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EDITORIAL

Public health implications of replacing screen time with physical activity and sleep in Brazilian children*

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Physical activity is a health behavior that is related to numerous physical, mental, and social-emotional health outcomes.[1-3] Higher levels of physical activity during childhood also contribute to physical and cognitive development and engaging in the recommended average of 60 min per day associated with better cardiometabolic risk profiles.[1-3] Despite previous research showing these positive associations, research examining how physical activity may be associated with a comprehensive assessment of cardiometabolic risk is relatively sparse in children from low- or middle-income countries such as Brazil.[4] It has been stated that a disconnect exists between the recognition of the importance of physical activity in Brazil and a lack of resources to promote the behavior.[4] The lack of resources also precludes conducting high-quality research on how to effectively reduce sedentary time and improve physical activity in youth; therefore, any peer-reviewed and quality research study linking physical activity to health outcomes in Brazilian children should be given utmost attention to help promote the behavior and facilitate the financing, evaluation, and scaling of effective school and community physical activity programs.

Past research examining how patterns of physical activity relate to health often ignores co-behaviors that may confound relationships, making it difficult to discern the magnitude of potential associations with outcomes such as cardiometabolic risk. However, within the past decade, novel analytic approaches have made it possible to examine how the replacement of a behavior with physical activity or one of its co-behaviors can be associated with changes in health outcomes. Specifically, compositional data analysis (CoDA) including isotemporal substitution methods allows behavioral analysts the ability to examine how replacing time spent in one behavior with another behavior correlates with changes in a respective health outcome.[5] This analytical approach has been used in the recent past examining how behavioral time use reallocation correlated with cardiometabolic health, health-related fitness, gross motor skills, and mental health.[6-8] The compositional is temporal substitution approach adds rigor to analytic plans by examining time-use behaviors as a composition within a single model, which mitigates collinearity issues and allows for examining how a hypothetical replacement of behaviors correlates with changes in health outcomes within the context of a respective research design.[5,9] It is particularly useful when behavioral analysts are examining the behaviors of physical activity, sedentary time, and sleep that when aggregated make up a 24-h day and are key components of the "24-h movement" or "24-h activity cycle" framework.[5,8,9]

Reis et al.[10] examined the associations of physical activity, sedentary time, and sleep with cardiometabolic health indicators and indicators of inflammation using a cross-sectional sample of children from southern Brazil. The researchers employed the compositional isotemporal modeling approach with physical activity, sedentary time, and sleep to determine how the reallocation of time spent in each behavior is associated with several cardiometabolic and inflammation outcomes. In this study, DXA was used to measure body fat percentage, and light physical activity (LPA) and moderate-to-vigorous physical activity (MVPA) were assessed using accelerometers and validated cut-off points that determined time in specific intensities. Calculation of aerobic fitness via the 6-minute run/walk test, calculation of resting blood pressure, and inclusion of somatic maturation added rigor to the analysis. Of great interest within this study may be the links made between the behavioral variables and indicators of inflammation, leptin, and C-Reactive Protein (CRF), which are thought

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to be a genesis of cardiometabolic risk and the chronic low-grade inflammatory phenotype that contributes to excess adiposity. The examined correlation with the inflammation variables was novel and the use of a sample of children from a middle-income country provides a meaningful knowledge contribution.

Reis et al.[10] collected leptin and CRP via blood samples after a 12-h fast with evaluation using the ELISA technique. Using a 4-compositional part behavioral model (MVPA, LPA, sedentary time, sleep), it was found that replacement of sedentary time with MVPA or sleep was associated not only with better body composition levels and systolic blood pressure but was also found that replacing screen use with MVPA or sleep was associated with significantly lower leptin levels with a trend toward significantly lower CRP. Specifically, for every 1-h replacement of sedentary with MVPA, there was an approximately 8% lower observed body fat percentage, an approximate 6.9 ng/mL lower leptin score, and a 2.4 mg/dL lower score for CRP. Also, a 1-h replacement of sedentary time with MVPA was associated with an approximately 2 kg/m^2 lower body mass index, a 5.5 cm lower waist circumference, and a 14 mmHg lower systolic blood pressure. Significant but smaller effect sizes were observed when replacing 20 min and 1 min of sedentary time with MVPA. Similar significant results were found when replacing sedentary time with sleep, but the associations were weaker in magnitude. No significant associations were observed replacing sedentary time with LPA except for changes in leptin.

Of note from the study conducted by Reis et al.[10] was that most of the significant associations were only observed when the physical activity of higher intensity (i.e., MVPA) replaced screen use. This finding supports the evidence that higher-intensity physical activity, which elicits higher intensity movement, is potentially needed to observe meaningful improvement in cardiometabolic health and also indicators of inflammation.[1,11] The positive changes in health indicators observed with sleep were evidenced by other studies.[12] Even though in past studies it was observed that the magnitude of association between sleep and health indicators may be just as large or larger compared to other behaviors for specific outcomes,[12] Reis et al.[10] observed that replacement of sedentary time with MVPA yielded stronger associations then replacing sedentary time with sleep. There are several potential mechanisms for the correlations of MVPA, sleep, and health that may be through better metabolic efficiency, reduced inflammation, and higher caloric expenditure.[13,14] Indeed, the findings specific to leptin and CRP are especially noteworthy and need future research in Brazilian young person populations.[14]

What these findings mean for children from middle-income countries like Brazil is that practitioners need effective, creative, and sustainable ways to reduce sedentary time and increase MVPA throughout the day to potentially impact cardiometabolic risk factors. Whole-of-school approaches that involve delivering quality physical education, and opportunities before, during, and after school to engage in higher levels of MVPA is a standard method for improving activity and movement in youth.[15] Delivering physical activity programming in out-of-school settings is essential given that observational research has shown poorer health behaviors in children during times and days when there are unstructured schedules.[16] Also, involving parents, peers, and staff may provide an overall feeling of social support for children that may lead to enhanced activity enjoyment and sustained physical activity behavior.[17] Additionally, educating students and students' parents on proper sleep hygiene is important to develop good sleeping habits. Setting consistent bedtime schedules in addition to minimizing light exposure and device (e.g., smartphone) exposure within a few hours of bedtime has been shown to improve both sleep quality and quantity in children.[18] Adequate sleep provides focus, attention, and energy to engage in activity the following day, and thus a positive spiral of engagement between physical activity and sleep can emerge yielding positive reciprocating effects across time.

An important consideration gleaned from Reis et al.[10] was that even a modest replacement of minutes of sedentary time with MVPA and sleep may provide benefits. The current World Health Organization's recommendation for physical activity is to engage in an average of 60 min per day across a week.[19] However, previous work has shown that to reap the benefits of physical activity, even small incremental improvements in behaviors can improve physical and mental health.[19] Thus, public health messaging in Brazil should state the benefits of complying with recommendations but also acknowledge that small improvements even below recommended levels can meaningfully improve health in Brazilian children.

Finally, although the results from using compositional isotemporal substitution do provide unique insight into how patterns of behaviors related to health indicators in Brazilian children, causation is still precluded using cross-sectional research designs and it is also unclear how replacement of behaviors affects children at different points on a health outcome's distribution as traditional methods only examine variation around the mean. Higher or lower levels of certain health indicators (toward the tails of the distribution) are where more meaningful patterns of variation may occur in those who are at high risk. Combining compositional isotemporal substitution with other quantitative methods such as quantile regression can help address these gaps in the literature.[20]

The work from Reis et al.[10] is commendable and provides unique insights into how patterns of movement behaviors are associated with indicators of cardiometabolic health and indicators of inflammation in Brazilian children. Science using rigorous analytical approaches is vital to help answer important public health questions. Despite the often lack of sufficient funding and resources to promote physical activity, the global approaches for research collaboration that research teams in Brazil are engaging in serve as a positive model moving forward to help improve the health of youth in countries like Brazil and worldwide.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Tarp J, Child A, White T, Westgate K, Bugge A, Grøntved A, et al. Physical activity intensity, bout-duration, and cardiometabolic

risk markers in children and adolescents. Int J Obes. 2018;42:1639—50. Erratum in: Int J Obes (Lond). 2019;43:2346.
2. Costigan SA, Lubans DR, Lonsdale C, Sanders T, Del Pozo Cruz B. Associations between physical activity intensity and well-being in adolescents. Prev Med. 2019;125:55—61.
3. Li B, Ng K, Tong X, Zhou X, Ye J, Yu JJ. Physical activity and mental health in children and youth during COVID-19: a systematic review and meta-analysis. Child Adolesc Psychiatry Ment Health. 2023;17:92.
4. de Carvalho FF, Vieira LA. The promotion of physical activity in LMICs: public health policy in Brazil. Lancet Glob Health. 2023;11:e1698.
5. Dumuid D, Pedišić Ž, Stanford TE, Martín-Fernández JA, Hron K, Maher CA, et al. The compositional isotemporal substitution model: a method for estimating changes in a health outcome for reallocation of time between sleep, physical activity and sedentary behavior. Stat Methods Med Res. 2019;28:846—57.
6. Fairclough SJ, Dumuid D, Mackintosh KA, Stone G, Dagger R, Stratton G, et al. Adiposity, fitness, health-related quality of life and the reallocation of time between children's school day activity behaviours: a compositional data analysis. Prev Med Rep. 2018;11:254—61.
7. Olds T, Burton NW, Sprod J, Maher C, Ferrar K, Brown WJ, et al. One day you'll wake up and won't have to go to work: the impact of changes in time use on mental health following retirement. PLoS One. 2018;13:e0199605.
8. Miatke A, Olds T, Maher C, Fraysse F, Mellow ML, Smith AE, et al. The association between reallocations of time and health using compositional data analysis: a systematic scoping review with an interactive data exploration interface. Int J Behav Nutr Phys Act. 2023;20:127.
9. Dumuid D, Stanford TE, Pedišić Ž, Maher C, Lewis LK, Martín-Fernández JA, et al. Adiposity and the isotemporal substitution of physical activity, sedentary time and sleep among school-aged children: a compositional data analysis approach. BMC Public Health. 2018;18:311.
10. Reis LN, Baptista PN, Brand C, Reuter CP, Okely A, Foshesatto CF, et al. Replacing screen time, with physical activity and sleep time: influence on cardiovascular indicators and inflammatory markers in Brazilian children. J Pediatr. 2024;100:149—55.
11. Umpierre D, Coelho-Ravagnani C, Cecília Tenório M, Andrade DR, Autran R, Barros MV, et al. Physical activity guidelines for the Brazilian population: recommendations report. J Phys Act Health. 2022;19:374—81.
12. Wilhite K, Booker B, Huang BH, Antczak D, Corbett L, Parker P, et al. Combinations of physical activity, sedentary behavior, and sleep duration and their associations with physical, psychological, and educational outcomes in children and adolescents: a systematic review. Am J Epidemiol. 2023;192:665—79.
13. Whooten R, Kerem L, Stanley T. Physical activity in adolescents and children and relationship to metabolic health. Curr Opin Endocrinol Diabetes Obes. 2019;26:25—31.
14. Verswijveren SJ, Salmon J, Daly RM, Della Gatta PA, Arundell L, Dunstan DW, et al. Is replacing sedentary time with bouts of physical activity associated with inflammatory biomarkers in children? Scand J Med Sci Sports. 2021;31:733—41.
15. Brusseau TA, Burns RD. Introduction to multicomponent school-based physical activity programs. The Routledge Handbook of Youth Physical Activity; 2020. p. p 557, 1st Edition 2020557—76.
16. Brazendale K, Beets MW, Weaver RG, Pate RR, Turner-McGrievy GM, Kaczynski AT, et al. Understanding differences between summer vs. school obesogenic behaviors of children: the structured days hypothesis. Int J Behav Nutr Phys Act. 2017;14:100.
17. Burns RD, Podlog LW, Bai Y. Enjoyment mediates associations of the physical and family environment with adolescent physical activity: a structural equation modeling approach. J Adolesc Health. 2022;71:628—34.
18. Fadzil A. Factors affecting the quality of sleep in children. Children. 2021;8:122.
19. Chaput JP, Willumsen J, Bull F, Chou R, Ekelund U, Firth J, et al. 2020 WHO guidelines on physical activity and sedentary behaviour for children and adolescents aged 5-17 years: summary of the evidence. Int J Behav Nutr Phys Act. 2020;17:141.
20. Mitchell JA, Dowda M, Pate RR, Kordas K, Froberg K, Sardinha LB, et al. Physical activity and pediatric obesity: a quantile regression analysis. Med Sci Sports Exerc. 2017;49:466—73.