The Buffering Effect of Caregiver Education on Early Childhood Development in Low-Income Households: Evidence from Indonesia

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Article

The Buffering Effect of Caregiver Education on Early Childhood Development in Low-Income Households: Evidence from Indonesia

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Highlights

What are the main findings?

A family's financial resources and a caregiver's educational background independently shape the physical setup of the home environment, with neither fully replacing the other.

For actual early childhood developmental milestones, higher caregiver education acts as a critical buffer, actively shielding young children from the negative impacts of severe poverty.

What are the implications of the main findings?

Addressing early childhood adversity requires treating financial capital and human capital differently: money secures necessary physical assets, while educated caregiving drives crucial cognitive and psychological growth.

Large-scale financial interventions, such as conditional cash transfer programs, will likely fail to maximize child development unless they are directly paired with community-based parenting education.

Abstract

Background/Objectives: Household poverty is a known risk factor for early childhood development. However, the extent to which caregiver education can mitigate these risks remains underexplored in Southeast Asian contexts. This study investigates whether caregiver educational attainment buffers the negative impact of low household income on child-rearing environments and early developmental outcomes in Indonesia. **Methods**: This study utilized cross-sectional data from Indonesian caregivers. To maximize statistical power, analyses of the home environment (Index of Child Care Environment) full sample (N = 933). Analyses of developmental outcomes (Early Childhood Development Index) were restricted to the validated age cohort of 3- and 4-year-old children (N = 355). General Linear Models (GLM) were conducted, controlling for child age and sex. **Results**: For the home environment, both household income ($p = .042$) and caregiver education ($p = .021$) were independent, significant predictors, with no significant interaction. However, for actual developmental outcomes, a highly significant interaction between income and education emerged ($p < .001$). **Conclusions**: While education and income independently improve the home environment, caregiver education acts as a robust protective buffer for actual child development, mitigating the risks typically associated with low-income households. Interventions targeting socioeconomic disparities should prioritize parenting and caregiver education.

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1. Introduction

The intersection of domestic poverty and early childhood development presents a significant challenge in global public health and developmental science. Millions of children in low- and middle-income countries (LMICs) are at risk of not reaching their developmental potential due to systemic material deprivation. The early years of life are characterized by rapid neurobiological and psychological maturation, establishing developmental trajectories that often persist into adulthood [1,2]. During this critical period, poverty acts as a pervasive environmental stressor, compromising both the physical resources within a household and the quality of the caregiving environment [3,4].

The Nurturing Care Framework and the Bioecological Model of Human Development are two theoretical frameworks that emphasize the significance of continuous, reciprocal interactions between children and their primary caregivers [5,6]. These proximal processes are heavily influenced by the psychosocial and material resources available to the family. For example, in Southeast Asia, especially Indonesia, the economy has grown quickly, but there are big differences in income. This makes many young children more vulnerable to the negative effects of poverty on their development [7].

Growing evidence shows that the education level of caregivers is a strong factor in child development, often working through ways that are different from just having money [8,9]. Higher levels of education for mothers and fathers are consistently linked to better language input, more responsive parenting, and more resources being spent on raising children. However, the specific capacity of caregiver education to buffer—or actively mitigate—the deleterious effect of low income remains fiercely debated, particularly in LMICs. Research involving Western, educated, industrialized, affluent, and democratic populations suggests that education may bolster resilience to economic shocks [10,11]. However, it remains uncertain whether these buffering effects are consistently applicable across various developmental domains in rapidly urbanizing and geographically diverse countries such as Indonesia.

A significant deficiency in the current literature is the recurrent conflation of the structural home environment with actual developmental outcomes. Although studies recognize that socioeconomic constraints restrict material investments, few elucidate the interaction between human capital (caregiver education) and financial capital (household income) in independently influencing proximal caregiving indices and distal developmental milestones [12,13]. The present investigation addresses these empirical gaps by evaluating the interactive and independent pathways through which household income and caregiver education influence the home caregiving environment and early developmental outcomes among families with preschool-aged children in Indonesia.

2. Materials and Methods

2.1. Study Design and Participants

This study represents a secondary analysis of a primary cross-sectional dataset originally collected to examine geographic variations in Indonesian child-rearing environments [14]. Rather than focusing on geographic location, the present study repurposes the data to track socioeconomic gradients. We shifted the analytical focus to treat household income and caregiver educational attainment as the core predictors.

We sampled participants from three distinct Indonesian settings with varying socioeconomic profiles: an urban environment (J city), a suburban area (D city), and a rural region (G Regency). By distributing self-administered questionnaires through local kindergartens and public health centers, we effectively engaged the community and maximized participant reach. All study procedures

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received approval from the institutional review board, and written informed consent was secured from all participants before their enrollment.

2.2. Measurement

To assess the quality of the home environment, we used the Index of Child Care Environment (ICCE). Parents complete this 13-item questionnaire by answering multiple-choice questions across four specific areas: The *Human Stimulation* subscale (5 items) captures the frequency of direct, reciprocal caregiver-child interactions, such as shared reading, face-to-face play, singing, and eating meals together. The *Social Stimulation* subscale (3 items) gauges the child's exposure to external environments and social networks, including park visits, shopping trips, and interactions with similar-aged peers. To evaluate parenting style and disciplinary practices, the *Avoidance of Restriction* subscale (2 items) assesses the caregiver's response to purposeful misbehavior (e.g., spilling milk) and their recent use of physical discipline. Finally, the *Social Support* domain (3 items) examines the caregiver's practical and psychosocial safety net by measuring their access to alternative childcare assistance and opportunities to discuss child-rearing with a spouse or external confidants. We scored the responses using the standard ICCE manual guidelines. By summing the values of all 13 items, we calculated a final score ranging from 0 to 13. In this scoring system, a higher score indicates a more supportive home-rearing setting.

We measured developmental outcomes using the Early Childhood Development Index (ECDI), a 10-item tool created by UNICEF specifically for three- and four-year-olds. The questionnaire asks parents to report on their child's milestones. These 10 questions comprehensively cover four key areas of early growth: language and cognitive development, physical well-being, social-emotional development, and approaches to learning.

To maximize statistical power when examining predictors of the child-rearing environment, analyses involving the Index of Child Care Environment (ICCE) utilized the full study sample (N = 933). However, because the Early Childhood Development Index (ECDI) is specifically validated as a clinical screening tool for children aged 36 to 59 months [13], all developmental outcome analyses were rigorously restricted to the sub-sample of 3- and 4-year-old children (N = 355).

2.3. Statistical Analysis

Univariate General Linear Models (GLM) were used to assess the main and interactive effects of household income (categorized into low, middle, and high brackets) and caregiver education (less than high school, high school, and post-secondary) on two continuous dependent variables: the total ICCE score and the overall ECDI score. To ensure the robustness of the statistical models, child age (continuous) and child sex (categorical) were included as covariates in all analyses. A full factorial specification was utilized to calculate the *Income* × *Caregiver Education* interaction term, serving as the primary metric for the hypothesized educational buffering effect. Statistical significance was established at $p < .05$.

3. Results

Table 1 presents the sociodemographic characteristics of both the full study sample (N = 933) and the subset restricted to 3- and 4-year-old children (N = 355). In the full sample, the sex distribution was roughly equal, comprising 50.2% girls and 49.8% boys. The majority of children were 5 years old (47.6%), followed by 4-year-olds (29.4%). Regarding socioeconomic status, a significant portion of households fell into either the low-income (40.9%) or high-income (42.2%) brackets, with only 16.8% classified as middle-income. Caregiver educational attainment was predominantly at the high school level (50.9%), while 35.2% had completed post-secondary education, and 13.9% had not finished high school. The restricted subset of 3- and 4-year-olds maintained a highly comparable demographic profile across child sex, household income, and caregiver education levels, ensuring that the subsample remained representative of the broader socioeconomic distribution.

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Table 1. Sociodemographic characteristics of the full sample and the 3–4-year-old subset.

Characteristic	Full Sample (N = 933)		Subset (N = 355)	
	n	%	n	%
Child Sex				
Girl	468	50.2	191	53.8
Boy	465	49.8	164	46.2
Child Age				
3 years old	81	8.7	81	22.8
4 years old	274	29.4	274	77.2
5 years old	444	47.6	-	-
6 years old	134	14.4	-	-
Household Monthly Income (IDR)				
Low (< 3,000,000)	382	40.9	147	41.4
Middle (3,000,000 – 4,500,000)	157	16.8	56	15.8
High (> 4,500,000)	394	42.2	152	42.8
Caregiver Education Level				
Less than High School	130	13.9	40	11.3
High School	475	50.9	167	47
More than High School	328	35.2	148	41.7

Table 2. General Linear Model (GLM) results testing the main and interaction effects of socioeconomic factors on the child-rearing environment and early childhood development.

Predictor	Child-Rearing Environment		Early Childhood Development	
	F*	p-value	F*	p-value
Child Sex (Covariate)	0.006	.937	7.555	.006 **
Child Age (Covariate)	0.513	.474	10.800	.001 **
Household Income	3.192	.042 *	5.335	.005 **
Caregiver Education	3.877	.021 *	8.728	< .001 *
Income × Education	0.994	.410	5.066	< .001 *

Notes: ICCE = Index of Child Care Environment (Full Sample, $N = 933$; error $df = 922$). ECDI = Early Childhood Development Index (Subset aged 3–4 years, $N = 355$; error $df = 344$). * $p < .05$. ** $p < .01$. *** $p < .001$.

A univariate General Linear Model (GLM) was conducted to examine the main effects and interaction of household income and caregiver education on the quality of the child-rearing environment (Total ICCE Score), while controlling for child age and child sex. The covariates of child sex, $F(1, 922) = 0.006$, $p = .937$, and child age, $F(1, 922) = 0.513$, $p = .474$, did not significantly influence the child-rearing environment. After accounting for these covariates, the model revealed a statistically significant main effect of household income on the home environment, $F(2, 922) = 3.192$, $p = .042$. Additionally, there was a significant main effect of caregiver education, $F(2, 922) = 3.877$, $p = .021$. The interaction effect between household income and caregiver education was not statistically significant, $F(4, 922) = 0.994$, $p = .410$. These findings indicate that while both financial resources and caregiver educational attainment independently contribute to higher-quality child-rearing environments, education universally benefits the home environment across all income brackets rather than acting exclusively as a buffer.

Another univariate General Linear Model (GLM) was used to assess the impact of socioeconomic variables on early childhood development (ECDI), restricted to the target cohort of children aged 3 and 4 years ($N = 355$). The model controlled for child sex and child age. Both covariates were statistically significant predictors of development: child sex, $F(1, 344) = 7.555$, $p = .006$, and child age, $F(1, 344) = 10.800$, $p = .001$. After accounting for these covariates, the model revealed a highly significant main effect of household income on child development, $F(2, 344) = 5.335$, $p = .005$.

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Furthermore, there was a highly significant main effect of caregiver education, $F(2, 344) = 8.728$, $p < .001$. Most importantly, a highly significant interaction was found between household income and caregiver education on developmental outcomes, $F(4, 344) = 5.066$, $p < .001$. This robust interaction demonstrates a profound educational buffering effect during the critical 3- to 4-year-old developmental window; the protective influence of a caregiver's advanced education significantly mitigates the developmental risks typically associated with low-income households.

4. Discussion

The current investigation elucidates the nuanced pathways through which socioeconomic status shapes early childhood in Indonesia, revealing a pronounced divergence in how financial and educational capital influence the home environment versus child developmental milestones.

The results of this study show that poverty and education shape early childhood in Indonesia through very different pathways. Financial capital and educational capital do not always do the same job. When we looked at the broad child-rearing environment using the ICCE, income and caregiver education both mattered, but they did not interact. This means that money and education are parallel, additive paths to a better home environment. They do not replace each other. Higher income makes it easier to buy toys, secure safe spaces, and take children on outings. At the same time, educated caregivers naturally improve the home by setting routines and avoiding physical punishment [15]. Because the ICCE measures both things you buy and things you do, education cannot completely cover up a lack of money. A family needs financial resources to buy materials and educational knowledge to interact well. Both are strictly necessary to maximize the physical home environment.

However, the story changed completely when we looked at the children's actual developmental milestones. In our 3- and 4-year-old cohort, we found a highly significant interaction between income and caregiver education. This provides strong proof for the educational buffering hypothesis. Poverty typically impairs a child's cognitive and social development. Yet, having a highly educated primary caregiver significantly erased that risk. This buffering effect likely occurs because educated caregivers possess the instructional capital necessary to optimize limited physical resources through high-quality relational interactions [3]. For example, while a low-income household may lack access to diverse children's literature or structured early education centers, a highly educated caregiver often compensates by engaging in what developmental scientists term "serve-and-return" interactions. These caregivers tend to use a wider range of words, ask open-ended questions, and give complex verbal scaffolding during boring daily tasks [4,5]. These free, intensive psychosocial interactions are very good for the brain, making sure that the developing brain gets the stimulation it needs to reach important milestones, even though poverty makes it hard to get things.

The current findings show a nuanced, bifurcated pathway through which socioeconomic variables affect early childhood trajectories in Indonesia. A key finding is that household income and caregiver education serve as independent, additive predictors for the home caregiving environment, while they interactively influence actual developmental outcomes. These distinct mechanisms highlight the complexity of early childhood ecosystems and contest singular models of poverty and child development.

For the structural home environment, the absence of an interaction effect indicates that financial constraints and educational capital independently restrict or enhance a family's ability to create an enriched setting. This corresponds with the Family Investment Model, which asserts that raw financial resources directly influence the acquisition of developmental assets, such as books, toys, and nutritious food, regardless of parental education [16,17]. Educating caregivers about child development and structuring daily routines in a certain way can also improve the quality of the environment [18]. In Indonesia, where material resources are not evenly distributed based on geography and socioeconomic status, educated caregivers may prioritize developmental investments even though they don't have a lot of money to spend.

Conversely, the highly significant interaction between income and education on developmental outcomes provides compelling evidence for a buffering effect. In low-income households, higher

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caregiver education actively safeguarded children from the adverse developmental effects commonly linked to material deprivation. This finding enhances resilience theories by indicating that the neurobiological and cognitive impacts of poverty can be alleviated through high-quality, responsive caregiving [4].In settings with limited resources, educated caregivers may demonstrate unquantified compensatory behaviors, including the use of sophisticated vocabulary, increased reciprocal vocalizations, and the adoption of superior coping strategies that protect the child from detrimental family stress [10]. Also, in Indonesia's decentralized healthcare and community system, caregivers who are more educated may have the health literacy they need to find and use local resources like Posyandu (integrated village health posts) and Bina Keluarga Balita (family toddler groups) in a way that helps them make up for any money they are missing. These findings offer a critical advancement to the literature by demonstrating that the protective mechanisms of caregiver education are outcome-specific. [19,20].

These findings offer a critical advancement to the literature by demonstrating that the protective mechanisms of caregiver education are remarkably outcome-specific. While financial poverty universally restricts material investments in the home, maternal and paternal education acts as a robust psychological and cognitive scaffold for the child [19]. To understand why this divergence occurs, we have to look closely at what education actually changes within daily household dynamics. It is not necessarily about having the financial means to alter the physical environment; rather, it is about how educated caregivers utilize themselves as the primary developmental tool.

On a cognitive level, this scaffolding takes place through the quality and complexity of daily interactions. Even without specialized educational toys or books, a caregiver with a higher level of education is more inclined to participate in frequent, high-quality "serve and return" interactions [21]. They typically utilize a richer, more diverse vocabulary, employ intricate syntax, and pose open-ended questions during routine activities such as cooking or bathing [22]. In resource-constrained Indonesian households, this means the caregiver's own linguistic and cognitive behaviors effectively substitute for purchased materials, directly stimulating the neural networks responsible for language and executive function [23].

Education not only stimulates cognitive development but also empowers caregivers to function as crucial psychological buffers against the physiological effects of poverty. Chronic economic hardship inherently induces stress, and if unaddressed, this "toxic stress" disrupts a child's developing hypothalamic-pituitary-adrenal axis, resulting in enduring cognitive and emotional deficits [4,24]. Nevertheless, educated caregivers typically exhibit enhanced executive functioning and superior emotional regulation strategies, enabling them to serve as emotional shock absorbers. By sustaining responsive, nurturing, and consistent parenting despite significant financial anxiety, they mitigate the risk of their economic distress manifesting in harsh or withdrawn caregiving [25].

This dual mechanism of cognitive stimulation and stress buffering perfectly explains the split we see in the data. Modifying the structural home environment demands actual financial capital. No amount of parental education can spontaneously generate physical resources. But shaping a child's developmental trajectory ultimately relies on the quality of human interaction. By proving that caregiver education actively mitigates the impacts of low income on actual child outcomes but not on the physical environment, this study forces a necessary decoupling of these concepts in early childhood research. We can no longer think of "the home environment" as one big thing; we need to understand that human capital and financial capital are two very different things that help kids be strong in early childhood.

This study has several strong points, including a large sample size and the use of validated assessment tools. We also strictly limited the developmental analysis to 3- and 4-year-olds. This prevented the scoring errors that often happen when researchers use the ECDI on younger toddlers. However, because the data is cross-sectional, we cannot prove cause and effect. We also relied on caregivers to report on their own environments and their children's milestones. This can lead to biased answers, especially regarding sensitive topics like harsh discipline. Future studies should

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follow children over time to see if this educational buffering helps them succeed once they start formal schooling.

5. Conclusions

Finding a strong educational buffering effect gives us clear directions for public health policy in LMICs. If we want to break the cycle of poverty, interventions have to increase caregiver knowledge at the same time. We need to integrate basic parenting education into local community health posts (Posyandu). Programs that teach parents how to use low-cost, high-impact stimulation are highly scalable and deeply effective [5]. Teaching caregivers how to interact with their children offers a permanent, sustainable way to protect early brain development against the harsh realities of poverty.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee, Institute of Medicine of the University of Tsukuba (No. 1999; Date of approval: 2024/8/1) and the Health Research Ethics Committee UPNVJ, Indonesia (No. 301/VI/2023/KEPK; Date of approval: 2023/6/22).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent was obtained from the parents or legal guardians of all participants prior to data collection and publication of the results.:.

Data Availability Statement: The datasets generated and/or analyzed during the current study are not publicly available due to privacy and ethical restrictions.

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Abbreviations

The following abbreviations are used in this manuscript:

ICCE	Index of Child Care Environment
ECDI	Early Childhood Development Index

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