Original Article

Physical activity in the recess of childhood education: A pilot study using Garmin Vivofit Jr wristbands

LAURA PÉREZ-TRABAZO[1], ROBERTO J. BARCALA-FURELOS[1,2], LUCÍA PEIXOTO-PINO[3], JAVIER RICO-DÍAZ[3]

[1]*Research Group on Performance, Motor, Rescue and Lifeguard (REMOSS), University of Vigo, Pontevedra, Spain*

[2]*Faculty of Education and Sport Sciences, University of Vigo, Pontevedra, Spain*

[3]*Faculty of Education Sciences, University of Santiago de Compostela, Spain*

ABSTRACT

Physical inactivity and obesity have important implications for health. Achieve 60 minutes per day of moderate physical activity (MPA) or vigorous is a recommendation of the World Health Organization (WHO) for children aged between 5 and 17 years. The school environment can be a generator of physical activity (PA) since early childhood education. The purpose of this study is to analyse the minutes of PA and its intensity in schoolchildren of 5 years during recess and to what extent its favours is reaching the recommendations of daily PA promoted by WHO. By monitoring 18 children for 8 days using the Garmin Vivofit Jr. wristband, were obtained the minutes of MPA and the number of steps (NS), disaggregated by time. The daily average of MPA was 87±16 minutes and 9100±1807 NS. During recess, schoolchildren reached an average of 16±4 minutes and 1666±370 NS. Statistically significant differences were found, both in minutes of MPA and in NS in favour of children ($p < .001$) and 50% more in days without rain compared with rainy days ($p < .001$). There were no significant differences in MPA ($p = .20$) or NS ($p = .16$) depending on the semester of birth. In the recess in the infantile age it reached approximately 25% of the MPA recommended by the WHO.
Keywords: Physical intensity; Children; School; School day.

Cite this article as:
Pérez-Trabazo, L., Barcala-Furelos, R.J., Peixoto-Pino, L., & Rico-Díaz, J. (2020). Physical activity in the recess of childhood education: A pilot study using Garmin Vivofit Jr wristbands. *Journal of Human Sport and Exercise*, *in press*. doi:https://doi.org/10.14198/jhse.2021.161.01

Corresponding author. *Faculty of Education Sciences, University of Santiago de Compostela, Campus Norte, Avda. Xoan XXIII, 15782. Santiago de Compostela, Spain.* *https://orcid.org/0000-0001-8858-145X*
E-mail: javier.rico.diaz@usc.es
Submitted for publication July 24, 2019
Accepted for publication September 29, 2019
Published *in press* January 13, 2020
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2021.161.01

INTRODUCTION

According to the World Health Organization (WHO) ('Obesity and overweight WHO', 2015) and the International Obesity Task Force (IOTF) (Lobstein et al., 2004), childhood obesity and physical inactivity is a global problem (WHO, 2014) and in Spain it is especially relevant (De Onis et al., 2010). In 2016, the population between 5 and 19 years old with overweight or obesity increased by 18%. The ALADINO report (Surveillance Study of Growth, Feeding, Physical Activity, Child Development and Obesity in Spain) (Ortega et al., 2016) of 2015 studied 10,899 boys and girls from 6 to 9 years of age from all Autonomous Communities; this sample allows to represent the whole of the Spanish population. The data obtained showed that 23.2% of schoolchildren are overweight and that 18.1% are obese.

Achieving at least 60 minutes of moderate physical activity (PA) is a recommendation of WHO (World Health Organization, 2010), for the population between 5 and 17 years of age. These recommendations try to avoid or reduce the current situation of childhood obesity. It is known that PA is a fundamental factor in maintaining an adequate weight and preventing cardiovascular and metabolic diseases in adult life, as well as a tool to generate healthy habits and foster social relationships (WHO, 2014).

Moderate physical activity (MPA) includes physical tasks of an aerobic nature that require an effort that accelerates the heart rate in a perceptible way. This type of activity in which they include, games, displacements, sports, programmed exercises or recreational activities, suppose an energetic expense of approximately 3 to 6 METs. A MET (metabolic equivalent) is the energy consumption of an individual in a state of rest, which is equivalent to 1 kcal per kg of weight and hour. (Leal et al., 2009).

Schools have an active role in reducing the rate of childhood obesity (Pate et al., 2006). Children spend a large part of the day in school, however most of the time the activities they do are of low or very low intensity (van Stralen et al., 2014); the importance of reconsidering the role in the promotion of physical activity makes more sense, especially at early ages and in the phase of development and strengthening of motor skills.

The American Heart Association (AHA) recommends that children should accumulate at least 30 minutes of moderate-vigorous PA during school hours (Pate et al., 2006). However, there are studies that indicate that elementary students can spend 62% of school time in a sedentary manner (van Sluijs et al., 2011).

Different research shows that recess is a time that influences the increase in the level of daily PA, thus contributing to the intensity and recommended minutes (Massey et al., 2018; Saint-Maurice et al., 2018), however, there are conditioning factors such as gender (Mckenzie et al., 1992; Ploeg et al., 2012), play space (Martin et al., 2012) or climate (Harrison et al., 2017) that influence the accumulation of minutes of MPA in children.

With this, the main objective of this study is to analyse the time of MPA and the NS of children of 5 years during recess and to what extent these favours achieve the levels of daily PA recommended by the WHO for the child population.

MATERIAL AND METHODS

The design of this work is defined as a prospective and quantitative cohort study.

Participants

A sample of convenience of 18 students of 5 years (9 children and 9 girls) 50% born in the first semester of the year (January-June) and the other half in the second (July-December), schooled in a school of the region of Pontevedra, participated in this study. The inclusion criterion is that they were schooled in the group of 5 years, that there was no physical or psychological contraindication that could condition the study and that their legal guardians authorized participation in this research.

The study was authorized by the educational centre and by all the legal tutors of the students through informed consent. This research respected the ethical principles of the Helsinki Convention for human experimentation.

Measurements

The dependent variable of this study was the minutes of MPA and the number of steps (NS). The independent variables were sex (Children vs. Girls), the presence of rain (With Rain vs. No Rain) and the semester of birth (First vs. Second). To obtain these variables, was used the Garmin Vivofit Jr PA wristband (Garmin, Schaffhausen, Switzerland), validated by Muller et al. for the quantification of MPA in children from 4 to 10 years (Müller et al., 2018).

The PA data were downloaded through the wristband software (APP Vivofit Jr, Schaffhausen, Switzerland). Each bracelet was linked to a record that corresponded to a participant. For the quantification of PA, the device software offers a graph of intensity of the MPA in a daily timeline (figure 1) and the number of total minutes of daily MPA.

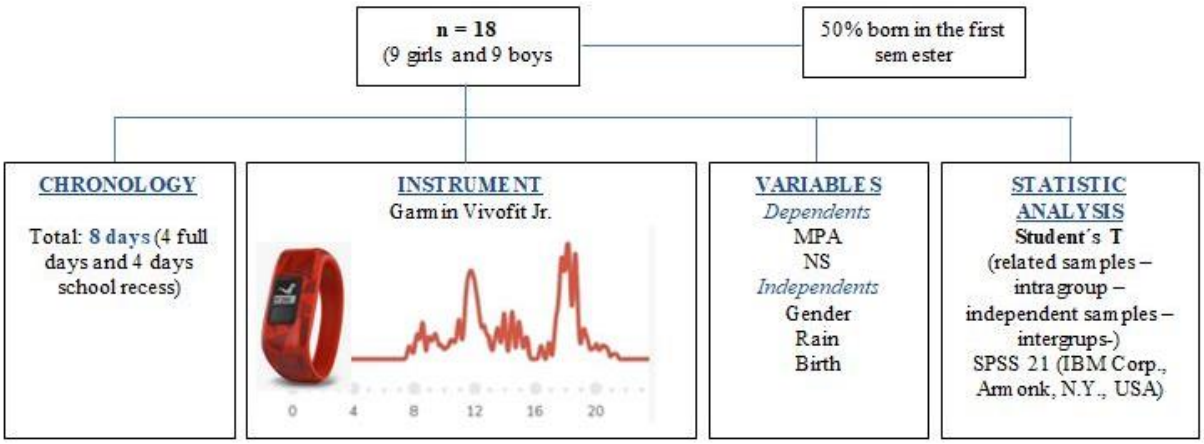

Figure 1. Flowchart of the main parts of the investigation.

Process

Prior to the experimental phase, an information meeting was held with the families of the students. It was indicated that they should not be manipulated or interacted with the wristband software and that they should be placed on children's wrist permanently on the days that the researchers indicated. They should also avoid as far as possible the change of habits and routines, in relation to the usual PA.

During the experimental phase, in a period of 8 days, the wristbands recorded the MPA of the children in this study; the total daily time (24 hours) was monitored during 4 days, and for 4 days the time only of the

childhood education recesses (single 50 minute recess). This procedure was motivated by the limitations of the wristband software that did not allow isolating the exact time slot of the recess. The aim of the daily record (24 hours) was to know the representation of the MPA and the NS of the recess in relation to a full day.

The selection of days took into account the same weather conditions in the comparison by pairs of days; four days of rain (2 full and 2 recesses) and four days without rain (2 full and 2 recesses), on the same day of the week chronologically located between October and November 2018, with similar temperatures in all days of registration. This variable was controlled through the predictions of the Spanish Meteorological Agency (AEMET), available in www.aemet.es

For the specific analysis of school recess, a control time of 50 minutes was taken into account, based on the follow-up of the usual recess routine in this school. The period included the transfer of students to the school playground (approximately 150 square meters), free play and return to the classroom. On rainy days, the recess was developed in its entirety in the children's classroom (interior space of approximately 30 square meters).

Statistical analysis

For data analysis, IBM SPSS for Windows software, version 21 (IBM Corp., Armonk, N.Y., USA) was used. The results are expressed in measures of central tendency (mean) and dispersion (standard deviation). For the verification of normality, the Shapiro-Wilk test was used. For the inter and intra group comparison, Student's T was used for independent and related samples. A significance of $p < .05$ was used for all analyses.

RESULTS

In this study, PA was monitored for 8 days (4 full days and 4 partial-recess-), to a group of 5-year-old children (weight 22.44 ± 3.82, height 115.06 ± 4, 19). The average accumulation of PA minutes analysed during 4 full days (24 hours) was 348 minutes (5.8 hours), which means an average daily PA of 87 ± 16 minutes.

Analysing specifically the MPA in the school recess, the average was 16 ± 4, which supposes 18% of the daily MPA activity and 27% of the recommendations of the WHO (Figure 2). In relation to NS, the daily average was 9100 ± 1807 steps, and a total of 1666 ± 370 steps correspond to recess (Table 1).

Table 1. Average of MPA and NS during the period studied.

Variables			
24 hours		**M±SD**	**CI 95%**
	MPA	87±16	[79-94]
	NS	9100±1807	[8171-10030]
50 min school recess		**M±SE**	**CI 95%**
	MPA	16±4	[14-17]
	NS	1666±370	[1476-1856]

MPA: Moderate Physical Activity (in minutes). NS: Number of steps. M: Mean. SD: Standard deviation. CI: Confidence Interval.

Table 2 shows the results disaggregated by gender, presence or absence of rain and semester of birth. In the analysis by sex, children perform an average of 9 minutes a day more than PA compared with girls, of which 6 minutes correspond to recess (Children 19 ± 1 vs. Girls 13 ± 2, $p < .001$). In relation to NS at recess,

children performed 619 more steps on average than girls, which is a statistically significant difference (Children 1994 ± 168 vs. Girls 1375 ± 215, $p < .001$).

Analysing the weather factor, on rainy days 15 minutes less MPA are performed ($p = .08$). Of this time, 11 minutes (73.5%) is the difference found in the recess without the climatological condition of the rain (With Rain 10 ± 2 vs. No Rain 21 ± 6, $p < .001$). In relation to the steps, to rain or not to rain supposes a difference superior to a 50% (Rain 1030 ± 161 vs. Without Rain 2302 ± 631, $p < .001$).

According to the semester of birth, no statistically significant difference was found, both in MPA (First Semester 17 ± 4 *vs*. Second Semester 14 ± 3, $p = .20$) and in steps (First Semester 1794 ± 380 *vs*. Second Semester 1523 ± 322, p = .16).

Table 2. Average of MPA and NS according to gender, presence or absence of rain and semester of birth.

Variables		**Boy**		**Girl**		
24 hours		**M±SD**	**CI 95%**	**M±SD**	**CI 95%**	**Sig** *(p)*
	MPA	91±16	[79-104]	87±16	[79-94]	.23
	NS	9631±1723	[8306-10955]	8504±1818	[6984-10024]	.21
50 min school recess		**M±SD**	**CI 95%**	**M±SD**	**CI 95%**	
	MPA	19±01	[17-20]	13±02	[11-93]	< .001
	NS	1994±168	[1854-2134]	1375±215	[1210-1540]	< .001
		Day without rain		**Rainy day**		
24 hours		**M±SD**	**CI 95%**	**M±SD**	**CI 95%**	**Sig** *(p)*
	MPA	94±25	[81-106]	79±21	[69-90]	.08
	NS	8444±2454	[7182-9706]	9757±2738	[8349-11164]	.17
50 min school recess		**M±SD**	**CI 95%**	**M±SD**	**CI 95%**	
	MPA	21±6	[18-24]	10±2	[9-11]	< .001
	NS	2302±631	1978-2627	1030±161	[947-1113]	< .001
		Born first semester of the year		**Born second semester of the year**		
24 horas		**M±SD**	**CI 95%**	**M±SD**	**CI 95%**	**Sig** *(p)*
	MPA	88±13	[78-96]	85±19	[70-99]	.64
	NS	9356±1738	[7904-10809]	8873±1941	7381-10365	.60
50 min school recess		**M±SD**	**CI 95%**	**M±SD**	**CI 95%**	
	MPA	17±4	[14-19]	14±3	[11-17]	.20
	NS	1794±380	[1502-2085]	1523±322	[1253-1792]	.16

MPA: Moderate Physical Activity (in minutes). NS: Number of steps. M: Mean. SD: Standard deviation. CI: Confidence Interval.

The MPA during the children's recess exceeded 25% of the daily accumulation recommended by the WHO in the global average and above 30% in the children and in the days without rain (Figure 2).

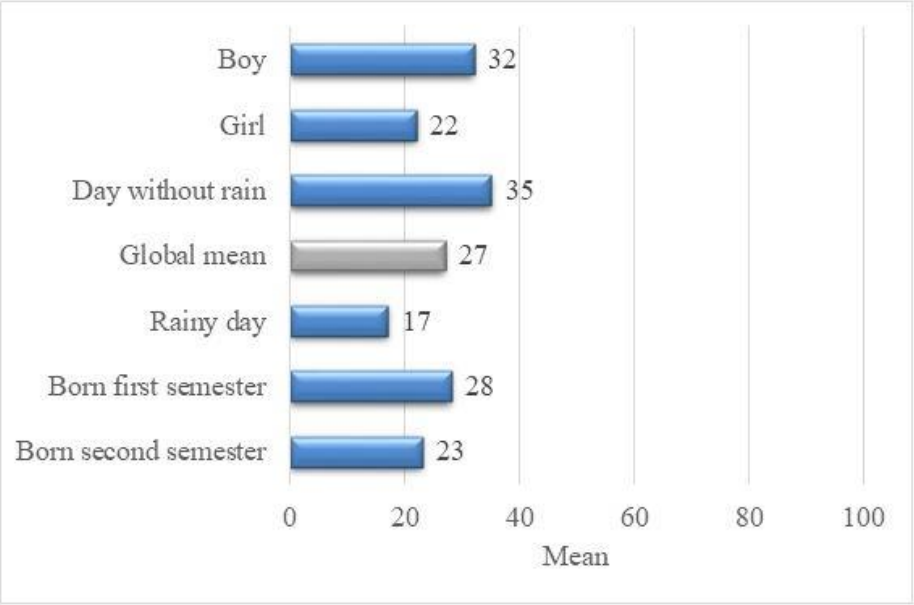

Figure 2. Percentage of MPA performed at recess in relation to WHO recommendations (60 minutes of MPA for children).

DISCUSSION

This study pretended to analyse the MPA and NS in students of 5 years during recess and to what extent it is favoured that the levels of PA recommended by the WHO are achieved. ('Obesity and overweight WHO', 2015).

Different methods have been used to monitor school PA (Berglind et al., 2017; Cardon & De Bourdeaudhuij, 2008; Hesketh et al., 2014; Vale et al., 2010). For this study, the Vivofit Jr wristband was used as a measurement tool. The study participants of Müller et al. with ages between 4 and 10 years, they made an average of 83 minutes a day in a 7-day follow-up (Müller et al., 2018). Our results show similar values for a population of 5 years, analysing a period of 4 days. However, NS is considerably lower in our study (around 3000), which suggests that NS is not necessarily related to exercise intensity. Another hypothesis for this finding is that, with the increase in age, students change active leisure for a more sedentary leisure, in the activities that are performed require less effort and whose level of intensity is lower. In an investigation carried out with elementary school students in the United Kingdom, it was found that participating in an organized physical activity after school is associated with a greater MPA and a reduction in sedentary time; In turn, this age range shows that children tend to participate more than girls in non-school activities (Jago et al., 2017). In our study, no significant differences were found between sexes in the daily MPA, however, differences were found in the specific analysis of the recess.

The results of the study by Beighle et al. (2006) they emphasize that there is a notorious difference in the percentage of PA made by the students in the recess, being higher than the one made outside the educational centre (Beighle et al., 2006). The data of the present investigation give a representativeness of the MPA around 25% at recess. In general, our study shows that the time of recess is crucial for school children to more easily reach the intensity of PA and recommended minutes on a daily basis; reaching an average of 19 minutes for boys and 13 minutes for girls. This idea seems to be supported by other studies: Zimmo et al.

(2006) analysed the minutes of activity of a group of schoolchildren of 5 years and another of 9 years in Qatar during school hours; the results of this analysis show that the children reached 30 minutes of daily PA or more (Zimmo et al., 2017), which is half of the daily minutes recommended by WHO.

Ramstetter, et al. suggests that schools should increase the length of the recess period as well as their regular intervals (Ramstetter et al., 2010). Similarly, Ridgers, et al. (2012) points out that the educational context should carry out different measures to increase PA levels during recess, such as facilitating better access to school facilities and promoting intervention strategies (Ridgers et al., 2012) such as courtyards. In our study, we found a difference of more than 70% of MPA time, the days in which the breaks were outdoors due to the absence of rain. Numerous studies have influenced the climate in general and the rain in particular, to a limiting aspect for the accumulation of child PA(Grønholt et al., 2015; Harrison et al., 2017, 2011).

In our study, we show a daily difference of 9 minutes of PA between boys and girls; the same thing happened in a Mexican investigation in which girls did less PA (Mckenzie et al., 1992; Ploeg et al., 2012). Gender seems to be a determining factor when maintaining more active or sedentary routines. The results of this study are consistent with other investigations that reflect the difference in minutes of activity of children with respect to girls from very early ages (Nettlefold et al., 2011; van Stralen et al., 2014). Different conditioning aspects have been described; the familiar and educational context, meteorological station, demographic and socioeconomic factor, the characteristics of the environment and time of gestation (Preterm Births vs. Term Births), among others (Boldemann et al., 2006; Finn et al., 2002; Forthofer et al., 2017; Hesketh et al., 2014). With this, in this study it is suggested that the semester of birth could be related to the disparity that exists in the PA levels of our results; As reflected in various studies, the month of birth influences the child's abilities and maturational development, being much more noticeable at early ages (Bell & Daniels, 1990; Dearden et al., 2010). Children born in the second semester tend not to reach the same level of performance as those of the first semester; however, this does not limit the possibility of reaching the same level in the future (Bell & Daniels, 1990). Our results do not find significant differences in this variable.

Study limitations

This study presents numerous limitations that should be reviewed. In the first place, since it is a pilot study, the sample is small and circumscribed to a locality and type of educational centre without a covered patio in a traditionally rainy area in autumn. Other populations may present MPA values or different steps. The follow-up time was 8 days; a broader period covering other times of the year could show different values. The duration of the recess in the centre studied for the early childhood education stage is 50 minutes. Another duration or recess fractions would possibly offer different data. In the study by Simunek et al. (2016), it was found that this type of bracelet can have a margin of error of 12% with the measurements made by the ActiGraph accelerometer (Simunek et al., 2016). For all the above, the results should be analysed with caution.

CONCLUSIONS

The students in this sample meet the recommendations on healthy PA of the WHO. School recess can accumulate up to 25% of the total daily PA recommended by WHO. There is a gender difference in favour of the children in the minutes and steps. The most determining factor is the presence or absence of rain. In the outdoor recreation without precipitation a greater accumulation of MPA is reached. There are no differences in relation to the semester of birth.

Educational and social policies should consider recessing as a key factor for the promotion of PA, valuing the possibility of more recreational time and outdoor spaces protected from rain.

AUTHOR CONTRIBUTIONS

All authors have contributed equally to this research.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

Beighle, A., Morgan, C. F., Le Masurier, G., & Pangrazi, R. P. (2006). Children's Physical Activity During Recess and Outside of School. J School Health, 76(10), 516–520. https://doi.org/10.1111/j.1746-1561.2006.00151.x

Bell, J. F., & Daniels, S. (1990). Are Summer-born Children Disadvantaged? The Birthdate Effect in Education. Oxford Rev Educ, 16(1), 67–80. https://doi.org/10.1080/0305498900160106

Berglind, D., Hansson, L., Tynelius, P., & Rasmussen, F. (2017). Levels and Patterns of Objectively Measured Physical Activity and Sedentary Time in 4-Year-Old Swedish Children. J Phys Act Health, 14(2), 117–122. https://doi.org/10.1123/jpah.2016-0250

Boldemann, C., Blennow, M., Dal, H., Mårtensson, F., Raustorp, A., Yuen, K., & Wester, U. (2006). Impact of preschool environment upon children's physical activity and sun exposure. Prev Med, 42(4), 301–308. https://doi.org/10.1016/j.ypmed.2005.12.006

Cardon, G. M., & De Bourdeaudhuij, I. M. M. (2008). Are Preschool Children Active Enough? Objectively Measured Physical Activity Levels. Res Q Exercise Sport, 79(3), 326–332. https://doi.org/10.1080/02701367.2008.10599496

De Onis, M., Blössner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. Am J Clin Nutr, 92(5), 1257–1264. https://doi.org/10.3945/ajcn.2010.29786

Dearden, L., Crawford, C., & Meghir, C. (2010). When you are born matters: the impact of date of birth on educational outcomes in England [Working Paper Series]. https://doi.org/10.1920/wp.ifs.2010.1006

Finn, K., Johannsen, N., & Specker, B. (2002). Factors associated with physical activity in preschool children. J Pediatr, 140(1), 81–85. https://doi.org/10.1067/mpd.2002.120693

Forthofer, M., Dowda, M., O'Neill, J. R., Addy, C. L., McDonald, S., Reid, L., & Pate, R. R. (2017). Effect of Child Gender and Psychosocial Factors on Physical Activity From Fifth to Sixth Grade. J Phys Act Health, 14(12), 953–958. https://doi.org/10.1123/jpah.2016-0487

Grønholt Olesen, L., Lund Kristensen, P., Korsholm, L., Boye Koch, A., & Froberg, K. (2015). Correlates of objectively measured physical activity in 5-6-year-old preschool children. J Sport Med Phys Fit, 55(5), 513–526.

Harrison, F., Goodman, A., van Sluijs, E. M. F., Andersen, L. B., Cardon, G., Davey, R., … on behalf the ICAD collaborators. (2017). Weather and children's physical activity; how and why do relationships

vary between countries? Int J Behav Nutr Phy, 14(1), 74. https://doi.org/10.1186/s12966-017-0526-7

Harrison, F., Jones, A. P., Bentham, G., van Sluijs, E. M. F., Cassidy, A., & Griffin, S. J. (2011). The impact of rainfall and school break time policies on physical activity in 9-10 year old British children: a repeated measures study. Int J Behav Nutr Phy, 8(47), https://doi.org/10.1186/1479-5868-8-47

Hesketh, K. R., McMinn, A. M., Ekelund, U., Sharp, S. J., Collings, P. J., Harvey, N. C., … van Sluijs, E. M. (2014). Objectively measured physical activity in four-year-old British children: a cross-sectional analysis of activity patterns segmented across the day. Int J Behav Nutr Phy, 11(1), 1. https://doi.org/10.1186/1479-5868-11-1

Jago, R., Macdonald-Wallis, C., Solomon-Moore, E., Thompson, J., L., Lawlor, D., A., & Sebire, S., J. (2017). Associations between participation in organised physical activity in the school or community outside school hours and neighbourhood play with child physical activity and sedentary time: a cross-sectional analysis of primary school-aged children from the UK. BMJ Open, 7(9). https://doi.org/10.1136/bmjopen-2017-017588

Leal, E., Aparicio, D., Luti, Y., Acosta, L., Finol, F., Rojas, E., … Velasco, M. (2009). Actividad física y enfermedad cardiovascular. 4, 17.

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. Obes Rev, 5(s1), 4–85. https://doi.org/10.1111/j.1467-789X.2004.00133.x

Martin, K., Bremner, A., Salmon, J., Rosenberg, M., & Giles-Corti, B. (2012). School and individual-level characteristics are associated with children's moderate to vigorous-intensity physical activity during school recess. Aust Nz J Publ Heal 36(5), 469–477. https://doi.org/10.1111/j.1753-6405.2012.00914.x

Massey, W. V., Stellino, M. B., & Fraser, M. (2018). Individual and environmental correlates of school-based recess engagement. Prev Med, 11, 247–253. https://doi.org/10.1016/j.pmedr.2018.07.005

Mckenzie, T. L., Sallis, J. F., Nader, P. R., Broyles, S. L., & Nelson, J. A. (1992). Anglo- and Mexican-American Preschoolers at Home and at Recess: Activity Patterns and Environmental Influences. J Dev Behav Pediatr, 13(3), 173-180. https://doi.org/10.1097/00004703-199206000-00004

Müller, J., Hoch, A.-M., Zoller, V., & Oberhoffer, R. (2018). Feasibility of Physical Activity Assessment with Wearable Devices in Children Aged 4-10 Years-A Pilot Study. Front Pediatr, 6, 5. https://doi.org/10.3389/fped.2018.00005

Nettlefold, L., McKay, H. A., Warburton, D. E. R., McGuire, K. A., Bredin, S. S. D., & Naylor, P. J. (2011). The challenge of low physical activity during the school day: at recess, lunch and in physical education. Brit J Sport Med, 45(10), 813–819. https://doi.org/10.1136/bjsm.2009.068072

Obesity and overweight WHO. (2015). Retrieved 16 February 2019, from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Ortega-Anta, R. M., López-Sobaler, A. M., Aparicio Vizuete, A., González Rodríguez, L. G., & Navia Lombán, B. (2016). Estudio ALADINO 2015: Estudio de vigilancia del crecimiento, alimentación, actividad física, desarrollo infantil y obesidad en España. 2015. https://doi.org/10.4321/s1139-76322011000300015

Pate, R. R., Davis, M. G., Robinson, T. N., Stone, E. J., McKenzie, T. L., & Young, J. C. (2006). Promoting Physical Activity in Children and Youth: A Leadership Role for Schools: A Scientific Statement From the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in Collaboration With the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. Circulation, 114(11), 1214–1224. https://doi.org/10.1161/circulationaha.106.177052

Ploeg, K. A. V., Wu, B., McGavock, J., & Veugelers, P. J. (2012). Physical Activity among Canadian Children on School Days and Nonschool Days. J Phys Act Health, 9(8), 1138–1145. https://doi.org/10.1123/jpah.9.8.1138

Ramstetter, C. L., Murray, R., & Garner, A. S. (2010). The Crucial Role of Recess in Schools. J School Health, 80(11), 517–526. https://doi.org/10.1111/j.1746-1561.2010.00537.x

Ridgers, N. D., Salmon, J., Parrish, A.-M., Stanley, R. M., & Okely, A. D. (2012). Physical activity during school recess: a systematic review. Am J Prev Med, 43(3), 320–328. https://doi.org/10.1016/j.amepre.2012.05.019

Saint-Maurice, P. F., Bai, Y., Vazou, S., & Welk, G. (2018). Youth Physical Activity Patterns During School and Out-of-School Time. Children, 5(9). https://doi.org/10.3390/children5090118

Simunek, A., Dygryn, J., Gaba, A., Jakubec, L., Stelzer, J., & Chmelik, F. (2016). Validity of Garmin Vivofit and Polar Loop for measuring daily step counts in free-living conditions in adults. Acta Gymnica, 46(3), 129–135. https://doi.org/10.5507/ag.2016.014

Vale, S., Silva, P., Santos, R., Soares-Miranda, L., & Mota, J. (2010). Compliance with physical activity guidelines in preschool children. J Sport Sci, 28(6), 603–608. https://doi.org/10.1080/02640411003702694

Van Sluijs, E. M. F., Jones, N. R., Jones, A. P., Sharp, S. J., Harrison, F., & Griffin, S. J. (2011). School-level correlates of physical activity intensity in 10-year-old children. Int J Pediatr Obes, 6(2–2), e574–e581. https://doi.org/10.3109/17477166.2010.518239

Van Stralen, M. M., Yıldırım, M., Wulp, A., te Velde, S. J., Verloigne, M., Doessegger, A., … Chinapaw, M. J. M. (2014). Measured sedentary time and physical activity during the school day of European 10- to 12-year-old children: The ENERGY project. J Sci Med Sport, 17(2), 201–206. https://doi.org/10.1016/j.jsams.2013.04.019

World Health Organization. (2010). Recomendaciones mundiales sobre actividad física para la salud. Retrieved from http://whqlibdoc.who.int/publications/2010/9789243599977_spa.pdf

World Health Organization. (2014). Global status report on noncommunicable diseases 2014: attaining the nine global noncommunicable diseases targets; a shared responsibility. Geneva: World Health Organization.

Zimmo, L., Farooq, A., Almudahka, F., Ibrahim, I., & Al-Kuwari, M. G. (2017). School-time physical activity among Arab elementary school children in Qatar. BMC Pediatrics, 17. https://doi.org/10.1186/s12887-017-0832-x