



Individual and community levels of maternal autonomy and child undernutrition in India

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Abstract

Objectives Investigate the relationship between maternal autonomy at multiple levels and the risk of child stunting, underweight, and wasting in India.

Methods Data were from a 2005–2006 nationally representative, cross-sectional sample of 51,555 children under 5 years from 29 states in India. Multilevel, multivariable, logistic regression analyses were used to estimate the odds of child stunting, underweight, and wasting in relation to maternal autonomy in healthcare, movement, and money at the individual level and community level, while adjusting for several child, maternal, and household factors.

Results When only adjusting for child age and sex, children in communities with a high proportion of women with autonomy in healthcare, or movement, or money, separately, had a lower risk of being stunted, underweight, or wasted, separately. However, adjusting for other explanatory factors attenuated these relationships and made them

statistically insignificant. Individual maternal autonomy in any of the three domains was not associated with any of the outcomes.

Conclusions The results suggest that caution should be taken when interpreting the direct relevance of maternal autonomy at both individual and community levels to measures of child undernutrition.

Keywords Maternal autonomy · Child undernutrition · Empowerment · Stunting · Multilevel · India

Introduction

The health and economic consequences of child undernutrition (a condition arising from insufficient caloric intake and infectious disease, and resulting in stunted growth) are well documented in the literature (Alderman et al. 2011; Black et al. 2008; Hoddinott et al. 2011). The roles of many proximate and intermediate factors in determining child undernutrition, such as inadequate dietary intake, breastfeeding, maternal education and health status, household poverty level, access to proper healthcare, access to clean water and toilet facilities, and social networks and social

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support, have been extensively discussed (Black et al. 2008; Corsi et al. 2015; Dangour et al. 2013; Pongou et al. 2006; Subramanian et al. 2009). In addition, linkages between measures of maternal empowerment and child undernutrition are important to consider, especially in traditional patriarchal contexts, such as India, where mothers are typically the primary caregivers for their children. Although the definition of women's empowerment may vary across contexts as well as the research question and study sample under consideration (Agarwala and Lynch 2006; Ghuman et al. 2006), social scientists generally agree that women's empowerment includes the freedom to exercise control over resources and ability to make decisions about one's self and family (Agarwala and Lynch 2006; Dyson and Moore 1983; Kabeer 2005; Mahmud et al. 2012; Malhotra and Schuler 2005). Critically, a mother's access to and control of domestic resources or information, and ability to make decisions, may not benefit the health of her children unless she is empowered to act upon her knowledge, resources, or skill.

A recent systematic review of research published between 1990 and 2012 showed that several studies found a positive association between women's empowerment at the individual level (as measured by sub-domains or composite indicators) and various measures of child undernutrition and health in South Asia (Cunningham et al. 2015b). The strength of the association, however, depended on the indicator and domain of empowerment, the outcome, the inclusion of other explanatory factors in analytical models, and, to some extent, the sample population. In contrast, some of the reviewed studies found no associations between women's empowerment and indicators of child undernutrition. A more recent study using a nationally representative dataset from India found that a mother's ability to freely move out of the house without seeking the permission of the husband, the mother's education relative to that of the father's, and the mother's attitude towards domestic violence in the case of a woman's unfaithfulness were each separately associated with children's nutritional status, albeit with different indicators of undernutrition (Imai et al. 2014). Similarly, another study using the same dataset found that a composite measure of empowerment (focused on mobility, decision making regarding several items, and access to finances) was associated with undernutrition only for children under 2 in rural places (Arulampalam et al. 2012). A different study on women's empowerment in agriculture found that empowerment was linked to child undernutrition in Nepal (Cunningham et al. 2015a). Thus, clarity on the relationship between diverse domains of women's empowerment (including dimensions of maternal autonomy to make decisions) and various measures of child undernutrition is needed.

In addition, substantial disempowerment of women across a community may be associated with child undernutrition (Desai and Johnson 2005; Imai et al. 2014). For example, a community low in women's empowerment may prevent women from accessing services or making decisions even if she herself has some degree of autonomy in her household. Indeed, a nationally representative study from India found that the proportion of women in one's community having decision-making power regarding several types of decisions was significantly associated with child undernutrition. The community-level measure was also more relevant to child undernutrition than was the parallel individual decision-making measure (Desai and Johnson 2005), though a limited number of other explanatory factors were included in the model. Alternatively, communities with high levels of women's empowerment might have greater collective bargaining power. Such communities may be able to successfully mobilize the requisite public good or service, such as healthcare, loans, or food assistance that, in turn, affect child undernutrition (Banerjee et al. 2005) or effectively encourage an otherwise low autonomous woman to take action for her child when needed. Few studies, however, have explored the role of community levels of women's empowerment in relation to child undernutrition. Yet, lack of women's empowerment (at either individual or community levels) may play a role in India's high prevalence rates of child undernutrition.

To address these gaps in the literature, this study tests for evidence of linkages between undernutrition among children under 5 years of age and women's empowerment at both the individual and community levels using a nationally representative dataset from India. For this study, we measured women's empowerment as having maternal autonomy in making household decisions regarding three sub-domains of decision making: (a) own healthcare, (b) own movement (visiting family and friends), and (c) spending money earned by the husband. We hypothesize that there will be an inverse relationship between child undernutrition and individual and community levels of maternal autonomy, and that these relationships will remain even after adjusting for several maternal and household socioeconomic characteristics.

Methods

Design

We used data from the 2005–2006 *National Family Health Survey* (NFHS-3) (IIPS and ORC-Macro 2007). It is the third of a series of nationally representative surveys

conducted by the Government of India through its Ministry of Health and Family Welfare to obtain data on health, demographics and nutrition. Although the focus of these surveys is predominantly on women of typical reproductive age, data are also collected from children. The study employs a multistage random sampling of households covering 124,385 ever-married women aged 15–49 years across all 29 states. In each state, the population was stratified by area of residence (rural or urban), and the chosen sample size was proportional to the respective size of urban and rural populations (IIPS and ORC-Macro 2007). In rural areas, villages or clusters of villages were chosen as the primary sampling units (PSUs), which are also referred to as communities. The selection was based on probability proportional to population size (PPS). A PSU represents a collection of households (not a standardized number across PSUs) that typically belong to the same village and are demarked by certain characteristics such as population size, female literacy, and number of Schedule Caste Schedule Tribe (SC ST) households. Subsequently, households for the survey were randomly picked from the selected PSUs. In urban areas, wards were first selected using a PPS method, followed by a random selection of one census enumeration block (representing a PSU) within the sample ward. Subsequently, households for the survey were picked randomly from the selected PSUs. All ever-married age-eligible women who resided the night prior to the survey in the selected household were qualified to be survey respondents (IIPS and ORC-Macro 2007). A child dataset was derived from this individual survey, by creating a unique record for every child 0–59 months of age born to these women in the previous 5 years. For this analysis, the child-recode dataset was used.

Sample

The child database (including maternal and household characteristics) covered 3850 PSUs across both rural and urban areas and 48,679 children under the age of five who were alive at the time the mother was interviewed. However, undernutrition data were not available for 7739 children because 1317 were not present, 2079 children refused to be measured, 863 did not have data for other reasons, and 680 were simply missing measurement data. In addition, 264 children were missing responses on at least one of the explanatory variables included in this study. This included 29 children whose maternal body mass index (BMI) response was extremely abnormal (less than 12 or over 45), and was therefore deleted. Thus, removing all children who had missing values led to a final analytical sample of 40,686 children.

Outcomes

We used three measures of anthropometric failure as markers of child undernutrition, which were calculated based on standardized Z-scores of height-for-age, weight-for-age and weight-for-height. As per WHO recommendations, we created binary measures representing stunting, underweight, and wasting, respectively, by assigning a value of one if the corresponding Z-scores were less than minus two standard deviations below the median and zero otherwise.

Main independent variables

We created three measures of individual maternal autonomy using information on the extent to which a woman participated in the household decision-making process regarding (a) her own healthcare (i.e., healthcare autonomy), (b) visiting family members and friends (i.e., movement autonomy), and (c) how to use money that the husband earns (i.e., money autonomy). Answer choices included ‘mainly respondent’, ‘mainly respondent’s spouse/partner’, ‘respondent and spouse/partner jointly’, or ‘someone else’. For each type of autonomy, we gave a value of one if the respondent was involved independently or jointly in the decision making above, and zero otherwise. To calculate the amount of maternal autonomy at the community level for each type of autonomy, we calculated the proportion of women per PSU scoring a value of one, and then categorized the proportion as low if less than 0.5, medium if within 0.5–0.749, and high if equal to 0.75 or greater.

Three separate measures of autonomy were used (instead of a composite score) because prior research has shown that sub-domains can be differently related to outcomes (Bloom et al. 2001). In this study, we sought to assess which type of autonomy might be the most relevant for child undernutrition as a target for future interventions. These particular sub-domains were chosen as indicators of maternal autonomy because we hypothesize that they might each separately be related to child undernutrition. For example, if a mother is able to make decisions about her own healthcare, she might be permitted to make decisions about a child’s healthcare. Similarly, if a mother can visit relatives on her own accord, she might feel comfortable leaving the house to seek care, food, or information regarding her child’s wellbeing. In addition, if a mother is able to decide to spend money on food or healthcare, sufficient resources for the child may be obtained.

Covariates

We also used data on several child, maternal, and household characteristics discussed in the literature as potential

explanatory factors of child undernutrition (Corsi et al. 2015), and which may also be related to women's empowerment. Child characteristics included birth order (continuous variable) and sex (coded as one for male and zero for female). Maternal characteristics included BMI (kg/m²) (categorized as <18.5, 18.5–24.9, or 25.0 and greater), height (categorized as <145, 145–149.9, 150–154.9, 155–159.9, or 160 cm or greater), age at first birth (continuous variable), number of births in the last 5 years (continuous variable), marital status (coded as one if married and zero otherwise), working status (coded as one if working part time or full time and zero otherwise), and primary education (coded as one if had completed primary education or greater and zero otherwise). Primary education (instead of completion of a higher level) was chosen as achieving primary education is difficult for many people in India.

Household characteristics included having a husband who completed primary education (coded as one if had completed primary education or greater and zero otherwise), caste of the household head (coded as one if the household head belonged to Scheduled Caste or Scheduled Tribe, and zero otherwise), and religion of the household head (coded as one if Hindu and zero otherwise). Household location was coded as one if rural and zero otherwise. Access to drinking water within the household or premises was coded as one if present and zero otherwise. Access to any kind of toilet facilities within the household or premises was coded as one if present and zero otherwise. Finally, we calculated household wealth quintiles utilizing the wealth index, which was created using principal components analysis related to the possession of 33 assets or household characteristics and was already available as part of the NFHS-3 dataset.

Statistical analyses

We first calculated the prevalence of each measure of malnutrition according to maternal and household characteristics, as well as the prevalence of each measure of undernutrition across each of the three categories representing the community level of maternal autonomy. We then used a series of multivariable, multilevel, logistic regression models to estimate the relationship between each of the three anthropometric outcomes (stunting, wasting, and underweight) and the level of maternal autonomy in the community for each of the autonomy domains, separately. The three-level random intercepts models accounted for the clustering of observations (level 1) within communities based on PSU designation (level 2) and within states (level 3). In Model 1, we included the level of community maternal autonomy and only adjusted for age and sex of the child. In Model 2, we adjusted for other explanatory factors to examine the extent of attenuation of the relationship

between outcomes and community level of maternal autonomy. In Model 3, we also adjusted for individual maternal autonomy to assess whether there would be any further attenuation between the outcomes and the community-level measure. We then ran a Model 4 where we focused on individual maternal autonomy as the main predictor and adjusted for all other variables except for community level of maternal autonomy to be able to compare estimates with those from the previous models to assess how much adding the community-level variable would attenuate the individual estimates. Finally, as supplementary analyses, we ran the same Model 3, but used the continuous proportion of maternal autonomy in the community instead of the categorized variable.

Results

Forty-four percent of children were stunted, 37 % were underweight, and 18 % were wasted. Table 1 provides a description of the sample and the prevalence of undernutrition according to child, maternal, and household characteristics. Among each of the three autonomy domains, more than 60 % of children had a mother with personal autonomy. For children with autonomous mothers, the prevalence of each measure of undernutrition was similar to that of the whole population across each of the domains of autonomy. At the community level, 41 % of communities had a high level of healthcare maternal autonomy, 41 % had a high level of movement maternal autonomy, and 45 % had a high level of money maternal autonomy. The percentage of children who were stunted across each category of each type of community-level autonomy was similar (see Table 2).

Tables 3, 4, and 5 present adjusted odds ratios representing the relationship between levels of maternal autonomy in the community (medium and high as compared to low prevalence (less than 50 %)) and stunting, wasting, and underweight, separately. The odds ratios of child stunting, adjusting only for child age and sex, were much lower in communities with higher levels of maternal autonomy for each of the three domains of autonomy (AOR = 0.89, 95 % CI 0.80–0.98 for high healthcare autonomy; AOR = 0.84, 95 % CI 0.76–0.94 for high movement autonomy; AOR = 0.88, 95 % CI 0.80–0.97 for high money autonomy). Similar results were found for child underweight, but not for child wasting. When estimates were adjusted for several maternal and household socioeconomic characteristics in Model 2, the odds ratios were substantially attenuated and were generally no longer statistically significant for any of the outcomes. Results from Model 3 (including individual maternal autonomy) remained statistically insignificant and essentially unchanged from Model 2.

Table 1 Descriptive statistics of three measures of anthropometric failure according to child, maternal, and household characteristics^a for children under 5 years across 29 states in India ($n = 40,686$; National Family and Health Survey, India, 2005–2006)

| | N (and %) of children | | % of child stunting (%) | % of children under-weight (%) | % of child wasting (%) |
|--|-----------------------|--------|-------------------------|--------------------------------|------------------------|
| Total children | 40,686 | – | 44 | 37 | 18 |
| Maternal characteristics | | | | | |
| Has healthcare autonomy | 25,588 | (63 %) | 41 | 36 | 17 |
| Does not have healthcare autonomy | 15,098 | (37 %) | 45 | 40 | 20 |
| Has movement autonomy | 24,652 | (61 %) | 43 | 36 | 17 |
| Does not have movement autonomy | 16,034 | (39 %) | 46 | 40 | 19 |
| Has money autonomy | 27,252 | (67 %) | 43 | 37 | 18 |
| Does not have money autonomy | 13,434 | (33 %) | 44 | 38 | 19 |
| BMI: <18.5 | 13,294 | (32 %) | 51 | 49 | 24 |
| BMI: 18.5–24.9 | 23,400 | (58 %) | 42 | 34 | 16 |
| BMI: 25.0+ | 3992 | (10 %) | 28 | 18 | 10 |
| Height: <145 cm | 4393 | (11 %) | 61 | 53 | 22 |
| Height: 145–149.9 cm | 10,587 | (26 %) | 52 | 45 | 20 |
| Height: 150–154.9 cm | 13,800 | (54 %) | 43 | 36 | 18 |
| Height: 155–159.9 cm | 8493 | (21 %) | 34 | 29 | 15 |
| Height: 160 + cm | 3412 | (8 %) | 25 | 22 | 16 |
| Age: 15–19 years | 1955 | (5 %) | 46 | 41 | 22 |
| Age: 20–24 years | 13,060 | (32 %) | 44 | 37 | 19 |
| Age: 25–29 years | 14,259 | (35 %) | 42 | 36 | 17 |
| Age: 30–34 years | 7462 | (18 %) | 42 | 37 | 17 |
| Age: 35–39 years | 2949 | (7 %) | 46 | 39 | 18 |
| Age: 40–44 years | 806 | (2 %) | 52 | 44 | 19 |
| Age: 45–49 years | 195 | (<1 %) | 57 | 46 | 22 |
| Currently married | 40,052 | (98 %) | 42 | 37 | 18 |
| Not married | 634 | (2 %) | 47 | 40 | 20 |
| Edu: no schooling | 16,200 | (40 %) | 55 | 49 | 22 |
| Edu: primary or higher | 24,486 | (60 %) | 36 | 30 | 16 |
| Currently working | 11,866 | (29 %) | 49 | 42 | 19 |
| Not currently working | 28,820 | (71 %) | 42 | 35 | 18 |
| Child characteristics | | | | | |
| Male | 21,196 | (52 %) | 44 | 37 | 19 |
| Female | 19,490 | (48 %) | 43 | 37 | 17 |
| 1st born | 12,910 | (32 %) | 36 | 31 | 16 |
| 2nd born | 11,604 | (29 %) | 42 | 35 | 11 |
| 3rd born or higher | 16,172 | (40 %) | 51 | 44 | 20 |
| Household characteristics | | | | | |
| Husband edu: no schooling | 9762 | (23 %) | 56 | 50 | 22 |
| Husband edu: primary or higher | 30,924 | (77 %) | 40 | 33 | 17 |
| Hindu | 28,172 | (69 %) | 44 | 39 | 19 |
| Other religions | 12,514 | (31 %) | 43 | 33 | 16 |
| Caste: schedule caste schedule tribe and backward castes | 26,951 | (66 %) | 48 | 41 | 20 |
| Other (forward) castes | 13,735 | (33 %) | 36 | 30 | 15 |
| First wealth quintile (low) | 7133 | (18 %) | 59 | 56 | 25 |
| Second wealth quintile | 7422 | (18 %) | 54 | 47 | 21 |
| Third wealth quintile | 8478 | (21 %) | 47 | 39 | 18 |
| Fourth wealth quintile | 9101 | (22 %) | 39 | 31 | 16 |

Table 1 continued

| | <i>N</i> (and %) of children | | % of child stunting (%) | % of children under-weight (%) | % of child wasting (%) |
|------------------------------------|------------------------------|--------|-------------------------|--------------------------------|------------------------|
| Fifth wealth quintile (high) | 8552 | (21 %) | 24 | 19 | 13 |
| HH has access to toilet facilities | 20,726 | (51 %) | 36 | 29 | 14 |
| Has no access to toilet facilities | 19,960 | (49 %) | 52 | 47 | 22 |
| Access to water within HH | 30,700 | (75 %) | 44 | 37 | 18 |
| No access to water within HH | 9986 | (25 %) | 43 | 38 | 19 |
| Rural | 25,707 | (63 %) | 48 | 42 | 19 |
| Urban | 14,979 | (37 %) | 37 | 30 | 16 |

^a Two other data points were considered in these analyses (maternal number of births in last 5 years and maternal age at first birth), but they were continuous variables and, therefore, not included in this table

Table 2 Descriptive statistics of child undernutrition (percent of stunting, wasting, and underweight, separately), by low, medium, and high community prevalence of three separate domains of maternal autonomy for children under 5 years across 29 states in India ($n = 40,686$; National Family and Health Survey, India, 2005–06)

| Type of autonomy | Level of community prevalence of maternal autonomy | <i>N</i> of communities (%) | <i>N</i> of children in community (%) | % of children who are stunted (%) | % of children who are underweight (%) | % of children who are wasted (%) |
|------------------|--|-----------------------------|---------------------------------------|-----------------------------------|---------------------------------------|----------------------------------|
| Healthcare | Low (<50 %) | 1031 (27 %) | 12,123 (30 %) | 47 | 42 | 20 |
| | Medium (50–74.9 %) | 1221 (32 %) | 13,879 (34 %) | 44 | 38 | 18 |
| | High (>74.9 %) | 1564 (41 %) | 14,684 (33 %) | 44 | 36 | 17 |
| Movement | Low (<50 %) | 1110 (29 %) | 13,441 (33 %) | 47 | 41 | 34 |
| | Medium (50–74.9 %) | 1144 (30 %) | 12,879 (32 %) | 41 | 38 | 19 |
| | High (>74.9 %) | 1562 (41 %) | 14,366 (35 %) | 43 | 33 | 16 |
| Money | Low (<50 %) | 809 (21 %) | 9286 (23 %) | 46 | 40 | 19 |
| | Medium (50–74.9 %) | 1280 (34 %) | 14,517 (36 %) | 45 | 39 | 19 |
| | High (>74.9 %) | 1727 (45 %) | 16,883 (41 %) | 42 | 35 | 17 |

When the community level of maternal autonomy was not included in the model, the estimated relationship between individual maternal autonomy and undernutrition was not statistically significant for any of the outcomes across any of the autonomy domains. The results did not change when the community level was included in the models (Table 6).

The supplemental analyses indicated a similar general pattern of results regarding the relationship between community level of maternal autonomy and child undernutrition when a continuous measure of the proportion of maternal autonomy in the community was included in the models (instead of a categorical measure). Only the estimates between child stunting and community level of

maternal health care autonomy (AOR = 0.85, 95 % CI 0.75–0.97), and between child stunting and community level of maternal money autonomy (AOR = 0.88, 95 % CI 0.78–0.99), remained statistically significant after adjusting for other explanatory factors.

Discussion

This study explored the relationships between child undernutrition in India and maternal autonomy at the individual level and community level across three different domains of autonomy. Overall, our results show that there

Table 3 Multivariate, multilevel, logistic regression adjusted odds ratios for stunting according to the level of community prevalence of maternal autonomy in three domains, separately, for children under 5 years across 29 states in India ($n = 40,686$; National Family and Health Survey, India, 2005–06)

| Type of autonomy | Level of community prevalence of maternal autonomy | Child stunting | | | | | |
|------------------|--|--|--------------|--|--------------|-------------------------------------|--------------|
| | | Model 1: adjusted for child age and sex only | | Model 2: adjusted for all variables except individual autonomy | | Model 3: adjusted for all variables | |
| | | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI |
| Healthcare | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 0.89* | (0.79, 1.00) | 0.92 | (0.81, 1.04) | 0.92 | (0.81, 1.04) |
| | High (>74.9 %) | 0.89** | (0.80, 0.98) | 0.98 | (0.87, 1.10) | 0.99 | (0.88, 1.10) |
| Movement | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 0.90* | (0.80, 1.02) | 0.96 | (0.85, 1.10) | 0.97 | (0.85, 1.10) |
| | High (>74.9 %) | 0.84*** | (0.76, 0.94) | 0.91* | (0.81, 1.02) | 0.91 | (0.81, 1.02) |
| Money | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 0.89** | (0.80, 1.00) | 0.94 | (0.83, 1.06) | 0.94 | (0.83, 1.06) |
| | High (>74.9 %) | 0.88** | (0.80, 0.97) | 0.95 | (0.85, 1.05) | 0.95 | (0.85, 1.06) |

All estimates were obtained from random intercepts three-level models which accounted for the clustering of observations within primary sampling units (PSUs also referred to as communities) and states. Model 2 was adjusted for child birth order, maternal characteristics (BMI, height, age, marital status, education, whether currently working, age at first birth, and number of births in the last 5 years), and household characteristics (paternal education, household wealth quintiles, religion, caste, access to toilet, access to water, and rural vs. urban location). Model 3 included the variables in Model 2 plus individual maternal autonomy

AOR adjusted odds ratio, CI confidence interval

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

is little evidence of a relationship between community level of maternal autonomy and undernutrition when adjusting for other maternal and household socioeconomic characteristics, and even less evidence of any relationship between undernutrition and individual maternal autonomy. The lack of relationship is seen regardless of type of autonomy (e.g., decision making about healthcare, visiting friends or family, and spending husband's earnings).

Yet given evidence of significant attenuation between community level of maternal autonomy and undernutrition when other explanatory factors were included in the models, community level of maternal autonomy may play a role somewhere in the pathway between maternal and household characteristics and measures of child anthropometric

failure. Alternatively, the relevance and direction of results may depend on the domain of autonomy assessed (and more generally on women's empowerment), though conventional measures of autonomy were used in this study.

In conclusion, although improving women's autonomy is an intrinsic socio-economic goal (particularly for a patriarchal society like India), the instrumental benefit of increasing individual and community levels of maternal autonomy for the reduction of child undernutrition may be limited. Improving maternal education and nutritional status, as well as improving the overall household socioeconomic circumstances, are likely to be more important in reducing child undernutrition in India (Corsi et al. 2015).

Table 4 Multivariate, multilevel, logistic regression adjusted odds ratios for wasting according to the level of community prevalence of maternal autonomy in three domains, separately, for children under 5 years across 29 states in India ($n = 40,686$; National Family and Health Survey, India, 2005–06)

| Type of autonomy | Level of community prevalence of maternal autonomy | Wasting | | | | | |
|------------------|--|--|--------------|--|--------------|-------------------------------------|--------------|
| | | Model 1: adjusted for child age and sex only | | Model 2: adjusted for all variables except individual autonomy | | Model 3: adjusted for all variables | |
| | | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI |
| Healthcare | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 1.01 | (0.90, 1.14) | 1.06 | (0.91, 1.23) | 1.06 | (0.91, 1.23) |
| | High (>74.9 %) | 0.97 | (0.88, 1.08) | 1.04 | (0.91, 1.19) | 1.04 | (0.91, 1.20) |
| Movement | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 1.00 | (0.89, 1.13) | 1.05 | (0.91, 1.23) | 1.06 | (0.91, 1.23) |
| | High (>74.9 %) | 1.00 | (0.01, 1.12) | 1.09 | (0.95, 1.25) | 1.09 | (0.95, 1.25) |
| Autonomy | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 1.06 | (0.95, 1.19) | 1.14* | (0.99, 1.32) | 1.14* | (0.99, 1.32) |
| | High (>74.9 %) | 1.01 | (0.91, 1.11) | 1.07 | (0.94, 1.22) | 1.07 | (0.95, 1.23) |

All estimates were obtained from random intercepts three-level models which accounted for the clustering of observations within primary sampling units (PSUs also referred to as communities) and states. Model 2 was adjusted for child birth order, maternal characteristics (BMI, height, age, marital status, education, whether currently working, age at first birth, and number of births in the last 5 years), and household characteristics (paternal education, household wealth quintiles, religion, caste, access to toilet, access to water, and rural vs. urban location). Model 3 included the variables in Model 2 plus individual maternal autonomy

AOR adjusted odds ratio, CI confidence interval

* $p < 0.05$

Table 5 Multivariate, multilevel, logistic regression adjusted odds ratios for underweight according to the level of community prevalence of maternal autonomy in three domains, separately, for children under 5 years across 29 states in India ($n = 40,686$; National Family and Health Survey, India, 2005–06)

| Type of autonomy | Level of community prevalence of maternal autonomy | Underweight | | | | | |
|------------------|--|--|--------------|--|--------------|-------------------------------------|--------------|
| | | Model 1: adjusted for child age and sex only | | Model 2: adjusted for all variables except individual autonomy | | Model 3: adjusted for all variables | |
| | | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI |
| Healthcare | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 0.91 | (0.81, 1.02) | 0.94 | (0.83, 1.07) | 0.94 | (0.83, 1.07) |
| | High (>74.9 %) | 0.90** | (0.81, 0.99) | 0.98 | (0.88, 1.10) | 0.98 | (0.88, 1.10) |
| Movement | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 0.85*** | (0.76, 0.96) | 0.88* | (0.77, 1.00) | 0.88* | (0.77, 1.00) |
| | High (>74.9 %) | 0.90*** | (0.82, 1.00) | 0.98 | (0.88, 1.11) | 0.99 | (0.88, 1.10) |
| Money | Low (<50 %) | (ref) | (ref) | (ref) | (ref) | (ref) | (ref) |
| | Medium (50–74.9 %) | 0.91* | (0.81, 1.02) | 0.95 | (0.84, 1.08) | 0.95 | (0.84, 1.07) |
| | High (>74.9 %) | 0.91* | (0.82, 1.00) | 0.97 | (0.87, 1.08) | 0.97 | (0.87, 1.08) |

All estimates were obtained from random intercepts three-level models which accounted for the clustering of observations within primary sampling units (PSUs also referred to as communities) and states. Model 2 was adjusted for child birth order, maternal characteristics (BMI, height, age, marital status, education, whether currently working, age at first birth, and number of births in the last 5 years), and household characteristics (paternal education, household wealth quintiles, religion, caste, access to toilet, access to water, and rural vs. urban location). Model 3 included the variables in Model 2 plus individual maternal autonomy

AOR adjusted odds ratio, CI confidence interval

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6 Multivariate, multilevel, logistic regression adjusted odds ratios for stunting, wasting, and underweight, separately, according to individual maternal autonomy in three dimensions, separately, for children under 5 years across 29 states in India ($n = 40,686$; National Family and Health Survey, India, 2005–06)

| Child's mother has autonomy in... | Stunting | | | | Wasting | | | | Underweight | | | |
|-----------------------------------|----------|--------------|---------|--------------|---------|--------------|---------|--------------|-------------|--------------|---------|--------------|
| | Model 4 | | Model 3 | | Model 4 | | Model 3 | | Model 4 | | Model 3 | |
| | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI | AOR | 95 % CI |
| ...healthcare (vs. none) | 0.98 | (0.94, 1.02) | 0.99 | (0.93, 1.04) | 0.98 | (0.93, 1.02) | 0.99 | (0.93, 1.04) | 1.00 | (0.95, 1.05) | 1.00 | (0.95, 1.05) |
| ...movement (vs. none) | 0.97 | (0.92, 1.01) | 1.00 | (0.95, 1.06) | 0.99 | (0.94, 1.05) | 1.00 | (0.95, 1.06) | 0.99 | (0.94, 1.04) | 0.99 | (0.95, 1.04) |
| ...money (vs. none) | 0.99 | (0.95, 1.04) | 0.96 | (0.91, 1.02) | 0.95 | (0.90, 1.00) | 0.96 | (0.90, 1.02) | 0.99 | (0.95, 1.04) | 0.99 | (0.94, 1.04) |

Model 4 was adjusted for all explanatory variables except for community level of maternal autonomy and accounted for the clustering of observations within primary sampling units (PSUs also referred to as communities) and states. Model 3 was adjusted for all explanatory variables including level of community prevalence of maternal autonomy, which is the same model used to calculate estimates shown in Tables 3, 4, and 5, but here, the estimates for individual maternal autonomy are shown instead of the estimates for the community-level measure of autonomy. AOR adjusted odds ratio, CI confidence interval

Compliance with ethical standards

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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