



## Short Communication

## Preschool children's physical activity intensity during school time: Influence of school schedule

Juliana Kain<sup>a,\*</sup>, Bárbara Leyton<sup>a</sup>, Fernando Concha<sup>a</sup>, Michael Close<sup>b</sup>, Johana Soto-Sánchez<sup>c</sup>, Gabriela Salazar<sup>a</sup>

<sup>a</sup> Institute of Nutrition and Food Technology (INTA), University of Chile, Santiago, Chile

<sup>b</sup> University of North Carolina at Chapel Hill, USA

<sup>c</sup> Universidad de Playa Ancha, Valparaíso, Chile

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## ABSTRACT

Chile's Physical Activity Report Card graded the overall index on PA behavior with an F The Ministry of Sports is implementing since 2014 "Jardín Activo" (JA program) which recommends 3 weekly teacher-led PE lessons for preschool children, on half or full day attendance. We determined the effectiveness of the JA program (contribution to MVPA during school time) and assessed if effectiveness varied according to schedule. 596 five y olds, (50% boys) were selected from 66 schools; 52.9% attended half day and 47.1% full day. Children wore accelerometers during school time a day with and one without PE lesson (JA day/non JA day). We compared PA intensity between both these days by gender, using descriptive statistics and *t*-tests and determined the differential effect on PA intensity, between non JA and JA days by school schedule, using mixed models analyses We compared  $\beta$  of sedentary and of MVPA by schedule with *t*-tests. Significant differences were found in PA intensity between both days within each gender. Minutes being sedentary were significantly less during JA days (14 and 15 min in boys and girls respectively); MVPA significantly higher in JA days (11 and 10 min respectively). % time children were sedentary and % they engaged in MVPA differed by schedule. Sedentary minutes were significantly higher ( $\beta = 16.2$  vs  $-13.2$ ) in half day, while the increase in MVPA was significantly higher ( $\beta = 12.5$  vs 9.7) in full day. The JA program is effective, especially when children attend school full time.

## 1. Introduction

There is ample evidence regarding the importance of engaging in sufficient physical activity (PA) for the healthy development of children (Timmons et al., 2012). However, many children do not accumulate the recommended 60 min/day of moderate-to-vigorous PA (MVPA) for 5–17 y old children (World Health Organization, 2010) and 180 min/day of total physical activity for 1–4 y old children (Tremblay et al., 2012; Hnatiuk et al., 2014).

In spite the school environment being an important venue for promotion of daily PA, several studies have shown that preschool children are very sedentary during school time. A recent review conducted by Barbosa and de Oliveira of 7 studies measuring PA of preschool children during school time, showed the proportion of MVPA was only 3.3% of school time in 4–5 y old children (Barbosa and Oliveira, 2016)

Chilean children engage in little total PA and excessive levels of sedentary behavior. According to the 2016 Report Card on Physical Activity and Youth, which graded several indicators on PA and

sedentary behavior, Chilean children ranked among the lowest 30% globally and assigned an overall grade of F (fail) (Aguilar-Farias et al., 2016). While data on Chilean preschool children are sparse, a study of 6–9 y old children in a low-income district of Santiago, found that only 25% and 14% of children met the guideline for PA on weekdays and weekend days, respectively (Moreno et al., 2015).

Given the need for increased PA among children, the Ministry of Sports initiated a nationwide program in 2014 to increase PA and sports participation among low-income schoolchildren between the ages of 3 and 14 y. This program includes an intervention component targeting 3–5 y olds attending preschool children in both public elementary schools and kindergartens for half or full day: "Active Preschools" or Jardín Activo (JA program). This program provides funding for certified physical education (PE) teachers to lead recommended three structured PE lessons (JA lessons) per week of 45 or 60 min each, for at least 7 months of the school year.

To achieve JA's general objective of increasing PA, the Ministry of Sports instructs teachers through an on-line session of 1 h, to

\* Corresponding author at: El Líbano 5524 Macul, Santiago, Chile.  
E-mail address: [jkain@inta.uchile.cl](mailto:jkain@inta.uchile.cl) (J. Kain).

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strengthen basic motor skills, using active play while addressing gender differences. In 2015, there were a total of 533 JA programs nationwide; of these 311 targeted preschool children in 92 schools (around 7500 participants) (Government of Chile, Minister of Sports, 2015)

The aim of this study is to determine a) the effectiveness of the JA program in terms of its contribution to MVPA during school time, and b) if effectiveness of the JA program varies according to school schedule.

## 2. Methodology

### 2.1. Participants

The study sample consists of preschool children in elementary schools. Because the 92 schools could house more than one JA program, we selected only one per school, as the same PE teacher taught all JA lessons. Sixty six schools from 28 districts located in 8 Regions (Chile has 15 Regions and 334 districts) met inclusion criteria of: a) agreeing to participate b) being logistically feasible for ten-week data collection and c) represent the urban/rural distribution of low income Chileans. The study was conducted from October 1, 2015 to December 10, 2015.

The Ethics Committee for Human Studies of the Institute of Nutrition and Food Technology (INTA), University of Chile approved this study. In addition, a signed informed consent form was obtained from a parent/guardian of every child.

In each school, the study PE teacher selected 4–5 preschool children upon arrival from the classroom list by alphabetical order (at least half of each gender), during one week, which normally included 3 JA days. The children were equipped with an Actigraph GT3X accelerometers (Actigraph LLC, Pensacola, Florida, USA) placed on the right hip with an elastic belt which was removed when the school day ended, so each participant wore the device for the entire duration of school.

Accelerometers were programmed to record at a 15-s epoch length, which has been used in most studies including preschool children (Migueles et al., 2017). Cut-points to define PA intensity were determined by counts per minutes (cpm): sedentary (0–204), light (205–976), moderate (977–1527) and vigorous ( $\geq 1528$ ) (Butte et al., 2014; Verbestel et al., 2015; Cerin et al., 2016). PA was monitored twice on the same children, a day with and one without a JA lesson (JA and non JA day). The data was processed with ActiLife 6 Software from Actigraph.

### 2.2. Statistical analyses

Initially, 766 children had accelerometer data on both days. We defined  $\leq$  and  $>$  15 min as the acceptable difference between school times between JA and non JA days. With this criteria and implausible measurements, we eliminated 114 children (86 and 28 respectively). The final sample included 596 children; of these, 27% attended schools located in rural districts. This is representative of the urban/rural distribution among Chileans classified as “poor”, which in 2015 was 25.4% (Government of Chile, Minister of Social Development, 2015)

The analyses included: a) the comparison of PA intensity during non JA and JA days by gender and b) the differential effect on PA intensity between non JA and JA days by school schedule, adjusting by gender and JA lesson scheduled length.

We used descriptive statistics to compare minutes accumulated in the different PA categories between children included and not included and also minutes in these categories during non JA and JA days, within each gender and also by school schedule, using *t*-tests for dependent samples. We also compared minutes of sedentary and MVPA between boys and girls, separately on non JA and JA days, using *t*-tests for independent samples.

We used mixed models analyzing the results of repeated measures calculated in fixed points in time (non JA and JA days), adjusted by gender and scheduled JA lesson length, separately for children

attending school for half and full day, in order to assess differences (in minutes) in each of the PA categories between non JA and JA days, by schedule. We compared  $\beta$  (from mixed models) for sedentary and MVPA between both days by schedule, using *t*-tests.

## 3. Results

PA intensity of children included ( $n = 596$ ) versus excluded ( $n = 170$ ) were similar. For example, on average, minutes being sedentary were 201.7 in children included and 202.8 in children excluded in non JA days, while in JA days, they were 187 and 183.3 in respectively. Results for MVPA showed 30.4 and 30.5 min in non JA days and 41.4 and 41.9 min in JA days respectively (not shown).

The mean age of the children was 5.2 y (SD = 0.3); 50% boys. Of the total sample, 52.9% attended school for half day (a mean of 4.2 h/day) and 47.1% full day (a mean of 6.9 h/day).

Most scheduled JA lessons lasted 60 min; in half day only 5 lessons lasted 45 min, while in full day schedule, 27 lessons or 9.7%. Although not recommended by the program, 20 lessons in half day (6.6%) and 53 (19%) in full day, had a duration of 90 min and were taught twice a week.

Table 1 compares minutes accumulated in different PA categories by gender in non JA and JA days. In boys, there were significant differences in all categories between both days, except light PA. In girls, all differences were significant. Minutes being sedentary were significantly less during JA days (14 min and 15 min in boys and girls, respectively), while MVPA was significantly higher in JA days (11 and 10 min in boys and girls, respectively). Both in non JA and JA days, boys were significantly less sedentary (about 12 min less in both days) and engaged in significantly more MVPA (about 10 more min)

Table 2 shows the effect of school schedule on PA intensity by comparing minutes in the different PA categories in non JA and JA days. Because there was no significant interaction with scheduled JA lesson length, we present the results of the mixed model analyses by school schedule, adjusted by gender. Although all differences were significant in favor of JA days, these were greater for sedentary and MVPA for both school schedules, however the decline in sedentary minutes was significantly higher during half day ( $\beta - 16.2$  compared to  $- 13.2$ ), while the increase in MVPA was significantly greater during full day attendance ( $\beta 12.5$  compared to 9.7)

## 4. Discussion

Although we show minutes in the different PA intensities during school time, we present the most important results in terms of MVPA, as recommended by WHO (2010) for children 5–17 (World Health Organization, 2010).

Both on half day and full day schedules, MVPA is significantly greater on JA days however the effect is greater when children attend

**Table 1**  
Comparison of physical activity intensity between non JA and JA days by gender among Chilean preschool children.

PA categories	Boys ( $n = 299$ )		Girls ( $n = 297$ )	
	Non JA days (mean and SD)	JA days (mean and SD)	Non JA days (mean and SD)	JA days (mean and SD)
Sedentary	195.6 (63.7)	181.4 (60.8) <sup>1</sup>	207.7 (64.2) <sup>2</sup>	192.2 (63.6) <sup>1,2</sup>
Light	106.6 (42.7)	109.2 (40.3)	98.2 (39.4)	103.0 (35.4) <sup>1</sup>
Moderate	27.9 (14.7)	35.2 (13.7) <sup>1</sup>	21.5 (11.8)	27.9 (13.2) <sup>1</sup>
Vigorous	7.2 (6.6)	11.6 (7.8) <sup>1</sup>	4.6 (4.5)	8.2 (6.6) <sup>1</sup>
MVPA	35.1 (19.7)	46.8 (19.3) <sup>1</sup>	26.1 (15.1) <sup>2</sup>	36.2 (18.4) <sup>1,2</sup>

1 = statistical differences between non JA and JA days ( $p < 0.001$ ).

2 = statistical differences between boys and girls ( $p < 0.001$ ).

**Table 2**  
Effect of school schedule on Chilean children's physical activity intensity between non JA and JA days \*.

Half day	Non JA days (mean and SD)	JA days (mean and SD)	$\beta$ (SE)	P value
Sedentary	157.6 (30)	141.0 (26.6)	- 16.2 (1.4) <sup>1</sup>	< 0.001
Light	73.9 (21.8)	79.8 (17.6)	5.9 (1.0)	< 0.001
Moderate	19 (10.3)	25.3 (8.7)	6.3 (0.6)	< 0.001
Vigorous	5 (4.9)	8.4 (6.1)	3.4 (0.3)	< 0.001
MVPA	24 (14.2)	33.7 (13.4)	9.7 (0.8) <sup>2</sup>	< 0.001
Full day				
Sedentary	251 (55.8)	238.1 (49.7)	- 13.2 (2.5) <sup>1</sup>	< 0.001
Light	134.5 (33.6)	135.6 (32.8)	1.2 (1.8)	< 0.001
Moderate	31 (14.3)	38.6 (15.3)	7.8 (0.9)	< 0.001
Vigorous	7 (6.4)	11.7 (8.4)	4.7 (0.5)	< 0.001
MVPA	38 (19.3)	50.3 (21.7)	12.5 (1.2) <sup>2</sup>	< 0.001

Mixed model analyzing results of repeated measures, adjusted by gender and scheduled JA lesson length.

1 statistical difference in sedentary minutes between half and full day schedules ( $p < 0.001$ ).

2 statistical difference in MVPA between half day and full day schedule ( $p < 0.001$ ).

school for a full day. Boys accrued significantly more MVPA than girls as shown by several studies (Trost et al., 2002).

During full day schedule children accumulated on average, 50.3 min of MVPA. If one applies the Canadian Guideline for whole school day PA (30 min of daily MVPA) (Governments of British Columbians, Ministry of Education, 2008), children in full day schedule during non JA days and those in half day schedule on JA days surpass this recommendation and significantly more on JA days in both schedules

It is important to point out that the scheduled length of JA lesson (30 or 45 min) did not influence MVPA accumulated during school time. The interaction term evaluating the effect of scheduled JA lesson length and minutes of PA accrued was non-significant. Indeed, the proportion of MVPA accrued in half day and full day was the same, 12.8 and 12.4% of MVPA, respectively (not shown).

Research shows that young children engage in limited MVPA during school time. Recently, Crosatti et al. analyzed PA in 370 children aged 4 to 6 years during school, and reported that children spent most of their time in sedentary behaviors (89.6%–90.9%) (Sara et al., 2014). Pagels et al. found that 3–5 y olds, engaged in MVPA for only 16.3 min or 3.8% of school time (Pagels et al., 2011). In our study, MVPA during school time varied from around 7.7 to 10.9%, much higher than that found in these studies.

Hollis et al. in a systematic review of studies reported that teacher-led PE lessons are one of the most effective ways to increase MVPA during school time, as on average, 32.6% of lesson time was spent in MVPA (Hollis et al., 2016). Although the recommendation is that 50% lesson time be spent on MVPA, minutes of MVPA accrued in physical activity during the lesson was considerably greater than other daily time periods in and out of school (US Department of Health and Human Services, 2000).

A study that is similar to ours was done by Van Cauwenberghe et al. and included 200 Belgian preschool children (5.3 y) (Van Cauwenberghe et al., 2013). It characterized PA levels with accelerometers during days with teacher-led PE lesson and days without. The mean PE lesson length was 49 min. Results showed that in PE days, sedentary time was 39.4 min and MVPA was 44.2 min, while in non PE days, these figures were 49.7 min and 34 min respectively, demonstrating that PE lessons contributed significantly to the decrease in sedentary time and the increase in MVPA during school time. Vale et al. in a similar study including Portuguese preschoolers showed that in PE days, boys accumulated 7 and girls 6 more min in MVPA. In comparison, in our study we showed that during full time schedule (approximately the same school time), children accumulated 12 more min of MVPA (Vale et al., 2011)

The most important strength of this study is that it not only shows that a nationwide program is effective in significantly increasing MVPA during school time, but that in full day attendance, the effect is greater. One limitation of the study is that PA was only assessed during the time children attended school, therefore we do not know how much MVPA children accumulated outside of school, and therefore cannot compare if children complied or not with the daily MVPA recommendation. Although we were not able to select a random sample due to time constraints, we collected data in 10 weeks on 8% of children targeted nationwide from 71.7% of the schools which housed JA programs.

In conclusion, JA days were associated with significantly greater time spent in MVPA (vs. non JA days) among preschool children during school time, especially when they attend school full time. The observed effect is meaningful given the importance of PA in early childhood, where even 10 min of additional vigorous PA may confer substantial benefits to bone mineral content, among other health outcomes (Janz et al., 2001; Timmons and Patti-Jean, 2007). Though our results suggest the JA program was effective, a cluster-randomized controlled trial may deliver conclusive evidence. Because girls are considerably less active, we recommend investigating the causes of gender disparities developing practical solutions to reverse this trend. Finally, we recommend the JA program to standardize the structure of the JA lesson, in terms of the types and duration of activities taught.

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## Conflict of interest

The authors declare that they do not have any conflict of interest.

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