

Paternal Stimulation and Early Child Development in Low- and Middle-Income Countries

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abstract

BACKGROUND AND OBJECTIVE: Few studies have examined the relationship between paternal stimulation and children's growth and development, particularly in low- and middle-income countries (LMICs). This study aimed to estimate the prevalence of paternal stimulation and to assess whether paternal stimulation was associated with early child growth and development.

METHODS: Data from the Multiple Indicator Cluster Surveys rounds 4 and 5 were combined across 38 LMICs. The sample comprised 87 286 children aged 3 and 4 years. Paternal stimulation was measured by the number of play and learning activities (up to 6) a father engaged in with his child over the past 3 days. Linear regression models were used to estimate standardized mean differences in height-for-age z-scores and Early Childhood Development Index (ECDI) z-scores across 3 levels of paternal stimulation, after controlling for other caregivers' stimulation and demographic covariates.

RESULTS: A total of 47.8% of fathers did not engage in any stimulation activities, whereas 6.4% of fathers engaged in 5 or 6 stimulation activities. Children whose fathers were moderately engaged in stimulation (1–4 activities) showed ECDI scores that were 0.09 SD (95% confidence interval [CI]: –0.12 to –0.06) lower than children whose fathers were highly engaged; children whose fathers were unengaged showed ECDI scores that were 0.14 SD lower (95% CI: –0.17 to –0.12). Neither moderate paternal stimulation nor lack of paternal stimulation was associated with height-for-age z-scores, relative to high stimulation.

CONCLUSION Increasing paternal engagement in stimulation is likely to improve early child development in LMICs.



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WHAT'S KNOWN ON THIS SUBJECT: The effects of maternal stimulation on early child development (ECD) have been well-documented. Few studies have examined paternal engagement in stimulation in low- and middle-income countries (LMICs); even less is known regarding the influences of paternal stimulation on ECD outcomes.

WHAT THIS STUDY ADDS: This study is one of the first to show that nearly half of fathers in LMICs do not engage in stimulation activities with their children and that lower levels of paternal stimulation are associated with poorer ECD outcomes.

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More than 200 million children <5 years across low- and middle-income countries (LMICs) are estimated to not reach their full developmental potential due to malnutrition, inadequate stimulation, and other risk factors associated with poverty.¹ Parenting interventions have become increasingly prioritized as a key strategy for mitigating such risk factors and increasing children's resilience during early childhood.²⁻⁵ A considerable body of evidence has demonstrated moderate-to-large effect sizes for responsive parenting interventions on various aspects of early child development (ECD), including cognitive and socioemotional development⁶⁻⁹ and early growth and nutrition.¹⁰⁻¹²

The majority of the ECD literature and ECD programing efforts, however, has focused on mothers. Although positive mother-child interactions and secure maternal attachment are important,^{13,14} the strong focus on mother-child dyads has resulted in limited attention to the role of other caregivers, and particularly fathers, in supporting children's development.

Over the past several decades, the role of men in families has evolved because of demographic, socioeconomic, and cultural transitions.¹⁵ For example, greater participation of women in the workforce and large-scale labor migration have resulted in men taking on shared family responsibilities with their female partners, including parenting and engaging in support for their children's healthy development.¹⁵ The importance of paternal involvement on children's wellbeing has been explored mainly in high-income countries.¹⁶ A variety of ways have been discussed, ranging from physically stimulating play¹⁷; decision making about health care and education¹⁵; coparenting with other caregivers to complement, strengthen, or compensate for each

other^{18,19}; and providing financial resources that can in turn improve nutritional care, hygiene, and the overall home environment.^{20,21}

Studies from high-income countries have furthermore demonstrated strong associations between paternal involvement and various areas of development, including improvements in young children's nutrition²⁰; early cognitive²²⁻²⁴ and socio-emotional skills²⁵⁻²⁸; increased language development^{24,29}; reduced child problem behaviors²⁶; and reduced rates of child neglect.³⁰ However, to date, few studies have examined the associations between paternal involvement and ECD in LMICs. Paternal stimulation may be an important protective factor in LMICs where children continue to be exposed to a host of risk factors.

In this paper, we aimed to describe the prevalence of paternal stimulation in LMICs and to understand whether different levels of paternal stimulation are associated with ECD. In particular, we defined paternal stimulation based on a set of cognitively and psychosocially enriching activities. We defined ECD broadly by examining physical growth and a composite index of basic learning, socioemotional, physical, and literacy-numeracy skills. These 2 outcomes were examined separately given the growing evidence that these processes are only mildly correlated.³¹

METHODS

Data

The Multiple Indicator Cluster Survey (MICS) program is a nationally representative and internationally standardized household survey program developed by United Nations Children's Fund that captures information about children in LMICs.³² Beginning with the MICS round 4 (MICS4) in 2010,

the Early Childhood Development Index (ECDI) was introduced to the ECD module of the questionnaire for children under 5. We combined all nationally representative MICS4 and MICS round 5 (MICS5) surveys that included the ECDI and caregiver stimulation questions and were publically available before March 2016. Figure 1 illustrates the geographic coverage of the pooled data set.

Measures

Child Growth and Development

Physical growth and child development were examined separately as 2 related but independent outcome measures of early child wellbeing. Children's heights were converted to height-for-age z-scores (HAZ) using the World Health Organization 2006 growth standards.³³ We analyzed both the continuous HAZ variable and a binary indicator for stunting (HAZ < -2 SD) as an indicator of growth faltering.

Child development was measured among children aged 36 to 59 months using the caregiver-reported ECDI.^{34,35} The 10 items of the ECDI were established through consultation among child development experts and based on the results of multistage and multicountry pilot tests, measurement analyses, and validation studies.³⁶ The 10 dichotomous (yes/no) ECDI items pertain to 4 domains of development, literacy-numeracy, physical, socioemotional, and learning, which have been previously validated across a large number of LMICs using confirmatory factor analysis.³⁷ (Supplemental Table 4 provides details on the ECDI). Several items of the ECDI are directly comparable to items found in well-validated ECD measures, such as the Ages and Stages Questionnaire and the Strengths and Difficulties Questionnaire³⁷; furthermore, the ECDI has been used in other recent studies.^{37,38} A composite score,

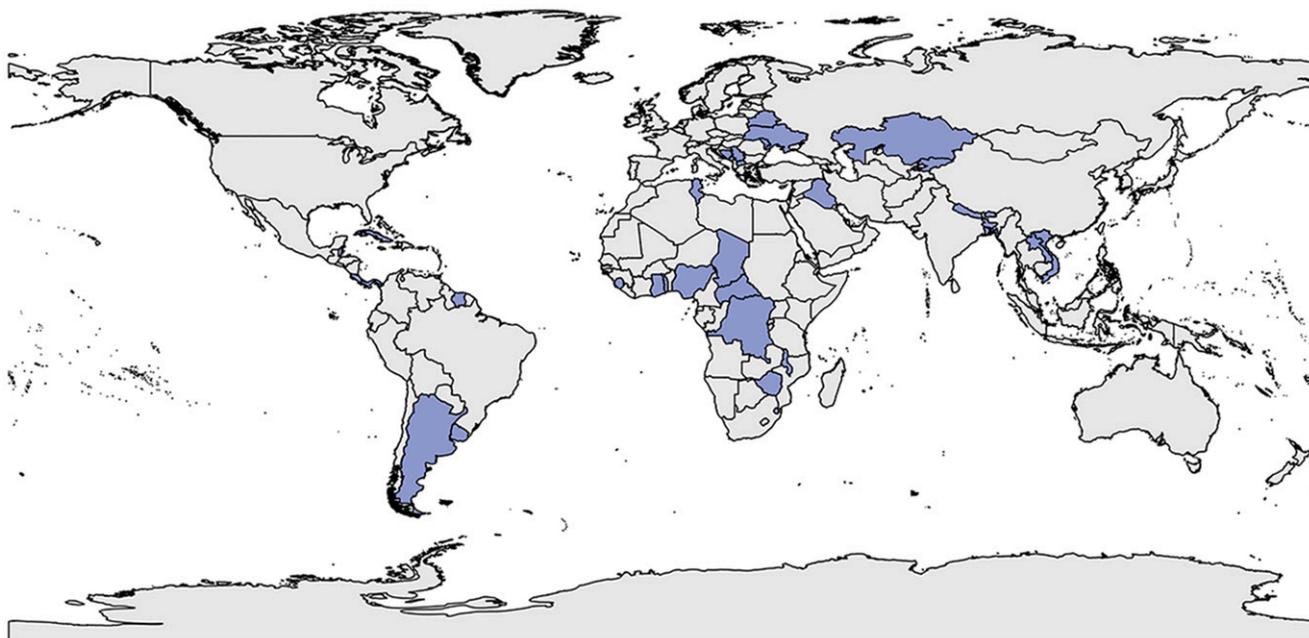


FIGURE 1
Map of 38 countries included in this analysis.

ranging from 0 to 10, was created by summing the number of positive responses. The internal consistency of the ECDI in this sample was fair ($\alpha = 0.55$). The ECDI total sum score was normalized to a mean of 0 and a SD of 1 so as to be directly comparable to the standardized scale of HAZ. ECDI was also dichotomized to categorize children with low developmental scores, or 1 SD below the mean score in the sample.

Paternal Stimulation

Primary caregivers were asked to report on whether mothers, fathers, and/or other household member were engaged in any of the following 6 activities with their children in the past 3 days: (1) reading books or looking at pictures; (2) telling stories; (3) singing songs; (4) taking the child outside; (5) playing with the child; (6) naming, counting, or drawing with the child. These items reflect a measure of caregivers' engagement in stimulation to support ECD.³⁹ A summary score was created, which ranged from 0 (no paternal engagement in any stimulation activity) to 6 (paternal engagement

in all stimulation activities within the last 3 days), similarly to how it has been described and used as a measure of caregiving and stimulation in other studies.^{39–41} In this sample, paternal stimulation showed good internal consistency ($\alpha = 0.77$). The total number of stimulation activities was categorized into 3 groups: high engagement (5–6 activities), moderate engagement (1–4 activities), or no engagement (0 activities). This classification was motivated by a primary interest in examining differences among fathers who engaged in none of the stimulation activities, as compared with those who engaged in some or all of the activities.

Other Covariates

To reduce the risk of confounding, we included the following covariates: maternal and other caregiver's stimulation; paternal and maternal education and marital status; maternal age; age (months) and sex of the child; ECE attendance; urban or rural residence; and household wealth quintile. Maternal and other caregiver's stimulation

were captured by using the same 6 items as paternal stimulation. Caregivers' level of education was categorized into 4 groups: no education or incomplete primary education, completed primary education, completed secondary education, or tertiary education. The wealth index variable included in the public-release MICS data set was calculated based on the first principal component of a group of context-specific assets owned by the household and divided into quintiles within each country: poorest, poor, middle, rich, richest.⁴²

Analysis

Separate unadjusted and adjusted linear regression models were estimated to examine the associations between levels of paternal stimulation and HAZ and ECDI z-scores. All models included country and survey year fixed effects to minimize any confounding through differences in survey methodology and over time. Adjusted models included the aforementioned set of covariates, which were determined a priori.

An additional set of models was tested that included 2-way interactions between paternal stimulation and any significant predictor of the adjusted model to examine the presence of effect modification in the sample. If any interaction term was statistically significant at $P < .05$, analyses were repeated for subgroups stratified by that predictor. Lastly, to assess robustness of results for paternal stimulation on child growth and development, stunting and low ECDI score were substituted for HAZ and ECDI z-score, respectively, in all models and rerun with logistic regression. Additionally, associations between paternal stimulation and the 4 subdomains of the ECDI were explored.

All children aged 36 to 59 months were included in the sample if they had information on either height-for-age or the ECDI measure and for the parental stimulation questions. The sample was restricted to children whose biological fathers were living in the household. Missing data were examined and assumed to be missing at random given the significant result of Little's Missing Completely at Random test at the $P < .001$ level (indicating that the data are not Missing Completely at Random)⁴³ and that the "missingness" of the data were predicted by other observed variables. Missing covariate values were estimated using separate multiple imputation regression models, including all other covariates as predictors. On substituting predicted values for missing values, adjusted models additionally included dummy variables that were coded 1 if data in that original covariate were missing, thereby retaining the total sample for the adjusted analyses and minimizing bias in estimation.⁴⁴

Statistical analyses were conducted in Stata version 13.1 (Stata Corp, College Station, TX). All estimates represent unweighted in-sample

TABLE 1 Sample Characteristics ($n = 87\,286$)

| Characteristics | Mean (SD) or % | N |
|---|----------------|--------|
| Child sex ($n = 87\,286$) | | |
| Boy | 50.9 | 44 418 |
| Girl | 49.1 | 42 868 |
| Age of child between 36 to 59 mo | 47.2 (6.9) | 87 286 |
| Mother's education ($n = 86\,759$) | | |
| None | 29.7 | 25 753 |
| Primary | 31 | 26 883 |
| Secondary | 32.1 | 27 835 |
| Tertiary | 7.2 | 6 288 |
| Father's education ($n=82\,792$) | | |
| None | 21.7 | 17 959 |
| Primary | 29.1 | 24 116 |
| Secondary | 42.5 | 35 187 |
| Tertiary | 6.7 | 5 530 |
| Caregiver's marital status ($n = 80\,020$) | | |
| Currently married/in union | 97.8 | 78 285 |
| Formerly married/in union | 1.9 | 1 508 |
| Never married/in union | 0.3 | 227 |
| Maternal age ranging from 15 to 49 | 30.6 (6.5) | 83 184 |
| Area of residence ($n = 85\,968$) | | |
| Urban | 36.5 | 31 364 |
| Rural | 63.5 | 54 604 |
| Paternal stimulation | | |
| No. of stimulation activities | 1.26 (1.63) | 87 286 |
| No stimulation ^a | 47.8 | 41 749 |
| Moderate stimulation ^b | 45.7 | 39 923 |
| High stimulation ^c | 6.4 | 5 614 |
| Maternal stimulation | | |
| No. of stimulation activities | 2.44 (2.04) | 87 286 |
| No stimulation ^a | 24.5 | 21 376 |
| Moderate stimulation ^b | 55.2 | 48 207 |
| High stimulation ^c | 20.3 | 17 703 |
| Other caregiver's stimulation | | |
| No. of stimulation activities | 1.78 (1.87) | 87 286 |
| No stimulation ^a | 38.1 | 33 227 |
| Moderate stimulation ^b | 50.3 | 43 886 |
| High stimulation ^c | 11.7 | 10 173 |
| ECDI score ranging from 0 to 10 | 5.76 (1.89) | 87 226 |
| Child growth | | |
| HAZ, mean (SD) | -1.41 (1.55) | 73 712 |
| Proportion of children stunted ^d ($n = 73\,712$) | 33.1 | 24 362 |

^a No stimulation reflects a caregiver who did not engage in any of 6 possible stimulation activities.

^b Moderate stimulation reflects a caregiver who engaged in 1 to 4 of 6 stimulation activities.

^c High stimulation reflects a caregiver who engaged in 5 or 6 stimulation activities.

^d Stunting refers to a HAZ < -2 SD.

relationships; to adjust for the complex survey design of MICS, SEs were clustered at the country enumeration area level.

RESULTS

A total of 87 286 child records were available across 38 countries (Supplemental Table 5). Sociodemographic and ECD-related characteristics for the sample are presented in Table 1. The average age

of the child was 47.2 months (SD = 6.9). Approximately 29.7% of mothers reported no formal education, and 21.7% of fathers reported no formal education. Nearly all caregivers (97.8%) reported being married or in a union. The mean age of mothers was 30.6 years (SD = 6.5; range, 15–49). The majority of the sample lived in rural settings (63.5%).

In total, 6.4% of fathers were highly engaged in stimulation activities (5 or 6 activities); 45.7% of fathers were

TABLE 2 Unadjusted and Adjusted Associations (95% CI) Between Levels of Paternal Stimulation and HAZ and ECDI z-Score

| | HAZ | | ECDI z-Score | |
|-------------------------------|---------------------------|--------------------------|---------------------------|---------------------------|
| | Unadjusted | Adjusted | Unadjusted | Adjusted |
| Paternal stimulation | | | | |
| Moderate paternal stimulation | -0.17*** (-0.22 to -0.11) | 0.02 (-0.03 to 0.07) | -0.26*** (-0.29 to -0.23) | -0.09*** (-0.12 to -0.06) |
| Lack of paternal stimulation | -0.30*** (-0.35 to -0.25) | -0.02 (-0.07 to 0.03) | -0.40*** (-0.43 to -0.38) | -0.14*** (-0.17 to -0.12) |
| Maternal stimulation | | | | |
| Moderate maternal stimulation | — | -0.05** (-0.08 to -0.01) | — | -0.14*** (-0.16 to -0.12) |
| Lack of maternal stimulation | — | -0.05* (-0.09 to -0.01) | — | -0.23*** (-0.25 to -0.21) |
| <i>N</i> | 73 712 | 73 712 | 73 712 | 87 226 |

Data are presented as standardized mean differences (95% CI), relative to the reference group of high stimulation (5 or 6 activities). Moderate stimulation reflects engagement in 1 to 4 of the 6 stimulation activities. Lack of stimulation reflects no engagement in any of the stimulation activities, or 0 activities. All models include country and survey year fixed effects. Adjusted models additionally control for: any other caregiver's stimulation, child's sex, child's age, ECE attendance, father's education, mother's education, caregiver's marital status, maternal age, place of residence, and wealth quintile. —, not included in the unadjusted model.

*** $P < .001$; ** $P < .01$; * $P < .05$.

moderately engaged (1–4 activities); and 47.8% of fathers did not perform any of the stimulation activities with their children in the previous 3 days. The proportion of fathers unengaged in any stimulation activities varied widely across countries, ranging from 11.3% in Serbia to 78.4% in Swaziland (Supplemental Table 6). On average, fathers who were highly engaged in stimulation were more educated, more wealthy, from urban areas, and had partners who were also more educated and engaged in stimulation activities (Supplemental Table 7).

Mean HAZ in the sample was -1.41 (SD = 1.55), ranging from a mean of -2.17 in Laos to 0.41 in Bosnia; prevalence of stunting ranged from 54.9% in Laos to 1.6% in St. Lucia. Children's average development score was 5.76 out of 10 (SD = 1.89). Average raw ECDI scores ranged from 4.35 in Chad to 8.43 in Barbados (Supplemental Table 6).

Relationships Between Levels of Paternal Stimulation and HAZ and ECDI Scores

Unadjusted and adjusted results for levels of paternal stimulation on HAZ and ECDI z-scores are presented in Table 2. In the unadjusted model, both moderate paternal stimulation ($\beta = -0.17$; 95% confidence interval [CI], -0.22 to -0.11; $P < .001$) and lack of paternal stimulation ($\beta = -0.30$; 95% CI, -0.35 to -0.25; $P < .001$) were negatively associated

with HAZ relative to high stimulation. In the fully adjusted model, these associations were smaller and not statistically significant ($\beta = 0.02$; 95% CI, -0.03 to 0.07; $P = .33$ for moderate, and $\beta = -0.02$; 95% CI, -0.07 to 0.03; $P = .42$ for lack of stimulation).

For ECDI z-score, moderate paternal stimulation was associated with a 0.26 SD lower ECDI z-score in unadjusted models ($\beta = -0.26$; 95% CI, -0.29 to -0.23; $P < .001$) and no paternal stimulation was associated with a 0.40 SD lower ECDI score ($\beta = -0.40$; 95% CI, -0.43 to -0.38; $P < .001$), as compared with high paternal stimulation. In the fully adjusted model, these associations were smaller but remained statistically significant: children whose fathers were moderately engaged in stimulation had a 0.09 SD lower ECDI score ($\beta = -0.09$; 95% CI, -0.12 to -0.06; $P < .001$); and children whose fathers were completely unengaged in stimulation had a 0.14 SD lower ECDI score ($\beta = -0.14$; 95% CI, -0.17 to -0.12; $P < .001$), as compared with children whose fathers were highly engaged. Figure 2 shows the dose-response relationships between paternal stimulation activities and HAZ and ECDI z-scores. Overall, the adjusted relationship between paternal stimulation and ECDI score is almost perfectly linear, whereas such a relationship is undetectable for HAZ.

Subgroup Analyses

Two-way interaction terms between paternal stimulation and each covariate of the adjusted model were tested to examine whether associations between paternal stimulation and ECDI z-score and/or HAZ differed across these other well-documented risk factors. Two interaction terms were significant predictors of ECDI z-scores: the interaction term between paternal stimulation and maternal stimulation ($P < .001$) and that between paternal stimulation and ECE ($P < .001$). None of the interaction terms were significant in the models predicting HAZ. The results of the subgroup analyses for ECDI z-scores are presented in Table 3.

Greater associations between paternal stimulation and ECDI scores were seen when there were low levels of maternal stimulation. The negative associations of paternal stimulation among children whose mothers were unengaged (moderate paternal stimulation: $\beta = -0.25$; 95% CI, -0.34 to -0.15; $P < .001$; and no paternal stimulation: $\beta = -0.33$; 95% CI: -0.43 to -0.24; $P < .001$) were nearly three-fold larger in magnitude than among children whose mothers were highly engaged in stimulation (moderate paternal stimulation: $\beta = -0.08$; 95% CI, -0.11 to -0.05; $P < .001$; and no paternal stimulation: $\beta = -0.11$; 95% CI, -0.15 to -0.07; $P < .001$).

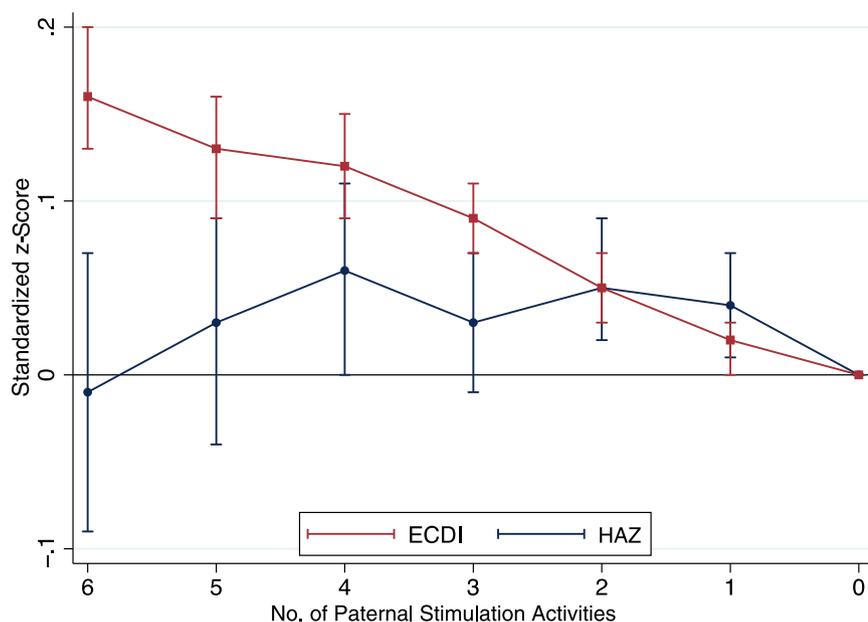


FIGURE 2 Adjusted relationships between decreasing number of stimulation activities performed by the father and HAZ and ECDI z-score.

Greater associations of paternal stimulation were also seen when children did not attend ECE. The negative associations of paternal stimulation among children who

did not attend ECE (moderate paternal stimulation: $\beta = -0.11$; 95% CI, -0.15 to -0.07 ; $P < .001$; and no paternal stimulation: $\beta = -0.16$; 95% CI, -0.20 to -0.13 ; P

$< .001$) were larger in magnitude in comparison with children who attended ECE (moderate paternal stimulation: $\beta = -0.08$; 95% CI, -0.12 to -0.05 ; $P < .001$; and no paternal stimulation: $\beta = -0.13$; 95% CI, -0.17 to -0.09 ; $P < .001$); however, the differences between subgroups by ECE attendance were not statistically significant.

Robustness Checks

To examine the robustness of results, HAZ and ECDI z-scores in all primary models were dichotomized and substituted as stunting and low ECDI scores, respectively. The results of these alternative classifications (Supplemental Table 8) corroborated our significant findings between levels of paternal stimulation and ECDI scores and null results for growth, as previously presented in Tables 2 and 3.

Adjusted associations between paternal stimulation and each of the subdomains of the ECDI were also

TABLE 3 Unadjusted and Adjusted Associations (95% CI) Between Levels of Paternal Stimulation and ECDI z-Score by Levels of Maternal Stimulation and Children's ECE Attendance

| | ECDI z-Score | |
|-------------------------------|---------------------------|---------------------------|
| | Unadjusted | Adjusted |
| High maternal stimulation | | |
| Moderate paternal stimulation | -0.12*** (-0.16 to -0.09) | -0.08*** (-0.11 to -0.05) |
| No paternal stimulation | -0.17*** (-0.21 to -0.13) | -0.11*** (-0.15 to -0.07) |
| N | 17 688 | 17 688 |
| Moderate maternal stimulation | | |
| Moderate paternal stimulation | -0.25*** (-0.30 to -0.20) | -0.14*** (-0.19 to -0.09) |
| No paternal stimulation | -0.33*** (-0.39 to -0.28) | -0.19*** (-0.24 to -0.14) |
| N | 48 198 | 48 198 |
| Lack of maternal stimulation | | |
| Moderate paternal stimulation | -0.36*** (-0.46 to -0.26) | -0.25*** (-0.34 to -0.15) |
| No paternal stimulation | -0.50*** (-0.60 to -0.41) | -0.33*** (-0.43 to -0.24) |
| N | 21 340 | 21 340 |
| Child attends ECE | | |
| Moderate paternal stimulation | -0.17*** (-0.21 to -0.14) | -0.08*** (-0.12 to -0.05) |
| No paternal stimulation | -0.27*** (-0.31 to -0.24) | -0.13*** (-0.17 to -0.09) |
| N | 23 776 | 23 776 |
| Child does not attend ECE | | |
| Moderate paternal stimulation | -0.21*** (-0.25 to -0.18) | -0.11*** (-0.15 to -0.07) |
| No paternal stimulation | -0.32*** (-0.36 to -0.28) | -0.16*** (-0.20 to -0.13) |
| N | 63 292 | 63 292 |

Data are presented as standardized mean differences (95% CI), relative to the reference group of high stimulation (5 or 6 activities). Moderate paternal stimulation reflects involvement in 1 to 4 of the 6 stimulation activities. Lack of paternal stimulation reflects no involvement in any of the paternal stimulation activities, or 0 activities. All models include country and survey year fixed effects. Adjusted models additionally control for: mother's stimulation, any other caregiver's stimulation, child's sex, child's age, ECE attendance, father's education, mother's education, caregiver's marital status, maternal age, place of residence, and wealth quintile.

*** $P < .001$; ** $P < .01$; * $P < .05$.

examined. Moderate and no paternal stimulation were most strongly associated with literacy–numeracy ($\beta = -0.11$; 95% CI, -0.14 to -0.07 and $\beta = -0.16$; 95% CI, -0.19 to -0.13 , respectively; Supplemental Table 9). Smaller associations were seen between moderate and no paternal stimulation and learning ($\beta = -0.03$; 95% CI, -0.06 to -0.01 and $\beta = -0.06$; 95% CI, -0.09 to -0.03) and socioemotional domains ($\beta = -0.05$; 95% CI, -0.07 and -0.03 and $\beta = -0.06$; 95% CI: -0.09 and -0.04). However, for the physical domain, associations were null for both levels of paternal stimulation.

DISCUSSION

In this paper, we used nationally representative data from 38 countries to estimate the prevalence of paternal stimulation and examine the associations between paternal stimulation and ECD in LMICs. Our analysis has 2 main findings. First, paternal stimulation remains limited in the majority of sampled LMICs. In the total sample, 47.8% of fathers were completely unengaged in stimulation activities with their 3- and 4-year-old children, which is twice the proportion of mothers who were unengaged (24.5%). This two-fold difference between prevalence of maternal and paternal stimulation is consistent with findings of the only other study known to the authors that has previously described maternal and paternal stimulation caregiving practices in LMICs.⁴⁰

Second, lower levels of paternal stimulation appear to have small but statistically significant negative associations with child development, even after controlling for various potentially confounding characteristics. Our results indicate that, relative to a highly engaged father, having a moderately engaged father is associated with 0.09 SD lower ECDI scores, whereas having an unengaged father is associated

with 0.14 SD lower ECDI scores. Although smaller in magnitude, these paternal stimulation effect sizes are consistent with the effect sizes seen for levels of maternal stimulation; they are also comparable in magnitude to the effect sizes of maternal primary school completion or an increase in wealth from the poorest to middle/rich quintile (Supplemental Table 10).

Results from subgroup analyses suggest that the associations between paternal stimulation and ECDI scores are more pronounced for children whose mothers were unengaged in stimulation and for children who did not attend ECE. These findings not only highlight the importance of having at least 1 engaged caregiver who can provide stimulating opportunities, but also suggest that engaged fathers might offer an important opportunity for buffering against high-risk environments of inadequate enrichment. Our results extend previous research in LMICs by revealing interactive and compensating effects of 1 parent for the lower engagement of the other that are similar to findings reported in high-income countries.^{45,46} More generally, our findings directly link to the broader resilience literature that underscores how responsive and stimulating parenting protects children from the adverse effects of early and cumulative risk factor exposures on ECD outcomes.^{47–50}

Results also revealed small associations between paternal stimulation and all developmental subdomain of the ECDI, except the physical domain. These findings suggest that paternal stimulation activities, such as reading, counting, and playing, may be particularly important for reinforcing children's ability to identify letters and numbers, to be independent and focused learners, and to engage well with others.

No associations were revealed between paternal stimulation and HAZ. Although HAZ has been commonly used as proxy measures of ECD, our results underscore important distinctions between the ECDI measure and HAZ that should be considered when examining relationships between stimulation and ECD. More research is needed to understand the specific mechanisms between paternal stimulation and ECD versus growth. Finally, although our results suggest no associations between paternal stimulation and HAZ, additional paternal roles, such as responsive care, decision-making around children's diet, or providing a safe home environment, should be examined to understand more broadly how fathers might influence child growth and ECD. Overall, future research should consider a more holistic perspective on the role of fathers in ECD.

Several limitations of this study are noted. First, the MICS data are cross-sectional and observational, which means that causality of the relationship between paternal stimulation and ECDI scores cannot be established. Second, both the stimulation measure and the ECDI relied on the same primary caregivers' self-report, which raises the possibility of recall bias and social desirability bias. Furthermore, the measure of stimulation only focuses on support for learning and does not capture duration or quality of paternal interactions or reflect other meaningful roles of fathers, such as financial investments in the child, physical touch, and culturally specific engagement approaches.⁵¹

In addition, despite the fact that the ECDI has provided some of the first population-level estimates of ECD across LMICs that are based on specific developmental behaviors and skills, it is also limited in important ways. This 10-item measure was designed to be brief enough to administer within the

existing and comprehensive MICS household survey program, but also broad enough to enable valid international comparisons. Although several items are found in well-validated measures of development (eg, ECDI item 13, “Does your child follow simple directions on how to do something correctly?” is also in the Ages and Stages Questionnaire for children aged 36–60 months), the ECDI is limited in its ability to fully capture children’s overall developmental capacities. Additionally, the ECDI showed low internal consistency in this study, a limitation that likely reflects the broad range of constructs it attempts to capture. To fully understand the nuances of the associations between stimulation and child outcomes, future research is needed using measures of ECD that are more domain-, age-, and culturally specific, as well as reliable for use across heterogeneous contexts within and across LMICs. Finally,

our results are limited to biological fathers who were also living in the household and do not reflect other important male caregivers, such as nonbiological fathers or nonresident fathers, who may still be engaged in stimulation and their children’s early development.⁵²

CONCLUSIONS

This study highlights how paternal stimulation remains severely limited in LMICs and how the lack of paternal stimulation has negative associations with developmental outcomes. ECD research, programs, and policies that reflect and target only maternal stimulation may overlook important influences of fathers. A deeper understanding of the relationship between paternal stimulation and children’s early development and approaches to encouraging paternal engagement in children’s learning, development, and health are needed to most effectively ensure that

children in LMICs reach their full developmental potential.

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ABBREVIATIONS

CI: confidence interval
ECD: early child development
ECDI: early childhood development index
ECE: early childhood education
HAZ: height-for-age z-score
LMICs: low- and middle-income countries
MICS: Multiple Indicator Cluster Survey
MICS5: Multiple Indicator Cluster Survey round 5
MICS4: Multiple Indicator Cluster Survey round 4

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