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Consequences of forced migration during early childhood on cognitive well-being in later childhood in Andhra Pradesh, India

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Abstract: Unlike its short-term impact on consumption and income, forced migration is expected to deliver a permanent shock to the overall well-being of households, specifically children in the stage of infancy. Studies on the effect of forced migration on child cognitive well-being are few in number. Therefore, the present study is intended to examine the consequences of forced migration during infancy on child cognition at later age. We hypothesized that the effect of forced migration on child cognitive well-being can be mitigated by social support. The study used longitudinal data from three waves of the Young Lives Study (YLS) conducted in 2002, 2006–2007, and 2009 in the state of Andhra Pradesh, India. We used bivariate and multivariate regression models to analyze the consequences of forced migration in early childhood on the cognitive well-being in later childhood. The information on forced migration was collected in Wave 1 (at age 1), whereas the information on the cognitive well-being of the children was collected in Wave 3 (at age 8). Child cognitive well-being was measured using scores obtained by the children on the Peabody Picture Vocabulary Test (PPVT), math, Early Grade Reading Assessment (EGRA), and memory tests. The results of the bivariate analysis show that the mean PPVT, math, EGRA, and memory scores obtained by children from the migrated households were lower than those obtained by children from the non-migrated households. Results of the multivariate linear regression models also show that children from the migrated households were statistically less likely to achieve higher scores on math (coefficient: -2.008, 95% C.I.-3.108, -0.908), EGRA (coefficient: -0.746, 95% C.I.-1.366, -0.126), and memory (coefficient: -0.503, 95% C.I. -0.834, -0.173) as compared to children from the non-migrated households. Our findings also indicate that the effect of forced migration on child cognitive well-being was not mitigated by social support. Findings of this study conclude that forced migration during infancy has a significant effect on child cognitive well-being at later age. Therefore, interventions should be made, paying attention to the most vulnerable children who were displaced during critical development ages.

Keywords: forced migration; cognitive well-being; Peabody Picture Vocabulary Test (PPVT); Early Grade Reading Assessment (EGRA); memory scores; social support; India

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1. Introduction

Forced migration poses challenges that modulate its influence based on the intensity. The last few decades have witnessed an increase in the inclination to study the impact of forced migration on population development. An estimated number of 230 million people are currently living as international migrants, and the number is projected to surpass 400 million by 2050 (Martin，2013). In addition to the people who cross international borders, more than two to three times as many probably are internal migrants, people who have moved within their own countries (Esipova *et al*., 2013). The experts in the study of forced displacement have projected that between 25 million to one billion people are expected to displace from their current environment to a new point of destination over the next 40 years (OCHA/IDMC, 2009). The last two decades have seen an upsurge in the occurrence of the sudden-onset climate-related natural disasters, resulting in the displacement of more than 20 million people in 2008 alone (OCHA/IDMC, 2009). The less developed regions are more likely to face forced migration-related challenges due to their higher dependency on climate-sensitive factors and lower adaptive capacity in terms of human, financial and natural resources as well as restricted institutional and technological capabilities (Kniveton *et al*., 2008).

Sudden forced displacement can have substantial repercussions on a child's overall development. Unlike its short-term impact on consumption and income, forced migration can deliver a more enduring shock that affects the overall well-being of households, specifically children in the infancy stage. Forced migration during infancy may affect a child's cognitive well-being in several ways. First, it may result in poor mental health of the mother. A number of previous studies have reported that poor mental health of the mother was negatively associated with the child's growth and cognitive development (Bennett *et al*., 2015). Second, it may be associated with a lack of nutrient intake, low immunization, childhood diseases and lower access to health care, which may lead to poor development of children at later ages.

Kondylis (2005) reported that conflict-induced migration has a negative impact on returnees' stock of human capital (Kondylis，2005). Rousseau *et al*., (1999) also examined the intergenerational effect of displacement on mental health. They reported that trauma experienced by parents before displacement was positively associated with risk behavior and school failure in boys. However, in the case of girls, trauma was associated with positive social adjustment. In a study in Colombia, the likelihood of chronic malnutrition due to forced displacement was found to range between 12.6% and 18.1% (Ortiz Becerra, 2014). Various studies have examined child immunization among refugee and displaced populations. Children born during increased hostilities in Sierra Leone were found lacking in age-appropriate immunization (Senessie *et al*., 2007). Hildebrandt *et al*., (2005) showed that migration may reduce the likelihood of breastfeeding and vaccinations (Hildebrandt *et al*., 2005). Some studies have shown that as a consequence of forced and environmental displacement, dropout rates were observed among children aged 12 years and above increased due to the emergence of alternative sources of household income (Ibáñez *et al*., 2010; World Bank, 2013). A study using the Young Lives data from Peru found maternal migration to be positively associated with child nutritional status, but found no significant effect of migration on cognitive development at the age of 5 years (Flores *et al*., 2009).

Pieces of evidence confirm the immediate and the long-term health implications of forced migration on the disadvantaged groups particularly in terms of child outcomes (Avogo *et al*., 2010; Ortiz Becerra, 2014; Rossi, 2008). Forced migration directly impacts childhood mortality through malnourishment and physical injuries. The less prominent impact includes psychological distress affecting a child's cognitive ability due to forced exit from a familiar environment to an unusual destination. Forced migrants are, therefore, more exposed to child developmental vulnerabilities as against non-forced migrants, who are better equipped to deal with the immediate as well as long-term disturbances arising out of migration (Agadjanian *et al*., 2003; Avogo *et al*., 2010; Doocy *et al*., 2007; Guha Sapir *et al*., 2004; O'Hare *et al*., 2007).

The availability of a social support system during forced migration helps to build a social environment that enables the displaced people to organize their life at the new destination. Displaced pregnant women seek prenatal care in order to ensure safe and healthy delivery. Support and referral services for such women are both directly and indirectly linked to child survival as well as development. In the absence of support, disturbances at the destination can result in abnormalities among the displaced children due to variations in the genetic, cognitive, physical, family, cultural, nutritional, educational, and environmental factors.

There is ample international literature on the impact of forced migration on early childhood nutritional development, schooling, household income, food consumption and adult human capital. However, there is no empirical study related to the effect of early childhood internal forced migration on children's cognitive well-being during later childhood in India. This may be on account of lack of data about migrant people. The present study aims to fills this gap by examining the effect of forced migration during infancy on the cognitive well-being of the children at the age of 8 years, using longitudinal data from the first, second and third waves of the Young Lives Study from Andhra Pradesh, India.

2. Data and Methods

2.1 Data

We used data from the first, second, and third waves of the Young Lives Study (YLS), conducted in the state of Andhra Pradesh in India in 2002, 2006–2007 and 2009, respectively. The Young Lives Study is an international longitudinal study investigating the changing nature of childhood poverty. About 12,000 children are being followed in four countries: Ethiopia, Peru, Vietnam and India (Andhra Pradesh). Each country has two cohorts: younger cohort and older cohort. The younger cohort consists of about 2,000 children born in 2001–2002, and the older cohort consists of about 1,000 children born in 1994–1995 to be followed over a period of 15 years. The YLS is conducted every three/four years to collect data on a range of indicators related to the growth and development of children. The YLS also collects information on child welfare outcomes including nutritional status, growth, physical health, cognitive development, social and emotional well-being, and educational development.

A multistage sampling design was adopted by the YLS in India. In the first stage, two districts were selected from each of the three geographic regions (Coastal, Rayalaseema and Telangana) of the state of Andhra Pradesh. The selection of the districts was based on their relative rankings on the economic, human, and infrastructure development fronts. In the second stage, 19 (15 from rural areas and 4 from urban areas) sentinel sites (administrative blocks or 'mandals') were selected from the six sampled districts. In addition, one sentinel site was selected from the urban slum of the city of Hyderabad. In the third stage, villages were selected from the sampled rural sentinel sites and wards were selected from the sampled urban sites. Each sentinel site was divided into four contiguous geographical areas, and one village was randomly selected from each area. All the households with a one-year-old child (born in 2001–2002) or an eight-year-old child (born in 1994–1995) in the selected villages and wards were included in the YLS. Overall, 2011 households (with 2011 children) in the younger cohort and 1008 households (with 1008 children) in the older cohort were included in the first wave of the YLS, which was conducted in 2002 (for details of the YLS sampling design, please see Kumra, 2008).

The second wave took place between the late 2006 and the early 2007. Of the 2011 children (younger cohort) surveyed in the first wave, 32 children had died, 7 (households) refused to continue with the study and 22 children were untraceable. Hence, the second wave included only 1950 children. The third wave took place in 2009 and included 1930 children (of the 1950 children in Wave 2, 4 children had died, 5 (households) refused to continue with the study and 11 were untraceable) in the younger cohort. The attrition rate between Waves 1 and 2 was about 3% and between Waves 2 and 3 about 1% (Barnett *et al*., 2012).

We used data from each of the three waves of the YLS to examine the effect of forced migration on child cognitive well-being. Of the 2011 children who were surveyed in the first wave, information on the migration status was available for 1,913 children in Wave 3. However, the analytical sample size to investigate the effect of forced migration on child cognitive well-being in terms of Peabody Picture Vocabulary Test (PPVT), maths, Early Grade Reading Assessment (EGRA), and memory scores was 1,845, 1,861, 1,864 and 1,875, respectively. Of the 1,913 children (for whom the information on forced migration was available), the PPVT, maths, EGRA and memory tests could not be conducted for 29, 26 and 15 children respectively.

2.2 Outcome Variables

The outcome variables of interest were the scores attained by children on the Peabody Picture Vocabulary Test (PPVT), Maths Achievement Test, EGRA, and memory test. The information on each of the outcome variables–the PPVT, math, EGRA, and memory scores–were collected during the third wave of the YLS (when the children were at age 8 years).

The PPVT is a very common and widely accepted assessment test for identifying the verbal abilities, learning disabilities and scholastic aptitude among school-going children. The YLS uses version-III (204 items, Dunn *et al*., 1997) to assess PPVT scores in India. We used the PPVT score in natural logarithmic units to model a potential non-linear association between PPVT score and forced migration. Mathematics achievement test was used to identify children's sense of numbers. The maths test included 20 items on addition, subtraction, multiplication and division. The EGRA was used to assess the ability to recognize letters of the alphabet, read simple words and understand sentences and paragraphs and to assess listening comprehension. For details of the PPVT, maths test and the EGRA, see Cueto and Leon, 2012.

2.3 Key Exposure Variables

The key exposure variables of interest were household forced migration (yes versus no) and the social support (low versus medium/high) received by the households in Wave 1 (children aged 1 year).

The variable of forced migration was created using two questions asked in the first wave of YLS. The survey asked “Since pregnancy of the index child, have there been any big changes or events (natural disaster; moved/migrated/fled; decrease in food availability; deaths of livestock; crop failure; deaths of household members; severe illness/injury and victim of crime) that decreased the economic welfare of your household? If the answer was yes, then the survey further asked “What did the households do in response to the big changes/events?”. Out of the 2,011 households/children recruited in Wave 1, the information on the migration status was available only for 1,913 households/children in wave 3. A total of 6.2% households (n = 119) reported that they had migrated since the pregnancy of the index child due to the aforementioned catastrophic events in Wave 1. It is worth noting that the present study used the term forced migration as defined by the International Organization for Migration (IOM) (Laczko and Aghazarm, 2009).

The information on social support (economic support and emotional support or assistance) was also collected in the survey. The survey asked the women in the previous 12 months they had received any kind of economic or emotional help or assistance from a work-related/trade union (yes, no), community association/co-op (yes, no), women’s group (yes, no), political group(yes, no), religious group (yes, no), credit or funeral group (yes, no), sports group (yes, no), family (yes, no), neighbourhood (yes, no), friends (yes, no), community leaders (yes, no), religious leaders (yes, no), politicians (yes, no), government officials/civil service (yes, no), charitable organizations/NGOs (yes, no), and any other group (yes, no). If a woman had received any kind of help, her reply was coded as ‘1’; otherwise, it was coded as ‘0’. Help received from each group/person was added so that the amount of help received ranged from 0 to 16. If a woman reported no help or assistance, it was regarded as ‘low’ social support. Support ranging from 1 to 4 was considered as ‘medium’ social support and from 5 to 16 as ‘high’ social support. The details of the social support measurement are presented elsewhere (Galab *et al*., 2003).

2.4 Other Variables

Past studies on the subject of child cognitive well-being have included a number of other socio-economic, demographic and residence-related variables. Accordingly, we included birth size (below average, average and above), preterm birth (full term, preterm), sex of child (male, female), ever breastfed (no, yes), serious illness/injury in Wave 1 (no, yes), stunting at Wave 1(not stunted, stunted), child immunization (no/partial, full), pre-schooling(no, yes), type of school (private, government), mother’s height (in cm), mother’s education (below primary, primary and above), mother’s age at birth of child (<18 years, 18–24 years, 25–29 years, ≥30 years), mother’s working status (not working, agricultural work, other), household head education (below primary, primary and above), sex of household head (male, female), drinking water (improved, non-improved), toilet facility (improved, non-improved), wealth index in Waves 1 and 3 (poor, middle, rich), religion (Hindu, Muslim, other), caste (Scheduled Tribe (ST), Scheduled Caste (SC), other backward classes (OBC), other), and place of residence (rural, urban).

The survey collected data on the respondent’s (mother/caregiver) perception of the size of the baby at birth. The YLS asked the respondent if the child was very small, small, average, large or very large at birth? Very small or small size at birth was coded as ‘below average’, and average, large or very large size at birth was coded as ‘average and above’.

During the first wave of the survey, the mothers/caregivers were asked whether the child had suffered from any serious illnesses or injury since birth which led the mother/caregiver to think that the child might die (Yes/No/Don’t know). If the mother replied with a ‘yes’, then serious illness was coded as ‘yes’; otherwise it was coded as ‘no’.

In the second wave of the YLS, the survey asked to the mothers whether the child had received vaccinations for tuberculosis (BCG); diphtheria, whooping cough (pertussis) and tetanus (DPT); poliomyelitis (Polio); and measles. Children who had received all the afore-mentioned vaccines were coded as ‘fully immunized’. The remaining children were coded as ‘no/partially immunized’.

The wealth index was calculated using the wealth scores, which are already computed and given in the YLS dataset. The wealth scores were generated through principal component analysis conducted on a set of variables including household assets (including radio, refrigerator, bicycle, television, motorbike/scooter, car, pump, sewing machine, mobile, phone, landline telephone, fan, almirah, clock, table, chair, sofa, bedsheet and animals), household quality (including wall, roof and floor) and services (including electricity, drinking water, toilet facility). The lowest 33.3% households were coded as poor, the next 33.3% as middle, and the remaining 33.3% as rich.

The YLS has also collected information on the main source of drinking water. Children were classified into two categories according to whether the households they lived in used safe or unsafe water for drinking. Households having piped water in a dwelling/yard/plot or using a public tap/standpipe or a tube well/borehole or protected dug well were considered as using safe drinking water. Other households were categorized as using unsafe drinking water. Information on the type of toilet facility used by the households was also gathered in each of the three waves of the YLS. Improved toilet facilities included flush toilet/pit latrine connected to a septic tank. Non-improved toilet facilities included public/shared facility, simple latrine, toilet in a health post or defecating in a/an forest/field/open place (WHO and UNICEF, 2012 update).

2.5 Statistical Methods

Bivariate analysis was performed to compare the characteristics of migrant and non-migrant households using cross tabulation. Furthermore, a series of multivariate linear regressions were used to examine the effect of forced migration on child cognitive well-being. Each of the four outcome variables–PPVT score, maths score, EGRA score and memory score (collected in the third wave)–were regressed on household forced migration (collected in the first wave) and included all other variables listed in the ‘other variables’. Adjusted coefficients and 95% confidence interval were reported. To assess whether social support mitigates the effects of forced migration on child cognitive well-being, we used the recommended procedure (Baron and Kenny, 1986). Variables were included into the multivariate model based on previous studies and based on their association with cognitive well-being in the bivariate analysis. All the variables were tested for multicollinearity using variance inflammation factor (VIF) before being included in the regression models. All the statistical computations were done in STATA 13.0.

3. Results

Figure 1 describes the mean PPVT-score, math-score, EGRA-score and memory-score obtained by children from migrant and non-migrant households. The children of non-migrant households outperformed than the children of migrant households on all tests. The mean PPVT, math, EGRA and memory scores of children from migrant households were 48.8, 9.1, 4.4 and 3.3 respectively, which were substantially lower than the scores of 59.3, 12.2, 5.4 and 3.8, respectively,

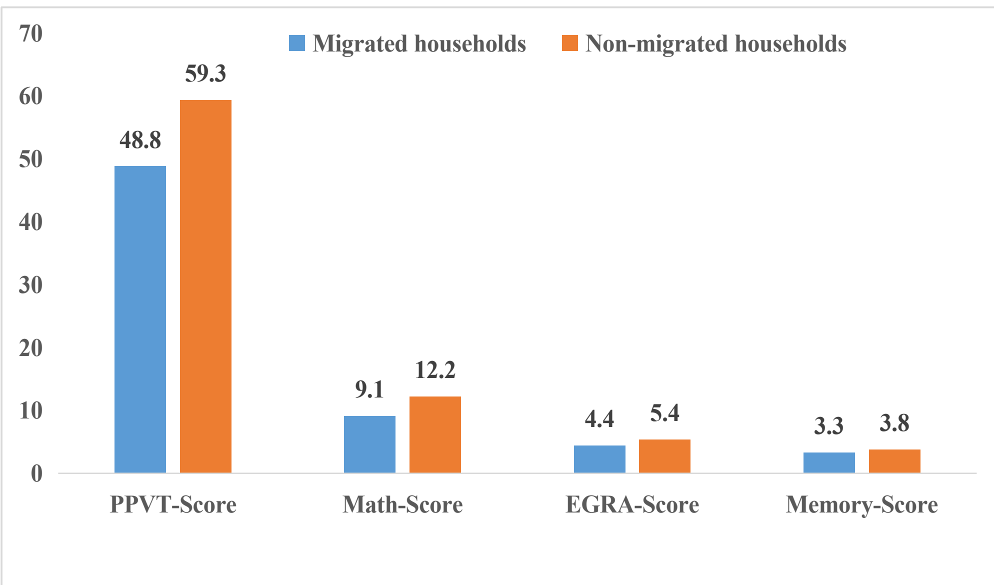

Figure 1. Mean PPVT-score, Math-score, EGRA-score and Memory-Score at the age of 8 years obtained by children from migrant and non-migrant households

obtained by children from non-migrant households.

Table 1 describes the bivariate analysis of child characteristics and maternal/household characteristics according to the status of forced migration in Andhra Pradesh (India). Results show that about 6.2% households had migrated since the pregnancy of the index child due to some catastrophic event following Wave 1. The information on the migration status of 1913 children interviewed in Wave 3 showed that around 29.4% of the children from the migrant households were below average size at birth, whereas only 25.5% of the children from the non-migrant households were below average size at birth. 87.4% of the migrant households and 79.7% of the non-migrant households had received medium/high social support. A higher percentage of children of non-migrant mothers had been breastfed compared to those of migrant mothers. Around 28.6% children from migrant households had suffered a serious illness/injury in wave 1, whereas only 21.7% children had done so in case of non-migrant households. About 33.9% migrant children were stunted, while only 29.7% non-migrant children experienced stunting. Migrant and non-migrant households enjoyed equal coverage of immunization and pre-schooling. The inter-class comparison of mother's education for both migrant and non-migrant households revealed that around 85.7% of the migrant mothers had below primary level education compared to only 58.7% of the non-migrant mothers. The migrant mothers were primarily engaged in agricultural work, while the majority of the non-migrant mothers were non-working. The majority of the migrant households lacked access to improved drinking water and improved toilet facility. About 94.1% of the migrant households belonged to a rural area compared to a lower figure of 72.4% in the case of non-migrant rural households.

Table 2 describes the results of multivariate linear regression analysis examining the effect of forced migration on child cognitive well-being in Andhra Pradesh, India. Model I presents the adjusted regression coefficients of all the scores for all the predictor variables except social support. Findings of Model I show that children born to migrant households were significantly less likely to achieve higher math (Coefficient: -2.008, 95% CI: -3.108, -0.908), EGRA (Coefficient: -0.746, 95% CI: -1.366, -0.126) and memory scores (Coefficient: -0.503, 95% CI: -0.834, -0.173) compared to the children of non-migrant households. Model II of **Table 2** presents the adjusted regression coefficients of all the scores for all the predictor variables including social support. The effect of social support was visible only in the case of PPVT scores. The children from households that had received medium/high social support were significantly more likely to achieve higher PPVT scores (Coefficient: 0.081, 95% CI: 0.030, 0.133) compared to those from households that had received low social support. Notably, in this model also, the children born to migrant households were significantly less likely to achieve higher math, EGRA and memory scores compared to the children of non-migrant households. By comparing Model I and Model II, we found that the magnitude of the effect of forced migration on child cognitive well-being remained unchanged even after controlling the social support.

A number of other variables were found to be statistically associated with the cognitive well-being of children. Preterm born children were significantly less likely to achieve higher PPVT scores (Coefficient: -0.101, 95% CI: -0.173, -0.030) compared to the children of full-term pregnancy. Age of children was also found to be significantly associated with the cognitive well-being, with the older children being more likely to achieve higher PPVT, math, EGRA and memory scores. Interestingly, female children were significantly less likely to achieve higher PPVT scores (Coefficient: -0.100, 95% CI: -0.140, -0.059), math scores (Coefficient: -0.539, 95% CI: -1.070, -0.008) and memory scores (Coefficient: -0.198, 95% CI: -0.358, -0.037) compared to the male children. Children who had suffered from a serious illness/injury during Wave 1 were significantly less likely to achieve higher PPVT scores (Coefficient: -0.062, 95% CI: -0.111, -0.014), math scores (Coefficient: -0.647, 95% CI: -1.283, -0.012) and EGRA scores (Coefficient: -0.388, 95% CI: -0.746, -0.029) than their counterparts. Stunted children during Wave 1 were significantly less likely to achieve higher PPVT, math, EGRA and memory scores compared to the non-stunted children during the same wave. It is worth noticing that the fully immunized children were significantly more likely to obtain higher math scores (Coefficient: 1.768, 95% CI: 0.757, 2.780) and EGRA scores (Coefficient: 0.577, 95% CI: 0.005, 1.149) compared to the not/partially immunized children. Children studying in government schools were significantly more likely to obtain higher EGRA and memory scores compared to the ones studying in private schools. Children whose mothers had primary and higher levels of education were significantly more likely to achieve higher PPVT, math and EGRA scores than those children whose mothers had below primary level education. The math, EGRA and memory scores were significantly higher among children of urban settings than those belonging to rural settings.

The estimates obtained from multivariate linear regression may have a potential selection bias due to the differences in

Table 1. Descriptive statistics of child characteristics and maternal/household characteristics according to status of forced migration in Andhra Pradesh (India)

Characteristics	Percentage	Sample Size (N = 1,913)#	Migrated (N = 119)	Not-Migrated (N = 1,794)	X^2(p-value)
Birth size					
Below average	25.7	492	29.4	25.5	0.906(0.341)
Average and above	74.3	1,421	70.6	74.5	
Social Support					
Low	19.7	373	12.6	20.3	4.108(0.043)
Medium/high	80.2	1,514	87.4	79.7	
Preterm birth					
Full term	91.5	1,750	92.4	91.4	0.149(0.699)
Preterm	8.5	163	7.6	8.6	
Sex of child					
Male	53.6	1,025	56.3	53.4	0.378(0.539)
Female	46.4	888	43.7	46.6	
Ever breastfed					
No	2.5	47	3.4	2.4	0.421(0.516)
Yes	97.5	1,842	96.6	97.6	
Serious illness/injury in Wave-1					
No	77.9	1,490	71.4	78.3	3.074(0.080)
Yes	22.1	423	28.6	21.7	
Stunting in Wave-1					
Not stunted	70.1	1,326	66.1	70.3	0.933(0.334)
Stunted	29.9	567	33.9	29.7	
Immunization					
No/partial immunization	7.6	145	7.6	7.6	0.001(0.994)
Full immunization	92.4	1,768	92.4	92.4	
Attended pre-schooling since age of 3-years					
No	12.9	246	13.5	12.8	0.0389(0.844)
Yes	87.1	1,667	86.5	87.2	
Type of school					
Private	44.2	846	32.8	45.0	6.745(0.009)
Government	55.8	1,067	67.2	55.0	
Mother’s education					
Below primary	60.4	1,156	85.7	58.7	33.928(0.000)
Primary and above	39.6	757	14.3	41.3	
Mother's age at birth of child					
<18 year	8.3	159	16.0	7.8	9.810(0.007)
18–24 year	69.7	1,333	64.7	70.0	
>=25 year	22.0	421	19.3	22.2	
Mother’s working status					
Not working	49.1	940	19.3	51.1	45.286(0.000)
Agricultural work	40.7	778	65.6	39.0	
Other work	10.2	195	15.1	9.9	
Household head education					
Below primary	59.1	1,130	77.3	57.9	17.464(0.000)
Primary and above	40.9	783	22.7	42.1	
Drinking water					
Improved	24.0	460	21.0	24.3	0.641(0.423)
Non-improved	76.0	1,453	79.0	75.6	

Table 1. Continued.

Characteristics	Percentage	Sample Size (N = 1,913)[#]	Migrated (N = 119)	Not-Migrated (N = 1,794)	X^2(p-value)
Toilet facility					
Improved	18.1	346	4.2	19.0	16.512(0.000)
Non-improved	81.9	1,567	95.8	81.0	
Wealth index in Wave-1					
Poor	33.4	639	51.3	32.2	39.237(0.000)
Middle	33.6	642	41.2	33.1	
Rich	33.0	632	7.5	34.7	
Wealth index in Wave-3					
Poor	32.9	629	45.4	32.0	13.498(0.001)
Middle	33.9	648	35.3	33.8	
Rich	33.2	636	19.3	34.2	
Place of residence					
Rural	73.7	1,410	94.1	72.4	27.279(0.000)
Urban	26.3	503	5.9	26.6	
Total	100	1,913	6.2	93.8	

Note: [#] number of cases may vary slightly based on missing observation of background characteristics

the socioeconomic development between migrant and non-migrant households. To partially overcome this bias, we used Propensity Score Matching (PSM) analysis in addition to multivariate regression models. PSM is a statistical technique that reduces the bias due to confounding variables, which in the case of the present study could be found in estimates for forced migration obtained from simply comparing outcomes for non-migrant and migrant households. Results obtained from PSM were similar to the results obtained by using multivariate linear regression analysis (see supplementary table S1).

4. Discussion

Using longitudinal data from three waves of the Young Lives Study conducted in 2002, 2006-2007 and 2009, we examined the consequences of forced migration during the early life of children on the cognitive well-being of the children at later age in Andhra Pradesh, India. Our study showed that migrant children were statistically less likely to have higher math, EGRA, and memory scores compared to the non-migrant children. These results hold even after adjusting for some of the well-known confounders of child cognitive well-being. Findings of this study are consistent with previous studies that have shown the adverse effect of forced migration on child outcomes in other countries (Avogo *et al*., 2010; Ortiz Becerra, 2014; Stevens *et al*., 2008). However, one particular study that used the YLS data from Peru, reported no significant effect of maternal migration on child cognitive well-being (Flores *et al*., 2009). Notably, the study from Peru had only taken the PPVT scores to measure child cognitive well-being. By contrast, the present study used some other test scores (math, EGRA and memory) to measure the child cognitive well-being. It is important to note that similar to the study from Peru, our study also did not find any significant effect of forced migration on child PPVT score.

Migrants in our study included those who had experienced economic loss due to drought, flood, earthquake, crime, crop failure, and so on. Therefore, it is possible that the observed effect of forced migration on cognitive well-being may be because of the economic loss at the household level. To ensure the robustness of our estimates, we ran another regression by taking interaction between economic shock and migration (results not shown) and comparing the cognitive well-being of the children for three groups: 1) household experienced economic shocks but did not migrate, 2) household experienced economic shock and migrated, and 3) non-migrated households. While comparing the cognitive well-being of children from these groups, we found that children belonging to households who had experienced an economic shock and had migrated were statistically less likely to get higher math, EGRA and memory scores than children from the households who had experienced an economic shock but had not migrated. No significant difference in child cognitive well-being was

Table 2. Results of multivariate linear regression analysis to examine the effect of forced migration on child cognitive well-being in Andhra Pradesh, India (2002-2009)

	PPVT-Score		Math-Score		EGRA-Score		Memory-Score	
	I	II	I	II	I	II	I	II
Migrant household (vs. non-migrant)	-0.074 (-0.157,0.009)	-0.078 (-0.162,0.005)	-2.008* (-3.108,-0.908)	-2.033* (-3.132,-0.934)	-0.746* (-1.366,-0.126)	-0.728* (-1.347,-0.109)	-0.503* (-0.834,-0.173)	-0.505* (-0.836,-0.175)
Social Support medium/high (vs. low)		0.081* (0.030,0.133)		0.419 (-0.257,1.095)		-0.029 (-0.410,0.352)		0.114 (-0.091,0.320)
Birth size average or above (vs. below average)	0.024 (-0.023,0.072)	0.020 (-0.028,0.067)	0.216 (-0.403,0.834)	0.194 (-0.427,0.816)	-0.142 (-0.492,0.207)	-0.168 (-0.519,0.183)	-0.001 (-0.188,0.187)	-0.017 (-0.206,0.171)
Preterm birth (vs. full term)	-0.101* (-0.173,-0.030)	-0.096* (-0.167,-0.024)	-0.356 (-1.291,0.579)	-0.332 (-1.272,0.609)	-0.292 (-0.820,0.235)	-0.344 (-0.874,0.186)	-0.175 (-0.458,0.107)	-0.172 (-0.457,0.113)
Age of child (in months)	0.010* (0.009, 0.019)	0.015* (0.010, 0.020	0.342* (0.275, 0.408)	0.344* (0.278, 0.411)	0.134* (0.097, 0.172)	0.134* (0.096, 0.171)	0.032* (0.012, 0.053)	0.033* (0.013, 0.054)
Female child (vs. male)	-0.100* (-0.140,-0.059)	-0.102* (-0.143,-0.061)	-0.539* (-1.070,-0.008)	-0.563* (-1.096,-0.030)	-0.067 (-0.367,0.232)	-0.038 (-0.339,0.262)	-0.198* (-0.358,-0.037)	-0.181* (-0.343,-0.020)
Serious illness/injury in Wave-1 (vs. no)	-0.062* (-0.111,-0.014)	-0.062* (-0.110,-0.013)	-0.647* (-1.283,-0.012)	-0.606 (-1.244,0.032)	-0.388* (-0.746,-0.029)	-0.365* (-0.725,-0.005)	-0.149 (-0.342,0.043)	-0.152 (-0.346,0.041)
Stunting at Wave-1 (vs. no)	-0.124* (-0.169,-0.079)	-0.126* (-0.172,-0.081)	-2.228* (-2.821,-1.635)	-2.213* (-2.808,-1.617)	-1.009* (-1.343,-0.674)	-0.982* (-1.318,-0.647)	-0.425* (-0.605,-0.245)	-0.430* (-0.610,-0.249)
Full immunization (vs. no/partial)	0.064 (-0.013,0.141)	0.064 (-0.013,0.142)	1.768* (0.757,2.780)	1.817* (0.802,2.832)	0.577* (0.005,1.149)	0.614* (0.041,1.188)	0.220 (-0.086,0.527)	0.231 (-0.077,0.539)
Enrolled a in public school (vs. private school)	0.012 (-0.038,0.062)	0.009 (-0.042,0.059)	0.620 (-0.036,1.276)	0.598 (-0.062,1.258)	0.704* (0.333,1.075)	0.715* (0.342,1.088)	0.270* (0.072,0.469)	0.272* (0.072,0.472)
Respondent's education is primary or above (vs. below primary)	0.090* (0.039,0.141)	0.086* (0.034,0.137)	2.611* (1.938,3.284)	2.554* (1.877,3.231)	1.119* (0.739,1.500)	1.093* (0.710,1.475)	0.202 (-0.002,0.406)	0.196 (-0.010,0.402)
Respondent's place of residence is urban (vs. rural)	0.009 (-0.059,0.078)	0.006 (-0.062,0.075)	1.732* (0.832,2.632)	1.706* (0.802,2.610)	1.130* (0.623,1.636)	1.095* (0.586,1.603)	0.369* (0.098,0.640)	0.339* (0.067,0.612)

observed between children from non-migrated households irrespective of whether had experienced an economic shock or not. Therefore, the significant effect in our study can be safely considered as an actual effect of forced migration on child cognition. Findings of the present study also indicate that the effects of forced migration on child cognitive well-being were not mitigated by social support. One of the possible reasons for the lack of association between social support and childhood cognitive well-being may be reverse causality, whereby households who were in a more adverse condition were more likely to receive support from other individuals within their community or from relatives and friends. Kawachi and Berkman (2001) reported that the protective effect of social support may not be uniform across society. To the best of our knowledge, this is the first study that examined the causal association between forced migration and child cognitive well-being in India.

When interpreting our findings, the following limitations should be taken into account. First, the effect of forced migration on child cognitive development may be influenced by the duration of migration (temporary, permanent, and returned migrants), the type of migration (rural to urban, urban to rural, and so on), and the urban-rural sampling structure. On our part, we were unable to assess this due to the unavailability of such information in the YLS. Also, comparisons of child cognition must be done at the sending places, particularly if the levels of socioeconomic development between the sending and receiving places are very different. Again, we were unable to split the sample according to their current migration status due to the unavailability of such information. Therefore, the negative effect of forced migration on child cognition in our study may be due to the socioeconomic differentials between the migrant and non-migrant households. However, the results obtained from PSM analysis also support the findings of the multivariate regression analysis. Consequently, estimates obtained from the multivariate regression analysis can be safely taken as the actual effect of forced migration on child cognition.

Second, we could not control the respondent/household characteristics prior to the forced migration due to the unavailability of data. We did, nevertheless, control the following variables: respondent's height, schooling of the respondent, respondent's age at birth of child and schooling of the head of household. We added respondent's height as a way of capturing genetic factors. We included the educational attainments of the respondent and the household head as a proxy for wealth (that is, household economic status prior to migration). Although, a number of previous studies have reported a high level of correlation between education and economic status, we must acknowledge the fact that all the variations in wealth may not be captured by education and, thus, some care is required while interpreting the findings of our study.

Third, the magnitude of the effect of forced migration on child cognitive well-being may be lower than expected due to mortality selection among children from migrant households. Some previous studies have reported that forced migration is significantly associated with higher infant and child mortality (Avogo *et al*., 2010). However, the effect of mortality selection on child cognitive development should be minimal due to the fact that only very few deaths occurred betwwen Wave 1 and Wave 3 in the YLS sample. Fourth, the observed differences in the cognitive well-being of migrant and non-migrant children may be due to a potential selection bias resulting from attrition between the first and third waves of the YLS. The attrition rate between waves 1 and 2 was about 3% and between waves 2 and 3 about 1% (Barnett *et al*., 2012). Dercon *et al*., (2008) found limited evidence of attrition bias in the YLS and argued that the attrition in the YLS samples were highly unlikely to cause a bias in research inferences.

Despite these limitations, our study has some strength. First, a large cohort of children was included in the analysis, representing children from a wide range of family backgrounds. Second, the YLS is the only large-scale available dataset that provides information on forced migration, social support, and child cognitive well-being in India. Third, the YLS uses a child-focused mixed sampling approach, allowing for an examination of the complex interrelationship between forced migration, social support, and child cognitive development in India. Fourth, the study included both rural and urban areas, representing a range of regions, policy context, and living conditions that reflect the ethnic, geographical and religious diversity of the country. Another key strength of this study is that the information on forced migration pertained to the period between pregnancy of the index child and attaining one year of age. Some studies have reported that the first 1,000 days of the child (including the duration of pregnancy) is a very crucial period for child cognitive well-being at later ages (Black *et al*., 2013). However, the majority of the previous studies have been unable to control for forced migration in this crucial period in their analyses (Flores *et al*., 2009; Rossi, 2008). Lastly, our study came out with some findings that may either lead to the formulation of new policies or may lead to the strengthening of the existing policies and programmes.

According to the United Nations High Commissioner for Refugees, the total number of displaced persons worldwide was about 42 million in 2008, and about 44% of these migrants were children below age 18 (UNHCR, 2009). Findings of the present study call for immediate interventions from government and non-government organizations. Given the evidence about the effect of early childhood cognitive development on education, productivity, and job performance, children from migrant households need special interventions that attenuate the long-term effect of early childhood cognitive development on human capital. Interventions should pay attention to the most vulnerable children who were displaced during critical development ages. Social programmes executed in other developing countries have shown a positive effect of the intervention programmes on education and health of displaced children (Bernal *et al*., 2009). Further studies are needed to compare cognitive development among children born in a household during migration and those born after migration in the same household. Moreover, a follow-up of these children is necessary to assess the relationship between cognitive development and income during adulthood.

5. Conclusions

A number of studies have examined the adverse effect of forced migration on child nutritional status, childhood immunization and school dropout rates in developing countries. However, research on the effect of forced migration on child cognitive well-being is still lacking in developing countries including India. Therefore, using longitudinal data from three waves of the Young Lives Study conducted during 2002, 2006–2007 and 2009, the present study examined the effect of forced migration during early childhood on cognitive well-being at later age. We found that forced migration during early childhood was significantly associated with poor cognitive well-being at later childhood. The study also found that the adverse effect of forced migration on child cognition was not mitigated by maternal social support. The findings of this study have implications for intervention programmes that should pay attention to the most vulnerable children who were displaced during critical development ages.

Authors' Contributions

AKU conceived the idea, designed the experiment and analysed the data; AKU, SS and CP drafted the manuscript. All authors read and approved the final manuscript.

Ethical Approval

Our study is based on a secondary dataset with no identifiable information on the survey participants. This dataset is available in the public domain for research use; hence no approval was required from any institutional review board. The data can be downloaded from the website of the United Kingdom Data Archives University of Essex after creating an account (https://www.ukdataservice.ac.uk/). The data for the current study was downloaded from the afore-mentioned website after taking permission (I.D. No. 90978).

Competing Interests

The authors declare that they have no competing interests.

Availability of Data and Materials

The data which support our findings is contained within the manuscript.

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