



# Assessment of Positive and Stimulating Home Environments for Global Monitoring

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## Abstract

Non-optimal early childhood development adversely affects educational attainment, productivity, and income, and may result in inter-generational cycles of non-optimal development and poverty. Optimal development requires multiple inputs including a stimulating environment and responsive care. Given the interest in being able to monitor, at a global level, children's exposure to positive and stimulating home environments, this paper aims to evaluate the suitability of the Family Care Indicators for this purpose. We review existing research about the features of home environments that are most important for supporting optimal early childhood development and how these features have been measured, with attention to the Family Care Indicators that have several distinct advantages for global monitoring. We report on several analyses using data from multi-country Multiple Indicator Cluster Surveys that address the validity and international comparability of the Family Care Indicators. We conducted these analyses using correlations and item response theory models to examine validity and cross-country equivalence. Based on prior studies that established validity of Family Care Indicators and on analyses reported in this paper, the items on early stimulation and responsive care from the set of Family Care Indicators will provide a valid and cross-country equivalent measure to monitor the percentage of young children experiencing positive and stimulating home environments. Additional work examining relationships between the Family Care Indicators and child development measures would further establish predictive validity.

**Keywords** Home environment · Child development · Care behaviors · Stimulation · Indicators.

## Highlights

- Optimal child development requires multiple inputs including a positive and stimulating home environment.
- Global monitoring of the provision of positive and stimulating home environments is important for tracking progress.
- Assessment of the home environment can provide valuable information on support for early child development and learning.
- The Family Care Indicators were valid and cross-context equivalent for the purpose of global monitoring of countries.

About 250 million children living in low- and middle-income countries are at risk of non-optimal early childhood

development (ECD) due to poor nutrition and extreme poverty (Black et al., 2017). Additionally, 80.8 million children ages three and four years old have low cognitive and/or socio-emotional development in low- and middle-income countries, with the highest prevalence in sub-Saharan Africa, followed by South Asia, and then East Asia and Pacific region (McCoy et al., 2016). Non-optimal development has adverse effects on educational attainment, productivity, and income, and may result in inter-generational cycles of non-optimal ECD and poverty (Black et al., 2017; Frongillo et al., 2017). These adverse consequences can be mitigated by providing nurturing environments that are sensitive to children's needs and

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promote their development (Britto et al., 2017; Daelmans et al., 2017; Shonkoff et al., 2017). For example, play and interactive activities may improve ECD even among children from poor households (Worku et al., 2018). Improving nutrition during the first 1000 days of life also supports ECD (Schwarzenberg & Georgieff, 2018).

The importance of ECD as a necessary and central component of global and national development has been recognized by the international community through the inclusion of a dedicated target within the Sustainable Development Goals (SDGs) (United Nations, 2018). Target 4.2 specifically calls upon countries to “ensure that, by 2030, all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education”. One of the indicators selected to measure progress towards achieving target 4.2 is the percentage of children under age 5 years who are developmentally on track in health, learning, and psychosocial well-being (indicator 4.2.1). Optimal development requires multiple inputs: a stimulating environment and responsive care, play, and attention from caregivers; adequate health and nutrition to feed and nourish the architecture of the body; opportunities for quality early learning; and safety and protection to buffer against stress (Black et al., 2017; Britto et al., 2017).

While the global monitoring framework for the SDGs does not include a dedicated indicator to measure aspects of children’s home environments that are essential for promoting child development, the Technical Advisory Group on Post-2015 Education Indicators, established by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2014, has elaborated a proposed expanded set of thematic indicators to monitor SDG4 and the Education 2030 Agenda intended to turn commitments to education into action. The proposed set of thematic indicators was approved by the Technical Cooperation Group on SDG 4-Education 2030 Indicators. One of the thematic indicators is 4.2.3: the percentage of children under 5 years experiencing positive and stimulating home environments (United Nations Educational, Scientific and Cultural Organization Institute of Statistics, 2017). The Technical Cooperation Group is composed of 38 regionally representative Member States, international partners, civil society, and the Co-Chair of Education 2030 Steering Committee, with the UNESCO Institute for Statistics hosting its Secretariat.

Given the opportunity and need to identify a measure that can yield globally comparable data on the thematic indicator 4.2.3 on the percentage of children under 5 years experiencing positive and stimulating home environments, this paper aims to evaluate the suitability of the Family Care Indicators (Kariger et al., 2012) for this purpose that were developed by UNICEF to assess family care behaviors. We review existing research about the features of positive and

stimulating home environments that are most important for supporting optimal ECD and how these features have been measured, with attention to the Family Care Indicators that have several distinct advantages for global monitoring. We then report on several analyses using data from multi-country Multiple Indicator Cluster Surveys (MICS) that address the validity and international comparability of the Family Care Indicators. The MICS are implemented by national statistical authorities with financial and technical support by the United Nations Children’s Fund (UNICEF) and provide statistically sound and internationally comparable data on children and women in countries worldwide. We conclude with a discussion of the strengths and weaknesses of the Family Care Indicators as a potential measure of indicator 4.2.3.

## Importance of Positive and Stimulating Environments

The early period of life is critical for development because of the number of structural and functional changes that occur in the brain during this time (Aboud & Yousafzai, 2015). Child development is influenced by health, nutrition, poverty, home environment, policies, and socio-cultural contexts. Human development is affected by interaction with people, objects, or symbols in the environment (Bronfenbrenner, 1986; Bronfenbrenner, 1994). Family is the immediate environment of children, and their home environment has a substantial impact on their health and well-being (Maggi et al., 2010; Frongillo et al., 2017).

Positive and stimulating environments may include provision of play or learning materials, adult involvement, and a variety of experiences or stimulations (Bradley & Corwyn, 2005; Tamis-LeMonda et al., 2001). Additionally, lack of punitive or violent disciplinary methods and provision of adequate supervision (i.e., not leaving child alone or under supervision of other young children) may help to promote development of children (Bradley & Corwyn, 2005). A positive and stimulating environment also includes provision of affection, warmth, responsiveness, and encouragement for autonomy and exploration (Engle et al., 1999). Parenting plays a critical role in provision of a positive and stimulating environment to children. Responsive and sensitive behaviors of the parents encourage parent-child interaction, attachment, and help in contributing to child development. Caregivers who are sensitive to the needs of children perceive and interpret signals and act appropriately (Mertesacker et al., 2004). Enhanced parental stimulation also protects children from the effects of adverse conditions (Jacobson & Jacobson, 2002).

Psychosocial stimulation at home such as exposure to speech, sounds, songs, lullabies, and faces of people may

influence child development (Aboud & Yousafzai, 2015). In Brazil, cognitive functioning (assessed by the Wechsler Pre-School and Primary Scale of Intelligence Revised) of 346 children at 5 years of age was influenced by the family socio-economic status mediated by stimulation at home and pre-school (assessed by the Home Observation for Measurement of the Environment score and school attendance), household sanitary infrastructure, and neighborhood (Santos et al., 2008). Play material and activities and adult conversation are needed for optimal development (Tamis-LeMonda et al., 2001). The importance of stimulation has been supported by multiple intervention studies (Aboud & Yousafzai, 2015). A study conducted with data from the MICS, for instance, demonstrated that children's literacy-numeracy and learning were positively associated with family care behaviors (Frongillo et al., 2017), and that the strongest associations for literacy-numeracy were with attendance at organized learning or early childhood education program, provision of books, and stimulating activities.

Children with stimulating learning materials and enriching experiences at home have higher levels of competence and adaptive functions, but many children do not have access to play or learning materials (Bradley & Corwyn, 2005). Additionally, parents and other caregivers may not engage with their children in play. Limited or lack of learning at home can be attributed to poverty, cultural practice, norms, lack of education or knowledge among caregivers (Bradley & Corwyn, 2005), and parental difficulties with mental health and addiction (Nicholson et al., 2019). Capabilities of caregivers also influence use of learning resources and provision of psychosocial stimulation to children (Bradley & Corwyn, 2005).

## Assessment of Positive and Stimulating Environments

### Home Observation for Measurement of the Environment Inventory

Given the importance of a positive and stimulating environment in supporting ECD, there has been substantial work on the assessment of its key features. The Home Observation for Measurement of the Environment (HOME) inventory has been used extensively in both low- and middle-income countries in Latin America, Asia, and Africa as well as high-income countries (e.g., United States, northern Europe, and Australia). The HOME was first developed by Caldwell and Bradley in 1978. The current HOME inventory has multiple versions for different age groups and involves semi-structured interviews with the caregiver/family members as well as observer ratings of home environment and parenting behaviors

(Bradley and Corwyn, 2005; Engle et al., 1999). Here we focus only on the early childhood version of the inventory for ages 0 to 3 years which has eight scales related to learning materials, language stimulation, physical environment, responsiveness, academic stimulation, modelling of behaviors that are socially acceptable, variety of stimulation, and acceptance.

There are several strengths of the HOME inventory. First, in a study by Bradley and colleagues, the HOME scale had theoretically meaningful correlations with family structure, family status, and child outcome measures in many cultures (Bradley et al., 1996). Second, the inventory uses both interviews and observations. It also provides a wide range of information which can be used in various populations and purposes (Elardo & Bradley, 1981). Third, this method includes assessment of both quality and quantity of psychosocial care (Bradley and Corwyn, 2005). Fourth, the HOME inventory has shown to be useful in both normally developing children and those with high-risk conditions (Totsika & Sylva, 2004). Therefore, the HOME inventory can produce robust and rich data on children's home environments.

The HOME inventory also has some important limitations for the purpose of countries for global monitoring. The HOME has largely been used to collect data for purposes of medical and epidemiological research and individual assessment rather than as a tool for population-level measurement (see, for example: Black et al., 2004; Bradley et al., 1994; Williams et al., 2003). The inventory takes a relatively long time (45–60 min) to be administered and requires well-trained and skilled interviewers. The inventory may also require considerable adaptations for use in low- and middle-income settings (Frongillo et al., 2014; Jones et al., 2017). For example, children in resource-limited settings may not have store-bought toys but are likely to have home-made toys or household objects used as toys, which are not covered by HOME. Furthermore, this method includes observations which may be difficult to standardize (for example, two observers may perceive differently the quality of the same interaction between a child and a caregiver) (Hamadani et al., 2010). For these reasons, results obtained by implementing the HOME are usually not comparable across countries given differences in research methods employed (Totsika & Sylva, 2004).

In summary, implementing the HOME inventory requires substantial time, training, and financial resources, and therefore is not suitable for large-scale population surveys (Hamadani et al., 2010). Other methods of direct observation such as the Nursing Child Assessment Satellite Training Feeding scale (Aspland & Gardner, 2003; Frith et al., 2009) are also not suitable for large-scale surveys because of the time and financial resources required to administer them. Therefore, the remainder of this paper

**Table 1** Family care indicators included in the multiple indicator cluster surveys round 6 (UNICEF, 2021)

Indicator	Item number in MICS <sup>a</sup>	Indicator definition
Early stimulation and responsive care	EC5 (Under-five questionnaire)	Percentage of children age 24–59 months engaged in four or more activities to provide early stimulation and responsive care in the last 3 days with any adult household member, father, mother
Father's support for learning	EC5 (Under-five questionnaire)	Number of children age 24–59 months whose biological father has engaged in four or more activities to promote learning and school readiness in the last 3 days
Mother's support for learning	EC5 (Under-five questionnaire)	Number of children age 24–59 months whose biological mother has engaged in four or more activities to promote learning and school readiness in the last 3 days
Availability of children's books	EC1 (Under-five questionnaire)	Percentage of children under age 5 who have three or more children's books
Availability of playthings	EC2 (Under-five questionnaire)	Percentage of children under age 5 who play with two or more types of playthings
Inadequate supervision	EC3 (Under-five questionnaire)	Percentage of children under age 5 left alone or under the supervision of another child younger than 10 years of age for more than one hour at least once in the last week
Violent discipline <sup>b</sup>	UCD2 (Under-five questionnaire) FCD2 (Questionnaire for 5–17 years old)	Percentage of children age 1–14 years who experienced any physical punishment and/or psychological aggression by caregivers in the past one month

<sup>a</sup>The individual items are available from UNICEF (2021)

<sup>b</sup>Also included in Sustainable Development Goals as indicator 16.2.1, specific to 1–17 years old

considers the applicability of an alternative measure that is compatible with nationally representative household surveys.

### Family Care Indicators

The Family Care Indicators (Table 1) were developed by UNICEF for use in the MICS and other large-scale surveys and are valuable for assessing the home environment of young children in low- and middle-income countries due to their validity and equivalence in these settings (Hamadani et al., 2010; Kariger et al., 2012). The Indicators are based on caregiver report in response to five questions and require less time (5–10 min) to administer and less training than the HOME inventory. The Indicators are simple to use in large population-level surveys (Hamadani et al., 2010; Frongillo et al., 2017) and assess adult support for stimulating environment and disciplinary behaviors. They also include items that measure adequacy of the alternative caregiver (i.e., not leaving the child alone or with another child less than 10 years of age) (Kariger et al., 2012).

The Family Care Indicators were developed through a multi-step process begun by UNICEF in November 2002. Guided by the HOME inventory and the UNICEF conceptual framework of care (Bradley & Corwyn, 2005; Engle et al., 1999), a panel of 25 international child-development experts developed a framework of family care domains and resources important for children's development and evaluate possible items for pilot testing (Kariger et al., 2012). Candidate items for each domain were selected from tools that had exhibited good psychometric properties across samples. Expert panel members suggested other candidate items when suitable ones could not be found in the literature. Field testing and cognitive interviews then were conducted in multiple countries to examine clarity, relevance, and applicability of the items across countries (Kariger et al., 2012). In November 2003, a second panel of 27 experts reviewed the findings from the cognitive interviews and quantitative data to evaluate the items for inclusion in MICS and to ensure that the items could be used cross-culturally (Kariger et al., 2012). Judgment by the panel of experts guided the selection of the final items and the cut-offs for learning materials and inclusion of homemade or household objects as playthings (Frongillo et al., 2017; Kariger et al., 2012), considering that availability of such materials would be lower in low-income countries and populations without access to economic resources to purchase materials (UNICEF, 2021).

The Family Care Indicators have been validated in rural Bangladesh (Hamadani et al., 2010). They included 801 children aged 18 months and their mothers and used the Bayley Scales of Infant Development to assess mental and motor development, while assessment of the language

expression and comprehension was based on reporting from the mothers. They found that the indicators had significant association with mental, motor, and language development. Among the five subscales, two subscales (play activities and variety of play materials) had the strongest associations with children's development. Additionally, three subscales (play activities, variety of play materials, and magazines and newspapers at home) independently predicted children's development. The indicators also demonstrated adequate test-retest reliability (Hamadani et al., 2010). Further evidence of the validity of the Family Care Indicators, including early stimulation and responsive care, at the individual level comes from the strong associations with literacy-numeracy found in analyses with the MICS4 (Frongillo et al., 2017).

The Family Care Indicators have been used in many multi-country analyses using MICS data (for example, Bornstein & Putnik, 2012; Bornstein et al., 2015; Bradley & Putnik, 2012; Cappa & Khan, 2011; Jeong et al., 2016; Lansford & Deater-Deckard, 2012; Ruiz-Casares et al., 2018). Besides being used in MICS, some of the Indicators, including those on early stimulation and responsive care, have also been used in several countries through Demographic and Health Surveys. Prado and colleagues investigated the association between domains of child development and child linear growth in Burkina Faso, Ghana, and Malawi, using the Family Care Indicators to assess the home environment. Mothers of the children were interviewed to assess the availability of play materials and psychosocial stimulation in the past 3 days (Prado et al., 2016). Associations between linear growth and language and motor development were weaker or absent in children in environments with high stimulation, suggesting a protective role for a stimulating environment. A study from Malawi and another multi-country study from India, Indonesia, Peru, and Senegal also used the Family Care Indicators to assess the availability of play materials, availability of books and magazines in the household, and interaction of caregiver with children (Fernald et al., 2012; Gladstone et al., 2018). Fernald et al. (2012) found that home stimulation was a strong mediator of the relationship between wealth and child development. One of the strengths of the Indicators is that they are easy to administer by trained general interviewers and specialized ones are not required. Additionally, relatively few questions are included in this method and the items used to measure family care are clear (Hamadani et al., 2010). In contrast, the Indicators are self-reported by the caregivers which may lead to recall or social-desirability biases. Additionally, this method does not include observations of the family environment (Hamadani et al., 2010; Kariger et al., 2012).

The Family Care Indicators, specifically the items on early stimulation and responsive care, availability of books

and play materials, inadequate supervision, and disciplinary practices, were included in the Regional Project on Child Development Indicators (Inter-American Development Bank, 2018; Verdisco et al., 2016). This project included nationally representative samples from four countries: Costa Rica, Nicaragua, Peru, and Paraguay. Results from an analysis of data collected in these countries found that aspects of the nurturing environment (as measured by the Family Care Indicators) were statistically and significantly associated with children's scores across the developmental domains assessed (socio-emotional, cognitive, motor and language and communication) in all of the countries. In some cases, this relationship was stronger for some domains than that observed for the socioeconomic situation of the household; for instance, in Costa Rica and Nicaragua, the wealth index was not found to be statistically significantly associated with socio-emotional development while the composite nurturing environment indicator was.

To augment what is already known about the Family Care Indicators, we addressed whether the Family Care Indicators assess meaningful information about home environments that is comparable over countries by examining whether the Family Care Indicators are (1) associated in expected ways with available measures of cognitive development (i.e., learning) and measures related to ECD (e.g., gross domestic product, fertility rate, center-based childcare, crowding, child height, and presence of biological mother) and (2) comparable across countries. Learning was used because this domain of development was most strongly associated with the Family Care Indicators in individual-level analyses with MICS4 data (Frongillo et al., 2017).

## Methods

### MICS

Begun in the mid-1990s, 118 countries have carried out one or more MICS to collect data on key indicators of the well-being of children and women in countries across the world. MICS questionnaires allow countries to monitor and report on a variety of child development and well-being domains including, for example, nutritional status, immunization, and parenting practices. In addition, specific questions were developed by UNICEF to gather data in three vital ECD areas: quality of care within a child's home environment (as measured by the Family Care Indicators); access to early childhood care and education; and overall developmental status of children. Beginning with MICS4, the early childhood development measures were consolidated into a single module included in the questionnaire for children under 5 which is administered to mothers or primary caregivers of children under the age of 5 (0–59 months).

## Sample

We conducted quantitative analyses of the Family Care Indicators using data from 31 and 20 countries from the fourth and fifth rounds, respectively, of MICS (MICS4 and MICS5). Surveys from 31 countries were available from MICS4 (conducted between 2009 and 2013) and had a total of 77,534 children aged 36–59 months, with country sample sizes having median 1322 and range 122, 13,967. The 20 countries from MICS5 (conducted between 2013 and 2017) had a total of 96,946 children, with country sample sizes having median 3656 and range 1185, 13,967. The 20 countries were chosen based on the sample size available for analysis (> 1000 children per country) and to be representative of the multiple regions of the world. The children in this sample were aged 36–59 months.

## Measures

The questionnaires used in the MICS ask respondents whether, in the last 3 days, they or any other adult household member age 15 or older engaged in any of the following activities with the child: reading or looking at picture books; telling stories; singing songs including lullabies; taking the child outside the home; playing with the child; and naming, counting or drawing things with the child. The questionnaires also ask respondents how many children's books or picture books they have for the child, with which types of toys and objects the child plays, how often the child is left with another adult or child to go shopping, wash clothes, or for other reasons, which ways adults use to teach child the right behavior or to address a behavior problem. The Family Care Indicators used were early stimulation and responsive care, availability of children's books, availability of playthings, inadequate supervision, and violent discipline. These Indicators were binary (i.e., yes or no) except for the first which was the number of stimulating activities in which 15 years or older individuals were engaged with the child to promote learning in the past three days.

Two measures of country economic and social development from the World Bank, gross domestic product (as the logarithm to linearize the relationship) and fertility rate, respectively, were used to compare with the Family Care Indicators based on prior research (Frongillo et al., 2019). We also used as comparators the country means of several variables collected by respondent report from MICS that represented either potential determinants or consequences of family care behaviors: attendance in center-based childcare, household crowding, height-for-age z-score, the learning subscale of the Early Childhood Development Index, maternal secondary education or higher, and presence of the biological mother in the home.

## Analysis

First, for each MICS4 survey, data from 31 countries were collapsed to means (for early stimulation and responsive care) or proportions (for availability of children's books, availability of playthings, inadequate supervision, and violent discipline) at the country level using sampling weights. We used a one-factor analytic model fitted with the principal factor method to examine the structure of the Family Care Indicators at the country level and then examined associations of the factor score with logarithm of gross domestic product and fertility rate.

Second, with data from 20 countries with MICS5 data, for concurrent validity, we examined relations at the country level of mean item response theory scale score obtained from two-parameter logistic models within each country with means of several comparison variables: attendance in center-based childcare, household crowding, height-for-age z-score, the learning subscale of the Early Childhood Development Index, maternal secondary education or higher, and presence of the biological mother in the home. Scatter plots were examined to determine the shape of the relationship between the scale scores and comparison variables; with only 20 countries, we did not expect to see notable deviations from linearity, and this was the case, so these relationships were summarized with Pearson product-moment correlations. In these 20 countries, we also examined cross-country equivalence, i.e., measurement invariance (Millsap, 2011; Frongillo et al., 2019) of the six binary items on early stimulation and responsive care using the alignment method (Asparouhov & Muthén, 2014). These items on early stimulation and responsive care were chosen for analysis because they measure most closely aspects related to indicator 4.2.3. The six binary items were read books or looked at picture books, told stories, sang songs, took outside the home, played with, and named, counted, or drew things. Our application of the alignment method used a two-parameter logistic model for item response theory within each country, and assessed whether items had similar difficulty (i.e., proportion endorsement) and reliability (i.e., proportion of variance shared with scale scores) over countries (Asparouhov & Muthén, 2014). We evaluated the overall influence of non-equivalence (i.e., measurement non-invariance) by comparing estimates of country-level means based on item response theory with (i.e., alignment model) and without (scalar equivalent model) adjusting for cross-country differences in the item properties. Sampling weights were used for all analyses that involved within-country data (e.g., the alignment analysis, computing country-level means and proportions), but were not directly used in between-country analyses (e.g., the concurrent validity analyses). For the alignment method, the samples sizes from each country were balanced to have

the same size by taking from each data set a simple random sample of 1185 children, the sample size of the country with the smallest sample available, because large disparities in sample sizes can lead to incorrect conclusions using this method (Yoon & Lai, 2018). Data analyses were conducted with Stata and Mplus software.

## Results

When collapsed as means or proportions at the country level, the five indicators that are intended to differentiate countries did so consistently as evidenced by correlations with the factor score and measures of economic and social development (Table 2). First, each of the five indicators was correlated strongly (magnitudes 0.512–0.952, all  $p < 0.003$ ) and in the expected direction with a single factor from factor analysis that accounted for 92% of the variability. Second, each of the five indicators was correlated with the logarithm of gross domestic product and fertility rate, measures of country economic and social development, respectively. Furthermore, the single factor was correlated 0.651 and  $-0.714$  with the logarithm of gross domestic product and fertility rate, respectively.

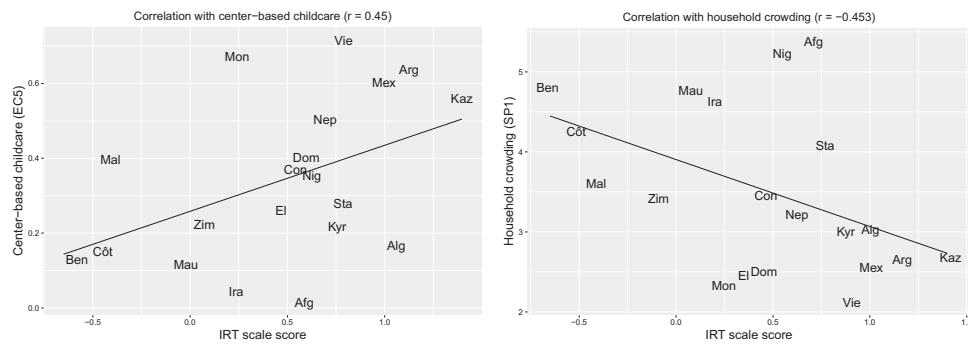
Regarding concurrent validity of specifically the items on early stimulation and responsive care, from MICS5 data at the country level, the scale score from item response theory was correlated 0.450 ( $p = 0.046$ ) with attendance in center-based childcare (Fig. 1, left),  $-0.453$  ( $p = 0.045$ ) with household crowding (Fig. 1, right), 0.504 ( $p = 0.023$ ) with height-for-age z-score (Fig. 2, left), 0.822 ( $p < 0.001$ ) with the learning subscale of the Early Childhood Development Index (Fig. 2, right), 0.690 ( $p < 0.001$ ) with maternal secondary education or higher (Fig. 3, left), and 0.554 ( $p = 0.011$ ) with the biological mother being at home (Fig. 3, right). The family care scale score explained two-thirds (i.e., 0.822 squared) of the variation among countries in the Early Childhood Development Index, which fits

expectations given that the family care behaviors measured are theoretically strong determinants of development. Separate analyses with item response theory models in each country found that none of the item response functions had shallow slopes or high or low probabilities of endorsement. In several countries, the item on “took the child outside the home, compound, yard, or enclosure” was the least reliable and had a high proportion of affirmations. No single item consistently fit the data worst across the countries. Regarding concurrent validity, the scale scores overall had plausible relationships with the comparison variables. In one country, Kyrgyzstan, the caregiver items performed abnormally and relationships with some comparison variables were unusual. Because the base rate of the comparison variables can differ widely over countries, comparing within-country analyses over countries can be misleading. In general, however, the scale scores were strongly positively related to maternal education (coded as secondary or higher) in every country, except for Kazakhstan and Kyrgyzstan for which there was insufficient variance to do the analysis.

Regarding cross-country equivalence of these items, the proportions of the variance that were common (i.e., attributable to a common underlying construct) for the item difficulty parameters were 0.806, 0.897, 0.736, 0.539, 0.425, and 0.809 for, respectively, (a) read books to child or looked at picture books, (b) told stories to child, (c) sang songs to or with child including lullabies, (d) took child outside, (e) played with child, and (f) named, counted, or drew things to or with child. For all activities except played with child, more than half of the variance was common among countries, meaning that the proportion endorsing the items was similar across countries given the same scale score. To examine the consequences of item bias, we compared country means on the scale scores estimated from two different models from item response theory that adjusted and did not adjust for item bias. The two scale scores were correlated 0.991, suggesting that the effect of

**Table 2** Correlations at the country level ( $n = 31$ ) of Family Care Indicators with a single factor from factor analysis, logarithm of gross domestic product, and fertility rate from Multiple Indicator Cluster Surveys round 4

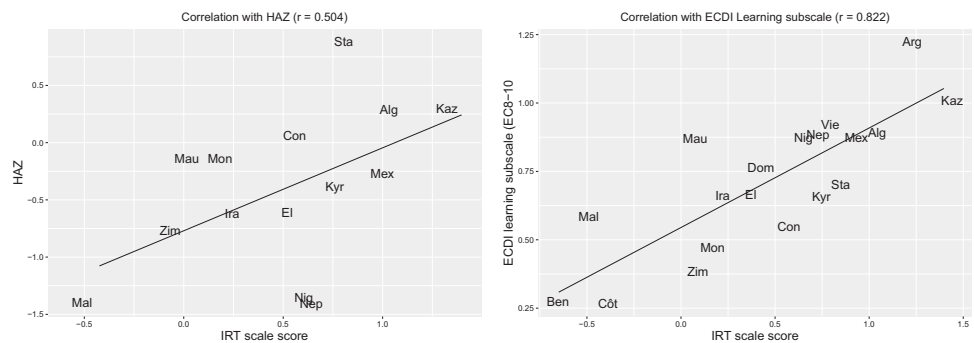
Family Care Indicators	Pearson correlations with:		
	Factor from one-factor model	Logarithm of gross domestic product per capita (i.e., economic development)	Fertility rate (i.e., social development)
Early stimulation and responsive care	0.803	0.558	$-0.533$
Availability of children’s books	0.952	0.654	$-0.675$
Availability of playthings	0.642	0.550	$-0.620$
Inadequate supervision	$-0.749$	$-0.816$	0.858
Violent discipline	$-0.512$	$-0.382$	0.479
Factor from one-factor model	–	0.651	$-0.714$



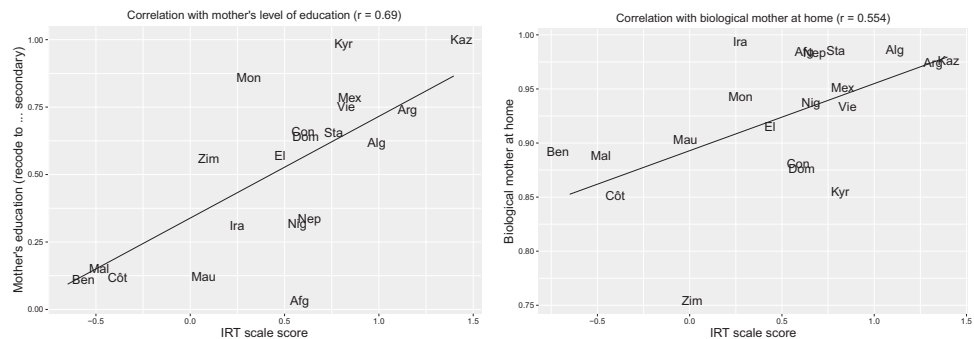
**Fig. 1** Correlation of the scale score from item response theory (IRT) with attendance in center-based childcare (left) and household crowding (right) from MICS5 data on 20 countries: Afghanistan (Afg), Algeria (Alg), Argentina (Arg), Benin (Ben), Congo (Con), Côte

d'Ivoire (Côt), Dominican Republic (Dom), El Salvador (El), Iraq (Ira), Kazakhstan (Kaz), Kyrgyzstan (Kyr), Malawi (Mal), Mauritania (Mau), Mexico (Mex), Mongolia (Mon), Nepal (Nep), Nigeria (Nig), State of Palestine (Sta), Viet Nam (Vie), and Zimbabwe (Zim)

**Fig. 2** Correlation of the scale score from item response theory (IRT) with height-for-age z-score (left) and the learning subscale of the Early Childhood Development Index (right) from MICS5 data on 20 countries



**Fig. 3** Correlation of the scale score from item response theory (IRT) with maternal secondary education or higher (left) and the biological mother being at home (right) from MICS5 data on 20 countries



item bias was small and that the items performed similarly in each country.

## Discussion

Using both classical test theory and item response theory, the Family Care Indicators had concurrent validity for the purpose of global monitoring of countries. Concurrent validity was demonstrated by using correlations to compare the ordering of countries by the Family Care Indicators with the ordering expected from comparison variables. Comparison variables for concurrent validity came both from external data

sources (i.e., gross domestic product and fertility rate) and from the MICS data collapsed to the country level. Regarding the latter, the consistency and magnitudes of the correlations fit theoretical expectations. The highest correlation was with the Early Childhood Development Index, expected given that family care is theorized to directly relate to child development, and the next highest correlation was with maternal education. Correlations were less strong with distal markers of the physical environment such as household crowding. The lowest correlation was with center-based childcare which is not available universally.

The Family Care Indicators functioned equivalently across countries. From item response theory models fitted



to each country, the difficulties of the items (i.e., the proportion endorsing the items or where the items fell along the scale score) were similar across countries. Items exhibited low bias, further evidence that endorsements were similar across countries. The similarity in the functioning of the items across countries means that the Family Care Indicators are scalar equivalent, i.e., scale scores and prevalence, and differences in them, are comparable across countries (Frongillo et al., 2019). Therefore, the Indicators can be used for global comparison of countries on family care.

The validity of the MICS Family Care Indicators for the purpose of differentiating children and their families was previously established in a few studies (Frongillo et al., 2017; Hamadani et al., 2010). Based on these prior studies and on analyses reported in this paper, the item on early stimulation and responsive care from the set of Family Care Indicators will provide a valid and cross-country equivalent indicator for monitoring the percentage of young children experiencing positive and stimulating home environments. Following a meeting in November 2018, the Technical Cooperation Group on SDG 4-Education 2030 Indicators has endorsed use of the MICS Family Care Indicator on positive and stimulating home environments for the measurement of SDG thematic indicator 4.2.3. The other Family Care Indicators are recommended for use in assessing the broader set of family care behaviors and the home environment even if they do not directly reference an SDG thematic indicator. Additional work examining relationships between the Family Care Indicators and child development measures would further establish predictive validity although doing so would require longitudinal studies or surveys that are typically expensive and difficult to implement. Furthermore, currently the indicator on positive and stimulating home environments is only being collected for children aged 24–59 months. Methodological work is needed to identify items relevant for children under age 2 years.

Assessment of the home environment can provide valuable information on access to quality environments that support ECD and early learning. The MICS Family Care Indicators are suitable to assess positive and stimulating home environment for large population surveys. They are easy to use, understood well by participants, take little time to administer, and do not require highly trained personnel for data collection. Most items do not require extensive local adaptation or customization regarding item wording. An interviewer manual includes detailed item descriptions and explanations and is intended for use when training interviewers on how to administer the module.

Interventions and policies that support the provision of positive and stimulating environments and ECD are needed. Effective implementation of interventions requires collaboration, coordination, and integration among multiple

stakeholders and sectors (Britto et al., 2014) such as health, nutrition, education, and social protection (Richter et al., 2017). Interventions that address poverty and social adversity may also assist families to invest in resources that support child care practices and ECD (Shonkoff et al., 2012). Providing stimulating environments and avoidance of harsh disciplinary practices may help all children to reach optimal development, especially children exposed to economic deprivation or environmental toxins (e.g., *p,p'*-dichlorodiphenyldichloroethene, lead) that adversely affect development (Torres-Sánchez et al., 2007; Moodie et al., 2013; Tran et al., 2017).

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare no competing interests.

**Ethical Approval** All procedures were in accordance with the ethical standards of the institutional review board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

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