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ORIGINAL RESEARCH

The Relations Between Caregiver Education, Home Stimulation, and Children's Developmental Outcomes: Research in Majority World Countries

Hang (Heather) Do[1] · **Dana C. McCoy**[2]

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Abstract

Caregiver education and home stimulation have shown positive associations with children's developmental outcomes in early childhood in high-income "Minority World" countries, and these processes also predict children's long-term health and well-being. However, relatively little is known about these processes in low- and middle-income "Majority World" countries, where an estimated 250 million children under the age of five are at risk of not reaching their developmental potential. This paper attempts to address these gaps in knowledge by exploring the relations between caregiver education, household stimulation, and early childhood development in a sample of infants and toddlers aged birth to three using data on 9,099 caregiver-child dyads from eight under-represented Majority World sites: Brazil, Guatemala, India, Jordan, Lebanon, Pakistan, the Philippines, and Zambia. It also explored the differences in these developmental processes between children's sex and geographical regions. Results showed that home stimulation partially mediated the associations between caregiver education and children's developmental outcomes across eight sites. These developmental processes differed by geographical regions and by children's sex. In sum, these findings contribute to the field's understanding of the universality and specificity of child development across settings and child characteristics. They also suggest the importance of supporting caregiver education and home stimulation activities as means of promoting children's developmental outcomes, as well as the need to promote gender equity in the Majority World to ensure equal access to learning opportunities, especially opportunities in the home.

✉ Hang (Heather) Do
htdo@upenn.edu

[1] University of Pennsylvania Graduate School of Education, 3700 Walnut Street, Philadelphia, PA 19104, USA

[2] Harvard Graduate School of Education, 704 Larsen Hall, 14 Appian Way, Cambridge, MA 02138, USA

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Résumé
L'éducation des soignants et la stimulation à domicile ont montré des associations positives avec les résultats de développement des enfants en bas âge dans les pays à revenu élevé du « Monde Minoritaire », et ces processus prédisent également la santé et le bien-être à long terme des enfants. Cependant, on sait relativement peu de choses sur ces processus dans les pays à revenu faible et intermédiaire du « Monde Majoritaire », où environ 250 millions d'enfants de moins de cinq ans risquent de ne pas atteindre leur potentiel de développement. Cet article tente de combler ces lacunes de connaissances en explorant les relations entre l'éducation des soignants, la stimulation domestique et le développement précoce de l'enfant dans un échantillon de nourrissons et de jeunes enfants âgés de la naissance à trois ans, en utilisant des données sur 9099 dyades soignant-enfant provenant de huit sites sous-représentés du Monde Majoritaire : Brésil, Guatemala, Inde, Jordanie, Liban, Pakistan, Philippines et Zambie. Il a également exploré les différences dans ces processus de développement selon le sexe des enfants et les régions géographiques. Les résultats ont montré que la stimulation à domicile médiatisait partiellement les associations entre l'éducation des soignants et les résultats de développement des enfants dans les huit sites. Ces processus de développement différaient selon les régions géographiques et le sexe des enfants. En résumé, ces résultats contribuent à la compréhension de l'universalité et de la spécificité du développement de l'enfant à travers les contextes et les caractéristiques des enfants. Ils suggèrent également l'importance de soutenir l'éducation des soignants et les activités de stimulation à domicile comme moyens de promouvoir les résultats de développement des enfants, ainsi que la nécessité de promouvoir l'équité des genres dans le Monde Majoritaire pour garantir un accès égal aux opportunités d'apprentissage, notamment les opportunités à domicile.

Resumen
La educación de los cuidadores y la estimulación en el hogar han mostrado asociaciones positivas con los resultados del desarrollo infantil en la primera infancia en los países de altos ingresos del "Mundo Minoritario", y estos procesos también predicen la salud y el bienestar a largo plazo de los niños. Sin embargo, se sabe relativamente poco sobre estos procesos en los países de ingresos bajos y medianos del "Mundo Mayoritario", donde se estima que 250 millones de niños menores de cinco años están en riesgo de no alcanzar su potencial de desarrollo. Este artículo intenta abordar estas lagunas de conocimiento al explorar las relaciones entre la educación de los cuidadores, la estimulación del hogar y el desarrollo en la primera infancia en una muestra de bebés y niños pequeños de cero a tres años, utilizando datos de 9,099 díadas cuidador-niño de ocho sitios subrepresentados del Mundo Mayoritario: Brasil, Guatemala, India, Jordania, Líbano, Pakistán, Filipinas y Zambia. También se exploraron las diferencias en estos procesos de desarrollo según el sexo de los niños y las regiones geográficas. Los resultados mostraron que la estimulación en el hogar mediaba parcialmente las asociaciones entre la educación de los cuidadores y

los resultados del desarrollo infantil en los ocho sitios. Estos procesos de desarrollo diferían según las regiones geográficas y el sexo de los niños. En resumen, estos hallazgos contribuyen a la comprensión de la universalidad y especificidad del desarrollo infantil en diferentes contextos y características infantiles. También sugieren la importancia de apoyar la educación de los cuidadores y las actividades de estimulación en el hogar como medios para promover los resultados del desarrollo infantil, así como la necesidad de promover la equidad de género en el Mundo Mayoritario para garantizar un acceso equitativo a las oportunidades de aprendizaje, especialmente las oportunidades en el hogar.

The first three years of life provide an important opportunity for children's future by setting the stage for healthy development across the lifespan (Shonkoff et al., 2012). Theory and research have highlighted the positive effects of close-knit, high-quality interactions and nurturing care on child development and growth (Black et al., 2017; Bronfenbrenner & Morris, 2006); however, most evidence on parenting and early childhood development comes from Western, educated, industrialized, rich, and democratic settings (Draper et al., 2022). Relatively little is known about early childhood development in non-Western, low- and middle-income "Majority World" countries, where an estimated 250 million children under the age of five are at risk of not reaching their developmental potential (Black et al., 2017). Indeed, whereas over 90 percent of children worldwide live in the Majority World, only a small minority of study participants in articles published in child development journals are from these contexts (Moriguchi, 2022; Nielsen et al., 2017).

Caregiver education and home stimulation have been shown to positively predict early childhood development and children's long-term health and well-being (e.g., Choi et al., 2008). However, there is a substantial gap in the literature regarding the role that caregiver education and home-stimulating activities play for children younger than three, as well as whether these processes differ based on some conceptual moderators such as child sex or region of origin. This paper attempts to address these gaps in knowledge by exploring the relations between caregiver education, household stimulation, and early childhood development in a sample of infants and toddlers aged birth to three from 8 sites in the Majority World: Brazil, Guatemala, India, Jordan, Lebanon, Pakistan, the Philippines, and Zambia. Please provide a definition for the significance of bold in the Table 2. Bold numbers indicate significant pairwise comparisons.

Importance of Caregiver Education for Early Childhood Development

Caregiver education is one of the most well-established predictors of children's development. A large body of research has reported that children of more educated caregivers tend to score higher on developmental assessments, achieve better academic outcomes in grade school, and are more likely to attend college (Harding et al., 2015; Sirin, 2005). Importantly, most existing empirical evidence about the

relations between caregiver education and children's development comes from high-income, "Minority World" countries. Less is known about these associations in the Majority World, where children may be at generally greater risk of poor developmental outcomes (Black et al., 2017).

What literature has explored the associations between caregiver education and child outcomes in the Majority World suggests that these processes are, in fact, linked. Research from Peru, India, Ethiopia, Chile, Vietnam, and Pakistan has shown that higher levels of maternal education and household factors are positively linked to a variety of child outcomes, including language skills (Finch et al., 2018), social-emotional skills (Lopez-Boo, 2016), as well as cognitive and motor skills (Black et al., 2016; Fernald et al., 2012). However, important differences in cultures, geographical locations, and beliefs imply that findings about the importance of maternal education may not be universally applicable, even across regions within the Majority World (Morelli et al., 2018). Indeed, the research cited above demonstrates that caregiver education is more strongly linked with early childhood development outcomes in certain contexts than others (Fernald et al., 2012; Lopez Boo, 2016). In particular, Fernald et al. (2012) found growing maternal education-related gaps in children's development in India and Peru, but no comparable associations in India or Senegal. Similar patterns applied to a study examining the role of caregiver education in explaining the relations between household socioeconomic status (SES) and children's cognitive skills in Peru, India, Ethiopia, and Vietnam (Lopez Boo, 2016). Results showed that caregiver education strongly mediated the association between household SES and children's cognitive skills across regions, but these processes also varied based on children's age. Together, these results suggest that additional variability in the relation between caregiver education and children's outcomes is likely across the Majority World.

The Mediating Role of Home Stimulation on Caregiver Education and Child Development

Researchers have explained the association between caregiver education and early childhood development outcomes using several different theoretical models. Perhaps the most popular of these is the Family Investment Model, which suggests that caregivers with higher levels of education may be able to create a richer environment with more physical materials (e.g., books, toys, games) and activities (e.g., reading to children, counting or naming objects, singing songs, etc.) to support their children's development and well-being (Conger & Donnellan, 2007; Cuartas et al., 2020; Frongillo et al., 2017). The Family Investment Model has been very well-studied in the Minority World, where evidence shows children's high academic achievements to be associated with parental involvement and frequent communication (Castro et al., 2015).

However, this model has only been studied recently in the Majority World. A meta-analysis of 21 parental interventions for children under age two in regions

within the Majority World showed a highly consistent relation between parental stimulation and children's cognitive outcomes, followed by language and motor skills (Zhang et al., 2021). Research using Multiple Indicator Cluster Survey (MICS) data examining preschool-age children in the Majority World found that home learning environments mediated the relationships between parental education and a brief measure of children's development (Jeong et al., 2017; Rao et al., 2021). Research using samples from specific regions within the Majority World has confirmed these general patterns, finding home-stimulating activities to at least partially explain the relations between caregiver education and child development (Bornstein et al., 2016; Cuartas, 2022; Telias et al., 2022). Collectively, these studies suggest that the Family Investment Model may be especially important in the Majority World because families in these settings might be more likely to experience physical, psychological, and environmental risk factors that have long-term consequences for early childhood development (Pitchik et al., 2020). However, as with caregiver education in general, additional research is warranted.

Knowledge Gaps in Early Childhood Development Research in the Majority World

Collectively, the above research suggests that caregiver education may be an important predictor of early childhood development in the Majority World, and that this association may be explained in part by differences in caregivers' provision of stimulation. However, research on this topic remains limited in several important ways. First, a lack of validated measures of early childhood development in international contexts has made the collection of data for very young children quite difficult, and therefore less is known about milestone attainment in the first three years (Grantham-McGregor et al., 2007; McCoy et al., 2018). Instruments originally designed for the Minority World settings tend to be both impractical and culturally irrelevant for children in the Majority World, leading to poor psychometric properties when applied in these settings (Fernald et al., 2017). Therefore, contextually relevant and population-level measures are crucial for studying infant and toddler development in Majority World settings (Draper et al., 2022). Indeed, while caregiver education and home stimulation activities have been researched in both the Majority and Minority Worlds—including in large-scale, multi-country studies (e.g., Jeong et al., 2017)—and have been shown to be beneficial for early childhood development, existing studies have largely focused on children above age three. The first years of life are a time when children are especially reliant on their parents to provide stimulation, compared to older children who may have greater access to outside support from community and peer interactions or formal learning contexts (e.g., daycare and preschools; Kim et al., 2023; Shonkoff et al., 2010). Understanding the influences of caregiver education and home-stimulating activities in the Majority World on children's development at early stages could help identify developmental trends in these regions, inform contextually relevant preventative interventions for children and families, and increase strategies and policies to improve early childhood development (Black et al., 2017).

Second, research conducted in the Majority World has largely investigated caregiver education and children's nutrition and physical health, with less consideration of children's broader developmental outcomes (Cuartas, 2022). The present study aims to address this gap by examining children's social-emotional, language, cognitive, and motor skills using a validated and culturally appropriate measure to better understand the role that caregiver education and stimulation play in shaping early childhood outcomes.

Third, previous multi-country studies investigating the mediating role of home stimulation (e.g., Bornstein et al., 2015; Jeong et al., 2017) have looked at relations across the Majority World or, in some cases, across countries grouped by income levels. However, these studies have not examined how these developmental processes vary by geographical regions within the Majority World. Notably, these studies have also called for additional research on the mediating role of home stimulation in sub-regions of the world or different cultural contexts (Jeong et al., 2017). Understanding how these processes operate similarly or differently under the moderation of cultures, contexts, or geographical regions is important for considering potential macrosystemic influences on parenting and child development. This research aims to provide somewhat more granular information on maternal education, maternal stimulation, and early childhood development by focusing on the relations amongst these variables across geographical regions, which supports the identification of similarities and differences in patterns of these frequently researched relationships through different lenses.

Fourth, sex-specific models have not been well-studied in the Majority World. Ingrained cultural perceptions, beliefs, and limited financial and material resources might induce parents in certain areas of the world to treat their children differently based on their sex (Mensah, 2023). Identifying trends in parents' interactions with children based on their child's sex is necessary to understand the differences in developmental trajectories between girls and boys, and to develop and disseminate tailored interventions and educational programs for children and their families. Doing so is even more important for Majority World settings, where research has already documented sex differences in later childhood outcomes, including child labor practices (Bornstein et al., 2016). Although limited, previous research has also shown some differences in the association between caregiver education, home stimulation, and developmental outcomes between boys and girls (Bornstein et al., 2016; Zadeh et al., 2010). While Bornstein et al. (2016) found that home stimulation mediates the relation between caregiver education and physical health in similar ways for boys and girls under age three across 39 Majority World countries, Zadeh et al. (2010) reported that home stimulation for 54-month-olds significantly explained the relation between caregiver education and math achievement in boys, and reading achievement in girls at first grade. However, these previous studies share the same general limitations as noted above—they focus on older children, children's physical and academic outcomes (as opposed to developmental outcomes), and do not probe for regional variation. The present study will test home stimulation as a mediator in the relations between caregiver education and four early childhood development domains to understand the extent to which there may be differences in these

processes across boys and girls, both across the full sample and within geographical regions.

The Present Study

To address some of the previously described gaps and further contribute to the literature on caregiver education and child development, this paper examines the role of home stimulation in explaining the relations between caregivers' (mainly mothers') education and early childhood development outcomes using a sample of children from eight under-represented Majority World sites. The Family Investment Model serves as the theoretical model for this study. Using newly available data about caregiver education and early childhood development from the *Caregiver Reported Early Development Instrument* (CREDI), as well as the home stimulation data as part of the *Family Care Indicators* by UNICEF, this study aims to address four research questions:

1. How do levels of (a) home stimulation and (b) caregiver education predict child development outcomes?
2. How does home stimulation explain the association between caregiver education and young children's motor, cognitive, language, and social-emotional outcomes in the full sample?
3. How do these processes vary by children's sex?
4. How do these processes vary based on specific geographical regions within the Majority World?

Based on the explained conceptual frameworks and limitations of existing research, we hypothesize that (1) higher levels of home stimulation and caregiver education will predict better child development outcomes; (2) home stimulation will mediate the relations between caregiver education and child's social-emotional, language, cognitive, and motor outcomes for the full sample; (3) caregiver education and home stimulation will operate differently for boys' and girls' development; and (4) these processes may vary across different geographical regions within the Majority World.

Methods

Data and Participants

This study is a secondary research based on the database from the *Caregiver-Reported Early Development Instrument* (CREDI). The data used in this study were collected during the pilot phase of the CREDI development process, with assistance and partnership with local sectors and NGOs (McCoy et al., 2018). The analytic

sample of this study consists of 9,099 children aged 0–36 months old from 8 underrepresented Majority World sites: 2,220 in Brazil, 197 in Guatemala, 1,194 in India, 387 in Jordan, 511 in Lebanon, 250 in Pakistan, 1,231 in the Philippines, and 3,109 in Zambia. Although data collected from some sites were predominantly convenience-based, some other sites (i.e., Brazil and Zambia) included samples that were representative of subnational units (i.e., districts or zones) (McCoy et al., 2018; Waldman et al., 2021). Caregivers who participated in the study were the children's primary caregivers or the person who spent the most time caring for the child. Although we did not have information about the caregivers' relationship with the children in this study, it can be assumed that the vast majority of these primary caregivers were mothers.

Compliance with Ethical Standards

This analysis was deemed exempt from human subjects' approval at the Harvard Institutional Review Board (IRB) approval because all data from the database were secondary and de-identified. The data collection and development process of the CREDI was reviewed and approved by the IRB from each site and followed ethical standards in each region. Additionally, all caregivers in this study provided informed consent (Waldman et al., 2021).

Measures

Child Development Outcomes

We used the CREDI to measure children's developmental outcomes. CREDI is a validated, linguistically and culturally neutral, and population-level measure of early childhood development from birth to age three (McCoy et al., 2018). This study used data collected from the CREDI Long Form, which is recommended for research and evaluation projects as it provides more thorough domain-specific scores than the CREDI Short Form (McCoy et al., 2018).

The CREDI Long Form was administered to the caregivers of children ages 0 to 36 months to report whether their children demonstrate a certain set of skills and behaviors in social-emotional, language, cognitive, and motor domains. All items from the CREDI were translated and back-translated from English to the local languages of each site and administered directly to the primary caregiver of the child using a "Yes," "No," and "I don't know" response scale. The CREDI Long Form uses a set of start and stop rules to determine the number of items administered to each child. The assessment began at a given item based on the child's age and proceeded until the caregiver answered "No" or "I don't know" to five consecutive questions. Responses to questions that are negatively worded (e.g., Does the child frequently act impulsively or without thinking (e.g., running into the street without looking)?) were reverse coded (Seiden et al., 2021). The measure has been tested in 17 Majority and Minority World countries – including the 8 sites used in this

analysis—with a multicultural sample, showing moderate to strong criterion validity (correlations with Bayley Scales of Infant and Toddler Development (BSID-III) ranging from r = 0.12 to r = 0.26; and with INTER-NDA ranging from r = 0.16 to r = 0.34) and moderate to high internal consistency in all domains (ranging from α = 0.64 to α = 0.94) (Waldman et al., 2021). It has also shown independent evidence for validity in several individual countries, such as Tanzania, Brazil, China, and India (McCoy et al., 2017; Altafim et al., 2020; Li et al., 2020; Alderman et al., 2020). For this sample, the measure had strong reliability (α = 0.95).

Items in the CREDI Long Form's social-emotional domain focused on children's emotional and behavioral self-regulation, emotional knowledge, and social competence (e.g., Does the child often show affection towards others?). Items in the language domain focused on children's receptive and expressive language skills (e.g., Can the child speak using short sentences of two words that go together?). Items in the cognitive domain assessed children's ability to remember information, solve problems, and acquire basic knowledge (e.g., Can the child identify at least one color (e.g., red, blue, yellow)?). Finally, items in the motor domain measured children's ability to use fine and gross movements to explore the world around them (e.g., Can the child pick up a small object (e.g., a small toy or stone) with just his/her thumb and a finger?). The CREDI Long Form domain and overall scores were calculated using the CREDI scoring app based on multidimensional factor analysis (Waldman et al., 2021). Consistent with the recommendations of the CREDI developers, this study used the CREDI raw score for hypothesis testing (Seiden et al., 2021).

Caregiver Education

In addition to completing the CREDI, caregivers (mainly mothers) were asked to complete a demographics survey, where they selected the highest level of education they had achieved. Responses were grouped into a variable with four categories: 0 (Never went to school), 1 (Some primary school/completed primary school), 2 (Some secondary school/completed secondary school), and 3 (University and Graduate degrees). Education categories were defined for each site using information from the World Bank (2017). Primary education ranges from grades 1 to 6 in Guatemala, Lebanon, and the Philippines; grades 1 to 7 in Zambia; grades 1 to 8 in India; grades 1 to 9 in Brazil and Pakistan; and grades 1 to 10 in Jordan. Secondary education ranges from grades 7 to 12 in Guatemala, Lebanon and the Philippines; grades 8 to 12 in Zambia; grades 9 to 12 for India; grades 10 to 12 in Brazil and Pakistan; and grades 11 and 12 in Jordan. Higher education levels include college and graduate degrees across all sites.

Home Stimulation

Caregivers were also asked to report on their stimulation behaviors using questions from the *Family Care Indicators,* a universally applicable measure that is used in households to assess the household learning environment for children (Kariger et al., 2012; UNICEF, 2020). Caregivers reported whether they engaged in any of the

Table 1 Descriptive statistics of sample characteristics for the full sample and by site

	Total (N = 9099)	Brazil (n = 2220)	Guatemala (n = 192)	India (n = 1194)	Jordan (n = 387)	Lebanon (n = 511)	Pakistan (n = 250)	Philippines (n = 1231)	Zambia (n = 3109)
Caregiver education	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Never went to school	1170 (12.9%)	87 (3.9%)	36 (18.3%)	392 (32.8%)	86 (22.2%)	70 (13.7%)	132 (52.8%)	11 (0.9%)	356 (11.5%)
Some/completed primary	3926 (43.1%)	529 (23.8%)	118 (59.9%)	382 (32.0%)	218 (56.3%)	320 (62.6%)	57 (22.8%)	704 (57.2%)	1598 (51.4%)
Some/completed secondary	2390 (26.3%)	931 (41.9%)	42 (21.3%)	111 (9.3%)	67 (17.3%)	52 (10.2%)	35 (14.0%)	180 (14.6%)	972 (31.3%)
Higher Education	1405 (15.4%)	609 (27.4%)	1 (0.5%)	309 (25.9%)	15 (3.9%)	67 (13.1%)	6 (2.4%)	335 (27.2%)	63 (2%)
Child Sex									
Female	4614 (50.7%)	1177 (53.0%)	91 (46.2%)	586 (49.1%)	192 (49.6%)	244 (47.7%)	128 (51.2%)	607 (49.3%)	1589 (51.1%)
	M (SD)	M (SD)	M (SD)	M **(SD)**	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Child age	18.5 (10.7)	21.0 (9.5)	17.4 (9.9)	27.9 (6.9)	18.4 (10.9)	17.4 (11.4)	18.7 (10.5)	22.3 (8.7)	11.8 (9.1)
Home stimulation	3.5 (2.0)	4.9 (1.3)	3.1 (1.6)	2.1 (1.8)	2.9 (1.4)	3.1 (1.7)	4.5 (1.1)	4.1 (2.4)	2.5 (1.3)
Child development scores									
Social-emotional	49.5 (3.0)	50.8 (1.8)	48.9 (3.0)	51.1 (1.5)	49.4 (3.0)	49.2 (3.1)	49.4 (2.9)	50.7 (2.2)	47.7 (3.2)
Language	50.0 (2.5)	51.0 (1.9)	49.6 (2.6)	51.4 (1.4)	49.8 (2.5)	49.8 (2.8)	49.9 (2.6)	50.7 (2.2)	48.5 (2.5)
Cognitive	49.5 (2.5)	50.7 (1.4)	49.0 (2.6)	50.5 (1.3)	49.3 (2.5)	49.1 (2.7)	49.4 (2.5)	50.4 (1.8)	47.9 (2.9)
Motor	49.4 (3.2)	51.0 (2.1)	48.9 (3.4)	51.1 (1.8)	49.2 (3.2)	49.1 (3.4)	49.2 (3.1)	50.5 (2.3)	47.4 (3.3)

following six stimulating activities with their children in the previous three days: reading books or looking at picture books, telling stories, singing songs, going outside the home, playing, and naming things. A summary score index ranging from 0 (no caregiver engagement in all activities) to 6 (with full caregiver engagement in all activities) was generated. This measure had moderate reliability ($\alpha = 0.78$).

Covariates

Children's age and sex were included as covariates in all models. Children's age was measured in months and sex was coded into a binary variable, (0) for males and (1) for females. This information was collected in the demographics survey distributed to primary caregivers at each site.

Statistical Analysis

Descriptive statistics were generated for key study variables across the full sample and for each site. Before conducting the mediation analysis, we fit separate models for each predictor and outcome to examine the relationships between home stimulation and each child development outcomes, and between caregiver education and each child development outcome (e.g., caregiver education predicting child's social-emotional skills, home stimulation predicting child's social-emotional skills, etc.). Then, to evaluate whether the association between caregiver education and early childhood development outcomes was explained by home stimulation, we used a series of path analyses in a structural equation modeling framework, where caregiver education served as the predictor variable, children's domain-specific development outcomes were used as dependent variables, and home stimulation was the mediator. To understand the statistical significance of the indirect effects, a bootstrapping method was employed to produce 95% bias-corrected confidence intervals (BCCIs) using 1,000 resamples of the data. Indirect effects were determined to be significant if the BCCIs did not contain zero (Preacher & Hayes, 2008). All analyses controlled for children's sex and age.

Next, we used multi-group analysis to understand whether the associations being tested in the full path (i.e., mediation) model varied based on 1) the child's sex in the full sample, 2) the site's geographical region, and 3) the child's sex within each geographical region. We did not conduct multigroup analysis for individual sites due to large variability of sample size in each site, as well as challenges in interpreting pairwise comparisons across eight different sites. Instead, we conducted multigroup analysis for geographical regions as a means to understand how these developmental processes operate differently across locations within the under-researched Majority World. Specifically, consistent with past research (e.g., McCoy et al., 2016), sites were categorized into three geographical regions based on World Bank (2017) classification. Specifically, Brazil and Guatemala were grouped into the Latin America region; India, Pakistan, and the Philippines were grouped into the Asia region; and Jordan, Lebanon, and Zambia were grouped into the Middle East & Africa region. The chi-square difference test was used to determine whether the model

fit differently by group (i.e., boys versus girls; Latin America versus Asia versus Middle East & Africa), and Wald's tests were used to determine path differences between groups (i.e., by sex or geographical region).

Full information maximum likelihood (FIML) was utilized to handle missing data for all analyses. Missing data for key variables were moderate (2.28% for caregiver education, 17.4% for home stimulation, and around 0.50% for all CREDI developmental outcomes). Model fit was evaluated using the following goodness of fit indices: chi square $p > 0.05$; CFI (comparative fit index) > 0.95; TLI (Tucker-Lewis Index) > 0.95; RMSEA (root mean square error of approximation) ≤ 0.05). Standardized coefficients (β) were reported for all models. All analyses were run in R version 4.3.0. (R Core Team, 2021).

Results

Table 1 includes descriptive characteristics of the full sample and each site. Overall, the mean age of children in the full sample was 18.50 months ($SD = 10.70$) with 50.7% of the children being identified as female. Approximately 43.1% of caregivers in the sample completed at least some primary education, and children received a moderate level of home stimulation from their caregivers ($M = 3.5$ of 6 stimulation practice, $SD = 2.0$). Furthermore, children's mean developmental scores all range around 50 ($SD = 2.5$–3.2).

Home Stimulation and Caregiver Education Predicting Children's Developmental Outcomes

Results showed that higher levels of home stimulation and caregiver education predicted significantly higher child development scores in the full sample, controlling for children's age and sex. In particular, the associations were the strongest between home stimulation and children's motor skills (β = 0.304, SE = 0.007, $p < 0.001$) and caregiver education and children's motor skills (β = 0.273, SE = 0.016, $p < 0.001$). Additionally, higher levels of home stimulation predicted higher social-emotional, language, and cognitive scores (β = 0.263, SE = 0.007, $p < 0.001$; β = 0.213, SE = 0.005, $p < 0.001$; β = 0.293, SE = 0.007, $p < 0.001$, respectively). Similarly, higher levels of caregiver education also predicted higher scores in children's social-emotional, language, and cognitive skills (β = 0.224, SE = 0.015, $p < 0.001$; β = 0.209, SE = 0.012, $p < 0.001$; β = 0.251, SE = 0.015, $p < 0.001$, respectively).

The Mediating Role of Home Stimulation in the Relation Between Caregiver Education and Children's Developmental Outcomes

Results of path analysis showed that home stimulation partially mediated the association between caregiver education and children's developmental outcomes, controlling for children's sex and age (Fig. 1). The mediation model had a good fit in the overall sample ($\chi 2 = 297.52$; $p < 0.001$; CFI = 0.997; TLI = 0.968; RMSEA = 0.02).

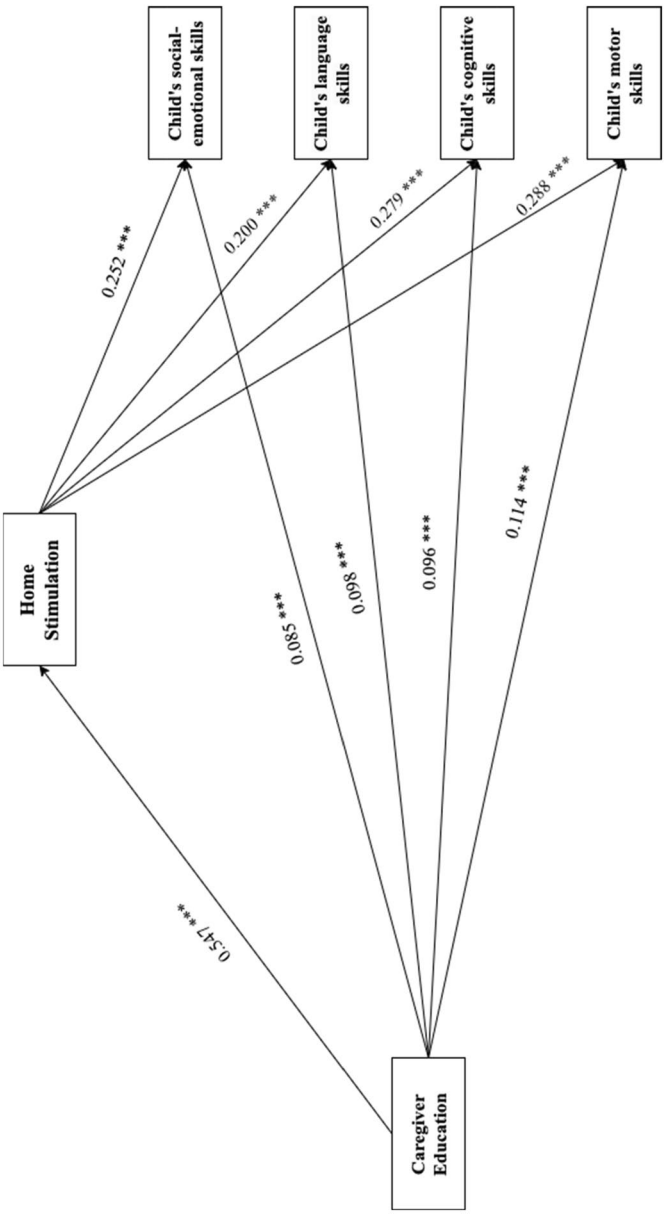

Fig. 1 Results of path analysis in the full sample examining the mediating role of home stimulation in the association between caregiver education and children's developmental domains. *Note*. Analysis controlled for children's sex and age. Indirect effects of home stimulation on caregiver education and child's developmental domains: Social-emotional ($\beta = 0.138$, SE = 0.007, 95% BCCI: 0.125–0.152, $p < 0.001$; $R^2 = 0.829$); Language ($\beta = 0.110$, SE = 0.006, 95% BCCI: 0.099–0.120, $p < 0.001$; $R^2 = 0.847$); Cognitive ($\beta = 0.153$, SE = 0.007, 95% BCCI: 0.138–0.167, $p < 0.001$; $R^2 = 0.757$); Motor ($\beta = 0.157$, SE = 0.008, 95% BCCI: 0.142–0.173, $p < 0.001$; $R^2 = 0.832$). ***$p < 0.001$. All coefficients are standardized

Caregivers with higher levels of education on average provided more home stimulation for their children (β = 0.547, SE = 0.023, $p < 0.001$). Across all sites, children receiving higher home stimulation and whose caregivers had higher educational levels tended to score higher on all CREDI domains. In general, caregiver education and home stimulation were most strongly associated with children's motor skills, compared to other developmental outcomes. Furthermore, we identified significant and positive indirect effects for the association between caregiver education and child social-emotional (β = 0.138, SE = 0.007, 95% BCCI: 0.125–0.152, $p < 0.001$), language (β = 0.110, SE = 0.006, 95% BCCI: 0.099–0.120, $p < 0.001$), cognitive (β = 0.153, SE = 0.007, 95% BCCI: 0.138–0.167, $p < 0.001$), and motor outcomes (β = 0.157, SE = 0.008, 95% BCCI: 0.142–0.173, $p < 0.001$) via home stimulation. These indirect effects tended to account for between 75.7% and 84.7% of the total association between caregiver education and child outcomes.

Comparisons by Child Sex

A chi-square difference comparing a path model in which parameters were freed versus constrained across child sex was found to be statistically significant ($\Delta \chi 2 = 73.35$; $p < 0.001$), suggesting that the mediation model operated differently for boys versus girls. As shown in Fig. 2, home stimulation partially mediated the association between caregiver education and children's developmental outcomes for both boys and girls; however, the relationships between caregiver education and home stimulation was 8.6% stronger for girls than boys, between caregiver education and developmental outcomes were between 0.3 and 0.9% stronger for girls than boys, whereas the associations between home stimulation and developmental outcomes were about 3% to 4% stronger for boys than girls.

Comparisons by Geographical Region

A chi-square difference test also revealed significant differences in model fit by geographical region ($\Delta \chi 2 = 4177.90$; $p < 0.001$; see Table 2). In particular, the relationships between caregiver education and home stimulation were approximately 10.3% stronger for Latin America and 16.6% stronger for Asia than Middle East & Africa, while there was no significant difference between Latin America and Asia. The relationships between caregiver education and children's language, cognitive, and motor skills were approximately 6.8% to 13.8% stronger in Asia relative to both Latin America and Middle East & Africa, whereas the path between caregiver education and children's social-emotional skills was 10.9% stronger for Asia relative to Middle East & Africa only.

In contrast, the relationships between home stimulation and children's developmental outcomes were generally stronger in the Middle East & Africa than in Asia and Latin America. Specifically, paths between home stimulation and social-emotional and cognitive skills were approximately 18% stronger in Middle East & Africa than in Asia, and 7% stronger in Middle East & Africa than Latin America. In

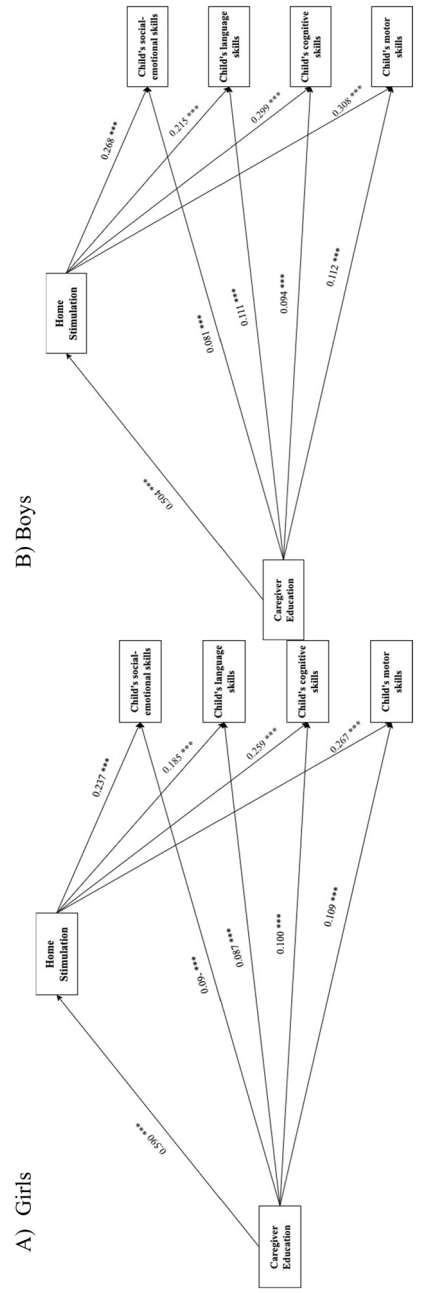

Fig. 2 Results of multigroup analysis examining the mediating role of home stimulation in the association between caregiver education and children's developmental domains among boys and girls. *Note.* Analyses controlled for children's age. Indirect effects of home stimulation on caregiver education and children's developmental domains: **a)** Girls: Social-emotional ($\beta = 0.140$, SE = 0.010, 95% BCCI: 0.121–0.158, $p < 0.001$); Language ($\beta = 0.109$, SE = 0.008, 95% BCCI: 0.094–0.124, $p < 0.001$); Cognitive ($\beta = 0.153$, SE = 0.010, 95% BCCI: 0.133–0.173, $p < 0.001$); Motor ($\beta = 0.158$, SE = 0.011, 95% BCCI: 0.137–0.179, $p < 0.001$). **b)** Boys: Social-emotional ($\beta = 0.135$, SE = 0.010, 95% BCCI: 0.115–0.155, $p < 0.001$); Language ($\beta = 0.108$, SE = 0.008, 95% BCCI: 0.093–0.124, $p < 0.001$); Cognitive ($\beta = 0.151$, SE = 0.011, 95% BCCI: 0.129–0.172, $p < 0.001$); Motor ($\beta = 0.155$, SE = 0.011, 95% BCCI: 0.133–0.177, $p < 0.001$). Chi-square difference test: $\Delta\ \chi 2 = 73.35$; $p < 0.001$. Multiple comparisons examining path differences between Girls vs. Boys: Caregiver education → Home stimulation ($\Delta\beta = 0.086$, $p = 0.045$); Caregiver education → Social-emotional ($\Delta\beta = 0.009$, $p = 0.016$); Caregiver education → Language ($\Delta\beta = -0.024$, $p = 0.321$); Caregiver education → Cognitive ($\Delta\beta = 0.006$, $p = 0.022$); Caregiver education → Motor ($\Delta\beta = 0.003$, $p = 0.025$); Home stimulation → Social-emotional ($\Delta\beta = -0.031$, $p = 0.039$); Home stimulation → Language ($\Delta\beta = -0.030$, $p = 0.006$); Home stimulation → Cognitive ($\Delta\beta = -0.040$, $p = 0.024$); Home stimulation → Motor ($\Delta\beta = -0.041$, $p = 0.025$). ***$p < 0.001$. All coefficients are standardized

Table 2 Multiple comparisons examining path differences among Latin America, Asia, and Middle East & Africa

Path	Comparison	Δβ	χ^2	*p*
Caregiver education → Home Stimulation	Latin America vs. Asia	0.063	1.42	0.233
	Latin America vs. Middle East & Africa	-0.103	4.22	**0.039**
	Asia vs. Middle East & Africa	-0.166	8.79	**0.003**
Caregiver education → Social-emotional skills	Latin America vs. Asia	0.057	3.63	0.056
	Latin America vs. Middle East & Africa	-0.052	2.17	0.140
	Asia vs. Middle East & Africa	-0.109	10.54	**0.001**
Caregiver education → Language skills	Latin America vs. Asia	0.138	21.68	**< 0.001**
	Latin America vs. Middle East & Africa	0.041	1.98	0.160
	Asia vs. Middle East & Africa	-0.097	12.57	**< 0.001**
Caregiver education → Cognitive skills	Latin America vs. Asia	0.098	10.39	**0.001**
	Latin America vs. Middle East & Africa	-0.040	1.25	0.264
	Asia vs. Middle East & Africa	-0.138	16.36	**< 0.001**
Caregiver education → Motor skills	Latin America vs. Asia	0.101	8.74	**0.003**
	Latin America vs. Middle East & Africa	0.004	0.01	0.916
	Asia vs. Middle East & Africa	-0.097	7.37	**0.007**
Home stimulation → Social-emotional skills	Latin America vs. Asia	-0.109	43.56	**< 0.001**
	Latin America vs. Middle East & Africa	0.074	11.94	**< 0.001**
	Asia vs. Middle East & Africa	0.183	95.20	**< 0.001**
Home stimulation → Language skills	Latin America vs. Asia	-0.082	25.47	**< 0.001**
	Latin America vs. Middle East & Africa	-0.020	1.31	0.252
	Asia vs. Middle East & Africa	0.068	17.91	**< 0.001**
Home stimulation → Cognitive skills	Latin America vs. Asia	-0.120	52.26	**< 0.001**
	Latin America vs. Middle East & Africa	0.069	9.88	**0.002**
	Asia vs. Middle East & Africa	0.189	96.17	**< 0.001**
Home stimulation → Motor skills	Latin America vs. Asia	-0.158	69.91	**< 0.001**
	Latin America vs. Middle East & Africa	0.036	2.31	0.129
	Asia vs. Middle East & Africa	0.194	93.14	**< 0.001**

Chi-square difference test: $\Delta\ \chi 2 = 4177.90$; $p < 0.001$

addition, for these two paths, Latin America was about 11% stronger than Asia. On the other hand, for paths between home stimulation and language skills, Asia was roughly 7% weaker than both Middle East & Africa and Latin America. Between

home stimulation and motor skills, Latin America was 15.8% stronger than Asia, and Middle East & Africa was 19.4% stronger than Asia. There were no significant differences between Latin America and Middle East & Africa with these two paths.

Comparisons by Child Sex Within Geographical Regions

A chi-square difference test showed significant differences between boys and girls in Latin America ($\Delta\ \chi2 = 34.781$; $p = 0.002$). The relationships between home stimulation and children's social-emotional, language, cognitive, and motor were 9.6% to 13.4% stronger for girls than boys, respectively. There were no differences in the paths between caregiver education and stimulation, and caregiver education and child outcomes.

Similarly, a chi-square difference test showed significant differences between boys and girls in Asia ($\Delta\ \chi2 = 26.930$; $p = 0.019$). The relationships between caregiver education and home stimulation were 16.4% stronger for boys than girls. However, there were no differences in the paths between caregiver education or home stimulation to child outcomes.

Finally, a chi-square difference test showed that there was an insignificant difference between boys and girls in Middle East & Africa ($\Delta\ \chi2 = 47.223$; $p = 0.076$), suggesting that these relationships are similar between boys and girls.

Discussion

This study explored the relations between caregiver education, household stimulation, and early childhood development outcomes in a sample of infants and toddlers aged birth to three years from 8 diverse sites in the Majority World: Brazil, Guatemala, India, Jordan, Lebanon, Pakistan, the Philippines, and Zambia. Findings showed that home stimulation partially mediated the association between caregiver education and early childhood development outcomes across sites, controlling for children's sex and age. We also found important differences in these processes by sex and geographical region. For example, caregiver education seemed to matter more for girls' developmental outcomes, whereas home stimulation practices mattered more for boys'.

The key finding that caregiver education predicts infants' and toddlers' development via differences in home stimulation was in line with the Family Investment Model, which acknowledges the importance of parental education for supporting parents' ability to invest in their young children's development. Similar to past work, we note a particularly strong association between caregiver processes and children's motor skills (Prado et al., 2017), suggesting that caregiver inputs may be especially useful for supporting children's fine and gross motor movements early in life. Importantly, however, we also find that caregiver education and household stimulation tend to predict lesser-studied developmental outcomes in the Majority World, including children's language and social-emotional development, both of which are especially predictive of later-life well-being (Burchinal et al., 2020; Wolf et al.,

2021). Together, these findings emphasize the consistent role that caregivers play in supporting children's skills across a number of areas, even very early in life.

Furthermore, our findings suggest that these processes operate somewhat differently across geographical regions within the Majority World. Specifically, the multigroup analysis suggested that the relation between caregiver education and home stimulation was strongest in Asia and Latin America, the relations between caregiver education and children's developmental outcomes were strongest in Asia, and the relations between home stimulation and children's developmental outcomes were strongest in the Middle East & Africa and Latin America. Prior work has shown differences in caregivers' levels of stimulation and children's development by region (e.g., Cuartas et al., 2020; McCoy et al., 2016). To our knowledge, this is the first study to suggest that *the relations* between caregiver education, household stimulation, and child outcomes may also vary regionally. Although the magnitudes of these differences were somewhat small, this pattern of findings suggests potential macrosystemic (e.g., cultural) variation in the Family Investment Model. Future research is needed to more carefully explain these differences. In particular, the measure of stimulation used in this study was quite coarse and did not capture culturally specific modes of interaction or activities involving more than one caregiver (Cuartas et al., 2020; Mesman et al., 2018). Research using deeper forms of measurement and qualitative methods would be helpful to generate a better understanding of exactly why these differences may have emerged, complementing the high-level descriptive results presented here (McCoy, 2022).

Our results also suggest that the developmental processes examined in our model may operate differently for boys versus girls. Specifically, we found that home stimulation seemed to matter more for boys' developmental outcomes. Caregiver education, on the other hand, mattered more directly for girls' outcomes, particularly in Latin America. These findings are consistent with previous research on parents' cultural perceptions, beliefs, and resources in the Majority World and with research about differences in developmental outcomes by child's sex. In particular, these prior studies indicate that in diverse cultures within the Majority World, parents often perceive boys as being more active than girls, resulting in greater levels of parent–child interactions for boys (Bornstein et al., 2016; Mensah, 2023). In contrast, educated parents may be more inclined to invest in the education of girls, particularly for their future well-being and to delay young marriages (Weber et al., 2017; Vásquez-Echeverría et al., 2021). These sex differences also varied across geographical regions. Specifically, the relationship between caregiver education and home stimulation was stronger for boys than girls in Asia, and the relationships between caregiver education and children's social-emotional, language, cognitive, and motor skills were stronger for girls than boys in Latin America. These findings suggest that these sex patterns might not be universal, but instead may differ based on cultural norms or other macrosystemic factors related to gender. To date, there has not been much research on gender-based differences in the effects of caregiver education and home stimulation on early childhood development outcomes, especially in the Majority World. Therefore, more research effort is needed to understand these pathways and to further understand the variability of developmental processes by the child's sex across diverse geographical regions within the Majority World.

Limitations and Future Directions

This study has several important limitations. First, our measure of caregiver stimulation consisted of only six questions about general activities, which—as noted above—might have not covered all possible and culturally relevant home stimulation activities across Majority World. The questionnaire also asked only one caregiver who responded to the survey, therefore it did not cover interactions between children and their other family members. Since the items only inquired about whether or not a given activity had been completed in the past three days, this tool also precluded a nuanced understanding of the exact amount or quality of stimulation that children receive on a day-to-day basis. For future directions, we recommend expanding measures of stimulation to capture a wider breadth of behavior, as well as the quality and frequency of these behaviors, using different assessment formats (e.g., direct assessment).

Second, variables regarding other household determinants (e.g., parental depression, number of children in the household, family income, or having a single parent, etc.) could be associated with caregiver education, home stimulation, and early childhood development, either confounding or explaining the relations observed in this study. Future research that controls for a wider range of potential variables and/or uses more rigorous study designs (e.g., with longitudinal or randomized data) could address the major concern regarding selection bias that could threaten the internal validity of our estimates. Furthermore, research including additional mediators (e.g., maternal depression) could help identify alternative or complementary pathways through which maternal education relates to child outcomes.

Third, although the CREDI was specifically administered to the children's primary caregiver, we did not ask caregivers for information about their relationship with the child. While most caregivers in this sample are assumed to be mothers, not having this data prevented us from looking at differences based on mothers', fathers', and other caregivers' education. Future studies should collect detailed information regarding caregivers' relationship to the child.

Fourth, consistent with past work and the Family Investment Model, in this analysis, we treat caregiver education as a predictor of child development outcomes via home stimulation. However, it is possible that caregiver education could inform children's development through other means. Moving forward, it will be helpful to examine the various roles that caregiver education may play in supporting child development, including as a moderator of the relationship between home stimulation and child development outcomes. It will also be important to collect data on children's receipt of stimulation outside of the home, including from the formal childcare and education programs in which children are increasingly spending their time. Indeed, prior work has suggested that center-based early education programs may serve alongside home stimulation to mediate the associations between caregiver education and children's early development outcomes (e.g., McCoy et al., 2015). More work is needed to better understand and compare these different mechanisms across the Majority World.

Finally, while this study was conducted in eight diverse sites, these sites were chosen for the study based on data availability. Accordingly, these data are convenience-based and not representative of the full population of 0- to 3-year-old children in the Majority World. It is therefore important to pay close attention to the sample size, cultural contexts, and caregivers' educational levels, children's age distribution when attempting to generalize these findings across countries and geographical regions. Future efforts to collect and use nationally representative data with a substantial sample size for each site are needed to better understand cultural variability and the differences in developmental processes across the Majority World.

Conclusions and Implications

The results of this study showed that home stimulation partially explained the positive associations between caregiver education and children's developmental outcomes across eight sites in the Majority World. These developmental processes differed slightly across geographical regions and children's sex, providing evidence for the "universality without uniformity" (Mesman et al., 2018) of caregiver inputs on early childhood development across and within the Majority World. Given the consistent positive role played by caregiver education within this study, our results highlight the importance of expanding educational opportunities to caregivers (or future caregivers) as a means of supporting intergenerational well-being. These results also suggest the potential importance of supporting parents—especially those with low levels of education—to improve the home learning environments they provide for their children. For example, systematic reviews in the Majority World suggested that home-visiting intervention programs may be an especially promising means of improving parents' provision of stimulation and, in turn, child outcomes (Jeong et al., 2021). Our results demonstrating differences based on child sex also suggest the need for further interventions to promote gender equity in the Majority World as a means of ensuring equal access to learning opportunities for both boys and girls. Recently, some intervention programs have been implemented to promote gender equity in early childhood education settings (Keating & Baker, 2023; Villardón-Gallego et al., 2023). Given the importance of home stimulation to children's development, such work should be complemented by efforts to promote gender equity in the home.

Declarations

Conflict of interest No funding was received for conducting this study and the authors have no conflict of interests to disclose.

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