessary and recommended daily physical activity. BMI and gender had no effect on physical activity in kindergarten children.

## INTRODUCTION

Regular physical activity (PA) is necessary for the short and long-term health of children and adolescents.<sup>1,2</sup> Increased activity rates in youth are associated with diminished cholesterol levels as well as a decrease in obesity prevalence.<sup>3</sup> Physical fitness, bone mass, high density lipoprotein (HDL) and psychological well-being are also positively associated with PA.<sup>1,2</sup> In addition, PA has been shown to increase concentration, mental performance and creativity in children.<sup>4,5</sup> These benefits can carry into adulthood if PA patterns are established in childhood.<sup>6</sup> Due to the significant body of evidence relating PA to improved physical and mental health outcomes, The United States Department of Health and Human Services recommends 60 minutes of moderate- or vigorous-intensity PA for children, 6-17 years of age, daily.<sup>6</sup> However, eighty percent of school-age children are falling short of these recommendations.<sup>4,6</sup>

### School curriculum drives physical activity

Physical education (PE) and recess are the primary drivers of PA in school-age children.<sup>7</sup> PE is structured and focused on education through exercise while recess is a break from the classroom and allows the child to free play by self-selecting their activity.<sup>8,7</sup> Despite the plethora of evidence related to the benefits of PA in children, both PE and recess are being eliminated from public school curriculum across the nation.<sup>7</sup> PE in school is the primary program responsible for training the nation's youth to be physically active, yet nearly 44% of schools have cut PE (and recess) to increase time spent in reading and mathematics.<sup>9</sup> PE can result in setting positive health patterns that carry into adulthood.<sup>9</sup> In addition to setting patterns for an active lifestyle, PE is positively correlated with enhancement of self-esteem, body image, creativity, self-efficacy, mental performance, mathematical performance, concentration and academic achievement in school-age

children and adolescents.<sup>10</sup> Moreover, recess has been shown to provide physical, cognitive, emotional and social benefits.<sup>11</sup> Without PE and recess, children are consistently less physically active. This lack of PA sets them up for the deleterious effects of a sedentary lifestyle as children and, eventually, sedentary adults.<sup>9</sup>

Alongside recess and PE, music is also being eliminated from public school curricula.<sup>12</sup> The presence of a music curriculum in secondary education has similar benefits to recess and PE. Participation in music lessons has been shown to improve brain development, enhance reading comprehension and mathematical problem solving.<sup>13</sup> While not considered a bastion of PA, music by its nature is not a sedentary activity. Marching band is the most compelling example of the cross over between music and PA. Not all musical outlets in the school setting have as significant a PA component as marching band, but nearly all instruments require an individual to use an assortment of muscle groups, alongside coordination and balance.

#### Other predictors of participation in physical activity

PA in school-age children, while possibly linked to the coursework offered, may also be affected by gender and body mass index (BMI).<sup>14</sup> The literature suggests that school-age females are nearly 20% less active than their male counterparts.<sup>14</sup> One of the largest data sets on the topic of PA looked at 68 million days in 717,527 people across 111 countries.<sup>15</sup> Their findings demonstrate lower PA in females compared to males and diminished activity for people with higher BMI.<sup>15</sup>

While there are numerous studies that look at PA in children, no research was found looking at PA in the kindergarten population or comparing PA patterns in specific coursework. Moreover, no

research that we found prior to the implementation of this study looked at gender or BMI as it relates to PA in the kindergarten classroom. The goal of this study was to evaluate the degree to which recess, PE and music add to kindergarten students' total PA during any given day and what impact eliminating these three PA outlets had on a students' accumulated PA. We hypothesized that kindergarten students' total PA during a school day would be significantly higher on days that included recess, PE or music and that their PA would be significantly diminished on days they remained in the classroom with no access to self-selected PA or structured PA in their course work. In addition, we hypothesized that our findings would be similar to others in the literature of less recorded PA in females and lower PA levels in higher BMI children. Our results have the potential to inform efforts to advocate for the inclusion of structured PA opportunities during the school day for kindergarteners and other children.

## METHODS

### Study participants and setting

The study population consisted of twenty-four children from Lewis and Clark Elementary School in Missoula Montana. Lewis and Clark had two half-day kindergarten classes, one in the morning and one in the afternoon. Twelve children were selected at random from the morning, and twelve were randomly selected from the afternoon class, which resulted in five males and seven females in the morning class and seven males and five females in the afternoon class. The average age of the children was five years.

### Physical activity interventions

There were three PA interventions implemented. They consisted of two active days and one inactive day. The two active days consisted of a regular school day with either PE and recess (PER) or music and recess (MR). The inactive day (I) consisted of a regular school day where the children were restricted to the classroom only with no recess, no PE and no music. The kindergarten teacher structured her classroom-time in such a way as to remove all recess, PE or music from a typical school day.

### Procedures

To meet inclusion criteria the participant had to be a kindergartner enrolled in elementary school in Missoula, Montana. Each child was sent home with a detailed explanation of the research project and an attached consent form. The project did not commence until all consent forms were signed and returned by a parent or guardian.

To collect data about PA, we attached an accelerometer to the waist of each student with a hip belt prior to the start of the school day and removed it after the school day ended. Data collected from each accelerometer was downloaded to a computer after each day.

The human subjects review board expressed initial concern over the exclusion of subjects because one to two individuals in each class would not have received an accelerometer due to the limited number of units. This raised concerns about these students being singled out for being different. This issue was remedied with two belts placed on those students, with identically appearing mock

accelerometers. The only exclusion criterion was not having a signed permission slip from a parent or guardian as required by the human subjects review board.

### Study Design

We used a crossover design looking at the effects of the intervention on PA by structuring the school day for the kindergarten children. Each subject was his/her own control for PER, MR or I days. Each structured school day was repeated twice for a total of six intervention days per classroom and twelve total intervention days in the study. See Table 1 for detailed schedule of interventions by day and class.

### Measures

While prior research has used various modalities to measure PA, the use of accelerometers has been shown to be an accurate, objective and noninvasive measure of PA in adults and children.<sup>15,17</sup> Accelerometers allow for the real-time discrimination of activity patterns by measuring acceleration and deceleration forces with human movement.<sup>16</sup> The output from these recordings is expressed in 'counts' and are averaged over a minute. Accelerometers eliminate the many problems with self-reported measures as they record all human movement and output objective data. The Computer Science and Applications (CSA), Inc. Activity Monitor (Model 7164, Shalimar Florida) is a single channel accelerometer that has been proven in the field to accurately and objectively record a child's PA.<sup>18</sup> Movement was recorded by a CSA accelerometer as counts and was summed over a one-minute interval; therefore, activity was defined in total counts and counts per minute. We measured gender by self-report and BMI by measuring the participants' height and weight and computing the BMI.<sup>19</sup>

### Data analysis

Weight, height, gender and BMI were used to describe the study population. In the data analyses, subject is considered a random effect, as individual children are likely to have different activity levels. When periods were combined, counts per minute were calculated by dividing the sum of the movement counts by the sum of the minutes and taking the sums first results in the periods being weighted by the length of the period. In most of the analysis, the log of the activity was used. The log function minimizes the impact of the skewness in the data.

A t-test was used to compare average total PA (counts/minute) in females and males. Linear regression was used to examine the relationship between Body Mass Index (BMI) and total PA (counts/minute).

## RESULTS

Demographic characteristics of study participants are summarized in Table 2. Twenty-four children were studied with a mean weight of 22.3 kg (17.7 - 33.6 kg) and mean height of 1.2 m (1.12 -1.29 m). Mean BMI was 15.5 (12.47 - 22.05).

### Physical Activity Levels

Total PA (Table 3) was statistically significantly greater ( $p < 0.0001$ ) on days when kindergarten children had either PER or MR when compared to I days when they did not participate in either PE, recess or music (Figure 1).

The mean activity with 95% confidence interval for type of day demonstrated that PER days had significantly greater average levels of PA than I days (PER = 781.5 counts/minute vs I = 276.4 counts/minute,  $p < 0.0001$ ). PA levels during MR days were also significantly greater than during I days (MR = 482.6 counts/minute vs I = 276.4 counts/minute,  $p < 0.0001$ ). In addition, PA levels during PER days were significantly greater than during MR days (PER = 781.5 counts/minute vs MR = 482.6 counts/minute,  $p < 0.0001$ ).

### Gender and BMI

PA of female students was not significantly different from that of male students ( $\mu = 529.4$  vs  $\mu = 531.3$ ,  $t = -0.04$ ,  $df = 138$ ,  $p = 0.97$ ) (Figure 2). The effect of BMI on total activity was not significant ( $p = 0.69$ ).

## DISCUSSION

This study examined whether restricting access to PE, recess and music in kindergarten students' school day significantly affects their overall accumulation of activity. Our results show that total PA from PE, recess and music was statistically significantly greater when compared to a day spent just in the classroom. Accumulation of PA was greatly accentuated by participation in structured coursework and free play that both encourage movement. This research highlights the need to add coursework that encourages movement, not remove it, providing children access to the well-documented health benefits of PA. <sup>1-10</sup>

In this study gender and BMI were not associated with PA levels. This finding does not align with previous research, which has shown an inverse relationship between PA and BMI and lower PA

in females.<sup>15</sup> Our results may not align with previous research due to much of the existing data being focused on adults. There was no data found in the literature on PA in kindergartners, so further research could investigate at what age we may be more likely to observe a divergence between genders with regards to PA.

Limitations to this study included small sample size and accelerometers (by 2025 standards) that were not very sensitive and were difficult to use. Placement of the unit was limiting, as these accelerometers were worn on the hip and did not capture data for upper body movement. This is an issue in as much of the kindergartners time, in class, is at a desk. This time seated at a desk is spent writing, drawing, painting, etc. and due to these and other activities primarily involving the upper extremity, this movement was not fully captured by the waist-worn accelerometers.

Despite these limitations, the data continues to reinforce the need for young children to have access to structured PE, music and recess. Removal of these outlets to PA disregards the vast amounts of research that illustrate the benefits of daily physical activity for children. By extrapolating the data from this study and considering that many school districts are only offering physical education only one time per week and shortening recess, young children are, in effect, being starved of PA. This highlights the need for advocacy in increasing PA through PE, music and recess to help children and adolescents avoid the negative long-term health outcomes of a sedentary lifestyle.

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Table 1. Intervention Schedule by Day and Class

Classroom	Monday	Tuesday	Wednesday	Thursday	Friday
	April 2	April 3	April 4	April 5	April 6
AM					PER Day1
PM		PER Day1			
	April 16	April 17	April 18	April 19	April 20
AM			MR Day1	I Day1	PER Day2
PM	I Day1	PER Day2	MR Day1		
	April 23	April 24	April 25	April 26	April 27
AM			MR Day2	I Day2	
PM			MR Day2	I Day2	

Table 2. Demographics

Variable	Value
Number of Kindergartners	24
Percent Male	50%
Percent Female	50%
Mean Weight	22.3kg
Mean Height	1.2m
Mean BMI	15.5

Table 3. Physical activity (counts/minute) by day

	MR Day1	MR Day2	PER Day1	PER Day2	I Day1	I Day2
Total Activity (counts/minute)	71581	85480.3	121641.5	122669.2	41015.8	261.2
Mean Activity (counts/minute)	483.8	506.2	569.2	596.2	261.2	238.2

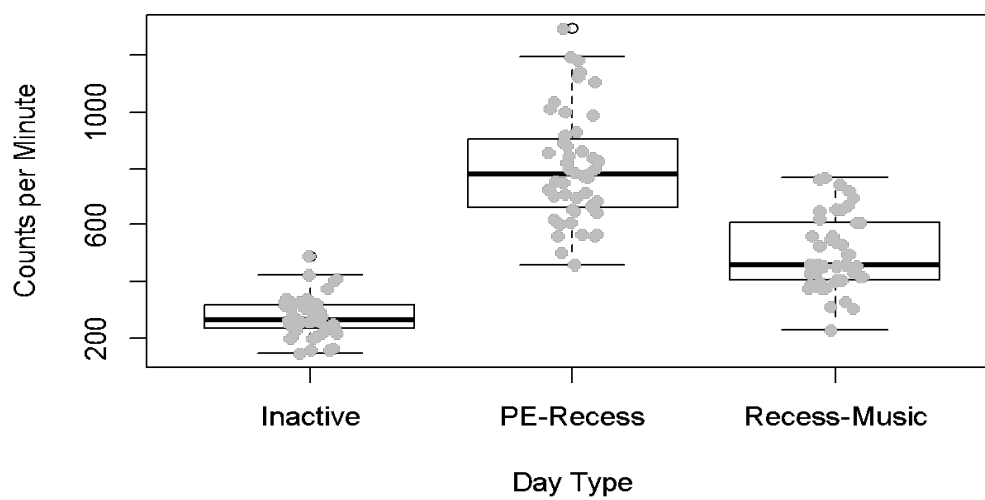


Figure 1. Total physical activity (total counts and total counts/minute) by day (PER, MR, I)

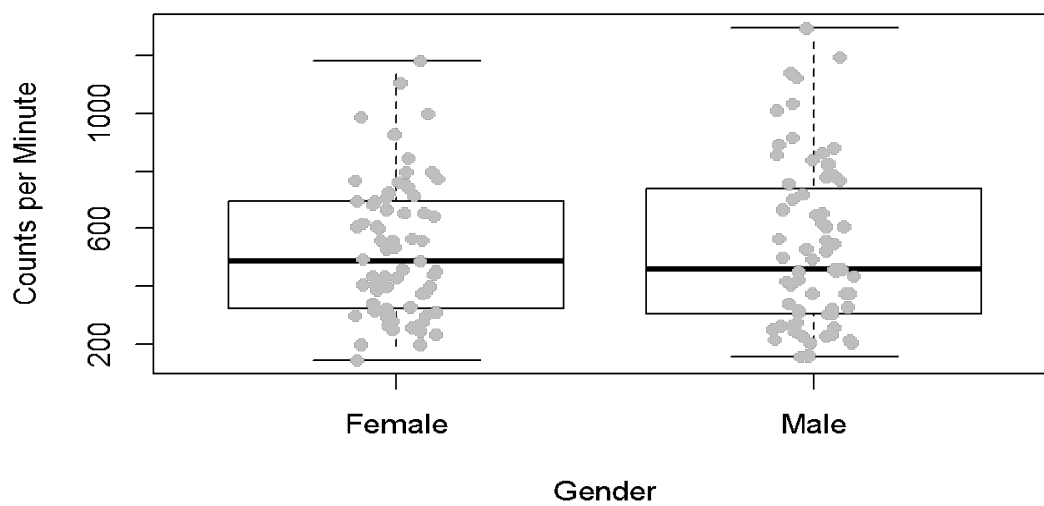


Figure 2. Total physical activity (counts/minute) M vs. F