“Mother’s milk”: Is there a social reversal in breastfeeding practices along with economic development?

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Elodie Rossi[1], Pierre Levasseur[2] and Matthieu Clément[1]

[1] BSE, Université de Bordeaux, CNRS, France.

[2] SADAPT, INRAE, AgroParisTech, Université Paris-Saclay, France.

Abstract:

The purpose of this article is to test the existence of a reversal in the association between household wealth and breastfeeding (BF) behavior throughout the development process of Asian countries. Our empirical investigations are based on 42 Demographic Health Surveys (DHS) conducted in 15 Asian countries with a large time window (1990-2017) aiming to capture the diversity of development levels. We construct four indicators describing adequate BF practices (early initiation of BF, exclusive BF, continued BF at one year and two years) and a harmonized asset-based composite index of household wealth allowing for comparison across DHS waves and countries. To highlight the dynamics of the wealth-BF association, we carry out econometric estimations including interaction terms between household wealth and the country’s level of economic development (low, medium, and high) or time. We also perform instrumental variable estimations aiming to limit suspected endogeneity issues. Our results confirm the existence of a transition in the wealth gradient of exclusive BF and continued BF in Asian countries. More precisely, while these practices are pro-poor in the poorest countries of the sample, they progressively spread to wealthier households along with the level of economic development. For exclusive BF namely, this transition has resulted in a reversal of the wealth gradient at the end of the period (i.e., exclusive BF prevalence among the rich overpassing that of the poor). We fail, however, to observe this kind of transition for early initiation of BF, this practice remaining pro-poor, whatever the level of economic development.

Keywords: Asia; breastfeeding; household wealth; economic development.

JEL: J13; J16; O15.

1. INTRODUCTION

Many infants and young children are not breastfed or breastfed inadequately according to international recommendations (WHO and UNICEF, 2003). These recommendations include early initiation of breastfeeding (EIBF) within one hour after the birth, exclusive breastfeeding (EBF) for the first 6 months and continued breastfeeding (CBF) for up to 2 years (with adequate complementary foods). According to the most recent estimates made by the Global Breastfeeding Collective (WHO and UNICEF, 2018), the prevalence of EIBF, EBF and CBF reaches respectively 42%, 41% and 45% worldwide, which is well below the 2030 international targets (70%, 70% and 60%, respectively). In terms of dynamics, recent evidence shows that breastfeeding practices (BF) have increased in high-income countries since the beginning of the 21st century whereas the trends are more contrasted in developing countries, depending on the BF indicator considered, the geographic zone and the level of development (Neves et al., 2020).

Suboptimal BF behavior (i.e., that does not combine EIBF, EBF and CBF, in line with WHO and UNICEF recommendations) is becoming a major health concern on the global agenda. On the one hand, the public health literature has increasingly emphasized the different health costs of inadequate BF for infants and children (greater exposition to infectious diseases, increased probability of obesity and diabetes, and reduction in cognitive and non-cognitive skills) and for mothers (increased risks of post-partum depression, ovarian and breast cancer, heart disease and type-2 diabetes) (Belfield & Kelly, 2012; Girard et al., 2017; UNICEF, 2018). Nowadays, approximately 600,000 children and 100,000 women may die each year due to inadequate BF behaviors worldwide (Walters et al., 2019). It is worth noting, however, that the purported benefits of good BF practices on infant and child health remains debated in the recent empirical literature. In particular, experimental studies tend to find mixed results regarding the effects of BF on cognitive and non-cognitive development (e.g., Kramer et al., 2007, 2008; Fitzsimons &

Vera-Hernández, 2022). On the other hand, inadequate BF has long-term economic costs, especially reduced educational attainment and labor market outcomes in adulthood (e.g., Fletcher, 2010; Cesur et al., 2017). Walters et al. (2019) estimate the global economic losses associated with not BF to be more than $340.3 billion, accounting for approximately 0.7% of global gross national income (GNI). Understanding the causes of optimal BF is hence crucial to designing effective long-term health policies.

Factors accounting for optimal BF practices are closely linked to the trade-off between breastfeeding and using milk formula. This trade-off is first conditioned by the development of the milk formula market (i.e., the 'supply-side') and especially by changes in the distribution, affordability and marketing of milk substitutes (Baker et al., 2016; Rollins et al., 2016). It is also influenced by the 'demand-side', mothers and their families comparing short-term opportunity costs and long-term health benefits associated with adequate BF, depending on the state of the supply side in the living area (Rippeyoung and Noonan, 2012). Finally, the BF vs. formula trade-off also depends on upstream factors such as access to safe water and healthcare, maternal employment and earnings, patterns of childbearing, psychological and cultural constraints against BF, access to information on BF benefits, and the existence of programs promoting BF (Rippeyoung and Noonan, 2012; Rollins et al., 2016). To sum up, the adoption of optimal BF practices is conditioned on a complex set of factors, combining supply- and demand-side determinants and macro- and micro-level determinants.

From an empirical perspective, many country-specific studies examine the effect of household (or mother) socioeconomic status (SES) on the adoption of optimal BF behaviors, assuming that the BF vs. formula trade-off depends on income, education, wealth, and occupation. While interesting, these studies do not provide general conclusions about the dynamics of the SES-BF association. Moreover, they tend only to consider demand-side microeconomic factors and thus to neglect potential macroeconomic determinants. Based on the idea that macro- and micro-

level factors may jointly influence BF practices, another set of studies adopts a comparative cross-country approach and reveals strong between- and within-country wealth-related heterogeneity regarding BF practices.

First, this strand of the literature suggests that optimal BF prevalence is lower among the richest countries (WHO, 1981; Grummer-Strawn, 1996; Victora et al., 2016; UNICEF, 2018; Neves et al., 2020; Neves, Barros et al., 2021). For instance, Victora et al. (2016) show that, with the exception of EIBF, the prevalence of all BF indicators tends to be lower among rich countries than in developing countries. Many macroeconomic factors account for this heterogeneity, including urbanization, workforce feminization, medicalization of pregnancy and childbirth, and affordability of milk formula and intensity of associated marketing practices (Grummer-Strawn, 1996; Neves et al., 2020).

Second, some of these cross-country studies also reveal that the wealth gradient of BF practices might depend on the level of a country's economic development (Neves, Barros et al., 2021; Neves et al., 2020; Victora et al., 2016). For instance, comparing 98 surveys from low-income and middle-income countries and using mean and variance analyses, Victora et al. (2016) find that the poorest mothers of each country tend to breastfeed longer than richer mothers (i.e., higher CBF), these results being fully confirmed by Neves et al. (2020). These authors consider that, in developing countries, constraints on access to safe water and low affordability of milk formula mainly explain the overrepresentation of CBF among the poorest individuals (even if psychological and cultural obstacles against BF persist). Conversely, as Volk & Franklin (2020) explain, richer women from developing countries tend to benefit from better affordability of formula milk since they usually live in the richest urban neighborhoods. Moreover, formula milk is often used as a social signal by affluent families to stand out from the poor and publicly demonstrate their wealth, prosperity and modernity. The situation observed in high-income countries tells an opposite story. Despite a lower prevalence of appropriate BF practices in these

countries, there is evidence that richer and better-educated women tend to breastfeed more commonly and more adequately compared to under-privileged women (e.g., Jones et al., 2011; Kohlhuber et al., 2008; Oakley et al., 2014; Sarki et al., 2019; Victora et al., 2016). This may be explained by the fact that in rich countries, the diffusion of information about BF benefits as well as the adoption of policies promoting and facilitating BF (maternity leaves, promotion campaigns, creation of BF rooms in the workplace, generalization of right to BF breaks, banning marketing and discounts for first-age formula milk, etc.) may first target wealthy mothers, thus explaining an increase in BF practices among the social elite. In a nutshell, the scarce previous comparative evidence points out the crucial role of the interaction between macro and micro drivers in explaining BF behavior. More specifically, it tends to suggest the existence of a socioeconomic reversal in the wealth gradient of BF along with economic development, i.e., where one country moves from low-income to lower middle-income, upper middle-income and high-income status. This reversal hypothesis has already been extensively explored and confirmed in the case of non-communicable diseases (NCDs) (e.g., Dinsa et al., 2012; Pampel et al., 2012; Zhang et al., 2023). However, the evidence remains scarce regarding optimal BF practices.

Asian countries are particularly concerned about BF challenges (Lee and Binns, 2019; Torlesse and Raju, 2018; Walters et al., 2019, 2016). Torlesse & Raju (2018) observe that, although improvements were reached between 2000 and 2016 regarding EIBF, both EBF and CBF prevalence has only marginally increased. Given the demographic weight of Asia, the costs of not BF are particularly high in this region, accounting for approximately 37% of global economic losses according to Walters et al. (2019). Paradoxically, except for Benedict et al. (2018) who provide partial comparative evidence for five countries from South Asia, no systematic study analyzing between- and within-country wealth disparities in BF practices in Asia was published to our knowledge. Likewise, country-specific studies failed to provide clear

results regarding the wealth-BF association in Asia (Bhandari et al., 2019; Chandhiok et al., 2015; Gayatri and Dasvarma, 2020; Hazir et al., 2013; Kounnavong et al., 2013; Ogbo et al., 2019; Rahman et al., 2020; Senarath et al., 2012; Um et al., 2020; Yadanar et al., 2020). This lack of clear evidence underscores the importance of conducting a cross-country comprehensive analysis at the Asian continent scale. Such a macro-regional overview allows to go beyond country specificities affecting BF practices (e.g., perception of breastfeeding or characteristics of the milk-substitute-market) and contributing to the complexity of the wealth-BF association. Based on this cross-country approach, we are also able to investigate whether and to what extent the association changes across time and countries' development level.

This article aims to test the social reversal hypothesis in Asian countries and to provide robust econometric evidence on between- and within-country wealth-related disparities in BF practices. To do so, we rely on the combination of 42 Demographic and Health Surveys (DHS) waves covering 15 Asian countries with a large time window to test the existence of a reversal in the wealth-BF association throughout the development process. We construct four breastfeeding indicators (EIBF, EBF, CBP up to 1 and 2 years), asset-based composite indices of household wealth allowing for comparison across DHS waves and indicators of economic development. Based on linear and instrumental variables econometric estimations, our results for Asian countries confirm the existence of a transition in the wealth gradient of EBF and CBF in Asian countries. More precisely, while these practices are pro-poor (i.e., more common among poor households) in the poorest countries of the sample, we emphasize a decrease in the negativity of their association with household wealth along with the level of economic development (i.e., an increase in the prevalence for the rich and a decrease for the poor). For EBF, this transition has resulted in a reversal of the wealth gradient at the end of the period (i.e., EBF prevalence among the rich overpassing that of the poor). We fail however to observe this

kind of transition for EIBF, this practice remaining pro-poor whatever the level of economic development.

This article has several major contributions. To the best of our knowledge, it is the first to econometrically demonstrate from a large sample of developing countries the occurrence of a shift in the wealth-BF association across levels of economic development. The existing cross-country literature on the topic mainly relies on descriptive statistics, mostly through the use of variance decomposition analyses (e.g., Victora et al., 2020; Nevel et al., 2020). While these studies are undoubtedly valuable, they only inform about the existence of bivariate correlations between household socioeconomic status, BF practices and development levels. Adopting an econometric multivariate approach allows to control for potential confounding factors (i.e., important determinants of BF practices correlated with wealth) that could bias bivariate analyses. It also offers the possibility of carrying out endogeneity-correction methods to go beyond crude correlations and identify potential effects. Finally, econometric methods are well suited to explore more in-depth the interactive effects of household wealth and development levels on BF practices. Consequently, based on econometric tools, this article enriches the scant literature examining the influence of the interaction between macro- and micro-level factors on BF practices and provides interesting insights regarding the design of BF promotion policies.

The rest of the article is structured as follows. Section 2 describes the dataset and the construction of the variables of interest. The econometric methodology and the results are respectively presented in Sections 3 and 4. Section 5 concludes, discusses our main findings and provides policy recommendations.

2. DATA AND VARIABLES CONSTRUCTION

Data and sample restrictions

This study is based on data from the Demographic and Health Surveys (DHS), which are collected through a collaboration between the United States Agency for International Development (USAID) and its technical partners, including ICF International. The main objectives of DHS data are to track demographic, health and nutrition patterns in developing countries, in order to facilitate public health and development research and enable informed decision-making in these domains. The data provide a nationally representative snapshot of a wide range of population, health, and nutrition indicators collected from women aged 15-49 and their children under five years old. These data allow for comparing countries over time as the DHS program applied standard procedures and methodologies. In this study, we focus on data available for the Asian continent. As shown in Table S1 in Supplementary Materials, we first compiled data from 62 DHS collected in 20 countries distributed across South Asia (6 countries), Europe & Central Asia (7 countries), and East Asia & the Pacific (7 countries), including low-income, lower-middle-income and upper-middle-income countries. However, due to data availability and comparability constraints for the construction of our development level and household wealth indicators, we finally were able to pool 42 DHS covering 15 countries from 1990 to 2017. We argue that the period and the number of countries covered are large enough to reflect a potential shift in the wealth gradient of BF practices according to different stages of development and time. After sample restrictions, the whole dataset is composed of 3,030,568 observations.

Outcome variables

Based on the WHO (2021)'s report, four indicators of optimal BF practices are considered and constructed in this study: (1) early initiation of breastfeeding (EIBF) is a dummy indicating whether children born in the past 24 months were put to the breast within an hour of birth; (2) exclusive breastfeeding (EBF) is a dummy indicating whether infants aged 0-5 months are fed exclusively with breastmilk; (3) continued breastfeeding at one year (CBF1) is a dummy

indicating whether children aged 12-15 months are still fed with breast milk, and (4) continued breastfeeding at two years (CBF2) is a dummy indicating whether children aged 20-23 months are still fed with breast milk. Table S2 in Supplementary Materials reports the sample means of the four BF indicators for each country and wave.

Construction of household wealth indices

To construct a standardized measure of household wealth allowing comparison across countries and DHS waves, we employed a principal component analysis (PCA) to reduce multidimensional information into a composite index. Specifically, our synthetic index includes seven variables accounting for consumer durables ownership (radio, TV, refrigerator, bicycle, motorcycle, car, and phone), two variables describing access to public facilities (water and electricity), and three variables describing housing conditions (number of sleeping rooms, quality of floor material, and toilet facility). In this study, we primarily focused on the PCA-based wealth index because it is the most used in the related literature, but as robustness checks, we also considered a multiple component analysis (MCA) to calculate a comparable index (using the same core variables as for the PCA). More details about calculating the wealth index and related PCA and MCA approaches are available in Textbox S1 in Supplementary Materials. The sample means of the PCA-based wealth index for each country and wave can be found in Table S2 in Supplementary Materials.

Construction of development-level categories

Another purpose of this study is to analyze how the association between BF practices and household wealth varies according to the level of development. Our initial idea was to use the World Bank's classification of countries by income levels for each survey wave.[1] Unfortunately, applied to our sample of Asian countries, this classification failed to capture enough

[1] Each year, this classification is adjusted based on GNI per capita in current US dollars, converted from local currency using the World Bank Atlas method exchange rates.

heterogeneity in terms of stages of development, with too many Asian countries being classified into the upper-middle income group. Consequently, we decided to generate our own cutoffs based on the sample distribution. More specifically, we collected information on the GDP per capita in PPP (constant 2017 international $), GNI per capita in PPP (constant 2017 international $) and human development index (HDI) for each country and survey year from the World Development Indicators of the World Bank. Then, we split these three indicators of national development into tercile groups (low, medium, and high), as shown in Table S8 in Supplementary Materials (each DHS wave by country representing a statistical unit). We decided to keep the classification based on GNI per capita PPP (constant 2017 international $) for the baseline analysis and used the other classification methods (with GDP and HDI) as robustness checks. The GNI-based category for country and wave is reported in Table S2 in Supplementary Materials.

Control variables

The econometric models (defined below) include a comprehensive set of covariates that the literature has hypothesized to be important determinants of BF behaviors (Bhandari et al., 2019; Chandhiok et al., 2015; Gayatri and Dasvarma, 2020; Hazir et al., 2013; Kounnavong et al., 2013; Ogbo et al., 2019; Rahman et al., 2020; Senarath et al., 2012; Um et al., 2020; Yadanar et al., 2020). The infant's characteristics include sex, age (in months), birth order, birth interval (in months), size at birth (5-point score), and information about multiple births. Obstetric data include the wantedness of pregnancy, the number of antenatal visits, the mode of delivery (C-section or not), and the place of delivery (at home or not). The mother's characteristics include her age (in years), marital status (married or not), number of children and level of education (no education; primary; secondary; higher). In addition to the wealth index (see above), we include the place of residence (urban or rural) to account for household characteristics and control for dummies specific to each round of DHS surveys. We also considered alternative covariates only

for robustness checks insofar as, due to various missing values, their introduction resulted in a significant loss of observations: mother's BMI (body mass index), mother's employment (yes or no), and religion (Muslim, Christian, Hindu, Buddhist, and others). Summary descriptive statistics for each covariate are reported in Table S9 in Supplementary Materials.

3. ECONOMETRIC FRAMEWORK

Using linear probability models estimated through OLS, our baseline models (Eq.1) separately regress the four BF practices (EIBF, EBF, CBF1, CBF2) a mother applied for a child *i* (BF_i) on the wealth index of a household *j* ($Wealth_j$), the category of economic development *k* (low, medium or high) a country belongs to (Dev_k), and a comprehensive set of covariates measured at the child level (X_i) and at the household level (X_j) recognized as important determinants of the choice to adopt or not a given BF behavior in the related literature (see previous subsection). We also include dummies for each round of DHS taking into account the dynamics of BF practices during the period (ω_t).

$$BF_i = \beta_0 + \beta_1 Wealth_j + \beta_2 Dev_k + \beta_3 X_i + \beta_4 X_j + \omega_t + \varepsilon_i \quad \textbf{[1]}$$

Then, to investigate potential changes in the wealth-BF relationship across economic development stages, Eq.2 includes an interaction term between household wealth and the category of economic development (low vs. medium vs. high). This interaction model can be expressed as follows:

$$BF_i = \alpha_0 + \alpha_1 Wealth_j + \alpha_2 Dev_k + \alpha_3 Wealth_j * Dev_k + \alpha_4 X_i + \alpha_5 X_j + \omega_t + \mu_i \quad \textbf{[2]}$$

In an alternative OLS model, we also test potential differences in the evolution of BF behaviors across wealth groups and time. Specifically, we introduce as regressors interaction terms

between the survey year (varying from 1990 to 2017) and household wealth index split into quintile groups (calculated from country- and time-specific subsamples).

Finally, we test the robustness of OLS estimates regarding the potential presence of endogeneity using an IV approach based on a two-stage least square (2SLS) estimation. Indeed, the wealth-BF association is assumed to be endogenous because of the potential omission of unobserved wealth determinants that also correlate with mothers' choices, such as mothers' employment status, occupation, and hours worked. One may assume, for instance, that unemployed or partial-time working mothers are more likely to adopt recommended BF behaviors, but may also be concerned with lower household wealth accumulation. Hence, the overrepresentation of unemployed (or partially employed) women among low-wealth households may overstate the negative association between household wealth and the adoption of optimal BF behaviors. In practice, the 2SLS estimator works in two steps: step 1 regresses the household wealth index on the selected instruments and covariates; step 2 regresses BF indicators on fitted values of household wealth (from step 1) and covariates.

Identifying a relevant instrument is challenging, as it must satisfy two requirements: being a significant determinant of household wealth (relevance condition) and uncorrelated to unobserved variations of BF indicators (exogeneity condition). In the health economics literature, spatially aggregated socioeconomic or demographic variables are commonly used to instrument household wealth since they are outside the control of individuals and households and thus may be treated as exogenous (Kim et al., 2010; Barnes et al., 2013; Kpelitse et al., 2014; Bonnefond & Clément, 2014; Clément, 2017; Daran & Levasseur, 2022). Based on this approach, we propose to instrument household wealth with the average height of mothers at the PSU level, excluding the household *i*. In line with the literature, this instrument may be considered as relevant as it is a metabolic driver of economic success: the tallest tend to be the wealthiest because a large proportion of them reached their full cognitive potential. In contrast,

an important proportion of relatively more minor individuals did not reach it (Case and Paxson, 2008). The strength of the instrument is tested in the next section. Regarding the exogeneity condition, there is no reliable empirical test that we are able to implement. Nonetheless, one can reasonably assume that a mother does not choose to breastfeed or not breastfeed based on the average height of her community.

4. RESULTS

4.1. Descriptive evidence

Figure 1 presents the dynamics of BF behaviors in Asia over time (i.e., using DHS rounds). The rate of EIBF significantly improved in the region between round 2 (early 1990s) and round 7 (late 2010s), increasing from 12% to 55%. We also observe an increase in the rate of EBF (from 38% to 52%), though to a lesser extent than EIBF. CBF (CBF1 and CBF2) that was already high in the early 1990s (above 80% for CBF1 and close to 60% for CBF2) slightly decreased over the period. Broadly speaking, our results align with previous estimates (e.g., Torlesse & Raju, 2018).

To go further, Table 1 shows that both CBF rates tend to decline with the level of economic development (i.e., higher rates observed in low-income countries), while the reverse is true for EIBF and EBF. Detailed statistics for the countries included in the sample can be found in Table S2 in Supplementary Materials.

Insert Figure 1 and Table 1

Then, to provide descriptive evidence on the association between BF behaviors, household wealth and economic development, Figure 2 presents graph bars of BF indicators across household wealth quintiles (specific to each country and period) and levels of GNI per capita (low, medium, and high). We observe a convergence process of BF practices across wealth quintiles and economic development. Put differently, household wealth-related disparities tend

to be less pronounced in high-income countries compared to low- or medium-income countries. However, once again, we detect the presence of heterogeneity according to the BF indicator considered. For EBF, there is evidence of a negative association between the prevalence of such behaviors and household wealth in low-income countries and then a decrease in the negativity of the association in high-income countries, indicating a process of catching up by the rich. For other BF indicators, the results are less clear.

Insert Figure 2

To sum up, all these findings suggest the existence of a transition in the BF-wealth association along with a country's economic development, which could be different according to the BF indicator considered. This preliminary evidence calls for further inferential analysis.

4.2. Econometric evidence

Table 2 presents the baseline OLS estimates of Eq.1 and Eq.2 for each BF behavior considered (EBF, EIBF, CBF1 and CBF2). In these estimates, the PCA approach and the GNI per capita in $PPP are used for computing the household wealth index (0-to-1 score) and the three categories of economic development (low, medium, and high). The corresponding full regression results (including control variables) are available in Table S10 in the Supplementary Materials.

Insert Table 2

OLS estimates of Eq.1 (linear specification) show negative associations between household wealth and each BF indicator, thus indicating that the adoption of adequate BF practices tends to decrease with household wealth. The results are particularly interesting when we refer to the interaction model specification (Eq.2), for which we plotted marginal effects in Figure 3. Based on this figure and Table 2, we observe a decrease in the negativity of the association of EBF and CBF with household wealth along with economic development (even though the interaction

terms are not significant for CBF1). These results are important insofar as they provide evidence of a transition in the wealth gradient of these BF indicators when a country shifts from low- to medium- and high-GNI status. More precisely, this transition is characterized by a rise in the prevalence of EBF and CBF among the rich (especially pronounced for EBF) and a decrease among the poor, as the level of economic development increases. This indicates the occurrence of a process of social convergence of such BF practices. In contrast, this process is not observed for EIBF; this practice remains pro-poor whatever the level of economic development.

Insert Figure 3

Insert Figure 4

With the alternative OLS model including interaction terms between household wealth quintiles and survey years (from 1990 to 2017), we investigate potential temporal dynamics in the process of social convergence of BF practices. Fitted coefficients resulting from these estimates are presented in Figure 4 (full regression results in Table S11 in Supplementary Materials). For EBF, we observe a clear reversal of the wealth-BF association across time. More precisely, while wealth inequality in EBF was substantial at the beginning of the period with higher rates observed among the poorest households, we note a social convergence in the 2000s driven by an increase in EBF prevalence greater among rich households than among poor households. As a result, wealth-related disparities slowly reversed during the 2010s, EBF becoming more prevalent among the wealthiest households. A quite similar process of catching-up of the rich throughout the period is also observed for EIBF. However, this process is less marked and more progressive since it has not yet been followed by a reversal of the wealth gradient, the rates of EIBF at the end of the period being very similar across wealth quintiles. For CBF2, we also emphasize a process of convergence but of a very different nature. Indeed, CBF2 was more prevalent among rich households at the beginning of the period. The catching-up of the poor thus characterizes the convergence process. Last, although Figure 4 suggests a certain

converging trend across wealth groups for CBF1, these observed changes across time are not significant (Table S11).

Insert Table 3

Finally, we adopt an IV approach to limit endogeneity issues that could bias OLS estimates. More precisely, we perform 2SLS estimations using average mothers' height at the PSU level (and its interacted declinations for the interaction model specification) as an instrument for household wealth. The results from first-stage regressions are available in Table S12 in Supplementary Materials and confirm that our instrument is a good predictor of household wealth and thus satisfies the relevance condition, as shown by F-statistics and partial R-squared on the excluded instruments. IV regressions are summarized in Table 3 (full results in Table S13 in Supplementary Materials). Broadly speaking, IV estimates are consistent with OLS estimates. First, the linear associations between household wealth and each BF indicator remain negative and significant. Second, when interacting the household wealth classification and the level of a country's economic development (based on GNI per capita), IV regressions continue to suggest a social reversal for EBF and CBF2 along with the economic development level, this reversal being particularly meaningful for EBF. In contrast, as observed with OLS estimates, IV regressions fail to identify a significant social change in EIBF and CBF1 as a country develops.

4.3. Robustness checks

Estimating Eq.1 and Eq.2 using alternative measures of household wealth (MCA approach instead of PCA approach) or development levels (GDP per capita in $PPP and HDI instead of GNI per capita) tend to confirm our baseline results and provide even more significant evidence of the process of social convergence identified previously. More specifically, while OLS estimates in Table 2 only support the idea of a social convergence process along with economic

development for EBF and CBF2 in high-income countries, several of these alternative estimates emphasize such process for EIBF and CBF1 too. The complete results can be found in Tables S14, S15 and S16 in Supplementary Materials.

We also carry out complementary econometric estimations of Eq.1 and Eq.2, including additional covariates that are important determinants of BF behaviors: mother's BMI, mother's employment, and religious affiliation dummies. We chose to exclude these control variables from previous estimates (Table 2) due to the drop in the number of observations it would have implied. These alternative estimates are reported in Table S17 in Supplementary Materials. Despite the reduction in the number of observations, the findings remain consistent with Table 2. Nonetheless, looking at Table S17, one could be surprised to see a positive correlation between maternal employment and optimal BF behaviors, which differs from the literature results (Rivera-Pasquel et al., 2015). However, our indicator of maternal employment/unemployment is imperfect since it measures the current employment status (i.e., when the survey was collected) and not the employment status after birth. Consequently, this surprising result could simply reflect the fact that Asian women having access to work also tend to have better access to antenatal visits and hospitals for birth than women excluded from the labor market, and so the former might be more aware of BF-related information than the latter and more likely to breastfeed.

5. DISCUSSION AND CONCLUSION

Based on a large sample of Asian countries and a large time window (1990-2017), this paper is the first to econometrically analyze the socioeconomic drivers of optimal BF practices, considering conjointly micro- and macro-economic drivers. Specifically, OLS and IV approaches were combined to estimate potential changes in the relationship between household wealth (a synthetic 0-to-1 score measured with factorial methods) and several BF indicators (EBF, EIBF, CBF1, and CBF2) according to the stage of economic development a country

belongs to (low, medium, or high). We also carried out several robustness checks (alternative measures of household wealth and economic development of countries and additional covariates). Our investigations provide new insights on the socioeconomic dynamics of BF practices and highlight interesting differences across BF indicators.

We emphasize a clear reversal in the wealth gradient of EBF characterized by the decrease of the negativity of the association between household wealth and EBF prevalence when one country moves from low- to medium- and high-income status. Put differently, this indicates that EBF tends to shift progressively from the poor to the rich along with economic development. A time-based analysis shows that this social reversal is characterized by a stronger increase in EBF prevalence for rich households than for poor households. As a result, EBF prevalence has become higher among the rich at the end of the period. Our results on EBF align with the cross-country study of Neves, Barros, et al. (2021) showing that, in countries from East Asia and Pacific and South Asia, the increase in EBF prevalence is higher among better-educated mothers. Some recent country-specific studies also confirm this trend, for instance in the case of Indonesia (Saputri et al., 2020) or India (Ghosh et al., 2022). The reversal in the wealth gradient of EBF might be driven by the implementation of baby-friendly hospital initiatives (namely including prenatal follow-ups, and hospitalization of births) that have disproportionally contributed to reducing the use of pre-lacteal feeds among the richest households for whom this risky practice was widespread (Neves et al., 2021). There is increasing but still limited evaluation literature assessing the implementation of such initiatives (e.g., Walsh et al., 2023; World Bank, 2019) and their impact on BF behavior and infant and child health outcomes (e.g., Pérez-Escamilla et al., 2016; Zhang et al., 2020). Conversely, the low increase in EBF observed among the poor across time and economic development is particularly worrying and should draw the attention of public health authorities. Several reasons may explain this tendency in Asia, including the increasing inclusion of poor women in the labor market and their strong

sensitivity to formula milk marketing (Baker et al., 2016). Hence, future BF policies should specifically target poorer households by reducing opportunity costs associated with EBF through, for example, (i) the introduction of maternity leaves (or the increase in their duration and monetary compensations) for (low income) working women (Kottwitz et al., 2016; Navarro-Rosenblatt and Garmendia, 2018), (ii) the implementation of conditional cash transfers for unemployed women and/or vulnerable households (Powell-Jackson et al., 2015), and (iii) the provision of nursery and lactating rooms by the employers, especially in low-profile jobs in which such facilities are often missing (Kim et al., 2019). In addition, implementing targeted promotion campaigns and regulating the formula milk market appear as necessary to limit the adoption of inappropriate BF practices among the poorest, and thus to avoid an increase in future health inequalities (Agampodi et al., 2021).

Our empirical investigations reveal similar trends, albeit less pronounced, for BF duration. Indeed, while CBF relatively remains a pro-poor practice in Asian countries with low and medium GNI, we observe a form of social convergence in CBF among Asian developing countries with higher GNI, especially for long CBF (i.e., CBF2). This social homogenization in CBF across economic development might have the same drivers as discussed above for EBF, such as the implementation of pro-rich oriented baby-friendly hospital initiatives, the entrance of poor women in the labor market, and the socially targeted marketing of the formula milk industry. However, one should note that contrary to EBF which has increased during the period, CBF prevalence has decreased. If we take a step back though, this fall is not so surprising. In fact, CBF is primarily recommended by the WHO in highly deprived contexts where breastmilk substitutes are potentially contaminated or of bad nutritional quality. CBF, and especially CBF2, can therefore be considered of lower importance for infant health in richer environments where clean water and baby food are accessible for all. It is probably why the WHO considers

CBF2 as an optional indicator for the assessment of infant feeding practices rather than a core indicator (WHO, 2010).

Regarding EIBF, although this practice has highly increased over time, the wealth gradient does not significantly change along with economic development, remaining globally negative (i.e., mostly a pro-poor practice). This result is once again consistent with Neves, Barros, et al. (2021) who observe a similar increase in EIBF among all educational groups. This generalized increase in EIBF among Asian populations may first be attributed to important improvements in prenatal follow-ups and a crude reduction in births at home (Doctor et al., 2019). Some authors like Sharma & Byrne (2016) also explain that BF acceptability has increased in South Asia in the last decades thanks to a decline in traditional cultural barriers (e.g., religious-based and popular beliefs) combined with empowerment of young women (e.g., a lower influence of mother-in-law advice). Despite this generalized improvement in EIBF, the lower prevalence observed among richer households reflects a potential persistence of constraints limiting a more important diffusion of EIBF in Asian societies. According to the public health literature, the overuse of C-sections among the richest households in developing countries might be one of these constraints (Roy et al., 2021); the proliferation of public and private C-sections negatively affecting EIBF (Li et al., 2021; Vaz et al., 2022). Consequently, regulating C-section is likely to be a lever to reduce the social gap in EIBF in developing Asian countries.

To sum up, our results provide original evidence on the occurrence of a transition in the wealth gradient of BF practices along with economic development in Asia. For EBF, this transition has resulted in a reversal of the gradient (i.e., EBF rates being higher among the rich at the end of the period). Based on our findings, we may also speculate that this reversal might occur shortly for CBF as it is nowadays observed in high-income countries. By contrast, the future social distribution of EIBF is more uncertain and should be monitored.

Our results undoubtedly echo the literature exploring a reversal in the social gradient of NCDs, which emphases that the burden of obesity, diabetes, hypertension and cardiovascular diseases progressively shift from higher-SES groups to lower-SES groups along with economic development, urbanization and globalization (e.g., Dinsa et al., 2012; Jung et al., 2019; Pampel et al., 2012; Zhang et al., 2023). This literature provides interesting insights that helps to better understand our results and their implications in terms of public policy. Indeed, this literature identifies several pathways that may also contribute to explain the social reversal in BF practices. For instance, we can assume that the lack of health literacy and knowledge of public health recommendations among poorer and less educated individuals is a risk factor for both NCDs and inappropriate nutritional behaviors such as not BF (Hoffmann and Lutz, 2019). Further, it seems that both NCDs burden and inappropriate BF practices are directly connected, at least in the long run. As documented by the literature (e.g. Horta et al., 2023; Stoody et al., 2019; Victora et al., 2016), having been exposed to non-optimal BF practices at young ages increases the risk of NCDs at adulthood. Hence, the progressive shift of inappropriate BF practices from the rich to the poor may reinforce the prevalence of NCDs among the most vulnerable populations some decades later, and then generate a form of vicious circle. From a public health perspective, this means that promoting optimal BF practices, especially among under-privileged social groups, should be considered as a policy lever to fight against NCDs.

Obviously, this work has some limitations. For instance, our sample does not include Asian high-income countries in the sense of the World Bank's classification, and so does not allow us to thoroughly test the social reversal hypothesis along with the process of economic development. Moreover, because of a lack of data, we do not control our estimates for supply-side factors, like information on the formula milk market in the living area (e.g., sells and market value). Despite such limitations, this work is a first step for future research that should focus on the transmission pathways between household socioeconomic status and BF practices.

Examining how maternal employment, BF policy interventions, formula market conditions, and changes in cultural norms may drive the wealth-BF gradient transition are important research avenues. Further, to better identify causality, we also encourage experimental and quasi-experimental impact assessments of baby-friendly hospital initiatives, labor reforms and social safety nets (e.g., maternity leave, and conditional cash transfers) on BF indicators, focusing on heterogeneous effects according to household socioeconomic status.

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REFERENCES

Agampodi, T.C., Dharmasoma, N.K., Koralagedara, I.S., Dissanayaka, T., Warnasekara, J., Agampodi, S.B., Perez-Escamilla, R., 2021. Barriers for early initiation and exclusive breastfeeding up to six months in predominantly rural Sri Lanka: a need to strengthen policy implementation. Int. Breastfeed. J. 16, 1–12.

Baker, P., Smith, J., Salmon, L., Friel, S., Kent, G., Iellamo, A., Dadhich, J.P., Renfrew, M.J., 2016. Global trends and patterns of commercial milk-based formula sales: is an unprecedented infant and young child feeding transition underway? Public Health Nutr. 19, 2540–2550.

Barnes, M.G., Smith, T.G., Yoder, J.K., 2013. Effects of household composition and income security on body weight in working-age men. Obesity 21, E483–E489. https://doi.org/10.1002/oby.20302

Belfield, C.R., Kelly, I.R., 2012. The Benefits of Breast Feeding across the Early Years of Childhood. J. Hum. Cap. 6, 251–277. https://doi.org/10.1086/667415

Bhandari, S., Thorne-Lyman, A.L., Shrestha, B., Neupane, S., Nonyane, B.A.S., Manohar, S., Klemm, R.D.W., West, K.P., 2019. Determinants of infant breastfeeding practices in Nepal: a national study. Int. Breastfeed. J. 14, 14. https://doi.org/10.1186/s13006-019-0208-y

Bonnefond, C., Clément, M., 2014. Social class and body weight among Chinese urban adults: The role of the middle classes in the nutrition transition. Soc. Sci. Med. 112, 22–29. https://doi.org/10.1016/j.socscimed.2014.04.021

Case, A., Paxson, C., 2008. Stature and status: Height, ability, and labor market outcomes. J. Polit. Econ. 116, 499–532. https://doi.org/10.1086/589524

Cesur, R., Sabia, J.J., Kelly, I.R., Yang, M., 2017. The effect of breastfeeding on young adult wages: new evidence from the add health. Rev. Econ. Househ. 15, 25–51.

Chandhiok, N., Singh, K.J., Sahu, D., Singh, L., Pandey, A., 2015. Changes in exclusive breastfeeding practices and its determinants in India, 1992-2006: analysis of national survey data. Int. Breastfeed. J. 10, 34. https://doi.org/10.1186/s13006-015-0059-0

Clément, M., 2017. The income-body-size gradient among Chinese urban adults: A semiparametric analysis. China Econ. Rev. 44, 253–270. https://doi.org/10.1016/j.chieco.2017.05.003

Daran, B., Levasseur, P., 2022. Is overweight still a problem of rich in sub-Saharan Africa? Insights based on female-oriented demographic and health surveys. World Dev. Perspect. 25, 100388. https://doi.org/10.1016/j.wdp.2021.100388

Dinsa, G.D., Goryakin, Y., Fumagalli, E., Suhrcke, M., 2012. Obesity and socioeconomic status in developing countries: a systematic review. Obes. Rev. 13, 1067–1079. https://doi.org/10.1111/j.1467-789X.2012.01017.x

Doctor, H.V., Radovich, E., Benova, L., 2019. Time trends in facility-based and private-sector childbirth care: analysis of Demographic and Health Surveys from 25 sub-Saharan African countries from 2000 to 2016. J. Glob. Health 9.

Fitzsimons, E., Vera-Hernández, M., 2022. Breastfeeding and Child Development. Am. Econ. J. Appl. Econ. 14, 329–366. https://doi.org/10.1257/app.20180385

Fletcher, J.M., 2010. Adolescent depression and educational attainment: results using sibling fixed effects. Health Econ. 19, 855–871. https://doi.org/10.1002/hec.1526

Gayatri, M., Dasvarma, G.L., 2020. Predictors of early initiation of breastfeeding in Indonesia: A population-based cross-sectional survey. PloS One 15, e0239446. https://doi.org/10.1371/journal.pone.0239446

Ghosh, P., Rohatgi, P., Bose, K., 2022. Determinants of time-trends in exclusivity and continuation of breastfeeding in India: An investigation from the National Family

Health Survey. Soc. Sci. Med. 292, 114604. https://doi.org/10.1016/j.socscimed.2021.114604
Girard, L.-C., Doyle, O., Tremblay, R.E., 2017. Breastfeeding, Cognitive and Noncognitive Development in Early Childhood: A Population Study. Pediatrics 139, e20161848. https://doi.org/10.1542/peds.2016-1848
Grummer-Strawn, L.M., 1996. The effect of changes in population characteristics on breastfeeding trends in fifteen developing countries. Int. J. Epidemiol. 25, 94–102. https://doi.org/10.1093/ije/25.1.94
Hazir, T., Akram, D.-S., Nisar, Y.B., Kazmi, N., Agho, K.E., Abbasi, S., Khan, A.M., Dibley, M.J., 2013. Determinants of suboptimal breast-feeding practices in Pakistan. Public Health Nutr. 16, 659–672. https://doi.org/10.1017/S1368980012002935
Hoffmann, R., Lutz, S.U., 2019. The health knowledge mechanism: evidence on the link between education and health lifestyle in the Philippines. Eur. J. Health Econ. 20, 27–43. https://doi.org/10.1007/s10198-017-0950-2
Horta, B.L., Rollins, N., Dias, M.S., Garcez, V., Pérez-Escamilla, R., 2023. Systematic review and meta-analysis of breastfeeding and later overweight or obesity expands on previous study for World Health Organization. Acta Paediatr. 112, 34–41. https://doi.org/10.1111/apa.16460
Jones, J.R., Kogan, M.D., Singh, G.K., Dee, D.L., Grummer-Strawn, L.M., 2011. Factors associated with exclusive breastfeeding in the United States. Pediatrics 128, 1117–1125. https://doi.org/10.1542/peds.2011-0841
Jung, L., De Neve, J.-W., Chen, S., Manne-Goehler, J., Jaacks, L.M., Corsi, D.J., Awasthi, A., Subramanian, S.V., Vollmer, S., Bärnighausen, T., Geldsetzer, P., 2019. The interaction between district-level development and individual-level socioeconomic gradients of cardiovascular disease risk factors in India: A cross-sectional study of 2.4 million adults. Soc. Sci. Med. 239, 112514. https://doi.org/10.1016/j.socscimed.2019.112514
Kim, D., Leigh, J.P., 2010. Estimating the Effects of Wages on Obesity. J. Occup. Environ. Med. 52, 495–500. https://doi.org/10.1097/JOM.0b013e3181dbc867
Kim, J.H., Shin, J.C., Donovan, S.M., 2019. Effectiveness of Workplace Lactation Interventions on Breastfeeding Outcomes in the United States: An Updated Systematic Review. J. Hum. Lact. 35, 100–113. https://doi.org/10.1177/0890334418765464
Kohlhuber, M., Rebhan, B., Schwegler, U., Koletzko, B., Fromme, H., 2008. Breastfeeding rates and duration in Germany: a Bavarian cohort study. Br. J. Nutr. 99, 1127–1132. https://doi.org/10.1017/S0007114508864835
Kottwitz, A., Oppermann, A., Spiess, C.K., 2016. Parental leave benefits and breastfeeding in Germany: effects of the 2007 reform. Rev. Econ. Househ. 14, 859–890.
Kounnavong, S., Pak-Gorstein, S., Akkhavong, K., Palaniappan, U., Berdaga, V., Conkle, J., Gorstein, J., 2013. Key Determinants of Optimal Breastfeeding Practices in Laos. Food Nutr. Sci. 4, 61–70. https://doi.org/10.4236/fns.2013.410A010
Kpelitse, K.-A., Devlin, R., Sarma, S., 2014. The Effect of Income on Obesity among Canadian Adults [WWW Document]. undefined. URL /paper/The-Effect-of-Income-on-Obesity-among-Canadian-Kpelitse-Devlin/d0a5d5c70f907b827d9e6ecd16d6d70e15ee8ccc (accessed 9.27.20).
Kramer, M.S., Aboud, F., Mironova, E., Vanilovich, I., Platt, R.W., Matush, L., Igumnov, S., Fombonne, E., Bogdanovich, N., Ducruet, T., Collet, J.-P., Chalmers, B., Hodnett, E., Davidovsky, S., Skugarevsky, O., Trofimovich, O., Kozlova, L., Shapiro, S., Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group, 2008. Breastfeeding and Child Cognitive Development: New Evidence From a Large Randomized Trial. Arch. Gen. Psychiatry 65, 578–584. https://doi.org/10.1001/archpsyc.65.5.578

Kramer, M.S., Matush, L., Vanilovich, I., Platt, R.W., Bogdanovich, N., Sevkovskaya, Z., Dzikovich, I., Shishko, G., Collet, J.-P., Martin, R.M., Davey Smith, G., Gillman, M.W., Chalmers, B., Hodnett, E., Shapiro, S., Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group, 2007. Effects of prolonged and exclusive breastfeeding on child height, weight, adiposity, and blood pressure at age 6.5 y: evidence from a large randomized trial. Am. J. Clin. Nutr. 86, 1717–1721. https://doi.org/10.1093/ajcn/86.6.1717

Lee, M.K., Binns, C., 2019. Breastfeeding and the Risk of Infant Illness in Asia: A Review. Int. J. Environ. Res. Public. Health 17, E186. https://doi.org/10.3390/ijerph17010186

Li, L., Wan, W., Zhu, C., 2021. Breastfeeding after a cesarean section: A literature review. Midwifery 103, 103117. https://doi.org/10.1016/j.midw.2021.103117

Navarro-Rosenblatt, D., Garmendia, M.-L., 2018. Maternity Leave and Its Impact on Breastfeeding: A Review of the Literature. Breastfeed. Med. 13, 589–597. https://doi.org/10.1089/bfm.2018.0132

Neves, P.A.R., Barros, A.J.D., Gatica-Domínguez, G., Vaz, J.S., Baker, P., Lutter, C.K., 2021. Maternal education and equity in breastfeeding: trends and patterns in 81 low- and middle-income countries between 2000 and 2019. Int. J. Equity Health 20, 20. https://doi.org/10.1186/s12939-020-01357-3

Neves, P.A.R., Gatica-Domínguez, G., Rollins, N.C., Piwoz, E., Baker, P., Barros, A.J.D., Victora, C.G., 2020. Infant Formula Consumption Is Positively Correlated with Wealth, Within and Between Countries: A Multi-Country Study. J. Nutr. 150, 910–917. https://doi.org/10.1093/jn/nxz327

Oakley, L.L., Henderson, J., Redshaw, M., Quigley, M.A., 2014. The role of support and other factors in early breastfeeding cessation: an analysis of data from a maternity survey in England. BMC Pregnancy Childbirth 14, 88. https://doi.org/10.1186/1471-2393-14-88

Ogbo, F.A., Dhami, M.V., Awosemo, A.O., Olusanya, B.O., Olusanya, J., Osuagwu, U.L., Ghimire, P.R., Page, A., Agho, K.E., 2019. Regional prevalence and determinants of exclusive breastfeeding in India. Int. Breastfeed. J. 14, 20. https://doi.org/10.1186/s13006-019-0214-0

Pampel, F.C., Denney, J.T., Krueger, P.M., 2012. Obesity, SES, and economic development: A test of the reversal hypothesis. Soc. Sci. Med. 74, 1073–1081. https://doi.org/10.1016/j.socscimed.2011.12.028

Pérez-Escamilla, R., Martinez, J.L., Segura-Pérez, S., 2016. Impact of the Baby-friendly Hospital Initiative on breastfeeding and child health outcomes: a systematic review. Matern. Child. Nutr. 12, 402–417. https://doi.org/10.1111/mcn.12294

Powell-Jackson, T., Mazumdar, S., Mills, A., 2015. Financial incentives in health: New evidence from India's Janani Suraksha Yojana. J. Health Econ. 43, 154–169. https://doi.org/10.1016/j.jhealeco.2015.07.001

Rahman, M.A., Khan, M.N., Akter, S., Rahman, A., Alam, M.M., Khan, M.A., Rahman, M.M., 2020. Determinants of exclusive breastfeeding practice in Bangladesh: Evidence from nationally representative survey data. PLOS ONE 15, e0236080. https://doi.org/10.1371/journal.pone.0236080

Rippeyoung, P.L.F., Noonan, M.C., 2012. Is Breastfeeding Truly Cost Free? Income Consequences of Breastfeeding for Women. Am. Sociol. Rev. 77, 244–267. https://doi.org/10.1177/0003122411435477

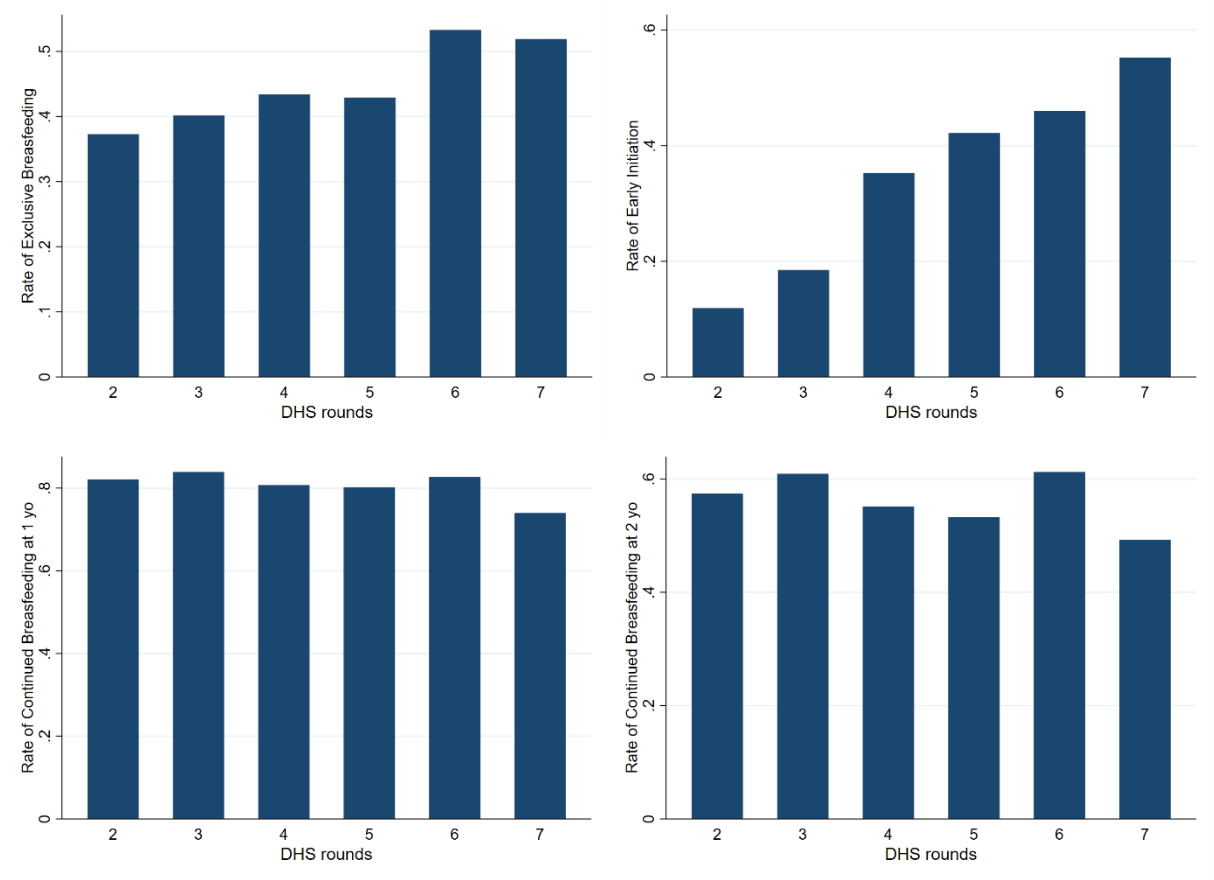
Rivera-Pasquel, M., Escobar-Zaragoza, L., González de Cosío, T., 2015. Breastfeeding and Maternal Employment: Results from Three National Nutritional Surveys in Mexico. Matern. Child Health J. 19, 1162–1172. https://doi.org/10.1007/s10995-014-1622-9

Rollins, N.C., Bhandari, N., Hajeebhoy, N., Horton, S., Lutter, C.K., Martines, J.C., Piwoz, E.G., Richter, L.M., Victora, C.G., 2016. Why invest, and what it will take to improve

breastfeeding practices? The Lancet 387, 491–504. https://doi.org/10.1016/S0140-6736(15)01044-2
Roy, N., Mishra, P.K., Mishra, V.K., Chattu, V.K., Varandani, S., Batham, S.K., 2021. Changing scenario of C-section delivery in India: Understanding the maternal health concern and its associated predictors. J. Fam. Med. Prim. Care 10, 4182–4188. https://doi.org/10.4103/jfmpc.jfmpc_585_21
Saputri, N.S., Spagnoletti, B.R.M., Morgan, A., Wilopo, S.A., Singh, A., McPake, B., Atun, R., Dewi, R.K., Lee, J.T., 2020. Progress towards reducing sociodemographic disparities in breastfeeding outcomes in Indonesia: a trend analysis from 2002 to 2017. BMC Public Health 20, 1112. https://doi.org/10.1186/s12889-020-09194-3
Sarki, M., Parlesak, A., Robertson, A., 2019. Comparison of national cross-sectional breast-feeding surveys by maternal education in Europe (2006-2016). Public Health Nutr. 22, 848–861. https://doi.org/10.1017/S1368980018002999
Senarath, U., Siriwardena, I., Godakandage, S.S.P., Jayawickrama, H., Fernando, D.N., Dibley, M.J., 2012. Determinants of breastfeeding practices: an analysis of the Sri Lanka Demographic and Health Survey 2006-2007. Matern. Child. Nutr. 8, 315–329. https://doi.org/10.1111/j.1740-8709.2011.00321.x
Sharma, I.K., Byrne, A., 2016. Early initiation of breastfeeding: a systematic literature review of factors and barriers in South Asia. Int. Breastfeed. J. 11, 17. https://doi.org/10.1186/s13006-016-0076-7
Stoody, E.E., Spahn, J.M., Casavale, K.O., 2019. The Pregnancy and Birth to 24 Months Project: a series of systematic reviews on diet and health. Am. J. Clin. Nutr. 109, 685S-697S. https://doi.org/10.1093/ajcn/nqy372
Torlesse, H., Raju, D., 2018. Feeding of Infants and Young Children in South Asia (Working Paper). World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-8655
Um, S., Chan, Y.Z.C., Tol, B., Sopheab, H., 2020. Determinants of Exclusive Breastfeeding of Infants under Six Months among Cambodian Mothers. J. Pregnancy 2020, e2097285. https://doi.org/10.1155/2020/2097285
UNICEF, 2018. Breastfeeding: A mother's gift, for every child. UNICEF, New York, NY, USA.
Vaz, J.S., Gatica-Domínguez, G., Neves, P.A., Vidaletti, L.P., Barros, A.J., 2022. Early initiation of breastfeeding is inversely associated with public and private c-sections in 73 lower-and middle-income countries. Sci. Rep. 12, 21081.
Victora, C.G., Bahl, R., Barros, A.J.D., França, G.V.A., Horton, S., Krasevec, J., Murch, S., Sankar, M.J., Walker, N., Rollins, N.C., 2016. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. The Lancet 387, 475–490. https://doi.org/10.1016/S0140-6736(15)01024-7
Volk, A.A., Franklin, P., 2020. When is the breast best? Infant feeding as a domain of intrasexual competition. Evol. Behav. Sci. 14, 6–18. https://doi.org/10.1037/ebs0000167
Walsh, A., Pieterse, P., Mishra, N., Chirwa, E., Chikalipo, M., Msowoya, C., Keating, C., Matthews, A., 2023. Improving breastfeeding support through the implementation of the Baby-Friendly Hospital and Community Initiatives: a scoping review. Int. Breastfeed. J. 18, 22. https://doi.org/10.1186/s13006-023-00556-2
Walters, D., Horton, S., Siregar, A.Y.M., Pitriyan, P., Hajeebhoy, N., Mathisen, R., Phan, L.T.H., Rudert, C., 2016. The cost of not breastfeeding in Southeast Asia. Health Policy Plan. 31, 1107–1116. https://doi.org/10.1093/heapol/czw044
Walters, D., Phan, L.T.H., Mathisen, R., 2019. The cost of not breastfeeding: global results from a new tool. Health Policy Plan. 34, 407–417. https://doi.org/10.1093/heapol/czz050

WHO, 2021. Indicators for assessing infant and young child feeding practices: definitions and measurement methods (No. ISBN: 9789240018389), WHO/UNICEF Technical expert advisory group on nutrition monitoring (TEAM). World Health Organization, Washington DC.
WHO, 2010. Indicators for assessing infant and young child feeding practices, Part 3: country profiles. Indic. Assess. Infant Young Child Feed. Pract. Part 3 Ctry. Profiles.
WHO, UNICEF, 2018. Enabling women to breastfeed through better policies and programmes: Global breastfeeding scorecard 2018.
WHO, UNICEF, 2003. Global Strategy for Infant and Young Child Feeding. World Health Organization, Geneva.
World Bank, 2019. South Asia - Baby-Friendly Hospital Initiative in South Asia : Implementing Ten Steps to Successful Breastfeeding - India, Nepal, and Bangladesh Challenges and Opportunities (Text/HTML). The World Bank, Washington DC.
Yadanar, Mya, K.S., Witvorapong, N., 2020. Determinants of breastfeeding practices in Myanmar: Results from the latest nationally representative survey. PLOS ONE 15, e0239515. https://doi.org/10.1371/journal.pone.0239515
Zhang, X., Pan, T., McPake, B., 2023. Re-examining the reversal hypothesis: A nationwide population-based study of the association between socioeconomic status, and NCDs and risk factors in China. SSM - Popul. Health 21, 101335. https://doi.org/10.1016/j.ssmph.2022.101335
Zhang, Y., Yang, J., Li, W., Wang, N., Ye, Y., Yan, S., Wang, S., Zeng, T., Huang, Z., Zhang, F., Li, Y., Yao, S., Wang, H., Rozelle, S., Xu, T., Jin, X., 2020. Effects of baby-friendly practices on breastfeeding duration in China: a case-control study. Int. Breastfeed. J. 15, 92. https://doi.org/10.1186/s13006-020-00334-4

Figure 1: Rates of BF practices across DHS rounds.



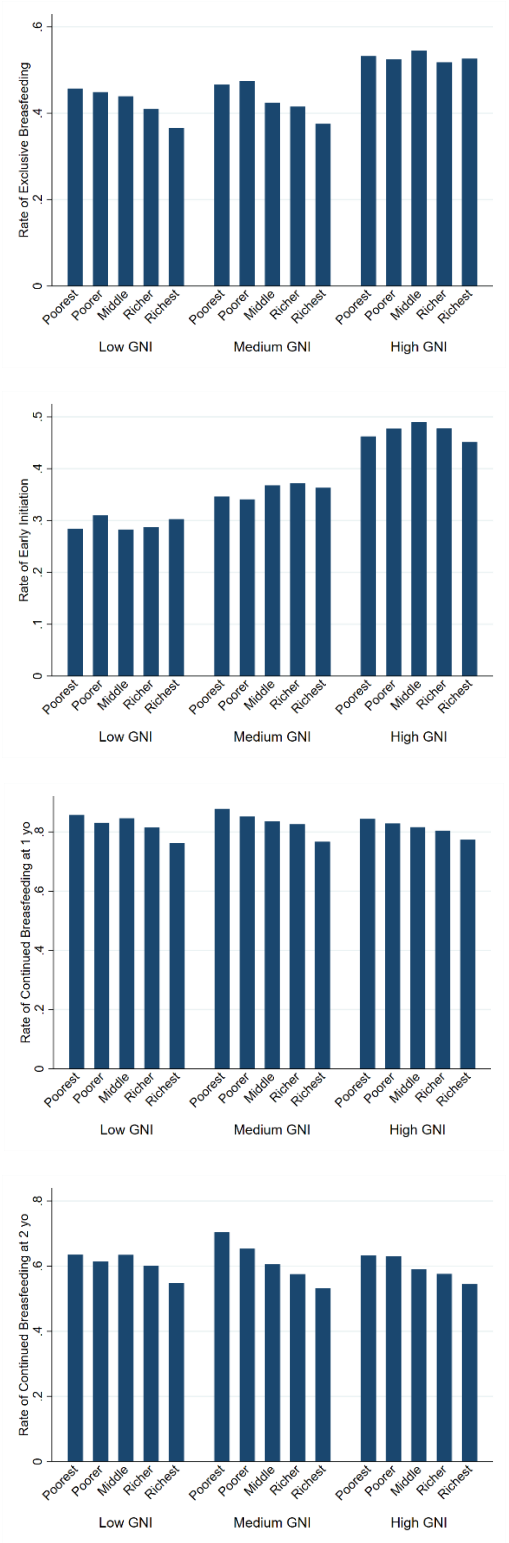
Source: Authors from Asian DHS data (rounds 2 to 7).

Table 1: BF practices rates by groups of GNI/capita ($PPP2017).

Groups of GNI/capita ($PPP2017)	EBF	EIBF	CBF1	CBF2
Low	42.75%	25.11%	82.45%	60.09%
Medium	44.69%	38.50%	82.23%	59.52%
High	49.57%	48.37%	77.09%	54.52%
ALL	46.11%	38.33%	79.93%	57.22%

Source: Authors from Asian DHS data (rounds 2 to 7).

Figure 2: Rates of BF practices by groups of household wealth (based on PCA quintiles) and GNI/capita ($PPP2017).



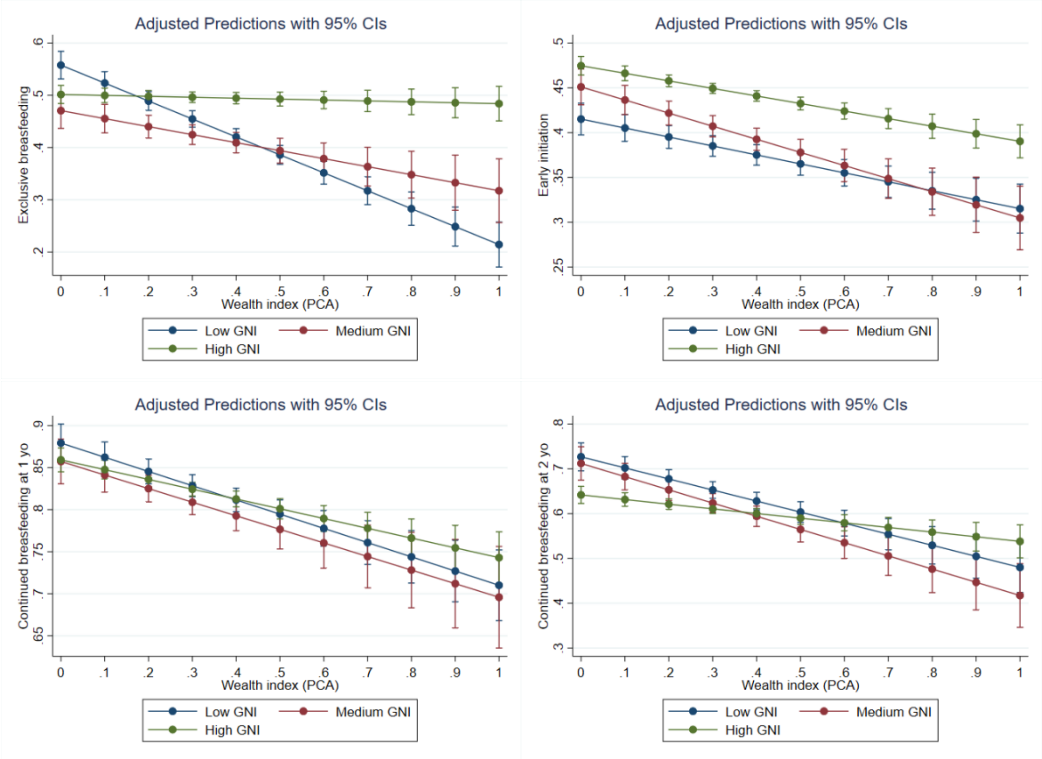
Notes: Specific wealth quintiles are calculated for each country and survey year.
Source: Authors from Asian DHS data (rounds 2 to 7).

Table 2: OLS regressions of BF practices on household wealth, GNI/capita ($PPP2017), and covariates.

Dependent outcome:	Exclusive breastfeeding (dummy)		Early initiation (dummy)		Continued breastfeeding at 1 yo		Continued breastfeeding at 2 yo	
	Linear	*Interacted*	*Linear*	*Interacted*	*Linear*	*Interacted*	*Linear*	*Interacted*
Household wealth score	-0.144***	-0.366***	-0.097***	-0.100***	-0.137***	-0.169***	-0.164***	-0.247***
	(0.019)	(0.031)	(0.011)	(0.020)	(0.017)	(0.030)	(0.022)	(0.040)
Medium GNI per capita (dummy)	-0.017	-0.088***	0.021**	0.036***	-0.019*	-0.022	-0.030**	-0.015
	(0.011)	(0.021)	(0.008)	(0.014)	(0.010)	(0.018)	(0.014)	(0.025)
High GNI per capita (dummy)	0.039***	-0.077***	0.064***	0.060***	-0.002	-0.020	-0.038***	-0.085***
	(0.010)	(0.017)	(0.007)	(0.011)	(0.009)	(0.014)	(0.013)	(0.020)
Wealth*MediumGNI		0.208***		-0.046		0.008		-0.048
		(0.052)		(0.031)		(0.049)		(0.062)
Wealth*HighGNI		0.336***		0.016		0.053		0.143***
		(0.036)		(0.023)		(0.034)		(0.044)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Observations	34,452	34,452	133,506	133,506	25,449	25,449	21,890	21,890
R-squared	0.086	0.088	0.084	0.084	0.080	0.080	0.118	0.119
Children's age interval (in months)	[0-5]	[0-5]	[0-23]	[0-23]	[12-15]	[12-15]	[20-23]	[20-23]

Notes: Standard errors are clustered at the PSU-level. Robust standard errors are in parenthesis: *** p<0.01, ** p<0.05, * p<0.1. Samples of children vary according to the dependent variable (see the line "age interval"). Control variables are: child sex, child age, child's size at birth size, birth order, birth interval, multiple births, child wantedness by parents, number of antenatal visits, delivery place (at home or not), delivery mode (C-section or not), mother's completed education, mother's age, mother's marital status, number of children in the household, living place of the household (rural or urban), and dummies of DHS rounds (round 2 to 7).
Source: Authors from Asian DHS data (rounds 2 to 7).

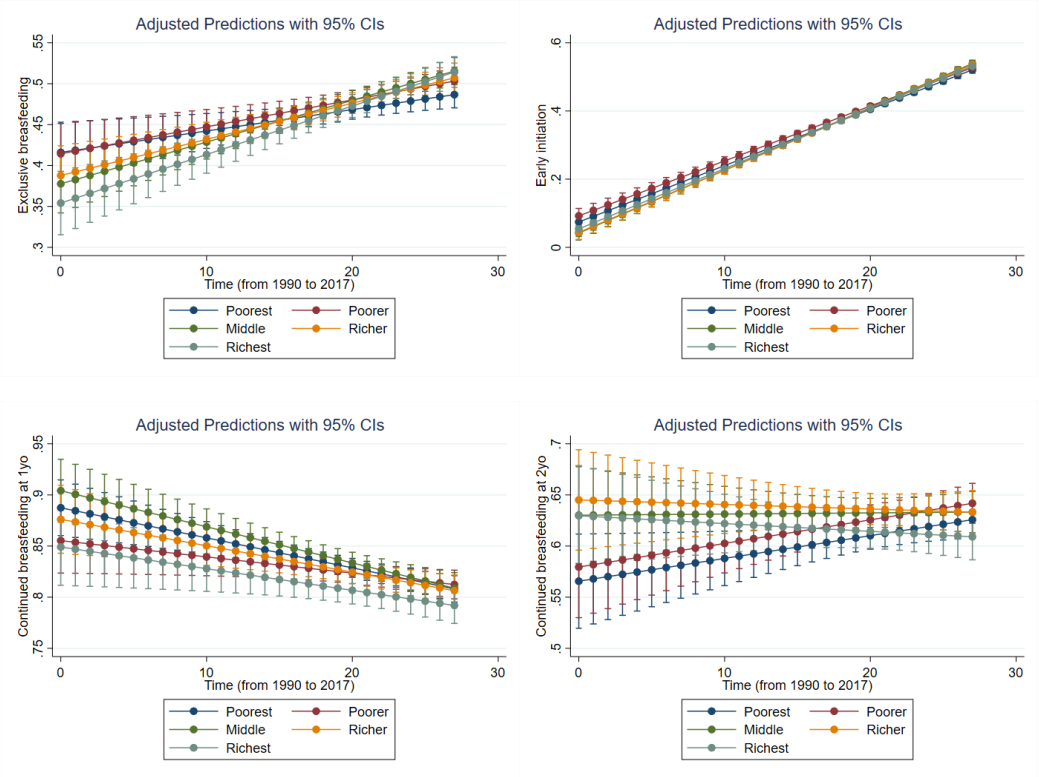
Figure 3: Marginal effects of OLS regression of BF practices on household wealth interacted by the level of a GNI/capita ($PPP2017) (including covariates).



Notes: Dots refer to the marginal effects and brackets to standard errors. Full regression results are available in Table S10 in Supplementary Materials. Samples of children vary according to the dependent variable (see Table 2 for age intervals). Control variables are: child sex, child age, child's size at birth, birth order, birth interval, multiple births, child wantedness by parents, number of antenatal visits, delivery place (at home or not), delivery mode (C-section or not), mother's completed education, mother's age, mother's marital status, number of children in the household, living place of the household (rural or urban), and dummies of DHS rounds (round 2 to 7).

Source: Authors from Asian DHS data (rounds 2 to 7).

Figure 4: Marginal effects of OLS regression of BF practices on household wealth quintiles interacted with time (including covariates).



Notes: Specific wealth quintiles are calculated for each country and survey year. Time refers to the survey year the data were collected and varies from year 0 (1990) to year 27 (2017). Dots refer to the fitted coefficients and brackets to standard errors at 0.95% confidence level. Full regression results are available in Table S11 of Supplementary Materials. Samples of children vary according to the dependent variable (see Table 3 for age intervals).

Source: Authors from Asian DHS data (rounds 2 to 7).

Table 3: IV regressions (using area mothers' height at the PSU level as instruments).

Dependent outcome:	Exclusive breastfeeding (dummy)		Early initiation (dummy)		Continued breasfteeding at 1 yo		Continued breasfteeding at 2 yo	
	Linear	***Interacted***	***Linear***	***Interacted***	***Linear***	***Interacted***	***Linear***	***Interacted***
Household wealth score	-0.425***	-1.325**	-0.575***	-0.293	-0.367***	-0.203	-1.165***	-2.381***
	(0.140)	(0.517)	(0.079)	(0.268)	(0.131)	(0.419)	(0.168)	(0.605)
Medium GNI per capita (dummy)	0.025	-0.097	0.056***	0.199**	-0.033	-0.040	-0.072***	-0.341**
	(0.021)	(0.153)	(0.014)	(0.082)	(0.021)	(0.125)	(0.026)	(0.168)
High GNI per capita (dummy)	0.052***	-0.322**	0.078***	0.183**	-0.020	0.054	-0.094***	-0.572***
	(0.019)	(0.161)	(0.012)	(0.085)	(0.019)	(0.129)	(0.024)	(0.178)
Wealth*MediumGNI/c		0.471		-0.480*		0.011		1.003*
		(0.524)		(0.283)		(0.427)		(0.601)
Wealth*HighGNI/c		1.268**		-0.357		-0.248		1.658***
		(0.545)		(0.288)		(0.434)		(0.628)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Number of instruments	1	3	1	3	1	3	1	3
Instruments	Area mothers' height	Area mothers' height and its interactions with medium GNI/c and high GNI/c	Area mothers' height	Area mothers' height and its interactions with medium GNI/c and high GNI/c	Area mothers' height	Area mothers' height and its interactions with medium GNI/c and high GNI/c	Area mothers' height	Area mothers' height and its interactions with medium GNI/c and high GNI/c
Observations	22,788	22,788	92,849	92,849	16,817	16,817	15,153	15,153
Children age interval (in month)	[0-5]	[0-5]	[0-23]	[0-23]	[12-15]	[12-15]	[20-23]	[20-23]

Notes: Standard errors are clustered at the PSU-level. Robust standard errors are in parenthesis: *** p<0.01, ** p<0.05, * p<0.1. Samples of children vary according to the dependent variable. Control variables are: child sex, child age, child's size at birth, birth order, birth interval, multiple births, child wantedness by parents, number of antenatal visits, delivery place (at home or not), delivery mode (C-section or not), mother's completed education, mother's age, mother's marital status, number of children in the household, living place of the household (rural or urban), and dummies of DHS rounds (round 2 to 7). Full results are available in Table S13 in Supplementary Materials.
Source: Authors from Asian DHS data (rounds 3 to 7).

SUPPLEMENTARY MATERIALS

https://www.dropbox.com/scl/fi/dzsvucs81wsamo9ax8sim/Supplementary-Materials.docx?rlkey=qcx8ilqeb2bktzq3vg0037hr0&dl=0