Parental Migration and Child Undernutrition Evidence form NFHS

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Internal migration is livelihood strategies for poor household. It can have significant impact on children health and well-being because children are especially vulnerable to change living conditions, access to food, and health services. In India, child undernutrition remains major public health concern. Therefore, the study examines impact of parental migration on children nutritional status. The study uses national representative data from National Family Health Survey-4, children nutritional status was measured using anthropometric indicators stunting, wasting and underweight. descriptive study has been use to understand the socio-economic differential. Further, we have applied a Propensity Score matching to estimate the effect of migration on children's nutritional outcomes. Result indicates urban migrant's children nutritional status is better than non-migrant's resident. Additionally, parental education significantly improves child nutrition. To assess the causal impact of migration on children nutritional status, the study employs regression analysis and propensity score matching (PSM) after balancing all covariates. Overall, the findings reveal a negative association between the migration and stunting/wasting/ underweight outcomes. However, migration stream appears to be positive for children health, as the average treatment effect on treated stunting (-0.05.2 % unmatched, ATT -0.02.2 % t=-2.39) and underweight (-0.05.2 unmatched, ATT-0.017% and t=-1.88). The finding suggests the socio-economic condition such a household wealth status, parental education, and regional disparities play a major role for children nutrition.

Keywords: Parental migration, Undernutrition, Urban residence, poor household

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Child undernutrition is a global concern with disproportionately huge and adverse well-being implications for low and middle-income countries (UNICEF & WHO,2025; Birhanu et.al, 2024). Studies have estimated that undernutrition is a major contributor to the global burden of disease (Heemann et.al, 2021; Victora et.al, 2021, Tamir et.al, 2024). In developing countries, undernutrition is associated with elevated risks of childhood mortality and morbidity including high prevalence of childhood ailments, cognitive impairments, and higher risk of chronic non-communicable diseases in adulthood (UNICEF, 2018; Kang et. al, 2018; Prendergast et. al, 2014; Danaei et.al, 2016; Martorell 2012).

Undernutrition has a multifactorial etiology and is caused by a range of demographic, socioeconomic and environmental factors. These contexts have an instrumental role in deciding upon nutritional status of the children and their future well-being (Black et.al 2013; Saidu et.al, 2024; Jiao, L, 2024; Choedon. et.al, 2024; Joe. et.al, 2017). The issue of child undernutrition has assumed increasing policy salience with launch of several national and international programmes aimed at accelerating nutritional improvements worldwide. Specifically, the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) Declarations has provided the much needed impetus to reduce the burden of undernutrition across developing countries (WHO, 2025; United Nation, 2023; Global Nutrition Report, 2020; UNICEF, 2020).

India is no exception and has launched several flagship programmes to curb the persistently high prevalence of undernutrition among children. However, the improvements are far from satisfactory. India accounts for one-third of the global burden of childhood stunting (low height-for age) and one-third of the global burden of underweight (low weight-for-age). The rapid economic growth witnessed in the past two decades has not translated into nutritional gains for the children (Rao, 2016; Sayeed.S, 2021). This is unlike the experience of neighbors such as Bangladesh where the prevalence of stunting has reduced from 36% in 2014-15 to 31% in 2017-18 (BDHS, 2017-18). The poor association between economic growth and child nutrition is a prominent concern for India. While it is argued that bulk of the growth benefits can materialize directly via household income and welfare but this has been an area of concern because of increasing inequalities in incomes and employment opportunities. These aspects can adversely affect food and nutritional security of the households including inadequate dietary diversity which are identified as critical concerns for child nutrition in India.

In this regard, it is important to present greater opportunities for households to improved contexts and circumstances for child well-being.

Migration of individuals and families for economic reasons offers a unique opportunity for households to change their contexts in terms of livelihood options and environmental amenities (De Brauw, 2007; Bhan. T, 2023; Srivastava. R, 2020;

Subbaraman. R, 2012). Several studies have documented the well-being implications of migration in terms of improvements in household income, employment opportunities, and access to health and educational services. The benefits are relatively large for urban migrants and those from advantaged socioeconomic background. In the theoretical prospective migration is always treat as outcome for the economic process of development. But in the same time various literature suggest that migration have adverse effect on heath. However, migration process involved stressor and strain that may increase migrant morbidity (Kristiansen M et.al, 2007; Glover S, 2001; Zimmerman C, 2011; Nauman. et.al, 2015). Moreover, studies suggest that lower socio-economic groups migrant's children are more undernutrition than the non-migrant because migrants as vulnerable and deprived when compared with the native population.

The other side of the argument disagrees. Migration has positive impact on children nutritional status. Evidence suggest that Guatemala population migrated to the US height for age Z score 0.5 standard deviation are higher than other children. Nutrition benefit those who are linked to the migration and China finding shows that migration is positively associate with lower birth weight and overweight. Those parents who have migrated with children have better nutritional status then who left behind child.

However, despite such relevance, there is a dearth of evidence to understand the effect of migration on child undernutrition. Migration can be categorized in four streams: viz. rural to rural migration, rural to urban migration, urban to rural migration and urban to rural migration. Although, studies have noted that migration has beneficial impact on household incomes and remittances but advantages of migration and its contexts (streams) on child nutrition is rather limited and unexplored. Some studies observe that parental absence due to migration is detrimental to children's physical health, psychological well-being whereas a few suggest that parental out-migration has a positive impact on child health. Similarly studies also find that the effects of parental migration vary according to whether one or both the parents are absent. However, no particular attention has been paid to migrant families with children and how migration streams are associated with nutritional status of children.

This study attempts to fill this gap and provides insights on the association of migration with child undernutrition. Based on the analysis of the nationally representative cross-sectional household survey (National Family Health Survey (NFHS), 2015-16), we examine whether migrant households are advantaged in terms of child nutrition then the natives or residents at destination. Also, we examine whether the advantage is associated with the socioeconomic background of the migrants and the stream of migration.

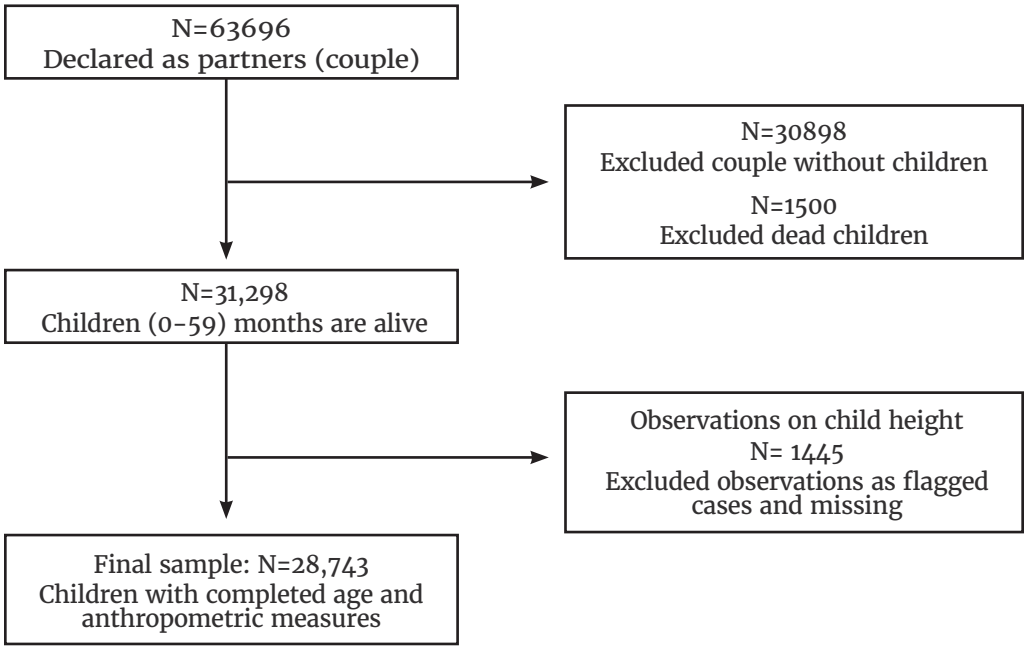
Data and Methods

The study is based on cross-sectional nationally representative National Family Health Survey (NFHS) of India conducted during 2015-16. NFHS sample households are selected based on a stratified two-stage sampling frame within states with stratification based on rural and urban areas (IIPS, 2018). A total of 699,686 women (age 15-49 years) and 112,122 men (age 15-54 years) were interviewed for the survey with a sample response rate of 94.5% for the women respondents and 87.1% for men respondents (IIPS, 2018). The analysis considers information on migration status of the married couples and nutritional status of their children. In India, marriage-related migration, particularly among women is a predominant contributor to overall migration. In order to eliminate cases of such marriage-related migration among women, we have focused on the migration status of men (husbands) and the reported information regarding their length of stay at the current place of residence. Specifically, the NFHS elicits information on time period of residence (in the current place of residence). Based on this information, a household is classified as migrant household if the respondent (man) has reported staying the current place of residence for less than 10 years period. Those men who report staying at the current place of residence for more than 10 years are considered as local residents or natives for the purpose of the analysis. Further, we also categorized in the destination couple migration 1). Both are residence (Native) 2). Male are migrated female are native 3). Female migrated male are native 4). Both are migrant. Individuals who were visiting the place (not an actual resident) were excluded from the analysis. The sample details are provided in Figure 1.

The present study uses NFHS-4 (2015-16) data rather than NFHS-5 (2019-21) for two substantive reason. The COVID-19 pandemic triggered one of the largest episodes of reverse migration in India recorded in history. Millions of urban migrants were compelled to return to their places of rural origin due to sudden lockdown, loss of livelihood and economic distress. Second, NFHS-4 has asked duration of stay of men at their current place of residence which is the key variable used in the study to classify migrant and non-migrant household. Accordingly, the finding of the study should be interpreted within the context of pre-pandemic migration pattern in India.

Thus, the analysis develops two categories of migrant households as follows: a) those who have migrated towards urban areas (urban migrants) and b) those towards rural areas (rural migrants). The nutritional status of children from thus classified migrant households is compared vis-à-vis the residents or native households. It is worth noting that the NFHS 2015-16 does not provide any information regarding the place of last residence. This disallows categorizing of migrant households in terms stream of migration (such as rural-to-urban migrant or urban-to-urban migrant).

Figure 1: Flow diagram to arrive at final analytical sample for the analysis, NFHS (2015-16)



Further, we use the following three anthropometric failure indices – stunting, underweight and wasting – constructed based on age, height and weight of the children and by following the WHO child growth reference standards (WHO 2006) to study nutritional failures among migrant and residents/native households. To elaborate, stunting, which reflects retarded skeletal growth due to chronic deprivation (UNICEF, 2009), was defined as height-for-age z-scores < -2 standard deviation (SD) below the WHO child growth reference standards (WHO, 2006). Underweight was defined as weight-for-age z-scores < -2SD. Wasting, signaling acute malnutrition, was defined as weight-for-height z-scores < -2SD.

The descriptive statistical analysis focuses on discerning the patterns in prevalence of anthropometric failure among children by migration status of their households. The prevalence is estimated for migrant households by their demographic and socioeconomic background. These variables include aspects such as age, place of birth, birth weight and birth order of the child, maternal age at birth, maternal height and BMI, parent's education, utilization of any ICDS services by children, and household factors such as access to improved sources of water and sanitation as well as households social group affiliation, economic status as per the NFHS wealth index quintiles and the region of residence. We also present logistic regression-based odds ratio (adjusted for the key demographic and socioeconomic variables)

to examine the association of nutritional status of children with migration status of the households.

However, for a robust comparison of the influence of migration status it is important to compare groups which are similar in terms of their demographic and socioeconomic background. The children of migrant and non-migrant's families from the study sample are not directly comparable because of the variations in exposure and socio-economic determinant. This may affect the inferences regarding the association of migration status with child anthropometric failures. Therefore, to study the association in a robust manner we have applied propensity score matching (PSM) analysis. The PSM analysis allows examination of average treatment effect related to the migrant households (the treatment group) with same characteristics as households who are natives or residents (the comparison group). The PSM approach has gained popularity as an effective tool to reduce selection bias that may crop in because of observed differences in demographic and socioeconomic characteristics between migrant and native households.

The PSM method comprises of two key steps. In the first step, a probit regression is used to identify the socioeconomic characteristics of the sample households and use this information to develop propensity scores (defined as the probability of family migrant's conditional to the characteristics included in the model). In the second step, the migrant and non-migrant households are matched based on comparisons of their propensity scores. Households which are having similar propensity scores are considered more comparable than those who are deviant in terms of their propensity scores.

The variables used to generate propensity based on the matching algorithm are as follows: age and birth order of the child, skilled birth attendance, maternal body mass index (BMI), mother's age at first birth, parental education, household wealth index, access to sanitation facilities and region of residence. Based on the PSM analysis, three parameters are estimated. These are average treatment

effect (ATE), average treatment effect on treated (ATT) and average treatment effect on untreated (ATU). The Average Treatment Effect (ATE) measures the mean impact of family

who are migrated. These parameters can be defined as follows:

$ATE = E(\delta) = E(Y_1 - Y_0)$

Where $E(\delta)$ represents the mean average and Y_1 represents the potential outcome describing

the nutritional status of children (viz. stunting, wasting and underweight) for the migrant household and Y_0 describing the expected outcome for the native households. In the post- treatment case, the counterfactual model helps to

understand the difference between the average outcome of those who received the treatment and the unobserved counterfactual.

Similarly, the Average Treatment Effect on the Treated (ATT) is estimated as follows:

ATT = E(Y 1 |D = 1) – E(Y 0 |D = 1)

Where E (Y 1 |D = 1) is the average outcome of the migrant households and E(Y 0 |D = 1) is the estimate for the counterfactual. Similarly, the average impact of the treatment only on those

who did not receive the treatment, is estimated using the ATE on the Untreated (ATU). It is defined as the difference between the average outcome of those who did not receive the

treatment and the counterfactual. It is defined as follows:

ATU = E (Y 1 |D = 0) – E (Y 0 |D = 0)

Where E (Y 1 |D = 0) is the average outcome of the residents or native households and E

(Y 0 |D = 0) is the estimate for the counterfactual.

Results

Table 1 shows the descriptive statistics of overall migrants and residents (local) by place of residence and the sample profile of migrants and residents (local) living with their children by place of residence. In the above table, the gender-based classification of migrants represents

those who had migrated and are married to a resident. The first category is native, the second is couples with males as migrants, the third is female migration due to marriage, and the fourth is when both migrants represent 'couple migrants' wherein both the partners are migrants, but their place of origin may or may not

Table 1: Sample description of migrant and native households, India, NFHS 2015–16

Migrant status	**% Migrant sample households**							
	Overall sample households (%)				Households with children (below 5) (%)			
	Urban	Rural	Total	N	Urban	Rural	Total	N
Residents (Natives)	43.8	57.8	52.9	1,924	19.9	30.4	27.2	788
Couples with male as migrant	3.9	2.8	3.2	34,527	2.0	2.2	2.1	9,310
Couples with females as migrant	28.6	33.0	31.5	6,311	50.0	59.4	56.5	3,857
Both as migrants	23.6	6.4	12.5	20,360	28.1	8.1	14.2	18,431

Source: Authors based on NFHS 2015–16

be the same. Out of the total residents (local), 43.8% reside in urban areas, wherein 19.9 % are cohabitating with their children. Moreover, out of 57.8% of residents residing in countryside, almost half of them are living with their children. Whereas, out of all migrants, 3.2% and 31.5% were male and female migrants who were married to a resident, respectively. Out of 12.5% of couples of migrants, more reside in urban areas compared to their counterparts, and 14.2% live with their children.

Table 2: Prevalence of anthropometric failure by place of residence among children of migrants and natives, India, NFHS-4 (2015-16)

10 years migrant	Stunting	95% CI	Wasted	95% CI	Underweight	95% CI
Urban migrant	27.2	[24.2,30.4]	20.6	[17.4,24.4]	26.7	[23.5,30.2]
Rural migrant	37.5	[34.6,40.6]	22.8	[20.2,25.6]	35.4	[32.5,38.4]
Urban native	30.7	[28.9,32.5]	20.2	[18.6,21.8]	29.2	[27.5,31.1]
Rural native	41.9	[41.0,42.8]	21.0	[20.3,21.8]	38.7	[37.8,39.6]
Total	37.8	[37.0,38.6]	20.9	[20.3,21.6]	35.3	[34.6,36.1]

Source: Authors based on NFHS 2015-16

Table 2 depicts the differences in prevalence of children's undernutrition by place of resident among children of migrant and natives. Among all children, 37.8% (CI 95% 37.0, 38.8) were stunted, 20.9% (CI 95% 20.3, 21.6) were wasted and 35.3% (CI 95% 34.6, 36.1) were underweight. Moreover, the prevalence of stunting was lower among urban migrant's children 27.2% (95% CI:24.2,30.4) compared with their counterpart, as rural migrants, urban migrants, rural resident and urban resident. The highest prevalence of wasting 22.8% (CI 95% 20.2, 25.6) was observed among children of rural migrants.

Table 3; shows undernutrition failure across the socio-economic group and regional difference in urban migrant's vs urban residence, rural migrant's vs rural residence. The undernutrition variation was observed and vary significantly between wealth of household and across social group. However, among urban migrant's prevalence of stunting and underweight bottom quintile is higher as counterpart to top quintile. Among urban migrants, stunting declines from 40.0% in the bottom wealth quintile to 21.4% in the top quintile, while underweight decreases from 36.5% (poorest) to 22.4% (richest). While comparison with urban residence vs urban migrants across quintile the prevalence stunting and underweight is lesser in urban migrant's than urban residence. Whereas, rural migrant's the prevalence of stunting and underweight is widening across the wealth quintile. Moreover, in rural migrant's prevalence of stunting and underweight is 43.6% and 40.5 % higher as counterpart to top quintile. Further, the prevalence of stunting and underweight is higher in rural migrant as counterpart to rural residence.

Table 3: Distribution of anthropometric failures by selected correlates among children of migrants and residence, India, NFHS-4 (2015-16)

	U-N1	95% CI	U-M2	95% CI	R-N3	95% CI	R-M4	95% CI
Wealth quintile								
Stunting								
Bottom quintile	40.2	[37.1,43.5]	40.0	[34.2,46.2]	45.3	[44.3,46.4]	43.6	[40.1,47.2]
Top quintile	26.0	[23.9,28.2]	21.4	[18.2,25.0]	28.0	[26.1,30.0]	18.8	[14.3,24.2]
Wasting								
Bottom quintile	20.5	[18.2,23.1]	20.7	[16.3,25.9]	22.1	[21.2,22.9]	24.9	[21.8,28.3]
Top quintile	20.0	[18.0,22.1]	20.6	[16.4,25.6]	17.0	[15.5,18.6]	16.2	[12.1,21.5]
Underweight								
Bottom quintile	38.1	[35.1,41.3]	36.5	[30.9,42.5]	42.4	[41.4,43.5]	40.5	[37.1,44.1]
Top quintile	24.9	[22.8,27.1]	22.4	[18.5,26.8]	23.6	[21.9,25.5]	19.6	[14.9,25.4]
Parental Education								
Stunting								
Illiterate	43.6	[39.5,47.8]	48.9	[40.1,57.7]	51.7	[50.2,53.2]	50.7	[45.2,56.0]
literate	28.2	[26.2,30.2]	24.2	[21.1,27.6]	36.8	[35.7,38.0]	32.0	[28.6,35.5]
Wasting								
Illiterate	20.6	[17.7,23.9]	24.2	[17.6,32.3]	23.9	[22.7,25.2]	26.4	[21.7,31.7]
literate	20.1	[18.3,22.0]	20.1	[16.6,24.3]	19.6	[18.6,20.5]	21.3	[18.2,24.7]
Underweight								
Illiterate	41.0	[36.9,45.2]	44.8	[36.4,53.5]	49.0	[47.5,50.5]	48.1	[42.7,53.5]
literate	27.0	[25.1,29.0]	24.3	[20.8,28.1]	33.4	[32.3,34.6]	30.0	[26.8,33.5]
Caste								
Stunting								
SC & ST	33.9	[30.3,37.7]	35.7	[28.9,43.0]	46.3	[44.8,47.8]	46.3	[41.6,51.1]
OBC & Others	30.2	[28.1,32.3]	24.8	[21.6,28.4]	39.4	[38.2,40.7]	32.7	[29.0,36.7]
Wasting								
SC & ST	21.8	[18.6,25.3]	23.8	[18.0,30.8]	22.5	[21.3,23.8]	29.7	[25.4,34.4]
OBC & Others	19.9	[18.1,21.9]	19.4	[15.6,23.9]	20.7	[19.7,21.7]	19.0	[15.8,22.8]

	U-N1	95% CI	U-M2	95% CI	R-N3	95% CI	R-M4	95% CI
Underweight								
SC & ST	35.7	[31.9,39.7]	36.9	[29.9,44.4]	42.8	[41.3,44.3]	43.4	[38.8,48.2]
OBC & Others	28.5	[26.4,30.6]	24.2	[20.5,28.3]	36.9	[35.7,38.1]	30.8	[27.2,34.7]
Region								
Stunting								
North	30.3	[26.9,33.8]	32.7	[25.3,41.1]	35.4	[33.6,37.2]	35.4	[28.1,43.6]
central	41.0	[38.1,44.0]	32.8	[27.1,39.0]	47.6	[46.0,49.1]	47.7	[42.3,53.1]
East	30.6	[26.0,35.5]	26.0	[16.8,38.0]	42.2	[40.2,44.2]	42.6	[36.0,49.5]
North East	21.9	[16.8,28.2]	32.6	[24.3,42.0]	35.2	[32.5,37.9]	36.6	[30.7,43.0]
west	26.4	[21.7,31.8]	23.1	[16.7,31.1]	45.6	[42.4,48.8]	38.1	[30.1,46.8]
south	24.5	[20.7,28.7]	25.9	[21.3,31.2]	35.3	[32.6,38.1]	29.0	[23.7,34.9]
Wasting								
North	18.5	[16.1,21.3]	21.9	[15.8,29.6]	21.3	[19.8,22.9]	16.3	[10.7,23.9]
central	21.6	[19.1,24.2]	18.3	[14.1,23.4]	21.5	[20.3,22.8]	28.2	[23.7,33.2]
East	15.9	[12.7,19.9]	18.0	[10.9,28.3]	20.9	[19.3,22.6]	24.1	[18.6,30.5]
North East	12.3	[8.2,18.0]	11.4	[6.7,18.5]	15.6	[13.6,17.8]	12.8	[9.3,17.3]
west	21.8	[17.4,26.9]	31.8	[22.0,43.6]	22.9	[20.4,25.5]	27.0	[20.2,35.1]
south	22.1	[18.3,26.5]	15.5	[12.2,19.6]	20.3	[18.1,22.6]	19.8	[14.8,26.0]
Underweight								
North	26.5	[23.3,29.9]	29.7	[22.5,38.0]	31.4	[29.7,33.2]	26.3	[19.6,34.2]
central	39.3	[36.4,42.3]	33.9	[28.3,39.9]	44.2	[42.7,45.7]	44.7	[39.4,50.1]
East	28.5	[24.2,33.3]	31.8	[21.9,43.6]	40.6	[38.7,42.6]	43.0	[36.4,49.8]
North East	21.2	[15.7,28.0]	27.2	[18.9,37.3]	27.5	[24.9,30.1]	26.4	[21.2,32.5]
west	27.4	[22.5,32.9]	29.6	[20.7,40.3]	41.6	[38.6,44.8]	41.6	[33.4,50.3]
south	23.4	[19.8,27.4]	20.6	[16.5,25.4]	32.4	[29.7,35.2]	25.6	[20.6,31.2]

*Notes: 1U-N; Urban Native; 2 U-M; Urban Migrant; 3 R-R; Rural Native; 4 R-M; Rural Migrants

Source: Authors based on NFHS 2015-16

Parental education strongly differentiates outcomes, especially among urban migrants. Migrant families with educated parents appear better able to access urban health services, nutrition practices, and childcare, resulting in improved child health outcomes. It shows that those parents are illiterate their children are higher undernutrition failure than literate parents. In the urban migrant's children are stunting and underweight is closely 20% higher in illiterate as compare to literate. Moreover, in regional pattern of urban migrant's vs rural migrants shows that in the North urban migrant's having a higher prevalence of stunting and underweight. Interestingly, within the south urban migrant vs residence shows that urban residence is less stunting and underweight. Whereas, in rural migrant's vs rural residence western having a higher stunting and north having higher underweight. Finally, the advantage of urban migration is higher in southern region and their children nutritional status as counterpart to northern, central, eastern, north eastern and western regions. Although urban migration may mask caste discrimination for SC/ST migrant children still experience higher nutritional deprivation, indicating structural inequalities, where 35.7% of urban migrant children are stunting as compared to 24.8% among OBC/Others. Urban migrant children remain vulnerable to anthropometric failures due to socio-economic inequalities, caste disadvantages, and regional disparities.

Table 4; represents that association between the undernutrition failure adjustment with socio- economic characteristics. The comparison between urban migrant's vs urban residence and Rural

migrant's vs Rural residence. As compared to affluent urban residents, urban migrants in the bottom wealth quintile has 40% higher odds of stunting, indicating that wealth significantly moderates the nutritional disadvantage among migrant households in cities. Poor migrant families living in urban areas remain highly vulnerable to chronic malnutrition, while wealthier migrant households appear to benefit from the urban advantage. It is interesting to note that neither urban migrant bottom nor top wealth groups show statistically significant differences in wasting.

Parental migration and child undernutrition failure is significantly associated. In urban areas, parental education appears to play a significant role among migrant households. The reduced risk of chronic malnutrition among children with educated migrant parents, as they may have better awareness of childcare practices, nutrition, and access to health services. Urban migrant with illiterate parents have 60 % higher odds of stunting, and underweight as compared with literate parents.

Table 5. Represents the propensity score matching (PSM) to understand the impact of migration on children nutritional outcome. In the overall sample, shows that migrant's children are significantly lower the prevalence of stunting compared to non-migrant children (ATT =-0.022; t=-2.39) while difference in wasting and

Table 4: Adjusted logistic regression for association between the socio-economic characteristics with stunting, wasting and underweight

Wealth Index	**OR Stunting4**	**OR Wasting5**	**OR Underweight6**
U-R Top (ref).	1.0 [1.0,1.0]	1.0 [1.0,1.0]	1.0 [1.0,1.0]
U-M Bottom	1.4** [1.1,2.0]	0.9 [0.6,1.3]	1.2 [0.9,1.6]
U-M Top	0.8* [0.6,1.0]	1.0 [0.7,1.4]	0.9 [0.7,1.2]
R-M Bottom	1.3** [1.0,1.6]	1.1 [0.8,1.4]	1.0 [0.8,1.3]
R-M Top	0.7** [0.5,1.0]	0.8 [0.5,1.1]	0.7* [0.5,1.0]
U-R Bottom	1.3** [1.1,1.6]	0.9 [0.7,1.2]	1.1 [0.9,1.4]
R-R Bottom	1.5*** [1.3,1.8]	0.9 [0.8,1.1]	1.2** [1.0,1.4]
R-R Top	1.1 [0.9,1.3]	0.8** [0.7,0.9]	0.8* [0.7,1.0]
Parental Education			
U-R literate (ref).	1.0 [1.0,1.0]	1.0 [1.0,1.0]	1.0 [1.0,1.0]
U-M illiterate	1.6** [1.0,2.6]	1.3 [0.8,2.1]	1.5* [0.9,2.5]
U-M literate	0.8* [0.6,1.0]	1.0 [0.7,1.3]	0.9 [0.7,1.1]
R-M illiterate	1.0 [0.8,1.4]	0.9 [0.6,1.4]	0.9 [0.7,1.3]
R-M literate	0.8* [0.7,1.0]	1.0 [0.7,1.2]	0.7** [0.6,0.9]
U-R illiterate	1.1 [0.9,1.5]	0.9 [0.7,1.2]	1.0 [0.8,1.3]
R-R illiterate	1.3*** [1.1,1.6]	1.0 [0.8,1.2]	1.2** [1.0,1.4]
R-R literate	1.0 [0.9,1.2]	0.8** [0.7,1.0]	0.9** [0.7,1.0]
Caste			
U-R OBC & Others (ref).	1.0 [1.0,1.0]	1.0 [1.0,1.0]	1.0 [1.0,1.0]
U-M SC & ST	1.0 [0.7,1.5]	1.1 [0.7,1.6]	1.2 [0.8,1.8]
U-M OBC & Others	0.8* [0.7,1.0]	1.0 [0.7,1.4]	0.9 [0.7,1.2]
R-M SC & ST	1.0 [0.8,1.3]	1.2 [0.9,1.6]	0.9 [0.7,1.2]
R-M OBC & Others	0.7*** [0.6,0.9]	0.8 [0.6,1.1]	0.7** [0.6,0.9]
U-R SC & ST	1.0 [0.8,1.2]	1.0 [0.8,1.3]	1.1 [0.9,1.4]
R-R SC & ST	1.1 [0.9,1.3]	0.9 [0.7,1.0]	0.9 [0.8,1.1]
R-R OBC & Others	1.0 [0.9,1.2]	0.9 [0.8,1.1]	0.9 [0.8,1.1]
Region[2]			
N-U Migration (ref).	1.0 [1.0,1.0]	1.0 [1.0,1.0]	1.0 [1.0,1.0]
N-R Migration	0.8 [0.5,1.5]	0.6 [0.3,1.2]	0.5** [0.3,0.9]

Wealth Index	OR Stunting4	OR Wasting5	OR Underweight6
N-U Residence	1.2 [0.7,1.9]	0.9 [0.6,1.5]	1.0 [0.6,1.6]
N-R Residence	1.0 [0.6,1.5]	0.9 [0.6,1.4]	0.8 [0.5,1.3]
C-U Migration	0.9 [0.5,1.5]	0.9 [0.5,1.6]	1.1 [0.7,1.9]
C-R Migration	0.9 [0.6,1.6]	1.1 [0.7,1.9]	0.9 [0.5,1.5]
C-U Residence	1.3 [0.8,2.0]	1.0 [0.6,1.6]	1.3 [0.8,2.0]
C-R Residence	1.0 [0.6,1.5]	0.8 [0.5,1.3]	0.9 [0.6,1.4]
E-U Migration	0.5 [0.2,1.2]	0.7 [0.4,1.5]	0.7 [0.3,1.3]
E-R Migration	0.6** [0.3,1.0]	0.7 [0.4,1.3]	0.5** [0.3,0.9]
E-U Residence	0.6* [0.4,1.1]	0.7 [0.4,1.2]	0.6* [0.4,1.0]
E-R Residence	0.7 [0.4,1.1]	0.8 [0.5,1.2]	0.7 [0.4,1.1]
N-E-U Migration	1.0 [0.5,1.8]	0.5* [0.2,1.1]	0.9 [0.4,1.6]
N-E-R Migration	0.5** [0.3,0.9]	0.4*** [0.2,0.8]	0.4*** [0.2,0.7]
N-E-U Residence	0.5** [0.3,0.9]	0.5** [0.3,0.9]	0.5** [0.3,0.9]
N-E-R Residence	0.6** [0.4,1.0]	0.5** [0.3,0.9]	0.4*** [0.3,0.7]
W-U Migration	0.7 [0.4,1.3]	1.9* [1.0,3.8]	1.1 [0.6,2.3]
W-R Migration	0.8 [0.4,1.4]	1.3 [0.7,2.3]	1.0 [0.5,1.7]
W-U Residence	0.9 [0.5,1.4]	1.1 [0.7,1.9]	0.9 [0.6,1.6]
W-R Residence	1.2 [0.8,1.9]	0.9 [0.6,1.5]	1.0 [0.6,1.6]
S-U Migration	0.8 [0.5,1.4]	0.8 [0.5,1.3]	0.7 [0.4,1.1]
S-R Migration	0.6* [0.4,1.1]	0.9 [0.5,1.6]	0.6** [0.3,1.0]
S-U Residence	0.7 [0.5,1.2]	1.2 [0.7,1.9]	0.8 [0.5,1.3]
S-R Residence	0.9 [0.6,1.4]	0.9 [0.6,1.4]	0.8 [0.5,1.3]

Source: Authors based on NFHS 2015-16

*Notes: 2 N-U; North Urban, N-R; North rural, C-U; Central urban, C-R; Central rural, E-U; East urban, E-R; East rural, N-E-U; North east urban, N-E-R; North east rural, W-U; West urban, W-R; West rural, S-U; South urban, S-R; South rural

*Notes 3; Regression model for Adjusted: Variables Child ICDS services, Parental education, Maternal BMI, Child age, Birth order, Maternal height, Mother age at birth, Children birth weight, caste, Skilled birth attendance, Toilet facility, Water facility and region

*Notes 4; Regression model for Adjusted: Variables Child ICDS services, Parental education, Maternal BMI, Child age, Birth order, Maternal height, Mother age at birth, Children birth weight, caste, Skilled birth attendance, Toilet facility, Water facility and region

*Notes 5; Regression model for Adjusted: Variables Child ICDS services, Maternal BMI, Child age, Birth order, Maternal height, Mother age at birth, Children birth weight, caste, Skilled birth attendance, Toilet facility, Water facility, Wealth Index and region

*Notes 6; Regression model for Adjusted: Variables Child ICDS services, Maternal BMI, Child age, Birth order, Maternal height, Mother age at birth, Children birth weight, caste, Skilled birth attendance, Toilet facility, Water facility, Wealth Index and region

Table 5: Propensity score matching estimates showing the effect of migration on children nutritional outcome

Migrant vs non-migrant children	Treated	Controls	Difference	S.E.	T-stat
Stunting					
Unmatched	0.312	0.365	-0.052	0.009	-5.77
ATT	0.312	0.334	-0.022	0.009	-2.39
ATU	0.365	0.346	-0.018	.	.
ATE			-0.019	.	.
Wasting					
Unmatched	0.193	0.207	-0.014	0.008	-1.84
ATT	0.193	0.195	-0.003	0.008	-0.35
ATU	0.207	0.205	-0.002	.	.
ATE			-0.002	.	.
Underweight					
Unmatched	0.280	0.332	-0.052	0.009	-5.88
ATT	0.280	0.296	-0.017	0.009	-1.88
ATU	0.332	0.317	-0.015	.	.
ATE			-0.015	.	.
Migrant vs non-migrant children urban					
Stunting					
Unmatched	0.287	0.301	-0.014	0.013	-1.08
ATT	0.287	0.285	0.002	0.013	0.16
ATU	0.301	0.292	-0.009	.	.
ATE			-0.006	.	.
Wasting					
Unmatched	0.186	0.196	-0.010	0.011	-0.92
ATT	0.186	0.194	-0.008	0.011	-0.67
ATU	0.196	0.188	-0.009	.	.
ATE			-0.008	.	.
Underweight					
Unmatched	0.262	0.276	-0.014	0.013	-1.07
ATT	0.262	0.261	0.002	0.013	0.14
ATU	0.276	0.275	-0.001	.	.
ATE			0.000	.	.

Migrant vs non-migrant children	Treated	Controls	Difference	S.E.	T-stat
Migrant vs non-migrant children Rural					
Stunting					
Unmatched	0.339	0.386	-0.047	0.013	-3.63
ATT	0.339	0.377	-0.038	0.013	-2.97
ATU	0.386	0.362	-0.023	.	.
ATE			-0.025	.	.
Wasting					
Unmatched	0.200	0.211	-0.010	0.011	-0.95
ATT	0.200	0.205	-0.005	0.011	-0.43
ATU	0.210	0.208	-0.002	.	.
ATE			-0.002	.	.
Underweight					
Unmatched	0.298	0.351	-0.053	0.013	-4.17
ATT	0.298	0.338	-0.039	0.012	-3.20
ATU	0.350	0.322	-0.028	.	.
ATE			-0.029	.	.

Source: Authors based on NFHS 2015-16

ATT = Average treatment effect on the treated. ATU = Average treatment effect on the untreated. ATE = Average treatment effect.

Note: control variables are Parental education, Maternal BMI, Child age, Birth order, Mother age at birth, Children birth weight, Skilled birth attendance, Toilet facility, region.

underweight are small and statistically insignificant. Moreover, in urban areas match indicate no significant differences in nutritional outcome between migrant and non-migrant children. The ATT among migrant is close to zero (0.002; t=0.16) and wasting and underweight difference is negligible. Whereas, in rural areas, migrant children exhibit lower level of stunting (ATT=-0.038) and underweight (ATT=-0.039) compared to non-migrant children.

Robustness check

The relationship between parental migration and children are complex and may depends on urban living condition and destination. Therefore, we have also checked the robustness to ensure the reliability of the study. Moreover, capturing a migration from NFHS is challenging, because migration is mostly being due to marriage. Therefore, we have used duration of father's residence at current place and living at current location less than 10 years were considered as migrants. This approach can use with NFHS data.

To further validate the migration pattern, we have used age specific migration pattern from census, 2011 (Table s1 and Table s2). The census table shows broadly comparable migration pattern between NFHS-4 and census data. Particularly prime age of 15-49 (women) and 15-54 (men) age groups. This analysis consistency provides confidence of migration definition which we have used for the analysis.

Moreover, to estimate the causal effect of migration on children nutritional outcome, PSM was employed first we use logit model to estimate the propensity score, where parental migration was treated as dependent variable and several socio-economic demographics characteristics were including as covariates. Afterwards, matching was done to ensure that the treated group (Migrants household) and control groups (non-migrants household). Further, to assess the quality of matching we conducted a balancing test (Table 6). The results indicate a substantial improvement in covariates balance after matching. For overall, Pseudo R2 decreased from 0.052 in the unmatched sample to nearly after matching, and the likelihood ratio (LR x2) statistic became statistically insignificant. Similar pattern was observed in rural and urban, it is suggesting that matching procedure effectively balance the covariates between migrants and non-migrants.

Migration research in India often face challenges particular related to endogeneity and selection bias, because migration pattern often influences by age, education, household composition, skill, employment, opportunities etc. According to migration theory is always seen as investment in human capital. In result, these factors of migration may influence the migration behavior and children health.

Also, additional validation has been performed by comparing a state's level migration pattern of NFHS-4 and census-2011 (Table S3). Although some difference

Table 6. Overall Significance of the Models after Conducting Matching Analysis

Sample for migration	Pseudo R2	LR χ2	p > χ2
Overall			
Unmatched	0.052	953.61	0.000
Matched	0.000	4.360	0.930
Urban			
Unmatched	0.036	265.44	0.000
Matched	0.000	0.800	1.000
Rural			
Unmatched	0.035	360.90	0.000
Matched	0.001	5.420	0.862

Source: Authors based on NFHS 2015-16

exists due to survey differences, but the overall distribution of migration pattern remains consistence.

Table 6: Represents overall significance of the model is shown. The pseudo R2 gives us an estimation of how well the predictors explain the probability of the outcome for child health outcomes (stunting, underweight, and wasting). After matching the value is decreasing, Further, it was found that mean difference became insignificant after matching for almost all covariates. Therefore, all the covariates were sufficiently balanced.

Discussion

Internal migration represents an India's economy transformation, approximately 450 million internal migrants (Census, 2011) and 17.5 million International migrants globally (IOM, 2019). These migrants are originated from rural states such as Bihar, Uttar Pradesh and Jharkhand to urban hubs such as Delhi, Mumbai and Chennai. While migration promote a better livelihood, but health is remained ambiguous. There are studies has been reveals that migration having negative impact on worker health such as lack of proper safety, extreme heat stress, construction accidents and exposure of hazardous chemical.

Moreover, the finding indicates effect of migration on children varies by residential context and socio-economic composition rather than migration itself. The descriptive finding shows differences among migrant and non-migrant group for example children of urban migrants has a lower prevalence of stunting (27.7%) and underweight (26.7%) compared with urban natives (30.7% and 29.2% respectively). Similarly, with rural migrant's children also appears to lower level of undernutrition than rural natives.

Parental education demonstrates a strong association with children nutritional status. Children of illiterate parents show considerably high stunting and underweight than those parents are literate. For instance, stunting is 48.9% among children of illiterate parents compared with 24.2 % among those literate parents. It is evidently shows importance of parental knowledge and health awareness shaping child nutrition. Further, adjusted regression analysis exhibit the importance of socio-economic factors. Children from poor household have significantly higher odds of stunting compared to a wealthier household, but the parental illiteracy remain the positively associated with poor nutritional outcome.

However, the descriptive and regression results may still influence by migration selectivity (In the context of internal migration), labour migration is always driven by the search of better economic opportunities for the better survival of the household. Further, applied a Propensity score matching to compare the migrant and non-migrants with similar socio-economic characteristics. After controlling

a household characteristic, there is no difference are observed between urban migrant with native children for stunting, wasting and underweight. it means the urban migrants children and urban native similar nutritional conditions after socio-economic difference are taken into account. The advantage of urban migrants has been observed in descriptive table, largely changed after PSM matching. Hence, indicating that differences are primarily due to household characteristics such as education, wealth and demographic factors rather than migration itself.

These results differences also reflect in the context of destination. Urban migrants may have relatively better access food market, health services and infrastructure, where rural migrants are often engaged in seasonal work, it may experience greater food insecurity. The finding pattern are consistence with the UNICEF conceptual framework which emphasis the role of underlying determinants such as parental education and access to services. Therefore, policy needs more portable ICDS services target to rural migrants and urban creches.

Recommendation

Taking together all the findings, support that view of migrants to urban area significantly positive impact on children growth and development. Moreover, if a migrant is educated, that it will definitely enhance children's education and lead to reduction in poverty for the upcoming generation of the migrants. Whereas, in the rural-to-rural migration or urban migration specially in case of short-duration where they take their children, especially in case of the marginalized social groups resulted in chronic poverty (Thorat & Jones, 2011). For migrant children should be provided a crèche, as mandated under labor laws in the construction, mining and plantation sectors and at MGNREGA worksites.

Limitations

While, NFHS-4 analysis acknowledge the limitation as cross-sectional design limit the causal inference on migration timing and decision. Migration data also constrained stream specific analysis for example Bihar to Delhi. Moreover, NFHS-4 capture the Pre-COVID migration pattern. Whereas, NFHS-5 has distorted the pattern due to reverse migration flow.

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