Beyond the Screen: Urban-Rural Contrasts in Filipino Preschoolers' Movement Behaviors – Findings from the SUNRISE Pilot Study

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Abstract: This pilot study examines the movement behaviors of Filipino preschoolers in relation to WHO's 24-hour movement guidelines and assesses associations with body mass index (BMI), executive function, and motor skills. Using standardized protocols from the SUNRISE international study, data were collected from 109 four-year-old children across urban (Sta. Rosa, Laguna) and rural (Northern Samar) sites. Objective measures included accelerometry, cognitive assessments, anthropometry, and caregiver surveys. Statistical analyses explored variation by sector, sex, and caregiver education. Only 10% of children met all five WHO recommendations. Rural girls had the highest compliance, while urban children exhibited higher BMI and screen time exposure. Sector, sex, and caregiver education significantly predicted compliance with screen time and restrained sitting guidelines. Cognitive and motor performance varied by age and location, highlighting early developmental disparities. Regardless of physical activity levels, the cohort exhibited growth patterns physically unfit for acquiring movement-related competencies, due to improper nutrition and limited safe spaces for physical exploration—potentially delaying the development of self-efficacy through socio-emotional learning. The findings reinforce the link between movement behaviors and children's capacity to engage in Early Childhood Care and Development (ECCD) curriculum activities. Policy recommendations include embedding movement behavior education within conditional cash transfer programs, aligning early childhood health promotion with ECCD frameworks, strengthening caregiver engagement, and expanding access to safe community play environments. The SUNRISE protocol demonstrated feasibility for the Philippine context and provides critical baseline data for establishing a national early childhood movement behavior surveillance system.

Key Words: Early childhood development; movement behaviors' WHO guidelines; screen time; BMI; urban-rural disparities
JEL Codes: **I12, I15, J13, I18, R23, O15**

1. BACKGROUND AND OBJECTIVES

Early childhood is a critical period for the development of physical, motor, cognitive, and social skills. The WHO's 2019 24-hour movement guidelines for children under five emphasize the importance of physical activity, sleep, and limited sedentary

behavior. This pilot study—part of the international SUNRISE project[1]—investigates Filipino preschoolers' adherence to these guidelines and examines associations with BMI, executive function, and motor skills. It also tests the feasibility of data collection methods using the SUNRISE international protocol in case of future plans for a larger national study.
The age range of children in the 2023 movement behavior study in terms of their formative or developmental age in months, i.e. from the time of measurement in February 2023 that would be 30-66 months old kindergarten learners (taken from the birth date record, 06-23-2020, youngest and 01-30-2017 oldest). The age range is used as reference in international standards for determining child's developmental milestones such as physical health, well-being and motor development.

Importantly, the findings of this study align with the Early Childhood Care and Development (ECCD) framework. The ECCD curriculum is play-based, child-centered, integrated, and flexible. Movement behaviors are foundational to daily activities that promote physical health, socio-emotional learning, creative expression, and literacy. Structured and unstructured play, storytelling, creative arts, health and nutrition awareness, and outdoor play are integral to developing competencies that are necessary for children's holistic growth.

2. METHODOLOGY

A total of 109 four-year-old children from Sta. Rosa (urban) and Northern Samar (rural) were recruited using cluster random sampling. Data were gathered using accelerometers, tablet-based cognitive tests (Go/No-Go and Mr. Ant), BMI measurements, and caregiver surveys. Compliance with WHO guidelines was assessed for total physical activity, moderate to vigorous physical activity, screen time, sleep time, and restrained sitting. The protocol followed SUNRISE procedures and best practices in wearable technology calibration and feasibility. REDCap was used for data management. Data analysis included t-tests, chi-square tests, and logistic regressions to determine associations with sociodemographic variables.

3. RESULTS AND DISCUSSION

Only 10% of children met all five WHO movement guidelines. Rural children, particularly females, showed higher overall compliance. Urban children had significantly higher BMI scores, while rural children, especially girls, were more likely to exhibit undernutrition. Children from urban areas showed higher screen time and

sleep duration, while rural children were more physically active.

Significant predictors of screen time and restrained sitting compliance included sector, sex, and caregiver education. Logistic regression results indicate that urban children are less likely to meet screen time guidelines but more likely to meet restrained sitting recommendations.

BMI was positively associated with urban residence, with urban children averaging 3.26 BMI points higher than rural counterparts. Cognitive and motor performance were significantly influenced by age and sector. Older children performed better on visual-spatial and balance tasks, while rural children scored higher on physical tasks. Female children showed lower performance in certain executive function tasks.

This study reveals critical disparities in movement behaviors among young Filipino children, shaped largely by geographic, socioeconomic, and gender-based factors. The higher BMI among urban children aligns with existing literature on sedentary lifestyles and food environments in urban settings. Conversely, the risk of undernutrition among rural girls raises concerns about access to quality nutrition, even when physical activity levels are adequate. These findings underscore the need to address not only behavior but also structural determinants of health.
The children in the study whether they are physically active or inactive, because of improper nutrition and limited safe places to experience the physical world, their body growth is physically unfit to acquire movement-related competencies such as motor skills, and may delay the progression of self-efficacy through socio-emotional learning.

The connection to the ECCD framework is evident: without foundational health and physical competencies, children's ability to fully engage in play-based, integrated, and flexible early childhood education activities is compromised. Movement behaviors directly influence children's participation in circle time, storytelling, creative arts, and socio-emotional learning, all critical to their holistic development.

Caregiver education emerged as a key determinant of compliance with guidelines, suggesting the need for health promotion strategies that target caregiver awareness and behavior. Differences in executive function and motor skills across groups also point to the potential cumulative impacts of early disadvantage, echoing the cumulative disadvantage theory and highlighting the need for early interventions.

The observed gender differences—particularly the lower cognitive scores among girls and higher obesity risk among boys—call for more nuanced program designs that account for these layered vulnerabilities. Collectively, the results illustrate how movement behaviors and developmental outcomes are mediated by broader social and environmental contexts.

4. CONCLUSION AND RECOMMENDATIONS

This pilot study demonstrates the feasibility of implementing the SUNRISE protocol in diverse Philippine settings. It provides empirical evidence on early movement behaviors and their correlates among preschool children, offering valuable inputs for designing early childhood health interventions. The dual burden of under- and overnutrition, shaped by location, sex, and household factors, demands a multisectoral response grounded in behavioral science and local realities.

Findings emphasize that early childhood interventions must go beyond individual behavior change to address caregiver education, built environment, and gender-sensitive programming. Establishing a national surveillance system using standardized tools, as validated in this pilot study, is a critical step toward ensuring every Filipino child achieves optimal health and developmental potential.

Policy implications include integrating movement behavior promotion into Family Development Sessions under the 4Ps program, emphasizing screen time reduction, balanced physical activity, and caregiver support. Furthermore, early childhood policies must prioritize integrated physical activity, nutrition, and socio-emotional learning within the Early Childhood Care and Development (ECCD) framework.

Tailoring health education modules in early childhood care programs and enhancing safe public spaces for active play are critical. Community-based strategies involving LGUs, schools, and families are needed to ensure sustainable and inclusive implementation.

This pilot confirms the feasibility of SUNRISE protocols in the Philippines and offers baseline insights for a national surveillance system on early childhood health and development.

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[1]The SUNRISE (International Study of Movement Behaviors in the Early Years) project is a global surveillance initiative examining physical activity, sedentary behavior, and sleep in children under five years of age. It aims to assess compliance with the WHO's 24-hour movement guidelines and to identify contextual factors influencing early childhood health and development across diverse income settings. The standardized protocol enables comparability across countries and informs local and global policies on early childhood well-being.

6. REFERENCES (use APA style for citations)

Berkowitz, R. T., Wadden, T. A., Tershakovec, A. M., & Cronquist, J. L. (2003). Behavior therapy and sibutramine for the treatment of adolescent obesity [Electronic version]. Journal of American Medical Association, 289, 1805-1812.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, 31(2), 143–164. https://doi.org/10.1177/109019810426366 0

Cagas, J. Y., et al. (2022). Results from the Philippines' 2022 report card on physical activity for children and adolescents. *Journal of Exercise Science and Fitness*, 20(4), 382–390. https://doi.org/10.1016/j.jesf.2022.10.001

Fairclough, S. J., et al. (2016). Wear compliance and activity in children wearing wrist- and hip-mounted accelerometers. *Medicine & Science in Sports & Exercise*, 48(2), 245–253.

Harris, P. A., et al. (2009). Research electronic data capture (REDCap)–A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, 42(2), 377–381.

Hardeman, W., et al. (2005). A causal modelling approach to the development of theory-based behavior change programmes for trial evaluation. *Health Education Research*, 20(6), 676–687.

LaMorte, W. W. (2019). Behavioral Change Models. Boston University School of Public Health.

http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories5.html

McArthur, B.A., Volkova, V., & Tomopoulos, S. (2022). Global prevalence of meeting screen time guidelines among children 5 years and younger: A systematic review and meta-analysis. *JAMA Pediatrics*, 176(4), 373–383. https://doi.org/10.1001/jamapediatrics.2021.6386

Okely, A. D., Reilly, J. J., Tremblay, M. S., et al. (2021). Cross-sectional examination of 24-hour movement behaviours among 3- and 4-year-old children in urban and rural settings in low-, middle-, and high-income countries: The SUNRISE study protocol. *BMJ Open*, 11, e049267. https://doi.org/10.1136/bmjopen-2021-049267

Okely, A. D., et al. (2010). Multi-site randomized controlled trial of a child-centered physical activity program, a parent-centered dietary-modification program, or both in overweight children: The HIKCUPS study. *Journal of Pediatrics*, 157(3), 388–394.

Orbeta, A., Melad, K., & Araos, N. (2021). Longer-term Effects of the Pantawid Pamilyang Pilipino Program: Evidence from a Randomized Control Trial Cohort Analysis. *PIDS Discussion Paper Series No. 2021-01.* https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps2101.pdf

Phillips, L. R. S., Parfitt, G., & Rowlands, A. V. (2013). Calibration of the GENEA accelerometer for assessment of physical activity intensity in children. *Journal of Science and Medicine in Sport*, 16, 124–128.

Schaefer, S. E., Van Loan, M., & German, J. B. (2014). A feasibility study of wearable activity monitors for pre-adolescent school-age children. *Preventing Chronic Disease*, 11, 130262.

Scott, J. J., et al. (2017). Comparability and feasibility of wrist- and hip-worn accelerometers in freeliving adolescents. *Journal of Science and Medicine in Sport*. https://doi.org/10.1016/j.jsams.2017.04.017

van Loo, C. M. T., et al. (2017). Wrist accelerometer cut-points for classifying sedentary behaviour in children. *Medicine & Science in Sports & Exercise*, 49(4), 813–822.

World Health Organization. (2019). *Guidelines on Physical Activity, Sedentary Behaviour, and Sleep for Children Under 5 Years of Age*. https://apps.who.int/iris/handle/10665/311664