Objectively measured physical activity, sedentary time, extracurricular habits, and IQ in 7 to 8 years old children

Atividade física, tempo sedentário, hábitos extracurriculares e QI em crianças de 7 a 8 anos de idade

DOI:10.34119/bjhrv5n6-150

Recebimento dos originais: 04/11/2022
Aceitação para publicação: 05/12/2022

Thais Burlani Neves
Master in Physical Education by Programa de Pós-Graduação em Educação Física da Universidade Federal de Pelotas
Institution: Instituto Federal de Educação, Ciência e Tecnologia Sul-Rio-Grandense – Departamento de Ensino, Pesquisa e Extensão – Câmpus Sapiranga
Address: Av. Carlos Gilberto Weis, 155, Quatro Colônias, Sapiranga – RS
E-mail: thaisbneves@gmail.com

Fernanda Burlani Neves
PhD in Health and Behavior by Programa de Pós-Graduação em Saúde e Comportamento da Universidade Católica de Pelotas
Institution: Instituto de Biologia – Departamento de Morfologia – Universidade Federal de Pelotas
Address: Avenida Duque de Caxias, 250, Fragata, Pelotas – RS
E-mail: fefisio_@hotmail.com

Felipe Fossati Reichert
PhD in Epidemiology from Programa de Pós-Graduação em Epidemiologia da Universidade Federal de Pelotas
Institution: Escola Superior de Educação Física – Universidade Federal de Pelotas
Address: R. Luís de Camões, 625, Três Vendas, Pelotas – RS
E-mail: ffreichert@gmail.com

ABSTRACT

The effects of an active lifestyle including extracurricular habits on children's cognitive function are topics of health and human development, besides that the maintenance of sedentary behavior seems to be related to cognitive function. Considering an active lifestyle, studies present mixed results in terms of cognitive factors, physical activity exposures and tests applied. Existent studies identified that objectively measured physical activity should be more explored to further help elucidate these results since this type of measure assessed by accelerometer provides accurate time spent in free-living daily physical activity. Moreover, children who spend time in specific sedentary activities and have active extracurricular habits present higher academic achievement. Therefore, it was conducted a cross-sectional study in 609 children at 7 and 8 years old from Pelotas, Brazil. WASI scale was applied to evaluate intelligence; total IQ, verbal IQ and execution IQ were considered. Reading practice was associated with verbal IQ and execution IQ and extracurricular physical activities were associated with execution IQ. Accelerometer analyses indicate an association for sedentary time and total IQ and execution IQ. Light PA was inversely associated with execution IQ. Moderate PA was inversely associated with execution IQ and vigorous PA was not associated with IQ. Significant

associations were found in the analyses between sedentary time, physical activity, and cognitive function.

Keywords: exercise, youth, cognition, behavior, health**.**

RESUMO
Os efeitos de um estilo de vida ativo para o funcionamento cognitivo de crianças, incluindo hábitos extracurriculares, são tópicos de saúde e desenvolvimento humano. Além disso, a manutenção do comportamento sedentário parece estar relacionada com a função cognitiva. Considerando um estilo de vida ativo estudos apresentam resultados diversos em termos de fatores cognitivos, variáveis de exposição de atividade física e testes aplicados. Estudos existentes apontam que atividade física medida de forma objetiva deve ser estimulada para ajudar a elucidar as associações encontradas na literatura. Este tipo de medida, coletada por acelerômetro, promove maior precisão com relação ao tempo diário de atividade física realizada. Ademais, crianças que realizam atividades sedentárias específicas e mantém hábitos extracurriculares apresentam desempenho acadêmico maior. Nesse sentido, um estudo transversal foi conduzido com 609 crianças de 7 e 8 anos, na cidade de Pelotas, região Sul do Brasil. A escala WASI foi aplicada para avaliar inteligência: QI total, QI verbal e QI de execução. Prática de leitura foi associada com QI verbal, QI de execução e atividade física extracurricular foi associada com QI de execução. Análises dos acelerômetros indicam associação para tempo sedentário e QI total e QI de execução. Atividade física de intensidade leve foi inversamente associada com QI de execução. Atividade física de intensidade moderada foi inversamente associada com QI de execução e atividade física de intensidade vigorosa não foi associada com QI. Associações significativas foram encontradas nas análises entre tempo sedentário, atividade física e função cognitiva.

Palavras-chave: exercício, juventude, cognição, comportamento, saúde.

1 INTRODUCTION

Studies involving aspects that could improve cognitive function (CF) have substantial roles in terms of child development. Since cognitive changes may be attributed to neurobiological, psychosocial, and behavioral mechanisms, it is important to identify influential factors of cognitive function during the formative years (Lubans et al., 2016). Accordingly, demographic characteristics, parental education, personality, genetic influence, environmental context, physical activity (PA) and life habits are factors that may affect CF.

Besides health benefits of PA during lifespan; physiological assistance and protection from the development of several chronic and cardiovascular diseases like obesity, diabetes, depression and hypertension, PA is studied to improve behavior, brain structure and cognitive functioning at the systemic, molecular, and cellular levels during youth (Heijnen et al., 2016). The relationship between PA and CF in children is very complex, studies results are mixed in terms of different cognitive factors, PA exposures and tests applied. Existent studies identified that objectively measured PA should be more explored (I. et al., 2014). The objective measure

by accelerometer provides accurate time spent in free-living daily PA in different intensities and the device is able to capture sedentary behaviors like reading, studying or screen time (Wickel, 2017a). Although the device does not distinguish activities when comparing to self-reported instruments, accelerometers deliver superior validity (Chillón et al., 2010).

Extracurricular physical activities (EPA) are considered those practiced before or after school regular learning shift assisting to increase volume of daily PA. These classes are also organized, systematized, structured, have a certain frequency and duration previously determined and could promote beneficial effect on cognitive skills, emotional regulation and attitudes (Esteban-Cornejo, Tejero-Gonzalez, et al., 2015).

Considering the influence of sedentary behavior on CF there is a concern about excessive media use. The theory about this behavior states that it could be associated with lower cognitive function in children because an expressive amount of time spent in front of the screen could expose children to a high risk of decrease attention, memory, and learning. On the other hand, some data supports the notion that certain sedentary habits like reading would contribute to a better performance in a variety of CF. Volume and exposure to reading time are theorized as predictive factors of children's CF that promote higher scores on general academic tests (Ritchie et al., 2015).

The aim of this cross-sectional study was to evaluate objectively measured PA and sedentary time, extracurricular physical activity, identify parent's habit of reading for their children, children reading behavior accessed by questionnaire and cognitive functioning by IQ in children at 7 to 8 years old from Pelotas, southern Brazil.

2 METHODS

It was conducted a cross-sectional study in 609 children belonging to twenty public schools sorted arbitrarily from the city of Pelotas, southern Brazil. It was carried out a random sampling process that stratified schools by size and neighborhood. Inclusion criteria comprehend all children registered in the chosen schools at 7 and 8 years old. Children were excluded in case of incapacity to answer and understand questionnaires due to any clinical condition. The Ethical Committee of Catholic University of Pelotas approved this study. Protocol number was 843.526.

Data collecting started by the following steps: contact with public educational union of the city; selected schools were invited to participate, and parents or legal guardians received informed assent and consent. After this first approach, a questionnaire was applied for social, anthropometric, demographic, reading characteristics and EPA as well as the WASI scale was

administrated to measure IQ. Reading characteristics was questioned for parents: Do you read for your child to sleep? Does your child read books, magazines, or comics every day? Extracurricular physical activities were collected by a question for parents: Does your child participate in extracurricular physical activities?

WASI scale is a wide well-known test applied in clinical and in research areas. This instrument evaluates intelligence in individuals aged from six to eighty-nine years old. It is composed by four sub-tests; vocabulary, cubes, similarities, and matrix reasoning which estimates many cognitive aspects like verbal knowing, information processing, spatial and non-verbal reasoning, fluid, and crystallized intelligence. The product of these four sub-tests is total IQ, verbal IQ, and execution IQ. This scale was properly validated in Brazil and has suitable psychometric characteristics (Heck et al., 2009).

Accelerometer analyses were also performed. This instrument is used to measure objective PA and sedentary time in a certain period. It is considered a superior assessment when compared to self-reported measures for being more accurate and detailed. Participants were asked to use the device at least five days, two days representative of weekends. Accelerometry data was analyzed in Actilife program. The cut points used to classify intensities were sedentary activities those considered until 819 counts per minute (cpm); light physical activities from 820 cpm to 3907 cpm; moderate physical activities from 3908 cpm to 6111 cpm; and vigorous physical activity from 6112 cpm and above. The device was set at the dominant wrist and only days with at least 600min of data were registered and included in the analyses. Furthermore, the epoch was set at 5s and the cut points were adjusted, consecutive periods of 60 minutes of zero counts were excluded (spike tolerance of 2 minutes) (Butte et al., 2014).

Descriptive statistics of the main variables of the study present the mean and standard deviation. Crude and multivariable analyses were performed. Participants were categorized for each domain of PA and sedentary time (low, medium, and high), where the third portion represents the highest volume. Crude associations were tested with oneway analyses of variance for trend and multivariable model of linear regression including sex, age, race, BMI, and socioeconomic status was built to test the association between physical activity and IQ scores adjusting for potential confounders. Analyses were performed on Stata 14 program considering p value <0.05.

3 RESULTS

According to study variables mean percentage of white skin color was 63.27 (62.20% in girls and 64.29% in boys). BMI were categorized according to z-scores for children, 25.21%

were considered obese, 22.24% overweight, 51.24% normal weight and 1.32% underweight. Extracurricular physical activities were performed by 18.42% of the sample (44% girls 55.9% boys). The EPA practiced by sample was sports project from school and city government, soccer, dance, capoeira, sports fights, and scout activities. Only 21.81% of parents read to their child before sleep and 19.46% of children have the routine of reading every day. Also, qui-square test of independence for these referred variables (parents reading and child reading) presented $p = 0.01$. Mean sample subjects total IQ was 79.7, which indicate that they have a border to low IQ.

Table 1 provides sampling descriptive information in terms of mean (SD) values for sex, socioeconomic status, age, BMI, race, EPA, parents reading and child reading characteristics in analyses related to total IQ, verbal IQ, and execution IQ. Table 2 presents crude and adjusted analyses of EPA, reading variables and IQ tests. Table 3 presents associations between accelerometry measures and IQ and, Table 4 presents adjusted analyses of accelerometry measures and IQ tests.

In this present study significant associations were found in crude analyses between extracurricular physical activities and total IQ ($p = 0.01$) and execution IQ ($p = 0.00$). Although children who perform EPA had higher verbal IQ scores, this difference was not significant. Children who have parents that usually read for them presented better IQ scores in all three subtests ($p = 0.00$) and children who have the habit of reading comics, magazines or books presented significant better scores in total IQ ($p = 0.00$) verbal IQ ($p = 0.00$) and execution IQ ($p = 0.02$). Despite this associations, some analyses lost significance when demographic variables and socioeconomic status entered in the multivariable model. Children reading practice in total IQ ($p = 0.00$) verbal IQ ($p = 0.00$) and execution IQ ($p = 0.01$) and EPA in execution IQ ($p = 0.03$) remain statistically significant when controlling for variables related to the outcome. According to accelerometer measures, sedentary time was associated with total IQ ($p = 0.00$) and light PA was inversely associated with total IQ ($p = 0.00$), verbal IQ ($p = 0.01$) and execution IQ ($p = 0.00$) in crude analyses. Moderate and vigorous PA were inversely associated in IQ total ($p = 0.00$) ($p = 0.03$) and execution IQ ($p = 0.00$) ($p = 0.04$) respectively. When demographic variables and socioeconomic status entered in the model, adjusted analyses revealed an association for sedentary time and total IQ ($p = 0.00$) and execution IQ ($p = 0.00$). Light PA was inversely associated with execution IQ ($p = 0.06$) and execution IQ ($p = 0.01$). Moderate PA was inversely associated with execution IQ ($p = 0.01$). And vigorous PA was not associated with IQ scores.

4 DISCUSSION

This cross-sectional study analyzed 609 children at 7 and 8 years old from public schools in a middle-income country. Cognitive function was assessed using WASI scale and behavioral variables were assessed through questionnaire. Mean IQ scores were very poor; no children achieve scores above median and superior corroborating with a meta-analysis about IQ worldwide which presented a decrease in mean IQ in adults and children from Brazil (Pietschnig & Voracek, 2015). Another concerning result is about BMI scores, 73,48% of the sample are considered at risk of developing chronic cardiovascular diseases, whether this subject could generate serious consequences for adults, in children it is even worse as earlier it is developed.

Besides that, this data seems to reinforce the importance of child reading and parents reading for their child for cognitive development since measures of engagement in reading are predictive of subsequent verbal intelligence (Ritchie et al., 2015). The positive association regarding EPA supports child active lifestyle for cognitive development corroborating with previews studies showing that EPA may positively influence cognitive performances (I. et al., 2014; Lopez-Vicente et al., 2017).

Present data about sedentary time appears to support the hypothesis that some sedentary behaviors might contribute positively to CF. Studies about objectively measured sedentary time using accelerometer shows the same pattern presented in this analysis. There is evidence showing that an increased time devoted to specific sedentary activities from childhood to adolescence predicted higher inhibition, working memory, fluid intelligence and sustained attention (Aggio et al., 2016; Syvaoja et al., 2014; Wickel, 2017b).

Studies about PA and cognitive function mention that the lack of objectively measures limits analyses and studies from developing countries are needed (Esteban-Cornejo, Hallal, et al., 2015; Esteban-Cornejo, Tejero-Gonzalez, et al., 2015; Pindus et al., 2015). Current analyses seem to indicate that objectively measured PA has no consistent positive effect over IQ. Moderate-to-vigorous PA is not associated with academic achievement in many studies (Aggio et al., 2016; Esteban-Cornejo, Hallal, et al., 2015; K.N. et al., 2017; Lambourne et al., 2013) and studies indicate that highest MVPA portion present lower cognitive performance scores (Esteban-Cornejo, Hallal, et al., 2015; Lambourne et al., 2013). Despite that, null associations are also existent evidence considering MVPA and academic achievement (E.E. & E.K., 2019; M. et al., 2018).

This study has limitations about design; lack of characteristics of extracurricular physical activity; and the modest IQ presented by the sample. But significant associations were

found in the crude and multivariable analyses considering demographic variables and socioeconomic status. It is important to identify and monitor environmental and structural social factors concerning, for example, family and school settings that could affect and mediate exposures involving intelligence and cognitive abilities in diverse samples, especially in developing countries, as well as physiological patterns related to cognition.

CONFLICT OF INTEREST DISCLOSURES

None.

REFERENCES

Aggio, D., Smith, L., Fisher, A., & Hamer, M. (2016). Context-specific associations of physical activity and sedentary behavior with cognition in children. *American Journal of Epidemiology*, *183*(12), 1075–1082. https://doi.org/10.1093/aje/kww031

Butte, N. F., Wong, W. W., Lee, J. S., Adolph, A. L., Puyau, M. R., & Zakeri, I. F. (2014). Prediction of energy expenditure and physical activity in preschoolers. *Medicine and Science in Sports and Exercise*, *46*(6). https://doi.org/10.1249/MSS.0000000000000209

Chillón, P., Ortega, F. B., Ruiz, J. R., Sjöström, M., Veidebaum, T., Oja, L., & Mäestu, J. (2010). Active commuting to school in children and adolescents: An opportunity to increase physical activity and fitness. *Scandinavian Journal of Public Health*, *38*(8). https://doi.org/10.1177/1403494810384427

E.E., W., & E.K., H. (2019). Prospective bi-directional associations between sedentary time and physical activity with cognitive performance: a cohort study. *Journal of Sports Sciences*, *37*(6), 630–637. http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L626100184%0Ahttp://dx.doi.org/10.1080/02640414.2018.1522685

Esteban-Cornejo, I., Hallal, P. C., Mielke, G. I., Menezes, A. M. B., Gonçalves, H., Wehrmeister, F., Ekelund, U., & Rombaldi, A. J. (2015). Physical Activity throughout Adolescence and Cognitive Performance at 18 Years of Age. *Medicine and Science in Sports and Exercise*, *47*(12), 2552–2557. https://doi.org/10.1249/MSS.0000000000000706

Esteban-Cornejo, I., Tejero-Gonzalez, C. M., Sallis, J. F., & Veiga, O. L. (2015). Physical activity and cognition in adolescents: A systematic review. *Journal of Science and Medicine in Sport*, *18*(5), 534–539. https://doi.org/10.1016/j.jsams.2014.07.007

Heck, V. S., Balem, Y. D., Poggere, L. C., Tosi, S. D., Bandeira, D. R., & Trentini, C. M. (2009). Validação dos subtestes verbais da versão de adaptação da WASI. *Avaliação Psicológica*, *8*(1).

Heijnen, S., Hommel, B., Kibele, A., & Colzato, L. S. (2016). Neuromodulation of aerobic exercise-A review. In *Frontiers in Psychology* (Vol. 6, Issue JAN). https://doi.org/10.3389/fpsyg.2015.01890

I., E.-C., C.M., T.-G., D., M.-G., V., C.-S., J.R., F.-S., J., C.-C., & J.F., S. (2014). Objectively measured physical activity has a negative but weak association with academic performance in children and adolescents. *Acta Paediatrica, International Journal of Paediatrics*, *103*(11), e501–e506. http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1651-2227/issues%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed12&NEWS=N&AN=2015311457

K.N., A., V.F., M., E., A., S.A., A., G.K., R., & Y., O. (2017). Relationships between physical activity, sedentary time, aerobic fitness, motor skills and executive function and academic performance in children. *Mental Health and Physical Activity*, *12*, 10–18. http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L614168881%0Ahttp://dx.doi.org/10.1016/j.mhpa.2017.01.001

Lambourne, K., Hansen, D. M., Szabo, A. N., Lee, J., Herrmann, S. D., & Donnelly, J. E. (2013). Indirect and direct relations between aerobic fitness, physical activity, and academic

achievement in elementary school students. *Mental Health and Physical Activity*, *6*(3), 165–171. https://doi.org/10.1016/j.mhpa.2013.06.002

Lopez-Vicente, M., Garcia-Aymerich, J., Torrent-Pallicer, J., Forns, J., Ibarluzea, J. J., Lertxundi, N., Gonzalez, L., Valera-Gran, D. D., Torrent, M., Dadvand, P., Vrijheid, M., Sunyer Payam; ORCID: http://orcid.org/0000-0002-2325-1027, J. A. I.-O. http://orcid. org/Dadvan., López-Vicente, M., Garcia-Aymerich, J., Torrent-Pallicer, J., Forns, J., Ibarluzea, J. J., Lertxundi, N., González, L., … Sunyer, J. (2017). Are early physical activity and sedentary behaviors related to working memory at 7 and 14 years of age? *The Journal of Pediatrics*, *188*, 35–41. https://doi.org/http://dx.doi.org/10.1016/j.jpeds.2017.05.079

Lubans, D., Richards, J., Hillman, C., Faulkner, G., Beauchamp, M., Nilsson, M., Kelly, P., Smith, J., Raine, L., & Biddle, S. (2016). Physical Activity for Cognitive and Mental Health in Youth: A Systematic Review of Mechanisms. *Pediatrics*, *138*(3). https://doi.org/10.1542/peds.2016-1642

M., M., C., A., M., G., U., P., & S., L. (2018). Moderate-to-vigorous physical activity, executive functions and prefrontal brain oxygenation in children: A functional near-infrared spectroscopy study. *Journal of Sports Sciences*, *36*(6), 630–636. http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L621388080%0Ahttp://dx.doi.org/10.1080/02640414.2017.1326619

Pietschnig, J., & Voracek, M. (2015). One Century of Global IQ Gains: A Formal Meta-Analysis of the Flynn Effect (1909–2013). *Perspectives on Psychological Science*, *10*(3). https://doi.org/10.1177/1745691615577701

Pindus, D. M., Davis, R. D. M., Hillman, C. H., Bandelow, S., Hogervorst, E., Biddle, S. J. H., & Sherar, L. B. (2015). The relationship of moderate-to-vigorous physical activity to cognitive processing in adolescents: findings from the ALSPAC birth cohort. *Psychological Research*, *79*(5), 715–728. https://doi.org/10.1007/s00426-014-0612-2

Ritchie, S. J., Bates, T. C., & Plomin, R. (2015). Does Learning to Read Improve Intelligence? A Longitudinal Multivariate Analysis in Identical Twins From Age 7 to 16. *Child Development*, *86*(1). https://doi.org/10.1111/cdev.12272

Syvaoja, H. J., Tammelin, T. H., Ahonen, T., Kankaanpaa, A., & Kantomaa Timo; ORCID: http://orcid.org/0000-0002-3281-1073 Marko T.; ORCID: http://orcid.org/0000-0002-5937-3456, Marko T A I - ORCID: http://orcid.org/Ahonen, K. (2014). The associations of objectively measured physical activity and sedentary time with cognitive functions in school-aged children. *PLoS ONE*, *9*(7). https://doi.org/http://dx.doi.org/10.1371/journal.pone.0103559

Wickel, E. E. (2017a). Sedentary time, physical activity, and executive function in a longitudinal study of youth. *Journal of Physical Activity & Health*, *14*(3), 222–228. https://doi.org/http://dx.doi.org/10.1123/jpah.2016-0200

Wickel, E. E. (2017b). Sedentary time, physical activity, and executive function in a longitudinal study of youth. *Journal of Physical Activity and Health*, *14*(3), 222–228. https://doi.org/10.1123/jpah.2016-0200

ATTACHMENTS

Table 1. Associations between sample characteristics and IQ.

	n	Total IQ	Verbal IQ	Execution IQ
		Mean (SD)	Mean (SD)	Mean (SD)
Sex	609			
M	315	79.26 (12.0)	79.68 (13.0)	84.38 (12.0)
F	294	80.32 (11.8)	80.84 (12.7)	85.12 (11.3)
p		0.279	0.270	0.440
Income	596			
Low	199	75.39 (12.0)	76.71 (12.8)	80.19 (12.2)
Intermediate	199	79.43 (10.9)	79.09 (12.4)	85.36 (10.8)
High	198	85 (10.8)	85.40 (11.6)	89.09 (10.1)
p		0.000*	0.000*	0.000*
Age	609			
Seven	268	80.69 (12.0)	80.92 (12.8)	85.76 (11.9)
Eight	341	79.05(11.8)	79.70 (12.9)	83.92 (11.5)
p		0.094	0.253	0.056
BMI	607			
Obesity	153	81.01 (12.2)	81.69 (13.3)	85.47 (11.4)
Overweight	135	79.20 (11.8)	80.17 (12.8)	83.63 (12.0)
Normal weight	311	79.26 (11.7)	79.44 (12.4)	84.72 (11.5)
Underweight	8	82 (15.9)	80.12 (17.0)	87.75 (16.6)
p		0.231	0.092	0.51
Race	593			
White	411	82.11 (11.6)	82.28 (12.8)	86.94 (11.0)
Other	182	75.93 (11.1)	76.96 (12.2)	81.04 (11.6)
p		0.000*	0.000*	0.000*
Extracurricular Activity	495			
Yes	117	82.29 (11.0)	82.00 (11.6)	87.53 (10.7)
No	378	78.94 (12.1)	79.65 (12.9)	83.79 (12.0)
p		0.008*	0.080	0.003*
Parents reading	585			
Yes	130	82.90 (10.9)	83.08 (12.6)	87.57 (9.5)
No	455	79.11 (12.0)	79.65 (13.1)	84.13 (12.1)
p		0.001*	0.007*	0.003*
Child reading	585			
Yes	114	83.12 (12.3)	83.68 (13.7)	87.14 (11.5)
No	471	79.19 (11.7)	79.63 (12.5)	84.35 (11.6)
p		0.002*	0.002*	0.022*

Test t e anova p<0.05*

Table 2. Crude and adjusted analyses of Extracurricular Activities, Parents reading for the child, Child reading and IQ tests according to demographic and socioeconomic variables.

	Crude analyses		Adjusted analyses	
	β ($CI_{95\%}$)	*p* value	β ($CI_{95\%}$)	*p* value
	Total IQ		**Total IQ**	
Extracurricular Activity	3.34 (0.87; 5.81)	0.008*	2.02 (-.25; 4.29)	0.082
Parents reading	3.78 (1.47; 6.10)	0.001*	2.08 (-0.04; 4.20)	0.055
Child reading	3.92 (1.49; 6.35)	0.002*	3.97 (1.67; 6.28)	0.001*
	Verbal IQ		**Verbal IQ**	
Extracurricular Activity	2.35 (-0.28;4.98)	0.080	1.15 (-1.24; 3.55)	0.344
Parents reading	3.42 (0.92; 5.92)	0.007*	1.92 (-0.58; 4.43)	0.133
Child reading	4.05 (1.43; 6.67)	0.002*	4.14 (1.54; 6.75)	0.002*
	Execution IQ		**Execution IQ**	

Extracurricular Activity	3.74 (1.30; 6.18)	0.003*	2.52 (-0.22; 4.82)	0.032*
Parents reading	3.44 (1.17; 5.70)	0.003*	1.84 (-0.12; 3.73)	0.066
Child reading	2.79 (0.40; 5.17)	0.022*	2.77 (0.55; 4.99)	0.014*

Multivariable analyses p<0.05*

Table 3. Association between accelerometry measures and IQ.

	N	**Mean (SD)** min/day	**Total IQ**	**Verbal IQ**	**Execution IQ**
Accelerometry Tertiles					
Sedentary time					
First	184	632.59 (81.27)	77.71	78.92	82.32
Second	184	740.57 (15.01)	79.57	80.34	84.56
Third	184	815.04 (52.17)	83.03	82.73	87.71
p			0.000*	0.018*	0.000*
Physical Activity Light					
First	184	142.15 (20.63)	82.77	82.28	87.92
Second	184	179.98 (7.49)	80.06	81.01	84.45
Third	184	215.94 (23.56)	77.47	78.70	82.22
p		50.28 (10.39)	0.000*	0.029*	0.000*
Moderate					
First	184	50.28 (10.39)	81.43	81.34	86.48
Second	184	72.66 (5.78)	81.23	81.85	85.71
Third	184	101.52 (15.44)	77.63	78.79	82.38
p			0.003*	0.056	0.001*
Vigorous					
First	184	3.06 (1.05)	81.42	81.71	86.16
Second	185	6.46 (1.16)	80.60	81.02	85.30
Third	183	13.96 (6.29)	78.27	79.25	83.13
p			0.036*	0.17	0.040*
Total Physical Activities	552	366.80 (80.91)			
Total MVPA	552	115.69 (38.57)			

Anova for trend p<0.05*

Table 4. Adjusted analyses of Accelerometry measures and IQ tests according to demographic and socioeconomic variables.

	Adjusted analyses					
	β ($CI_{95\%}$)	*p* value	β ($CI_{95\%}$)	*p* value	β ($CI_{95\%}$)	*p* value
Sedentary Time	**Total IQ**		**Verbal IQ**		**Execution IQ**	
Second	1.36 (-0.77; 3.50)	0.006*	1.26 (-1.14; 3.66)	0.098	1.50 (-0.68; 3.69)	0.003*
Third	3.54 (1.03; 6.05)		2.29 (-0.43; 5.02)		3.62 (1.20; 6.03)	
Light Physical Activity	**Total IQ**		**Verbal IQ**		**Execution IQ**	
Second	-1.46 (-3.84; 0.91)	0.008*	-0.07 (-2.56; 2.70)	0.226	-2.49 (-4.82; 0.16)	0.001*
Third	-3.21 (-5.59; -0.82)		-1.63 (-4.26; 1.00)		-3.78(-6.04; -1.51)	
Moderate Physical Activity	**Total IQ**		**Verbal IQ**		**Execution IQ**	
Second	0.33 (-2.07; 2.75)	0.064*	1.04 (-1.58; 3.67)	0.474	-0.26 (-2.59; -2.06)	0.017*
Third	-2.22 (-4.56; 0.10)		-0.98 (-3.63; 1.66)		-2.77 (-5.04; -0.50)	
Vigorous Physical Activity	**Total IQ**		**Verbal IQ**		**Execution IQ**	
Second	-0.04 (-2.41; 2.31)	0.223	0.00 (-2.62; 2.63)	0.520	-0.13 (-2.37; 2.11)	0.184
Third	-1.46 (-3.81; 0.87)		-0.85 (-3.46; 1.74)		-1.58 (-3.91; 0.74)	

Multivariable analyses $p<0.05$*