



Original/Deporte y ejercicio

Compliance of physical activity guidelines by Chilean low-income children: difference between school and weekend days and nutritional status

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Abstract

The main objectives of this study were to compare in 6-9 y Chilean low-income children, daily minutes of moderate/vigorous physical activity (MVPA) and compliance of the guideline of 60 min of daily MVPA on weekdays versus weekends, by sex and nutritional status (NS). The sample included 250 children (139 boys). Weight and height were measured; MVPA was assessed with NL1000 pedometers during 7 days. The sample was categorized into normal-weight (N) and overweight (OW) according to BMI z score (WHO reference 2007). Comparisons between weekdays and weekends included: a) MVPA by sex, using t-test b) MVPA of N and OW by sex, using ANOVA c) Compliance of guideline by sex and NS, using test of proportions. 66% of the children were OW, accumulating significantly more MVPA on weekdays, 50.5 min versus 40.3; boys more than girls; this result was similar by NS, except for N girls who spent similarly on weekdays as on weekends. Only 33 % boys and 15% girls ($p=0.03$) and 17 and 9% ($p=0.058$) met the guideline on weekdays and weekends respectively, similarly by NS. A very small proportion of children met the MVPA guideline; adopting an active lifestyle is key, considering their high overweight prevalence.

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Key words: *Pedometer. Moderate and vigorous physical activity. Children. Nutritional status. Chile.*

GRADO DE CUMPLIMIENTO DE NIÑOS CHILENOS DE BAJOS RECURSOS CON LA RECOMENDACIÓN DIARIA DE ACTIVIDAD FÍSICA: DIFERENCIA ENTRE SEMANA Y FIN DE SEMANA SEGÚN ESTADO NUTRICIONAL

Resumen

Los principales objetivos de este estudio fueron comparar en escolares chilenos de bajos ingresos (6-9 años), minutos diarios de actividad física moderada / vigorosa (AFMV) y el cumplimiento de la recomendación de 60 minutos diarios de AFMV durante la semana y fin de semana, por sexo y estado nutricional (EN). La muestra incluyó a 250 niños (139 varones). Se midieron peso, talla y AFMV que se evaluó con podómetros (NL1000) durante 7 días. La muestra se clasificó en peso normal (N) y sobrepeso (SP) según puntaje z de IMC (OMS 2007). Las comparaciones entre días de semana y fines de semana incluyeron: a) AFMV por sexo, utilizando la prueba t b) AFMV de N y SP según sexo, usando ANOVA y c) grado de cumplimiento de la recomendación por sexo y EN, utilizando la prueba de proporciones. 66% de los niños eran SP, acumulando significativamente más AFMV los días de semana, 50.5 min versus 40,3; los niños más que las niñas. Este resultado fue similar según EN, excepto para las niñas N. Sólo 33% de los niños y 15% de las niñas ($p=0,03$) y el 17% y el 9% ($p=0,058$) cumplieron con la recomendación durante la semana y fin de semana, respectivamente con resultados similares según EN. Un bajísimo % de niños chilenos cumple con la recomendación diaria de AFMV. La adopción de un estilo de vida activo desde temprana edad es clave, teniendo en cuenta además la alta prevalencia de sobrepeso.

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Palabras clave: *Podómetros. Actividad física moderada e intensa. Niños. Estado nutricional. Chile.*

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Abbreviations

WHO: World Health Organization.

MVPA: Moderate to vigorous physical activity.

OECD: Organization for Economic Cooperation and Development Countries.

INTA: Institute of Nutrition and Food Technology, University of Chile.

METS: Metabolic Equivalents.

BMI: Body mass index.

BMI Z: Body mass index z-score.

N: Underweight + normal.

OW: Overweight + obese.

Introduction

The importance of physical activity for the healthy development of children has been well established, as sedentary behavior and low levels of physical activity are associated with an increased risk of developing childhood obesity and chronic diseases in late childhood and adulthood¹. So, if engaging in sufficient physical activity is crucial at every age, in childhood it becomes more important to comply with the daily guideline as it increases the probability of becoming a lifetime behavior². Current guideline established by the World Health Organization (WHO) indicates that children should accumulate at least 60 minutes daily of moderate to vigorous physical activity (MVPA)³. Even though daily activities of children vary during weekdays (when attending school) and thus minutes spent on daily MVPA, the difference between MVPA accumulated on weekends compared to that weekdays tends to be greater⁴⁻⁶. Therefore assessing MVPA in both school days as well as on weekend days provides information on children's compliance with the guideline when they are at school or not and gives insight into the lifestyle they are leading.

In Chile, although the prevalence of childhood obesity is one of the highest among Organization for Economic Cooperation and Development Countries (OECD) (23% of 6 y olds are obese and 28% are overweight)⁷, very few studies have quantified daily minutes and intensity of physical activity. In Chile, Godard et al.⁴, using accelerometers during 2, 3 or 4 consecutive days measured minutes of physical activity accumulated by 109 schoolchildren (4-10 years old) showing a greater amount of MVPA on weekdays. Also Vasquez et al.⁸, using accelerometers, but only on 24 obese preschool children, reported greater daily MVPA on weekdays (32 vs 22 min). At the national level since 2011, physical fitness is being assessed on a representative sample of adolescents (around 14 y olds). Recent results show that 90% of them are unfit, being this proportion greater in those attending public schools (93%) compared to private ones (86%). These evaluations do not collect data on physical activity (either minutes or intensity)⁹. It is evident that more studies addressing the quantity

and intensity of physical activity performed by Chilean children are necessary. Therefore, the aim of this study was to determine daily minutes of MVPA and compare compliance with the guideline of ≥ 60 minutes on school and weekend days. Also we sought to determine if there is an association between the nutritional status of the children and daily MVPA.

Methods

Participants and setting

This study was approved by the Institutional Board of the Institute of Nutrition and Food Technology (INTA) of the University of Chile, which meets both national and international certification standards. School principals and teachers received the information regarding the study's characteristics. Parents or guardians had to approve a written consent to allow their children to participate in the study.

A convenience sample of children attending first to third grade (6-9 years) was drawn from three public schools located in a low income district of Santiago, called Ñuñoa. The sample size at baseline included 259 children (we then excluded 9 children, because they did not have data on weight and/or height) so the total sample for this study was 250 children. Based on the standard deviation and the difference observed in MVPA (10 minutes) between weekdays and weekend days found in the study by Vasquez et al.⁸, our sample of 250 children was expected to provide power exceeding 80% to detect differences of at least 10 minutes between weekdays and weekend days. Although measurements in that study were done with accelerometers while we used pedometers (New Lifestyle NL 1000), this type of pedometer is similar to an accelerometer and has been validated with the Actigraph GT1M on children of similar age as the ones we studied^{10, 11}.

As recommended by the manufacturer and several authors¹¹, pedometers were set at level 4, recording time in activities above 3.6 metabolic equivalents (METS). The device was placed on the right hip clipped onto a waistband. Parents were instructed to remove it when the child would take a shower, bath and go to sleep and placed back again in the morning¹². Parents received a data sheet to record the time when the device was removed, the reason for removing it and the time it was placed back again¹³. Every evening a researcher called each parent to check if there were any problems and each school day she checked if the pedometers were placed properly on the hip. When a problem was detected regarding the proper use of the pedometer, recording was repeated all over again.

To determine the nutritional status of the children, two trained nutritionists assessed their weight and height with portable scale and stadiometer (Seca models 804 and 213 respectively) to the nearest 0.1 kg and 0.1 cm respectively.

Statistical analyses

All data were checked for normality before analysis. Pedometers were worn for 8 consecutive days between August and November 2012. We considered day 2 through 8 (7 days) for a minimum of 10 hours/day on weekdays and 8 hours on weekend days¹³. We calculated the average amount of minutes of MVPA on weekdays dividing the total recorded on those days by 5 and on weekends, dividing by 2.

We calculated body mass index (BMI) as weight/height² and determined the BMI Z score for each child, using the 2007 WHO reference¹⁴ in order to classify their nutritional status as follows: low weight (BMI Z < -1), normal weight (BMI $\geq -1 \leq Z +1$), overweight (BMI Z > $\leq +1 +2$) and obese (BMI Z > +2). Because the purpose of the study was to present the results for each sex and category of nutritional status and the sample size in each category was small, we categorized the sample into: underweight + normal = N and overweight + obese = OW. Because only 6 children were classified as underweight (see Table 1) and their mean BMI Z was very close to that of the lower limit of normal weight, they were included in the N group.

All data presented normal distribution assessed by Shapiro-Wilk. Descriptive statistics were used to characterize the sample. Subsequent analyses included: a) the comparison of minutes in MVPA on weekdays and weekends separately between sexes, using t-test b) the comparison of minutes in MVPA between weekdays and weekend days in each sex, using t-test c) the comparison of minutes in MVPA spent by N and OW separately on weekdays and on weekend days, in each sex using ANOVA and d) the same comparison as before,

but now between weekdays and weekends, also using ANOVA. The ANOVA considered 2 fixed factors, the first one, group (N or OW) and the second one, sex.

To determine if there was an association between minutes spent on MVPA and BMI Z score, we used the Pearson correlation. Finally, we calculated compliance with the daily guideline of MVPA in 3 separate analysis, using the test of proportions: a) the difference between sexes separately on weekdays and weekend days: b) in each sex, between N and OW separately on weekdays and weekend days and c) the difference in each sex and group, between weekdays and weekend days.

Data were analyzed with the statistical program Stata/SE10.1 (Stata Corp, Texas, USA).

Results

Table I shows the anthropometric characteristics of the sample by sex. Boys had a significantly higher weight ($p=0.087$), BMI ($p=0.00116$) and BMI Z score ($p < 0.000$) than girls. In this sample, the prevalence of overweight children (OW) was 66%, higher among boys (71%).

Table II presents the mean daily minutes of MVPA spent on weekdays and weekends for the total sample, by sex and nutritional status. On average, children accumulated significantly more daily minutes of MVPA during weekdays than on weekends (50.5 vs 40.3 min); boys significantly more than girls, both on weekdays as well as on weekends, independent of their nutritional status ($p>0.05$). When the comparison between minutes spent on weekdays versus weekends was done in each sex and category of nutritional status,

Table I
Anthropometric characteristics of the sample (6-9 y) by sex

Anthropometry	Boys	Girls	Total	P value
N	139	111	250	
Age (years)	7.4 (0.9)	7.6 (0.9)	7.5 (0.9)	0.284
Weight (kg)	33.1 (8.0)	30.7 (5.9)	32.1 (7.2)	0.0087
Height (cm)	129.4 (8.0)	128.1 (7.1)	128.8 (7.6)	0.1901
BMI (kg/m ²)	19.6 (3.2)	18.6 (2.6)	19.1 (3.0)	0.0116 ¹
BMI z score	1.88 (1.37)	1.26 (1.05)	1.61 (1.27)	0.0001 ¹
% Low weight (n)	2 (3)	3 (3)	2 (6)	
% Normal weight (n)	27 (37)	38 (42)	32 (79)	
% Overweight (n)	25 (35)	31 (34)	28 (69)	
% Obese (n)	46 (64)	29 (32)	38 (96)	
% N Group (n)	29 (40)	40 (45)	34 (85)	
% OW Group (n)	71 (99)	59 (66)	66 (165)	

¹Significant difference by sex (Student t test) $p<0.05$.

Data on age, weight, height, BMI and BMI Z score are presented as mean and SD.

Data on the nutritional status is presented as percentage and number of participants.

Table II
Minutes of MVPA accumulated daily on weekdays and weekend days by sex and nutritional status

	<i>N</i>	<i>Minutes of MVPA (mean and SD)</i>	<i>Minutes of MVPA N Group</i>	<i>Minutes of MVPA OW Group</i>
<i>Weekdays</i>				
Boys	139	54.8 (19.3) ¹	55.5 (19.6) ^{2,3}	54.6 (19.3) ^{2,3}
Girls	111	45.1 (13.5) ¹	44.2 (12.7) ²	45.7 (14.1) ^{2,3}
Total	250	50.5 (17.6) ¹	49.6 (17.2) ^{2,3}	51.0 (17.9) ^{2,3}
<i>Weekend days</i>				
Boys	139	42.3 (21.7) ¹	42.5 (23.5) ^{2,3}	42.2 (21.1) ^{2,3}
Girls	111	37.7 (17.3) ¹	40.3 (20.1) ²	35.9 (15.0) ^{2,3}
Total	250	40.3 (20.0) ¹	41.3 (21.6) ^{2,3}	39.7 (19.1) ^{2,3}

¹Statistical difference between weekdays and weekend days Student t test $p < 0.05$.

²No statistical difference between same sex N and OW groups, determined with ANOVA, $p > 0.05$.

³Statistical difference between weekdays and weekend days determined on N and OW groups by sex. ANOVA, $p < 0.05$.

significantly more minutes were accumulated during weekdays by N boys as well as by OW boys and girls ($p < 0.05$), however N girls spent similarly, 44.2 and 40.3 min during weekdays and weekend days respectively ($p > 0.05$).

No association was observed between BMI Z and minutes of MVPA, neither on weekdays nor weekends for each sex, as p values obtained from the Pearson correlation analysis gave 0.727 and 0.517 and 0.813 and 0.38 in boys and girls respectively (not shown).

Table III shows the proportion of children who met the guideline of at least 60 min of daily MVPA³. On weekdays, only 25% of the children met the recommendation; this percentage was even lower on weekends (14%). Although the proportion of boys and girls who met the guideline was higher on weekdays, the difference was only significant in boys ($p = 0.041$). When

the comparison of compliance between weekdays and weekends was done in each sex and category of nutritional status (for example N girls weekdays versus N girls weekends and so forth), the % was higher on weekdays (except for the N group), however the only significant difference was in OW boys ($p = 0.037$). Finally, a higher proportion of OW boys and girls (compared to their normal-weight counterparts) fulfilled the recommendation of MVPA on weekdays compared to weekends; however none of the differences were statistically significant (all $p > 0.05$).

Discussion

In this study, we determined in 6-9 y old low income Chilean boys and girls, minutes of MVPA accumulated

Table III
Compliance with at least 60 minutes of daily MVPA on weekdays and weekend days by sex and nutritional status

	<i>% of boys who comply with MVPA</i>	<i>% of girls who comply with MVPA</i>	<i>% of children who comply with MVPA</i>	<i>p value</i>
<i>Weekdays</i>				
N Group (N= 85)	11	5	9	0.0303 ¹
OW Group (N=165)	22 ²	10	17	0.0454 ¹
Total weekdays (N= 250)	33 ³	15	25	0.0013 ¹
<i>Weekend days</i>				
N Group (N= 85)	6	5	6	0.8396
OW Group (N=165)	11 ²	4	8	0.0184 ¹
Total weekend days (N= 250)	17 ³	9	14	0.0584

¹Statistical difference between the sexes; comparison of proportions $p < 0.05$.

²Statistical difference between weekdays and weekend days for each sex and group; comparison of proportions $p < 0.05$.

³Statistical difference between weekdays and weekend days for boys; comparison of proportions $p < 0.05$.

daily on school days and weekend days, by sex and nutritional status and assessed the proportion of children who met the daily guideline of MVPA.

The most important results show that children engaged in significantly more MVPA during weekdays than on weekends, boys more than girls. On average, boys were close to complying with the guideline, but only on weekdays, similarly in normal and overweight children. We also showed that only 25% of the children met the daily guideline on weekdays, while on weekends, this proportion was much lower, (14%). The % of N and OW children from either sex who met the daily guideline was similar on weekdays as well as on weekends.

Vásquez and Salazar⁶, in their study including preschool children reported lower values of MVPA than the ones we found with slightly older children, but also more minutes of MVPA spent on weekdays (32 and 24 minutes respectively). Vale et al.⁵, including 245 Portuguese 3-6 year old children reported that they accumulated significantly more daily minutes in MVPA, also much higher on weekdays (102 and 88 minutes respectively) while Uvacek et al.¹⁵, also found higher mean values, 87 and 55 minutes accumulated on weekdays and weekends respectively by 63 eleven year old Hungarian children.

With our data we are unable to explain why MVPA decreases significantly during weekends; it is important to investigate the types of activities children engage in and for how long on weekdays as on weekends in order to specifically target negative behaviors¹⁶.

One of the drawbacks of using pedometers is that it is not possible to determine in which periods during the day, children are more or less active. However, studies using accelerometers¹⁷, have found that during school days there are more opportunities to engage in moderate physical activities, as they include time in structured activities (travel to school, recess, physical education) where children, even sedentary ones participate in these activities¹⁸.

Conversely, a lower MVPA during weekends may be due to the parent's lack of interest in participating or motivating their children to engage in moderate and vigorous activity¹⁵. The findings of our study highlight the importance of increasing opportunities for active play at school¹⁹ but more so during weekends^{19, 20}, involving those directly responsible, that is, the parents.

This study as most others have shown that boys are significantly more active than girls. Although at such a young age, the reasons are not well understood¹⁰, they could be related to the type of activities boys like most compared to girls, such as football, climbing, competitive activities etc, which are more intense compared to less active games preferred by girls²¹. Because it has been shown that physical activity behavior is established at a young age²², interventions addressing this age group both at school and outside, should consider promoting moderate and vigorous activities early in life, considering sex differences^{10, 20}.

No differences were observed in daily MVPA accumulated by N and OW children. This result was not influenced by the higher proportion of OW children that comprised the sample, as both on week as on weekend days, MVPA was very similar between these groups and in both sexes. These results did not change when we compared normal versus obese children (BMI Z > 2) on weekdays and weekend days. Although unexpected, as most studies²³, have found an inverse relationship between adiposity and physical activity, but mainly determined as fitness, we assumed that in our study daily MVPA would be significantly greater among the N children. It is clear that fitness in any of its components is not equivalent to physical activity and as reported for example by the Ballebeina intervention study implemented in Australian nurseries²⁴, it is possible to observe an association between fitness and obesity, but not between total MVPA and obesity. The authors reflect that maybe only the amount of vigorous activity is associated with overweight and not moderate activity. As in our study, we measured total MVPA; we do not know what proportion corresponds to vigorous activity. There are some studies which have not found a difference between MVPA in overweight and normal-weight children. Laguna et al.¹⁰, compared (using accelerometers) in a sample of 9-year old children from Madrid, patterns of physical activity between the non-overweight and overweight children, observing that MVPA was associated more closely to sex than to nutritional status. Zamora and Lacle²⁵, determined minutes of MVPA during 3 weekdays and 1 weekend day in a sample of 6-9 year old Costa Rican boys and found that overweight and normal weight accumulated an average of 155 and 140 respectively of daily MVPA. Treuth et al.²⁶, in 7-10 year old girls reported no difference in physical activity energy expenditure by nutritional status. The authors concluded that the high % of body fat observed in non-overweight girls, may have "precluded to finding a difference between the groups". In our sample however, this was not the case as the mean BMI Z score was 0.24 and 2.2 for the N and OW group respectively.

Because during weekdays, most of the MVPA originates from mandatory PE classes and recess in which all children (in this age group) regardless of their nutritional status probably participate similarly, minutes spent on MVPA is almost the same between these groups²⁷. Participation of overweight children might be more a matter of obligation rather than a desire to move²⁷.

Our study showed that a very low proportion of children comply with the daily MVPA guideline which demonstrates that in most children it is insufficient to promote good health. Several studies have determined compliance with a wide range of results. Although comparisons are questionable, because of different sample sizes, ages and methods to determine MVPA, some studies have found similar results as the ones we obtained. For example, Jekauc et al.²⁸, in a large sample of German children between 4 and 17 years,

found that compliance in the 6-10 year old group was 17.4% and 13.1 % in boys and girls respectively. Montil et al.²⁹, reported that 20% of 10-13 year old Spanish children comply with the daily recommendation and Colley et al.³⁰, from data collected on 5 year olds as part of the Canadian Health Measures Survey between 2009 and 2011, found that only 14% of the children met the daily guideline. Reilly et al.³¹ found even lower compliance in 5 year old Scottish children (4%). Other studies however have reported higher rates of compliance. For example, Van Sluijs et al.³², in a large cross-sectional study of British 9-10 year old children found an average of 84 and 66 minutes in MVPA in boys and girls respectively. Vale et al.³³, observed that most Portuguese preschool children met the daily guideline. In our study, although compliance was higher among OW boys and girls on weekdays and OW boys on weekends (compared to their respective N counterparts), no statistical difference was observed. These results coincide with the similar amount of MVPA accumulated by OW and N children found in our study.

One of the most important strengths of this study is that it provides evidence on physical activity characteristics of children from a middle-income country, where there is very limited information regarding this important aspect. In general, data on childhood obesity rates is collected, but not physical activity or fitness levels. Also, this study includes the objective measurement of MVPA during one week in children of similar socioeconomic characteristics and school facilities which enabled us to compare minutes accumulated on weekdays with weekends.

There are several limitations to be noted. Ideally one should use accelerometers to know the patterns of daily physical activity, however with this sample size, we had to choose less expensive devices, which in this case were NL 1000 pedometers, because they have been validated and used by several researchers¹¹. Our sample included a higher proportion of overweight children than that found in the national population (66 vs 48 %). This is probably due to the fact that parents/guardians of overweight children were keener that their children participate in this study. However as described before, results were not affected, as minutes spent on MVPA during weekdays and weekends were similar in normal and overweight children. Finally, being this a cross-sectional study it is not possible to infer causality between physical activity and nutritional status. Results of this study cannot be extrapolated to children belonging to better socioeconomic levels. It has been shown that children attending private schools have multiple opportunities to engage in physical activity both at school (curriculums that promote physical activity and better facilities) as well as out of school with their families, as more active parents transmit this behavior to their children³⁴.

Unfortunately low income children constitute around 60 % of the national population³⁵, so our results could be extrapolated to a large proportion of Chilean children.

In conclusion, the results of this study show that a very small proportion of low income Chilean children comply with the guideline of at least 60 minutes of daily MVPA, girls significantly less than boys and similarly in overweight as in normal-weight children. This constitutes a huge challenge as sedentary behavior is one of the main risk factors for chronic diseases, highly prevalent in the country. Identifying what types of activities children engage in during the day and in what circumstances, would provide evidence to be more specific in increasing physical activity.

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