



Original/Pediatría

# Motor skills and nutritional status outcomes from a physical activity intervention in short breaks on preschool children conducted by their educators: a pilot study

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## Abstract

**Introduction:** childhood obesity is a worldwide health concern. For this issue different intervention have being planned to increase physical activity patterns and reduce the excess of weight in children with limited or no success.

**Objective:** the aim of this study is to evaluate the results of a pilot intervention consisting in three 15-minute breaks conducted by educators and supervised by physical education teachers on motor skills and nutritional status in preschool children.

**Methods:** sample was 70 preschool children (32 boys and 38 girls), age  $4 \pm 0,6$  years. The physical activity classes were performed three times a week, 45 minutes daily, distributed in three 15 minutes breaks. The circuits were planned to have; jumps, sprints, carrying medicinal balls, gallops and crawling. Motor skill tests that were performed Standing long jump (SLJ) and Twelve meter run.

**Results:** with the intervention no significant differences in nutritional status were found on mean Z score (boys  $p=0,49$ , girls  $p=0,77$ ). An increment on weight and height was found after the intervention ( $p<0,0001$ ). Regarding the 12 meter run test, we found significant changes after the intervention when we normalize by weight in boys ( $p=0,002$ ) and girls ( $p<0,0001$ ). Our results have shown than boys significantly increased their SLJ and SLJ normalized by weight ( $p<0,0001$ ); a similar result was found in girls after the intervention ( $p<0,0001$ ) suggesting the increment of power independent of weight gain.

## RESULTADOS EN PATRONES MOTORES Y ESTADO NUTRICIONAL DE UNA INTERVENCIÓN DE ACTIVIDAD FÍSICA DE RECREOS REDUCIDOS A NIÑOS PREESCOLARES, CONDUCTA POR SUS PROFESORAS EN UN ESTUDIO PILOTO

### Resumen

**Introducción:** la obesidad infantil es ya un problema de salud pública. Para su disminución, han sido planteadas diferentes estrategias con el fin de aumentar la actividad física y con ello reducir la ganancia de peso en niños; estas estrategias se han llevado a cabo con un éxito limitado.

**Objetivo:** el objetivo de este estudio es evaluar los resultados de una intervención piloto, la cual consiste en tres recreos de 15 minutos tres veces por semana conducidos por las educadoras y guiados por educadores físicos en los patrones motores y el estado nutricional de niños preescolares.

**Métodos:** la muestra consta de 70 niños preescolares (32 niños y 38 niñas), edad  $4 \pm 0,6$ . Las clases de educación física fueron llevadas a cabo tres veces por semana en recreos de 15 minutos. Se plantearon circuitos, los cuales contenían saltos, gateo, galopes, carreras, carga y manipulación de balones medicinales. Las pruebas motoras evaluadas fueron el salto horizontal y la carrera de 12 metros.

**Resultados:** con la intervención no se encontraron diferencias significativas en el estado nutricional (media Z score niños  $p=0,49$ , media Z score niñas  $p=0,77$ ). Sí se encontró un aumento significativo en el peso ( $p<0,0001$ ) y la talla ( $p<0,0001$ ) tanto en niños como en niñas al término de la intervención. En cuanto a las pruebas motoras, la carrera de 12 metros ajustada al peso tuvo cambios significativos en niños ( $p=0,002$ ) y en niñas ( $p<0,0001$ ); mientras que el salto horizontal mejoró en ambos grupos tras la intervención ( $p<0,0001$ ). Cuando se ajustaron las pruebas motoras por estado nutricional, se encontraron cambios significativos tanto en la carrera de 12 metros en los niños con sobrepeso ( $p=0,008$ ) como en el salto horizontal/talla ( $p<0,0001$ ), lo que sugiere el incremento de la potencia independientemente del aumento de peso observado.

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**Conclusions:** in conclusion, this pilot study found that an intervention with more intense activities in small breaks (15 minutes), and guided by the educators could improve essential motor skills (running and jumping) in preschool children of a semi-rural sector independent of nutritional status. This gaining in motor skills is the first step to increase physical activity levels in preschool children.

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## Introduction

Childhood obesity is a growing health problem in Chile<sup>1</sup> and worldwide<sup>2</sup>. According to the last data from the National Board of Day Care Centres (JUNJI), nine percent of children under 6 years are obese and 22% overweight<sup>3</sup>. To prevent weight gain, short and long term interventions<sup>4</sup> had being conducted in places such as elementary schools<sup>5</sup> and playgrounds<sup>6</sup>, this considering that these early stages are critical for the acquisition of movements and skill patterns which will allow the children to participate in more intense activities in later years<sup>7</sup>. It is important to mention that recent evidence suggest that interventions in childhood are associated with a more favourable body composition<sup>8,9</sup> and decrease of cardiovascular risk<sup>10,11</sup>, for that the role of parents<sup>12</sup> and primary care teachers<sup>9</sup> is important to stimulate the increase moderate to vigorous activities<sup>13</sup>.

Nowadays, physical inactivity is considered a mayor health problem<sup>14</sup> affecting equally adults<sup>15</sup> and childrens<sup>16</sup>. Physical activity patterns in childrens have a tendency to be poor<sup>6,17</sup>. A recent study conducted in Chilean pre-schoolers, has shown that when they quantified the intensity during a physical activity class (with activity monitors), 60% of the activities represent a minimum energy expenditure while moderate intensity activities just achieved 3% of the whole class<sup>18</sup>. Several authors have found a direct relation between the developments of motor skills with the increase of physical activity levels<sup>19,20</sup>. This has being described mainly due to the significant changes on the performance in locomotion and objects manipulation<sup>19</sup>. Fisher *et al.* demonstrated a low but positive correlation between motor skills and physical activity participation on 4 year old children<sup>21</sup>. In practical terms, batteries Test to measure motor skills need to be simple and reliable, these because between two and four years, there is no rivalry among children<sup>22</sup>. Morris documented the first investigation on age and gender differences on motor skills performance, mentioning the importance of age on the results in advanced motor test like balance and throwing objects<sup>23</sup>. For this reason, quantitative test (centimetres, time) have being generated and valida-

**Conclusión:** este estudio piloto encontró que una intervención con actividades más intensas en pequeños recreos guiadas por educadoras pueden incrementar los patrones motores básicos en niños preescolares, independientemente del incremento de peso. Esta ganancia en los patrones motores es el primer paso para el incremento de los niveles de actividad física en niños preescolares.

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Palabras clave: *Patrones motores. Preescolares. Actividad física. Intervención.*

ted with the objective to compare individual, grouped or even gender differences with more easy-going protocols<sup>24</sup>.

The aim of this study is to evaluate the results of a pilot intervention consisting in three 15-minute breaks conducted by educators and supervised by physical education teachers on motor skills and nutritional status.

## Methods and Materials

### *Participants*

A cohort design to increase in 30 minutes the time of playing for the children, was conducted in 81 preschool children (41 girls and 40 boys), mean age  $4 \pm 0,6$  years, all belonging to JUNJI. The sample included only kindergarten childrens with the objective that they can perform the selected motor tests that we considered for the pilot intervention. The inclusion criteria considered to have three years of age at the time of the study, attend regularly to the day care centre and written acceptance by the parents. Evaluated children had no disease that could interfere with practice of physical activity. For the final analysis, 11 childrens where excluded (8 boys who did not assist to the final evaluation and 3 girls who at the moment of the final evaluation presented a medical letter for not to practice vigorous activities). For the final sample, 70 participants were included in the statistical analysis (32 Boys and 38 Girls). Local education board approved the intervention and all parents signed an informed consent with all the procedures conducted in study.

### *Previous to the Intervention*

Previous to the beginning of the school year (February) all the educators were trained during a three-day seminar. The topics selected for the seminar included; evaluation of motor skills, physical activity circuits, aspects of food and nutrition, first aid and anthropometric measurements.

## Intervention

The intervention was carried out only by the educators and guided by Physical Education teachers (who watched the classes and give a weekly feedback). The physical activity classes were performed three times a week, 45 minutes daily, distributed in three 15 minutes breaks for six months. Class was divided in two groups (Approximately 15 children each) to be able to work in a more personalized way. While a group was performing the intervention, the other group stayed in class, after the 15-minutes they switch. On each session circuit activities were performed; whose aim was to achieve more vigorous movements and to avoid the inactivity observed in previous studies<sup>18</sup>. The circuits were planned to have; jumps, sprints, carrying medicinal balls, gallops and crawling's, all these activities where adapted from the Physical Activity Guidelines validated by MINSAL-INTA<sup>38</sup>. Tunnels, coordination scales cones, medicinal balls, ropes where used in all the activities, all which have been demonstrated to have a great impact in motivation on the practice of physical activity in this ages<sup>25</sup>.

## Measurements

### Anthropometry

Weight and height was evaluated at baseline and at the end of the intervention. All the measurements where made by the educators previously trained. To determine the weight and height we used a digital scale (SECA, Model 713, USA) with limits from five to 200 kg and one to 200 cm scale (precision of 0,1 kg and 0,1 cm respectively).

### Motor Skill Tests

Two motor tests previously used by several authors<sup>24,26</sup> were selected:

- a) **Standing Long Jump (SLJ)**; it was measured from a horizontal line, where the children were told to jump as long as they can in a non-sliding surface. The distance was measured with an inextensible iron tape (SECA, USA) and the result was expressed in centimetres (cm).
- b) **Twelve Meter Run**; measured in a flat surface, in a school backyard, where the children were instructed to run as fast as they can. Children started to run one meter before the test's distance, to eliminate the slow beginning and ensure a good final velocity (23). The time elapsed to cover the 12m distance, was recorded with a digital chronometer Casio® (1/100Seg), by two evaluators, at each side of the arrival line. Both tests where repeated three times and the mean of the best two values was considered

as best performance. A week before, in three different days, children performed the two tests, to be familiarized with them.

### Statistical analysis

Data analysis was assessed using a Graphpad Prism (V.5.1, San Diego, California). Firstly, Shapiro-Wilk was used to determine the normality of the sample. All variables were expressed in means and standard deviation; paired T-test was used to determine grouped differences in parametrical variables meanwhile for non-parametrical variables Wilcoxon test was set. A  $p < 0.05$  was considered to be significant

## Results

The main results of pilot intervention are shown below. Children characteristics are shown in table I; the nutritional status change, produced by the intervention can be found in table II. Change in the motor skills test is shown in table III, and changes by different nutritional status are described in table IV.

## Discussion

This study supports the small but growing evidence of the important role of a well prepared educator for the improvement in motor skills<sup>27</sup>. Early interventions are important to facilitate the increase of the game time duration and intensity; this change will impact directly on physical inactivity at preschool centers and schools. Recently in a one-year intervention performed in 4-5 year old pre-schoolers at Playground/Home/Community, where the teachers and parents where educated besides playground modification, authors found a significant re-

**Table I**  
Children Characteristics

	Boys (n=32)	Girls (n=38)	p
Age (years)	3.2 ± 0.4	3.3 ± 0.7	0.89
Weight (kg)	16.3 ± 2.5	16.2 ± 2.6	0.62
Height (cm)	98.6 ± 4.3	98.9 ± 4.9	*0.02
Z score	1.0 ± 0.8	0.82 ± 1.2	*0.05
<b>Nutritional Status</b>			
Under nutritional Risk	1.4%	1.4%	
Normal Weight	24%	37%	0.01
Overweight	13%	5%	0.05
Obese	11%	7%	0.13

Values are mean and ± SD. Paired t test \* $p < 0.05$ .

**Table II**  
*Anthropometric and nutritional status differences pre and post -intervention*

	Boys (n = 32)			Girls (n = 38)		
	Pre	Post	P value	Pre	Post	P value
Weight/Age	0.36±1.1	0.47±0.9	0.11	0.36±1.2	0.36±1.1	0.86
Height /Age	0.35±1.0	0.12±1.5	0.03*	-0.14±1.1	-0.30±1.0	0.008**
Weight/Height	0.84±1.0	1.1±0.95	0.02*	0.66±1.2	0.83±1.1	0.02*
Mean Z score	1.09±0.8	1.00±0.8	0.49	0.82±1.2	0.79±1.1	0.77
Weight (kg)	16.3±2.5	17.7±2.5	<0.0001***	16.2±2.6	17.6±2.7	<0.0001 ***
Height (m)	98.6±4.3	102±4.4	<0.0001***	98.9±4.9	102±4.8	<0.0001***
BMI (kg/m <sup>2</sup> )	16.7±1.5	16.8±1.5	0.87	16.6±2	16.5±1.9	0.80

Values are mean and±SD. Significance paired *t* test \**p*<0.05 BMI: Body mass index, Normalized (/).

duction in fat mass (1.2% respectively), BMI and BMI (z score) and a important increase in physical fitness scores<sup>28</sup>. With our intervention no significant differences in nutritional status were found, even though there was a larger number of boys who were overweight; girls with normal nutritional stayed the same at the end of the study.

Regarding the 12 meter run test, we found no changes after the intervention when compared by gender, although when compared by nutritional status we observed that there was a significantly reduction in the time that the test was achieved, in normal nutritional girls there was a change from 5.9±0.77 to 5.6±0.75 seconds (*p*=0.024); additionally, overweight boys reduction of time ranged from 5.3±1.07 to 4.9±0.81 seconds (*p*=<0.001). It has being suggested that obese children manifest different kinematics in their gait, especially in fast gait when compared to normal weight, exhibiting lower cadence, relative velocity and stance periods<sup>29</sup>, this is why to our knowledge we are the first study to normalize the run by weight. Our findings implied that independent of the weight gain the overweight children increase their speed in 12 meters (*p*=0.008). It is documented that excessive body weight induces an excess load that increases energy needed to maintain the same speed of locomotion in older childrens<sup>30</sup>; having included weight-bearing activities (medicine balls) may have help to the increase of

strength shown only in overweight boys and not in girls as in normal weight counterparts (Table IV). Other study shown significant increment on the distance during a six-minute walk test independently of the weight gain in preschool childrens<sup>6</sup>. Early intervention are essential, because if primary care teachers promote game and physical activity on long breaks, children increases their play time and intensity, which in turn favours adequate growth<sup>31,32</sup>.

Our results have shown than boys significantly increased their SLJ from 46.1±16 cm to 72.7±14 cm; in girls, a similar result was found in girls as they augmented the jumped distance from 36.1±14 to 56.6±19 cm. Boys had a better performance in the SLJ test than girls, from the beginning of the intervention, even when normalized by weight (Table III). In a recent study, the kinematics of the SLJ was tested in three to six years old Chinese children<sup>33</sup>, with jumped distances of 44.23 (16.95) and 59.65 (16.64) cm in pre-schoolers of three to 3.5 years and 3.5 to four years respectively. These values are similar to the data shown by the boys in our study (Table III) and regarding the Chilean girls evaluated, their performance is below the Chinese children.

It has being suggested to normalise the jump distance by weight<sup>34</sup>, as the obtained distance in the SLJ had a significant association with the length of the legs and body composition changes<sup>35</sup>. The same relationships sustained

**Table III**  
*Physical activity intervention outcome in motor skill tests by gender*

	Boys (n = 32)			Girls (n = 38)		
	Pre	Post	P value	Pre	Post	P value
12 Meter Run (seg)	7.04±9	5.2±0.8	0.51	5.9±0.8	5.7±0.8	0.15
12 meter run/ Weight	0.45±0.69	0.30±0.07	0.002*	0.37±0.08	0.33±0.07	<0.0001 ***
SLJ (cm)	43.1±16	72.7±14	<0.0001 ***	35.1±14	56.6±19	<0.0001 ***
SLJ / Height	0.43±0.17	0.71±0.13	<0.0001 ***	0.35±0.14	0.55±0.19	<0.0001 ***

Values are mean and±SD Significance paired *t* \**p*<0.05. Normalized by weight (/). SLJ: Standing Long Jump.



**Table IV**  
*Intervention outcomes in motor skill test by Nutritional Status*

	Boys			Girls		
	Pre	Post	P value	Pre	Post	P value
12 Meter run/Normal Weight (seg)	5.5±0.72	5.8±0.44	0.187	5.9±0.77	5.6±0.75	0.024*
12Meter Run/Overweight (seg)	5.3±1.07	4.9±0.81	0.008**	5.6±0.9	5.5±0.6	0.92
SLJ/Normal Weight (cm)	44.5±16.4	74.5±15.8	<0.0001***	34.6±13.4	54.5±16.9	<0.0001***
SLJ/Overweight (cm)	40±16.4	70.2±13.4	<0.0001***	42.4±20.2	63±28.3	0.01*

Values are mean and±SD Significance paired *t* test \**p*<0.05. Normalized by nutritional status (/)SLJ: Standing Long Jump.

between girls and boys, once the adjustment has been applied.

The main differences established in the performance on the SLJ could be linked to recent Zvomivir *et al.* publication that has shown that in 5.9 years old children performing balance and SLJ test, a significant improvement in motor tests is accomplished by previous familiarization<sup>36</sup>. A current research conducted in European children, verified the differences between physical activities in five year olds by gender<sup>37</sup>. In this study, similarly to our study, boys had greater moderate to vigorous physical activity in the week, than girls, and higher light to moderate physical activity during weekend, where greater vigorous activities are related to strength and physical fitness improvements<sup>38</sup>. Having more intense activities (specially moderate to vigorous) was significantly associated to all cardiometabolic outcomes, independent of age and gender, so the increment of these type of activities are fundamental for preventing health outcomes in the future<sup>39</sup> specially in overweight and obese children.

To our knowledge, this is the first study conducted in Chile, which applied motor skills to assess the impact of a physical activity intervention in 3-4 year olds, living in a semi-rural setting. Probably, the absence of other similar studies at this age is due to the previous lack of consensus about the appropriate tests to measure motor skills performance in this population. Ortega *et al.* recently have proposed a fitness battery tests to evaluate preschool children, called PREFIT, whereas the authors consider the following tests: a) Shuttle run test (20m) for cardiovascular fitness. b) Handgrip and SLJ for muscle power/strength and c) Four by four 10 shuttle test<sup>29</sup>. Thus, our study may be one of the first to evaluate some aspects of the battery proposed by Ortega *et al.*, in three year olds, for assessing the impact of physical activity intervention<sup>40</sup>.

The limitations of our study refer to the number of children participating in the intervention, which has probably impaired statistical power in some of the comparisons. Additionally, only one motor tests of the PREFIT battery was utilised, the others were previously evaluated by Morris *et al.*<sup>23</sup>, although at the initiation of our study, this set of fitness tests (PREFIT) was not published yet. Further investigations should attempt to include all the

battery measurements, to evaluate physical activity programs in playground-community-based interventions.

In conclusion, this Pilot study found that an intervention with more intense activities in small breaks (15 minutes), and guided by the educators could improve essential motor skills (running and jumping) in preschool children. These are known to be the first steps to increase moderate to vigorous activities<sup>19</sup> and consequently, adequate energy expenditure and weight balance in childrens.

Finally, the actual energy expenditure guidelines<sup>41</sup> postulate that a children under six years should performed one hour of moderate to vigorous activity, where gross motors skills are predominant (running, jumping, throwing, climbing). The role of the family and the playground teachers is vital, to accomplish these recommendations and motivate children “daily activities” to ensure and facilitate physical play, which will result in an adequate fitness and optimum growth and health.

### Conflict of interest

Authors declare no conflict of interest.

### Key messages

- Physical Activity is an important factor in child development
- Physical interventions at early age can modify motor skills independent of nutritional status
- The role of preschool educators is important towards nutritional and physical activity patterns
- Motor skills improvement must the first approach to moderate-vigorous activity in children
- Different visual and texture materials can improve the adherence to movement

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