Digital and Physical Influences in Early Childhood: Understanding Sedentary Behavior and Psychomotor Development

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Abstract: This study investigates the digital and physical factors influencing sedentary behavior and psychomotor development in early childhood. Utilizing a sample of early childhood educators in West Java, Indonesia, the research employs Structural Equation Modeling-Partial Least Squares (SEM-PLS) to analyze the relationships between parental involvement, parental digital behavior, teacher digital literacy, physical activity levels, sedentary behavior, motor coordination, and psychological development in young children. The results reveal significant impacts of teacher digital literacy and physical activity levels on sedentary behavior, which in turn significantly affects both motor coordination and psychological development. Parental digital behavior and involvement also show notable influences on sedentary behavior. The study underscores the importance of balancing digital and physical activities to foster optimal psychomotor development in early childhood. These findings highlight critical areas for educational policies and parental practices to mitigate the negative effects of sedentary behavior and promote healthier developmental outcomes. This research contributes to a deeper understanding of how modern lifestyle factors intersect with early childhood development, providing actionable insights for educators, policymakers, and parents.
Keywords: Early childhood, Sedentary behavior, Psychomotor development, Digital literacy, Physical activity

INTRODUCTION

Early childhood, often referred to as the "golden age" is a critical period of rapid development and learning (Hurlock, 2017). Children's growth and development heavily depend on the stimuli they receive, significantly influencing their physical and psychomotor development. The United Nations Sustainable Development Goal 4 aims for all young children to access quality pre-primary education by 2030, highlighting the importance of early education (Boeren, 2019).

Current statistics from the Indonesian Ministry of Education and Culture for the 2019/2020 academic year report over 6.5 million students served by 202,991

early childhood education (ECE) centers, with only 666,678 educators. This drastic educator-to-student ratio far exceeds the national standard, highlighting a severe shortage of qualified early childhood educators. The Indonesian government's Regulation No. 137/2014 specifies an educator-to-child ratio of 1:4, yet current ratios stand closer to 1:10, indicating a pressing need for more educators (2014).

Educator scarcity is compounded by inadequate compensation and professional development. In West Java, non-permanent teachers earn between IDR 20,000 and IDR 24,000 per teaching hour, far below a decent living standard. This disparity leads to uneven educator distribution, with significant urban concentrations and rural deficiencies. Many educators possess qualifications below the national requirements, impacting the quality of education and care for young children.

This research explores the relationships between parental involvement, educators' digital literacy (Wardana et al., 2023), physical activity (Yu et al., 2021), sedentary behavior (Carson et al., 2020; Tammelin, 2018; Yu et al., 2021), and psychomotor (Tonge et al., 2021) development among young children in West Java. It integrates the World Health Organization's guidelines on physical activity and sedentary behavior to examine these interactions. WHO recommends young children engage in varied physical activities and minimize sedentary time to promote health and developmental outcomes (World Health Organization, 2019). The study aims to offer insights into effective strategies for enhancing early childhood education and development through improved educator practices, parental involvement, and health-promoting behaviors aligning with international standards.

The early childhood education landscape is shaped by various methodologies impacting child development. Play-based learning, highlighted by Ali et al. (2018), stimulates a child's desire to learn and enhances psychological development. Parental engagement, as detailed by Ludyanti & Ishariani (2020), significantly influences sedentary behaviors in preschool children. The digital era introduces new challenges, with studies by Yohana & Mulyono (2021) and Ishariani & Ludyanti (2020) highlighting the impact of high gadget use on children's eating behaviors and sedentary lifestyles (Veldman et al., 2023). Physical activity's importance is emphasized by Jones et al. (2013) and Hinkley et al. (2014), underscoring active lifestyles for healthy development.

These studies highlight the complex interplay of educational strategies, parental involvement, digital exposure, and physical activity, all crucial for shaping children's developmental pathways.

Research Questions

1. How does parental involvement influence the sedentary behavior of early childhood students?

2. What is the impact of parental digital behavior on the sedentary behavior of early childhood students?
3. How does teacher digital literacy affect the sedentary behavior of early childhood students?
4. What is the relationship between physical activity and sedentary behavior in early childhood students?
5. How does sedentary behavior influence the motor coordination of early childhood students?
6. What is the effect of sedentary behavior on the psychological development of early childhood students?

Research Purpose

The purpose of this study is to examine the complex interplay between various factors such as parental involvement, parental digital behavior, teacher digital literacy, and physical activity, and how these factors influence the sedentary behavior of early childhood students. Additionally, the study aims to explore the consequential impacts of sedentary behavior on the psychomotor development of these students, specifically looking at motor coordination and psychological development. This research seeks to provide insights into how each variable contributes to sedentary lifestyles and its broader implications on the health and development of children in early childhood education settings.

METHOD

Contains the research methods used, the time and place of the study, targets and targets, research participants, procedures, data collection techniques, data analysis and instruments. Related to the way the research can be written in sub-subsections, left-aligned, capitalized.

This study employs Structural Equation Modeling (SEM) using the Partial Least Squares (PLS) method, analyzed with SmartPLS software. The SEM-PLS approach is chosen for its robustness in handling complex models and its ability to assess relationships between latent constructs. The research population consists of all early childhood education (ECE) teachers in West Java Province, Indonesia. The total population of schools is 38,895, including TK (Kindergarten), KB (Playgroup), TPA (Childcare), and SPS (Similar Early Childhood Units). The total population of teachers is 73,289, distributed across these school types.

Sampling is conducted using cluster sampling to ensure representation from various sub-groups. The sample size is determined using Slovin's formula, resulting in 400 respondents:

$$n = \frac{N}{1 + N.e^2}$$

n is the sample size, N is the population size (73,289 educators), and e is the margin of error (5%). This calculation yields a sample size of approximately 400 educators.

Data collection involves a structured questionnaire assessing various constructs: Parental Involvement (X1), Parental Digital Behavior (X2), Teacher Digital Literacy (X3), Physical Activity (X4), Sedentary Behavior (Y), Motor Coordination (Z1), and Psychological Development (Z2). Each construct is measured using validated instruments with high reliability and validity metrics (Cronbach's alpha, composite reliability, and average variance extracted).

Data analysis follows a two-step approach: evaluating the measurement model and assessing the structural model. The measurement model analysis ensures reliability and validity, with all constructs meeting the minimum thresholds for Cronbach's alpha, composite reliability, and AVE. The structural model analysis tests the hypothesized relationships between constructs using path coefficients, t-statistics, and p-values to determine significance.

The hypothesized relationships tested in this study are:

1. Parental Involvement influences Sedentary Behavior.
2. Parental Digital Behavior impacts Sedentary Behavior.
3. Teacher Digital Literacy affects Sedentary Behavior.
4. Physical Activity is related to Sedentary Behavior.
5. Sedentary Behavior influences Motor Coordination.
6. Sedentary Behavior impacts Psychological Development.

The hypotheses for this study are outlined below, each reflecting a proposed relationship between the key variables.

No.	Hypotheses
H1	Educators' Digital Literacy negatively influences Sedentary Behavior among young children.
H2	Parent's Digital Behavior positively influences Sedentary Behavior among young children.
H3	Parental Involvement positively influences Sedentary Behavior among young children.
H4	Physical Activity Levels negatively influence Sedentary Behavior among young children.
H5	Sedentary Behavior negatively influences Motor Coordination among young children.
H6	Sedentary Behavior negatively influences Psychological Development among young children.
H7	Educators' Digital Literacy indirectly influences Motor Coordination through Sedentary Behavior.
H8	Educators' Digital Literacy indirectly influences Psychological Development through Sedentary Behavior.

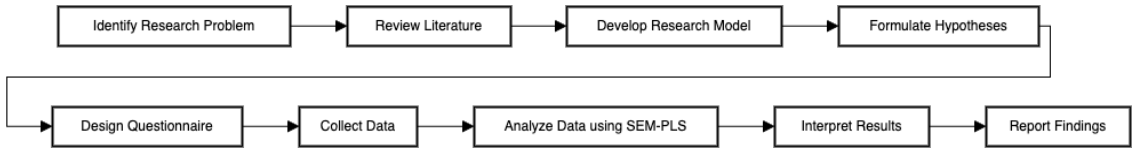
H9	Parent's Digital Behavior indirectly influences Motor Coordination through Sedentary Behavior.
H10	Parent's Digital Behavior indirectly influences Psychological Development through Sedentary Behavior.
H11	Parental Involvement indirectly influences Motor Coordination through Sedentary Behavior.
H12	Parental Involvement indirectly influences Psychological Development through Sedentary Behavior.
H13	Physical Activity Levels indirectly influence Motor Coordination through Sedentary Behavior.
H14	Physical Activity Levels indirectly influence Psychological Development through Sedentary Behavior.

The following table summarizes the key constructs and their measurement:

Table 1 Research Instruments

Construct	**Indicator**	**Scale**
Parental Involvement	Cognitive, Affective, Psychomotor	Ordinal (1-5)
Parental Digital Behavior	Digital Literacy, Culture, Ethics, Safety	Ordinal (1-5)
Teacher Digital Literacy	Digital Literacy, Culture, Ethics, Safety	Ordinal (1-5)
Physical Activity	LLPA, HLPA, MVPA, TPA	Ordinal (1-5)
Sedentary Behavior	Learning, Gaming, Watching	Ordinal (1-5)
Motor Coordination	Fine Motor, Gross Motor	Ordinal (1-5)
Psychological Development	Cognitive, Socio-Emotional	Ordinal (1-5)

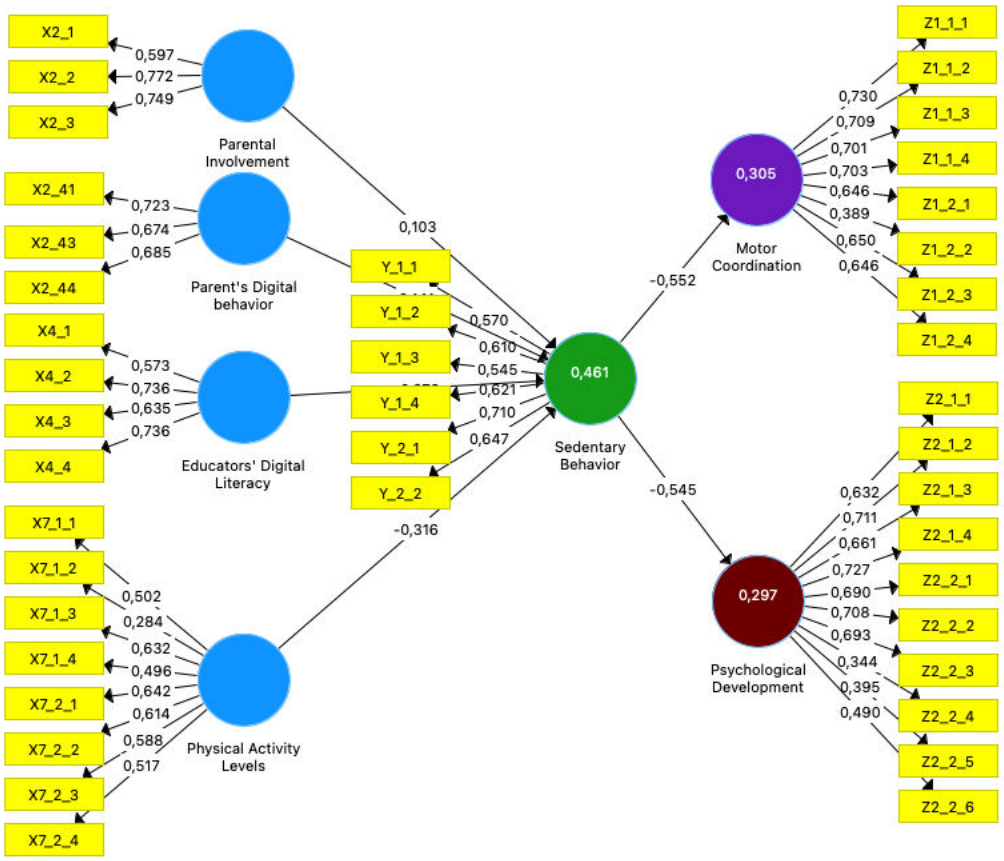
The research flowchart is presented below:



Picture 1 Research Flowchart

RESULTS

Below is the path coefficient model figure that visually represents the relationships identified through structural model analysis regarding the influences shaping sedentary behavior and psychomotor development in early childhood:



Picture 2 Result of Path Coefficient Model Calculation

These tables summarize the key findings in a structured format to facilitate understanding and interpretation of the data:

Table 2 Summary of Path Coefficients and Their Statistical Significance

Predictor	Outcome	Path Coefficient	Standard Deviation	T-Statistics	P-Value
Educators' Digital Literacy	Sedentary Behavior	-0.273	0.053	5.134	<0.001
Parent's Digital Behavior	Sedentary Behavior	0.141	0.048	2.932	0.004
Parental Involvement	Sedentary Behavior	0.103	0.050	2.058	0.040
Physical Activity Levels	Sedentary Behavior	-0.316	0.059	5.333	<0.001
Sedentary Behavior	Motor Coordination	-0.552	0.032	17.067	<0.001
Sedentary Behavior	Psychological Development	-0.545	0.033	16.356	<0.001

The following table summarizes the total effects of the predictors on the outcomes, incorporating both direct and indirect effects. This comprehensive view

highlights how each predictor variable influences the dependent variables, providing a clearer understanding of the interconnected relationships within the study. These total effects underscore the significance of the predictors in shaping both motor coordination and psychological development outcomes through their impact on sedentary behavior.

Table 3 Summary of Total Effects

Predictor	Outcome	Total Effect	Standard Deviation	T-Statistics	P-Value
Educators' Digital Literacy	Motor Coordination	0.151	0.032	4.769	<0.001
Educators' Digital Literacy	Psychological Development	0.149	0.031	4.854	<0.001
Parent's Digital Behavior	Motor Coordination	-0.078	0.027	2.85	0.005
Parent's Digital Behavior	Psychological Development	-0.077	0.027	2.857	0.004
Parental Involvement	Motor Coordination	-0.057	0.028	2.012	0.045
Parental Involvement	Psychological Development	-0.056	0.028	2.003	0.046
Physical Activity Levels	Motor Coordination	0.174	0.035	5.011	<0.001
Physical Activity Levels	Psychological Development	0.172	0.036	4.774	<0.001

The structural model analysis revealed significant predictors affecting sedentary behavior among early childhood students. Educators' Digital Literacy exhibited a strong negative influence on Sedentary Behavior, with a path coefficient of -0.273, suggesting that higher digital literacy among educators correlates with less sedentary behavior in children. This finding aligns with the hypothesis that more digitally literate educators implement activities that engage children more dynamically, thus reducing sedentary periods.

Furthermore, Parental Involvement and Parent's Digital Behavior also impacted Sedentary Behavior, albeit with lesser magnitudes indicated by path coefficients of 0.103 and 0.141, respectively. These effects underscore the role parents play in shaping their children's activity levels through both direct engagement and modeling digital behavior.

Physical Activity Levels significantly countered Sedentary Behavior with a path coefficient of -0.316. This underscores the critical role of physical activity in mitigating sedentary lifestyles among young children, suggesting that interventions aiming to increase physical activity could effectively reduce sedentary time.

Sedentary Behavior's influence on Psychomotor Development was notably significant, negatively affecting both Motor Coordination and Psychological Development with path coefficients of -0.552 and -0.545, respectively. This result indicates the profound impact of sedentary behavior on children's overall development, particularly in areas crucial for early learning and psychological well-being.

The following table presents the hypotheses testing results, providing a detailed evaluation of the proposed relationships between variables. This table highlights which hypotheses were supported by the data, demonstrating the statistical significance and strength of each relationship within the research model.

Table 1 Hypotheses Testing

No.	Hypotheses	Path Coefficient (β)	T Statistics	P Values	Conclusion
H1	Educators' Digital Literacy -> Sedentary Behavior	-0.273	5.134	< 0.001	Supported
H2	Parent's Digital Behavior -> Sedentary Behavior	0.141	2.932	0.004	Supported
H3	Parental Involvement -> Sedentary Behavior	0.103	2.058	0.04	Supported
H4	Physical Activity Levels -> Sedentary Behavior	-0.316	5.333	< 0.001	Supported
H5	Sedentary Behavior -> Motor Coordination	-0.552	17.067	< 0.001	Supported
H6	Sedentary Behavior -> Psychological Development	-0.545	16.356	< 0.001	Supported
H7	Educators' Digital Literacy -> Sedentary Behavior -> Motor Coordination	0.151	4.769	< 0.001	Supported
H8	Educators' Digital Literacy -> Sedentary Behavior -> Psychological Development	0.149	4.854	< 0.001	Supported
H9	Parent's Digital Behavior -> Sedentary Behavior -> Motor Coordination	-0.078	2.85	0.005	Supported
H10	Parent's Digital Behavior -> Sedentary Behavior -> Psychological Development	-0.077	2.857	0.004	Supported
H11	Parental Involvement -> Sedentary Behavior -> Motor Coordination	-0.057	2.012	0.045	Supported
H12	Parental Involvement -> Sedentary Behavior -> Psychological Development	-0.056	2.003	0.046	Supported
H13	Physical Activity Levels -> Sedentary Behavior -> Motor Coordination	0.174	5.011	< 0.001	Supported
H14	Physical Activity Levels -> Sedentary Behavior -> Psychological Development	0.172	4.774	< 0.001	Supported

In summary, the results underscore the interplay between educator practices, parental behaviors, and child activities, all contributing to sedentary behaviors and their impact on psychomotor outcomes. The statistical validation of

these relationships provided clear evidence supporting the research hypotheses, with all models showing good fit and reliability measures meeting the acceptable thresholds.

DISCUSSION

The findings of this study highlight the critical role of educators' digital literacy and physical activity in mitigating sedentary behavior among young children. The negative impact of educators' digital literacy on sedentary behavior aligns with previous research by Ali et al. (2018), which underscores the importance of play-based learning and active engagement in reducing sedentary tendencies. Additionally, the significant negative effect of physical activity on sedentary behavior corroborates the work of Jones et al. (2013), who found that increased physical activity levels are crucial in maintaining lower sedentary behavior in children. This is further supported by the World Health Organization's guidelines on physical activity and sedentary behavior, emphasizing the need for regular physical activity to promote overall health and well-being in children.

On the other hand, the positive relationship between parents' digital behavior and sedentary behavior in children suggests that children are more likely to engage in sedentary activities when their parents frequently use digital devices. This finding is consistent with the research by Ishariani and Ludyanti (2020), indicating that parental behavior significantly influences children's activity patterns. Moreover, the study reveals that higher parental involvement is associated with increased sedentary behavior. This paradoxical finding may be explained by the nature of the involvement, where highly involved parents might engage children in more structured, less physically active pursuits. This aligns with the findings of Ludyanti and Ishariani (2020), who observed that parent coaching could sometimes inadvertently lead to more screen-based activities.

The direct negative impact of sedentary behavior on motor coordination and psychological development is a critical finding. It aligns with the study by Yu et al. (2021), which highlighted the adverse effects of sedentary lifestyles on children's motor skills and overall development. The negative impact on psychological development also supports the research by Tammelin (2018), who found that sedentary behavior is associated with poorer cognitive and emotional outcomes in children. The study emphasizes the importance of enhancing educators' digital literacy and promoting physical activity to reduce sedentary behavior in children. It also highlights the need for balanced parental involvement that encourages active, rather than sedentary, engagement. These findings have significant implications for educational policies and parental practices, aiming to foster healthier developmental outcomes in young children.

CONCLUSION

Based on the findings of this study, it can be concluded that educators' digital literacy, parental digital behavior, parental involvement, and physical activity levels significantly influence sedentary behavior among young children. Specifically, educators' digital literacy and physical activity levels negatively impact sedentary behavior, while parental digital behavior and parental involvement have a positive effect. Furthermore, sedentary behavior was found to negatively affect both motor coordination and psychological development. These results highlight the importance of promoting physical activity and digital literacy among educators, as well as encouraging positive digital behavior and active involvement from parents, to mitigate sedentary behavior and support the overall psychomotor development of young children.

Conflict of Interest

The authors declare that there are no competing interests associated with this manuscript.

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