Migration and Child Health Inequities in Nigeria: A Multilevel Analysis of Contextual- and Individual-level Factors

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Summary

Objective

To assess the role of rural-urban migration in the risks of under-five deaths, assess the possible mechanisms through which migration may influence mortality, and assess the individual-and community-level relationship between migration status and under-five deaths.

Method

Multilevel multivariable logistic regression analysis was used on a nationally-representative sample of 6029 children from 2735 mothers aged 15-49 years and nested within 365 communities from the 2003 Nigeria Demographic and Health Survey. Odds ratios with 95% confidence intervals were used to express measures of association between the characteristics. Variance partition coefficients and proportional change in variance were used to express measures of variation.

Results

Children of rural non-migrant mothers had a significantly lower risk of under-five deaths compared to children of rural-urban migrant mothers. The disruption of family and community ties, low socio-economic position and vulnerability, as well as the difficulty migrants face in adapting into the new urban environment, may predispose the children of rural-urban migrants to higher mortality.

Conclusion

Our results stress the need for community-level and socio-economic interventions targeted at migrant groups within urban areas, and directed at improving accessibility to health care services, maternal education, and improving the general socio-economic situation of women.

Keywords: Migration, disruption, selectivity, adaptation, under-five mortality, multilevel modelling, Nigeria.

Introduction

Rural-urban migration still accounts for most of the migratory movements in West Africa (Black *et al*. 2004). Most of the migrants typically move from hostile areas characterised by drought and low agricultural productivity in search of more fertile lands to farm or for better paying jobs in urban areas. While many of these movements are temporary or seasonal, they provide the rural poor with avenues to supplement meagre farm earnings during unproductive seasons, while ensuring that they keep the rights to their land (Findley 1994). Rural-urban migration in sub-Saharan Africa, either temporary or permanent urban, appears to be the most significant form of movement for long-term spatial redistribution, and is therefore regarded by many policy makers and governments as the overriding internal migration pattern in the region, after the exclusion of periodic and seasonal movements (Oucho & Gould 1993; Oucho 1998; Chattopadhyay *et al*. 2006).

Migration is an important strategy for the diversification of livelihoods for many in the world's poorest nations (Quisumbing & McNiven 2007). Several studies in developing countries have shown rural-urban child mortality differentials in favour of urban areas, and indicate that survival chances of children in rural areas could be improved by urban migration (Brockerhoff 1994; Ssengonzi *et al*. 2002). Explanations for this proposed rural disadvantage in child mortality include the concentration of public health resources in urban areas (UNICEF 1994), low immunization coverage levels and family planning programmes in remote areas (USAID 1991), and the effect of malaria and other infectious diseases in some tropical regions (WHO 1991). Contradicting evidence suggests that urban child survival advantage over rural areas has narrowed considerably over time and that standard of living in some urban areas is even worse than in rural areas as a result of high levels of poverty in several urban populations (Brockerkhoff & Brennan 1998).

Most rural-urban migrants initially often settle in poor neighbourhoods, which are characterized by lack of adequate sanitation and clean water, poor housing and overcrowding, and lack of access to modern health services (Woldemicael 2000; Todaro 1996; Crompton & Savioli 1993; Aaby 1992). Rural-urban migrants tend to be young, often students between 15–29 years of age, predominantly single, educated, and seeking better educational opportunities (Brockerhoff 1994; Sastry 1996; Oucho 1998). This is believed to have a negative effect on the development of rural areas (Mabogunje 1988), but other studies suggest differently, stating that migration impacts positively upon sending areas (Hugo 1998), in that household members who migrate can facilitate investments in new activities by providing rural households with liquidity in the form of remittances, and income security in the event of an adverse income shock (Adepoju 1974; Wouterse & Taylor 2008).

Migration to urban areas has been shown to result in a dramatic short-term increase in the risk of child mortality. With extended urban residence, survival chances of children tend to improve compared to children of rural non-migrants (Brockerhoff 1995) as a result of behavioural change and economic progress (Brockerhoff 1994), improved access to maternal child health services, improved housing conditions and overall levels of fertility (Tam 1994).

Rural-Urban Migration in Nigeria

With the shift in reliance of the Nigerian economy from agriculture to heavy dependence on crude oil as the major source of foreign revenue, the rural economy has experienced significant deterioration (Ayadi 2005). This decline triggered a steady rural-urban migration in search of emerging job opportunities in the oil and related sectors. Better social conditions and government policies favourable to cities have helped sustain rural-urban migration with resulting increased unemployment and urban poverty (USAID 2002). Existing studies on internal migration processes in Nigeria are few and limited to a few villages or medium-sized towns (Olurode 1995; Adepoju 1986). Most migrants in Nigeria (especially rural-urban) are young persons between 15–29 years of age and unemployed (Adepoju 1986).

The objectives of this study were to: (1) estimate and compare the under-five mortality rates for the different migrant groups; (2) assess the role of rural-urban migration on under-five mortality; 3) assess the possible mechanisms through which migration may influence under-five mortality; and (4) assess the individual-and community-level relationship between migration status and the risk of under-five deaths.

Theoretical framework

Three perspectives of migration could be used to explain the differential health outcomes between migrants and non-migrants. Firstly, *migrant disruption*, suggests that the process of migration disrupts the natural progression of demographic events in the lives of the migrants. For instance, migration causes a break in mothers' network of social support in terms of advice on childcare and treatment during the childrens' illness, financial support, and even social & cultural practices (Ssengonzi *et al.* 2002). Shorter birth intervals are associated with reduced child survival, and rural women are reported to have longer birth intervals than urban women (Vitzthum 2001), thus increasing the survival chances of their children (Witwer 1993). The disruption perspective therefore argues that despite availability of better health services in urban areas, children of rural-urban migrants will have lower survival chances than children of non-migrants due to consequences of the migration itself.

Secondly, *migrant selectivity*, suggests that rural-urban migration is selective for those with specific demographic and socio-economic characteristics that are favourable to child survival (e.g. education, occupation, and wealth). These are also characteristics that increase their propensity to migrate (Ssengonzi *et al.* 2002; Stephenson *et al.* 2003; Amankwaa *et al.* 2003).

Thirdly, *migrant adaptation* refers to the extent to which migrants effectively use healthcare facilities and thus adapt into the new urban environment (Tam 1994). Social institutions, such as health services, family members already living in the host area, and community groups are of importance in aiding the adaptation of migrants into the host population and hence child survival

(Stephenson *et al.* 2003). Failure of migrants to adapt to their new urban environment may lead to their continued use of traditional rural medical services and the under-utilization of modern health services (Davidson 1983; Uyanga 1983). In addition, migrants tend to be concentrated in low income and informal employment, which often prevents them from fully adapting into urban societies (Stephenson *et al.* 2003). These factors are believed to result in mortality differentials between migrant and non-migrant populations.

Data and Methods

Data from the 2003 Nigeria Demographic and Health Survey (NDHS) was used in this study. This is a nationally-representative sample, collected using a stratified two-stage cluster sampling procedure. The list of enumeration areas developed from the 1991 Population Census sampling frame was used for the sampling. In the first sampling stage, 365 clusters or primary sampling units (PSUs) were selected with a probability proportional to the size, the size being the number of households in the cluster. Households from the chosen clusters were systematically selected in the second sampling stage, resulting in a nationally representative probability sample of 7864 households. From these households, data were collected by face-to-face interviews from 3725 women aged 15 to 49 years who contributed a total of 6029 live born children born to the survey. A full report of the survey can be found elsewhere (NPC 2004).

Measures

Outcome

The outcome variable is the risk of under-five death, defined as a live born child dying between birth and the fifth birthday.

Exposures

Migrant status

Migrant status was categorized as: urban non-migrant, rural non-migrant and rural-urban migrant. A migrant was defined as a person who moved between any combination of rural and urban areas in the 10 years prior to the survey. The 2003 NDHS does not collect migration histories; rather, it collects basic information relating to number of years spent in the respondents current place of residence (coded as single years, always, and visitor), and type of both the previous and current place of residence (rural and urban). These were used to establish migration status. We created a variable that categorized the migration streams into rural-to-urban migrants, rural non-migrants, and urban non-migrants. Urban-rural migrants were excluded from the analysis. In this study, migration status was defined by a person who changed his/her place of residence across an administrative boundary, and may omit those involved in circular migration within an area. Visitors were excluded from the analysis. A woman who reported previous residence as rural and current residence as urban was classified as a rural-urban migrant. The non-migrant groups were classified as rural- or urban non-migrant depending upon their reported duration at the place of residence as "always".

Individual-level risk factors

Child- and mother-level variables of interest were grouped into three categories: *demographic* characteristics, which included: *a)* birth order and interval between births, created by merging "birth order" & "preceding birth interval" and classified as: first births, birth order 2-4 with short birth interval (<24 months), birth order 2-4 with medium birth interval (24-47 months), birth order 2-4 with long birth interval (48+ months), birth order 5+ with short birth interval (<24 months), birth order 5+ with medium birth interval (24-47 months), and birth order 5+ with long birth interval (48 months); *b)* sex of the child, categorized as: male and female; *c)* mother's age, grouped as: 15-18, 19-23, 24-28, 29-33, and 34 years and older; *d)* mother's age at birth of first child, categorized as: 18 years or less and 19 years or older; *e)* marital status, categorized as: single, married, and formerly married. *Socio-economic* characteristics, assessed as: *a)* mothers' education, categorized as: no education, primary, and secondary or higher education; *b)* mother's occupation, grouped as: professional/technical/managerial; clerical/sales/services/skilled manual; agricultural self employed /agricultural employee/household & domestic/ unskilled manual occupations; and not working; and *c)* wealth index, which was computed since the DHS does not generally collect information on household income or wealth, and applied in the analysis as a composite index and an indicator of the socio-economic status of households. It is consistent with expenditure and income measures. Variables relating to household ownership of durable assets, household environmental conditions, and household socio-economic characteristics were used to compute the index, with each asset owned being given a score, and the scores summed up and divided into quintiles (poorest, poorer, middle, richer and richest) to represent different levels of wealth. *Health care utilization* was assessed as: *a)* mother received tetanus toxoid injections in pregnancy, categorized as: yes and no; *b)* place of delivery of child, categorized as: home, and hospital facility; and *c)* prenatal care by doctor, categorized as: yes and no.

Community-level risk factors

The community-level variables included region of residence, categorized according to the six geo-political zones in Nigeria, as North Central, North East, North West, South East, South South, and South West; and three contextual variables, namely: *i)* community full immunization, defined as the percentage of children that received the eight vaccines in the Expanded Program on Immunization (EPI) schedule recommended by the World Health Organization (WHO) and include: Bacillus Calmette-Guerin (BCG) at birth, three doses of diphtheria, pertussis and tetanus (DPT) vaccine at 6, 10 and 14 weeks of age, three doses of oral polio vaccine (OPV) at birth, and at 6, 10 and 14 weeks of age, and one dose of measles vaccine at 9 months of age. This was categorized as: low, middle, and high; *ii)* community hospital delivery, defined as the percentage of mothers who delivered their child in the hospital, and categorized as: low, middle, and high (cut-off at the median value) and *iii)* community mother's education, defined as the percentage of mothers with secondary or higher education in the PSU, and categorized as: low and high (cut-off at median value in all PSUs combined, 13%). The contextual variables were at the level of the primary sampling unit (PSU) (*n* = 365). PSUs are administratively-defined areas used as proxies for "neighbourhoods" or "communities" (Diez-Roux 2001; Pearl *et al.* 2001). They are small and designed to be fairly homogenous units with respect to population socio-demographic characteristics, economic status and living conditions, and are made up of one or more enumeration areas (EAs), which are the smallest geographic units for which census data are available in Nigeria. Each cluster consisted of a minimum of 50 households, with a contiguous EA being added when a cluster had less than 50 households (NPC 2004).

Statistical analysis

We assessed the distribution of the children and mothers in the sample by migration status. Normalized sample weights provided in the DHS data were used for all analyses in order to adjust for non-response and enable generalization of findings to the general population, using Stata 10 software package (StataCorporation 2001). We estimated the under-five mortality rates for the different migrant groups. We used a three-level logistic regression model to account for the hierarchical structure (Snijders & Bosker 1999) of the DHS data, with children (level 1) nested within mothers (level 2), who were in turn nested within communities (level 3). We fitted six models containing variables grouped into categories. **Model 0** (empty model) contained no explanatory variable, and intended only to decompose the total variance into its individual and community components and to identify a possible contextual phenomenon that can be quantified by clustering of under-five mortality within neighbourhoods (Merlo *et al.* 2005). **Model 1** contained mother's migration status as the only explanatory variable, whilst **Model 2** included mother's migration status and demographic characteristics of children and mothers (sex of the child, birth order/birth interval, mother's age, mother's age at birth of first child, and marital status). **Model 3** contained mother's migration status and socio-economic variables (mother's education, mother's occupation, and wealth index). **Model 4** contained mother's migration status and health care utilization (mother received tetanus toxoid injections in pregnancy, place of delivery of child, and prenatal care by doctor). Finally, **Model 5** contained mother's migration status and community-level variables (mother's region of residence, community child immunization, community hospital delivery, and community mother's education).

In each of the five models, migration status was fitted with a different category of exposure variables against the risk of under-five deaths – a modelling strategy intended to enable a comparison of the influence of each of the different exposure variables on the association between migration and the risk of under-five deaths. The fixed effects (measures of association) are expressed as odds ratio (OR) and corresponding 95% confidence intervals (95% CI). The random effects (measures of variation) are expressed as variance partition coefficient (VPC) and proportional change in variance (PCV). The variance partition coefficient measures the clustering of under-five mortality among individuals i.e. the extent to which members of a family resemble each other more than they resemble individuals from other families in relation to the risk of under-five deaths. The VPC is the percentage of the total variance ($V_F + V_I$) in the risk of under-five deaths that is attributed to the family level (V_F) and is, thus, a measure of clustering within neighbourhoods. It can therefore be used to operationalize the concept of contextual phenomena (Merlo *et al.* 2005; Merlo 2003). The equation for the variance partition coefficient is:

$$\text{VPC} = \frac{V_f}{V_f + \pi^2/3}$$

Where $\boldsymbol{V_n}$ represents the variance between families and $\boldsymbol{\pi^2/3}$ represents an approximation of the variance between individuals. A large VPC value (close to 1) would indicate maximally segregated clusters, while a low VPC value (close to zero) would suggest homogeneous risks of under-five deaths among clusters. Neighbourhood differences in the risk of under-five deaths may be attributable to contextual influences or to differences in the individual composition of neighbourhoods in terms of child and maternal characteristics, and other individual characteristics not considered in our study model. By adjusting for individual characteristics in models 1 - 4, and community-level characteristics in model 5, we take into account some part of the compositional differences and explain some of the neighbourhood variance detected in the empty model (model 0) using the proportional change in variance (PCV). The equation for the proportional change in variance is:

$$PCV = \frac{(V_A - V_B)}{V_A} \times 100$$

Where V_A = variance of the initial model, and V_B = variance of the succeeding model.
The precision of the estimates was appraised by their standard error. Parameters were tested using Wald statistics i.e. the ratio of an estimated variance to its standard error (Larsen & Merlo 2005) and exact *p*-values. The Deviance Information Criterion (DIC) was used as a measure of the goodness of fit of our models. A lower DIC value in subsequent models indicates a better fit of the model. MLwiN software package 2.0.2 (Center for Multilevel Modelling 2000) was used for the multilevel analyses, with Binomial, Penalized Quasi-Likelihood (PQL) procedures (Rashbash *et al.* 2000).

Results

Distribution of the characteristics of children and women by migration status (Table 1)

A total of 6029 children were nested within 3725 mothers who were in turn nested within 365 communities. About half (48%, n=1918) of the children were rural-urban migrants. Most of the children (24%, n=982) were first births, born to mothers 15-18 years of age (29%, n=1167), who gave birth to their first child at 18 years or younger (55%, n=2216), and married (94%, n=3742). A higher proportion of the children had mothers with no education (50%, n=1994), who were clerical employees (47%, n=1878), had received tetanus toxoid injection during pregnancy (58%, n=1468), but delivered at home (63%, n=2505) and did not receive prenatal care by doctor (85%, n=3411). The majority of mothers had their first child at 18 years or less (64%, n=1223), with no education (65%, n=1253) or employment (40%, n=762) and belonging to the poorer wealth quintiles were most likely to be rural-urban migrants. Rural-urban migrants were also most likely not to either receive tetanus toxoid injection during pregnancy (61%, n=741) or prenatal care by doctor (94%, N=1797), and to deliver their baby at home (81%, n=1533). The estimated under-five mortality rates were 12 per 1,000 live births among rural-urban migrants, 8 per 1,000 live births among rural non-migrants, and 16 per 1,000 live births among urban non-migrants (results not shown).

Table 1 (about here)

Multilevel logistic regression analysis (Table 3)

Exposure variables included in the multilevel analysis are presented in Table 2. In **Model 0** (empty model), the variance in the odds of under-five mortality was significant across mothers ($\tau = 0.316$, $p = 0.021$) and communities ($\tau = 0.253$, $p = 0.001$), thus justifying the use of multilevel analysis. As indicated by the variance partition coefficient, 8.2% and 6.6% of the variance were explained by mother- and community-level characteristics, respectively.

Table 2 (about here)

Migration status was entered into the multilevel models as the only explanatory variable to assess the influence of migration on under-five mortality. Fitting only migration status into **Model 1** showed that the process of migration by mothers significantly influenced the risk of under-five deaths for children of rural-urban migrant mothers. Compared with children of rural-urban migrant mothers, children of rural non-migrant and urban non-migrant mothers had 52% (OR =

0.48, 95% CI = 0.37 - 0.62) and 26% (OR = 0.74, 95% CI = 0.58 - 0.94) lower odds of dying, respectively. The variation in under-five mortality remained significant only across mothers (τ = 0.533, p = 0.004) in Model 1. According to the variance partition coefficient, the intra-mother- and intra-community correlations were 13.9% and 0.5% respectively. Comparing model 1 with model 0, the proportional change in variance indicates that -68.5% of the variance in the odds of under-five mortality across mothers and 92.5% across communities were attributable to migration status.

After adjustment for demographic characteristics (birth order/birth interval, sex of the child, mother's age, mother's age at birth of first child, and marital status) in **Model 2**, the risks of under-five deaths did not change and remained significantly lower for children of rural non-migrant (OR = 0.49, 95% CI = 0.37 - 0.63) and urban non-migrant (OR = 0.75, 95% CI = 0.59 - 0.95) mothers, indicating that the effect of migration on under-five death is independent of demographic characteristics. The variation in under-five mortality in Model 2 remained significant only across mothers (τ = 0.533, p = 0.004). As judged by the variance partition coefficient, the intra-mother correlation was 8.9% and the intra-community correlation was 0%. The proportional change in variance in the odds of under-five mortality across mothers (-2.2%) and communities (100%) was attributable to the individual (demographic) compositional factors considered, meaning that part of the clustering of child mortality within areas is due to the composition of the communities by demographic characteristics. In addition, first births (OR = 1.45, 95% CI 1.04 - 2.02), 2^{nd} – 4^{th} birth order with medium birth interval 24 - 47 months (OR = 1.75, 95% CI 1.04 - 2.92), and 5+ birth order after short birth interval < 24 months (OR = 2.06, 95% CI 1.40 - 3.05), had higher risks of dying, while children of 5+ birth order after long birth interval 48+ months had a lower risk of dying (OR = 0.43, 95% CI 0.25 – 0.77). Children born to mothers 34 years or older (OR = 1.49, 95% CI 1.07 – 2.08), single (OR = 0.37, 95% CI 0.16 – 0.89) and divorced (OR = 0.61, 95% CI 0.40 - 0.93) also had lower risks of dying.

Model 3 introduced socio-economic characteristics (mother's education, mother's occupation, and wealth index) along with migration status. The risks of under-five deaths for children of rural non-migrants was attenuated but still significantly lower than children of rural-urban migrants (OR = 0.74, 95% CI = 0.55 - 0.99). However, the risks for children of rural-urban migrants became similar to the risk of children of rural-urban migrants. This suggests that the mortality differentials in the risk of under-five death of the migrant and non-migrant groups are partly explained by the differences in the distribution of socio-economic characteristics. The variation in under-five mortality in Model 3 remained significant only across mothers ($\tau = 0.437$, $p = 0.006$). The variance partition coefficient indicated that intra-mother and intra-community correlations were 11.7% and 0% respectively. The proportional change in variance in the odds of under-five mortality across mothers (-38.3%) and communities (100%) was explained by the individual (socio-economic) characteristics, indicating that part of the clustering of child mortality within areas is due to the composition of the communities by socio-economic characteristics. In addition, children of mothers with primary education (OR = 1.53, 95% CI = 1.09 – 2.17), and in the poorest (OR = 1.67, 95% CI = 1.06 - 2.63), poorer (OR = 1.96, 95% CI = 1.28 - 3.00), and middle (OR = 1.53, 95% CI = 1.01 - 2.31) wealth quintiles had higher risks of dying.

Model 4 contained characteristics associated with health care utilization (mother received tetanus toxoid injections in pregnancy, place of delivery, and prenatal care by doctor) and migration status. The effect of factors associated with the health care utilization on the risk of under-five mortality was similar to the effect of socioeconomic variables in Model 3. Children of rural non-migrants had a 47% significant lower risk of dying (OR = 0.53, 95% CI = 0.34 - 0.83) compared to children of rural-urban migrants while there were still no differences between the risks for children of rural-urban migrants. Thus, the observed mortality differentials between the migrant and non-migrant groups could be partly explained by the unequal utilization of health care services between these groups. The variation in under-five mortality in Model 4 was non-significant across communities ($\tau = 0.028$, $p = 0.865$), and the intra-community correlation was

1%. The proportional change in variance of the odds of under-five mortality indicates that 100% of the variance across mothers and 88.9% across communities were attributable to the individual (health care utilization) compositional factors. Children of mothers who had not received tetanus injection during pregnancy had a 51% higher risk of dying (OR = 1.51, 95% CI = 1.06 - 2.16), compared with children of mothers who did.

Finally, **Model 5** introduced community-level variables (mother's region of residence, community child immunization, community hospital delivery and community mother's education) along with migrant status in order to assess the effects of community-level and regional variations in the provision of services on the risk of under-five deaths. Children of rural non-migrants had a 43% lower risk of dying (OR = 0.57, 95% CI = 0.41 - 0.80) compared to children of rural-urban migrants, while the risks became non-significant for children of rural-urban migrants. The significant association between rural non-migration status and the risk of under-five deaths suggests that this relationship is independent of the community-level characteristics. The variance in under-five mortality was only significant across mothers ($\tau = 0.489$, $p = 0.016$). As indicated by the variance partition coefficient, the intra-mother and intra-community correlations were 12.7% and 1.6% respectively. The proportional change in variance in the odds of under-five mortality across mothers (-54.7%) and across communities (75.5%) was explained by contextual factors.. Children of mothers who lived in communities with high hospital delivery had a 40% lower risk of dying (OR = 0.60, 95% CI = 0.41 – 0.87) compared with children of mothers living in communities with median level of hospital delivery. Lower values of the deviance information criterion (DIC) in successive models were indicative of the fit of the multilevel model in explaining the variation in the odds of under-five mortality by individual compositional factors (models 2,3 and 4) and contextual variables (model 5).

Table 3 (about here)

Discussion

The estimated under-five mortality rate for children of rural-urban migrant mothers (12 per 1,000 live births) was lower than that for children of urban non-migrant mothers (16 per 1,000 live births), but higher than that for children of rural non-migrant mothers (8 per 1,000 live births), with rural-urban migrants experiencing 33% lower risks of under-five deaths than urban non-migrants. This result supports the gradual convergence of migrant and non-migrant behaviours and living conditions implied by such concepts as migrant assimilation and adaptation in urban areas.

Furthermore, findings from the multivariable multilevel logistic analysis indicated that under-five mortality rate for children of rural-urban migrant mothers was higher than that for children of rural non-migrant mothers on introduction of migration status in Model 1. This association is indicative of *migrant disruption* resulting from the migration itself and associated with the disruption of family and community attachments and possibly income-generation ability. Adjustment for socio-economic characteristics attenuated the risks for children of rural non-migrants and removed the effect of urban non-migrants compared to children of rural-urban migrants. Furthermore, we found that it is the children of poorer and more vulnerable mothers who are most likely to migrate i.e. uneducated, unemployed mothers who had their first child at 18 years or less and in the poorer wealth quintiles. Rural non-migrants on the other hand tend to be more adjusted to their environment and better-off, hence better child survival outcomes than rural-urban migrants. In addition, children of mothers with primary education and lower wealth status had significantly increased risks of under-five deaths. It could therefore be argued that the combination of the migration process itself and the fact that rural-urban migrants are a pre-selected more vulnerable population that elevates the risk of under-five deaths for children of rural-urban migrants compared to rural non-migrants. Socio-economic characteristics are therefore important in explaining the mortality differentials found between rural-urban migrant and rural- and urban non-migrants, thus indicating that *migrant selectivity* plays a significant role in the risks of under-five deaths among children of migrants.

Health care utilization also slightly attenuated the risks for children of rural non-migrants and removed the effect of urban non-migrants, and thus explained mortality differentials between children of urban- and rural non-migrants compared to rural-urban migrants. Rural-urban migrants were disadvantaged compared to rural non-migrants and urban non-migrants in terms of receiving tetanus toxoid injection during pregnancy, prenatal care by doctor, and home delivery of their baby as shown in table 1. Our analysis also showed that not receiving tetanus toxoid injection during pregnancy was associated with higher risks of under-five deaths compared to receiving tetanus toxoid injection during pregnancy. Migration between two different environments with differing availability of health services, environmental conditions and social infrastructures may be associated with consequences, such as the continued use of traditional rural medical services, which together with the vulnerable socio-economic selectivity act to create differences in mortality between migrant and rural non-migrant groups. Consequences of rapid urbanization, such as population explosion and high population density, household congestion, overcrowding, and poor social amenities in urban areas of low-income countries like Nigeria may further predispose to such mortality disparities, and thus indicates that *migrant adaptation* plays a significant role in the survival of children of rural-urban migrants.

Finally, the introduction of community-level factors further had a similar effect as socioeconomic and health care utilization factor and attenuated the risks for children of rural non-migrants compared to children of rural-urban migrants. Our findings raise interesting issues related to the "compositional" and "contextual" aspects of spatial community variation. One key advantage of a multilevel statistical model is its ability to estimate the between-community variation. A significant variation between communities provides a clue about the influence of community contexts in shaping under-five mortality, and more importantly to establish whether the community differences in under-five mortality are due to the characteristics of the people who live in these communities (compositional variation in communities) or due to factors that relate to communities themselves (contextual variation in communities). The community variation from Model 5 (Table 3) was statistically non-significant, suggesting that the sampled communities are homogeneous in terms of under-five mortality, but does not necessarily imply an absence of contextual effects. Arguably, it is possible to "mis-specify" a statistical model by omitting a "relevant" variable at the contextual (community) level. The statistically significant and lower risks of under-five deaths associated with living in communities with a high proportion of hospital delivery substantiates our argument and compels us to develop contextual lines of explanation.

Limitations of the current study include: *i)* other factors not addressed in the present study may also be relevant determinants of under-five mortality among migrant and non-migrant groups; *ii)* the administratively defined boundaries used as a proxy for neighbourhoods in this study may cause misclassification of individuals into inappropriate administrative boundaries capable of generating information biases and reduce the validity of analyses; *iii)* other community correlates likely to affect the risks of under-five deaths may not have been measured or are not measurable, such as distance to immunization centres and quality of immunization services; *iv)* our data do not have direct information about the social networks of parents, making it impossible to accurately measure the extent of mother's connectedness in the community they reside; and *v)* data on household income or expenditure, which are the indicators commonly used to measure wealth, are not routinely collected in the DHS. The assets-based wealth index used here is only a proxy indicator for household economic status, and may not always produce results similar to those obtained from direct measurements of income and expenditure where such data are available or can be collected reliably (Filmer & Pritchett 2001). The strengths of this study are also worthy of mention. First, the use of multilevel modelling to test the theoretical perspectives of migration on the risks of under-five deaths. Second, the DHS surveys are nationally-representative and allow for generalization of the results across the country (Fotso 2006). Third, DHS variables are defined similarly across countries and results are therefore comparable across countries (de Walque 2006).

Conclusion

Rural-urban migration is an important determinant of under-five mortality. Our findings suggest that the traditional migration hypotheses act to create difference in under-five mortality between migrant and non-migrant groups. The disruption of income, family and community attachments arising from the migration itself, the selectivity (vulnerable and low socio-economic status) of migrants, and difficulty in adapting into the new urban environment predispose the children of rural-urban migrants to higher mortality. These results highlight the need to target migrant groups within urban areas in the direction of increasing affordable and accessible health care services, maternal education, and improving the general socio-economic situation of women.

Ethical considerations

Both the National Ethics Committee in the Federal Ministry of Health, Nigeria and the Ethics Committee of the Opinion Research Corporation Macro International, Incorporated, (ORC Macro Inc.), Calverton, USA approved the survey procedure and instruments for the 2003 Nigeria DHS. Informed consent was obtained from the participants prior to participation in the survey, and data collection was done confidentially. This study is based on analysis of secondary data with all participant identifiers removed. Permission to use the DHS data in this study was obtained from ORC Macro Inc.

Competing interests

None

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Table 1. Number and proportion of children in each migrant group by demographic and socio-economic characteristics

Characteristics	Total *N* (%)	Migration Status Urban non-migrant *n* (%)	Rural non-migrant *n* (%)	Rural-urban migrant *n* (%)
Migration status				
Urban non-migrant	977 (24)	977 (24)	-	-
Rural non-migrant	1112 (28)	-	1112 (28)	-
Rural-urban migrant	1918 (48)	-	-	1918 (48)
Birth order and birth				
First birth (order 1)	982 (24)	227 (23)	300 (27)	455 (23)
Order 2-4 & <24 months	873 (22)	234 (24)	224 (20)	415 (21)
Order 2-4 & 24-47 months	413 (10)	89 (9)	120 (11)	204 (11)
Order 2-4 & 48+ months	293 (8)	90 (9)	98 (9)	105 (5)
Order 5+ & <24 months	307 (8)	68 (7)	60 (5)	179 (8)
Order 5+ & 24-47 months	857 (21)	198 (21)	231 (21)	428 (25)
Order 5+ & 48+ months	282 (7)	71 (7)	79 (7)	132 (7)
Sex of the child				
Male	2059 (51)	478 (49)	576 (52)	1005 (52)
Female	1948 (49)	499 (51)	536 (48)	913 (48)
Mother's age				
15 - 18	1167 (29)	312 (32)	320 (29)	535 (28)
19 - 23	201 (5)	50 (5)	25 (2)	126 (6)
24 - 28	756 (19)	183 (19)	155 (14)	418 (22)
29 - 33	851 (21)	193 (20)	273 (24)	385 (20)
34+	1032 (26)	239 (24)	339 (31)	454 (24)
Mother's age at birth of first child				
18 years or less	2216 (55)	531 (54)	462 (42)	1223 (64)
19+	1791 (45)	446 (46)	650 (58)	695 (36)
Marital status				
Single	94 (2)	23 (3)	18 (2)	53 (3)
Divorced	171 (4)	58 (7)	45 (4)	68 (3)
Married	3742 (94)	876 (90)	1049 (94)	1797 (94)
Mother's education				
No education	1994 (50)	433 (44)	308 (28)	1253 (65)
Primary	927 (23)	233 (24)	291 (26)	403 (21)
Secondary or higher	1086 (27)	311 (32)	513 (46)	262 (14)
Mother's occupation				
Not working	1447 (36)	355 (36)	330 (29)	762 (40)
Agric. self empl./agric. empl./ household & domestic/unskilled manual occupations	511 (13)	122 (13)	97 (9)	292 (15)
Clerical/sales/services/skilled manual	1878 (47)	458 (47)	587 (53)	833 (43)
Prof./Tech./Manag.	171 (4)	42 (4)	98 (9)	31 (2)
Wealth index				
Poorest	726 (18)	75 (7)	35 (3)	616 (32)

Poorer	790 (20)	112 (12)	109 (10)	569 (30)
Middle	796 (20)	166 (17)	180 (16)	450 (24)
Richer	878 (22)	372 (38)	285 (26)	220 (12)
Richest	817 (20)	251 (26)	503 (45)	63 (3)
Received tetanus toxoid injection during pregnancy				
No	1078 (42)	176 (28)	161 (23)	741 (61)
Yes	1468 (58)	453 (72)	541 (77)	474 (39)
Place of delivery				
Home	2505 (63)	522 (54)	450 (41)	1533 (81)
Hospital facility	1463 (37)	440 (46)	656 (59)	367 (19)
Prenatal care by doctor				
No	3411 (85)	799 (82)	815 (73)	1797 (94)
Yes	596 (15)	178 (18)	297 (27)	121 (6)

Note: Birth order and birth interval were created by merging "birth order" and "preceding birth interval", and classified as follows: first births, order 2-4 (<24 months) denotes child is 2nd to 4th in birth order and born less than 24 months before the next birth; order 2-4 & 24 – 47 months denotes child is 2nd to 4th in birth order and born between 24 and 24 months before the next birth; order 2 -4 & 48+ months denotes child is 2nd to 4th in birth order and born 48 months or more before the next birth; order 5+ & < 24 months denotes child is 5th or more in birth order and born less than 24 months before the next birth; order 5+ & 24-47 months denotes child is 5th or more in birth order and born between 24 and 24 months before the next birth; order 5+ & 48+ months denotes child is 5th or more in birth order and born 48 months or more before the next birth

Table 2. Exposure variables used in modelling the association between migration status and the risk of deaths of children under five years of age

Model 1 Migration status	Model 2 Demographic	Model 3 Socioeconomic	Model 4 Health care utilization	Model 5 Community
Migration status	Migration status	Migration status	Migration status	Migration status
	Birth order/ birth interval of child	Mother's education	Mother received tetanus toxoid injections in pregnancy	Mother's region of residence
	Sex of child	Mother's occupation	Place of delivery	Community full immunization
	Mother's age	Wealth index	Mother received prenatal care by doctor	Community hospital delivery
	Mother's age at birth of first child			Community mother's education
	Mother's marital status			

Table 3: Odds ratios and 95% confidence intervals for multivariable multilevel logistic regression models of the association between under-five mortality and migration status

Variables	Model 0 (Empty model)	Model 1 (Migration status)	Model 2 (Demographic)	Model 3 (Socio-economic position)	Model 4 (Health care utilization)	Model 5 (Community)
		OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**		**OR (95% CI)**
Migration status						
Rural-urban migrant		1	1	1		1
Rural non-migrant		0.48 (0.37 – 0.62)	0.49 (0.37 – 0.63)	0.74 (0.55 – 0.99)	0.53 (0.34 – 0.83)	0.57 (0.41 – 0.80)
Urban non-migrant		0.74 (0.58 – 0.94)	0.75 (0.59 – 0.95)	0.99 (0.76 – 1.30)	0.97 (0.67 – 1.40)	0.83 (0.61 – 1.12)
Birth order/ birth interval						
First birth (order 1)			1.45 (1.04 – 2.02)			
Order 2-4 & <24 months			1.37 (0.96 – 1.95)			
2-4 & 24-47 months			1.75 (1.04 – 2.92)			
Order 2 -4 & 48+ months			1			
Order 5+ & < 24 months			2.06 (1.40 – 3.05)			
Order 5+ & 24- 47 months			1.06 (0.75 – 1.50)			
Order 5+ & 48+ months			0.43 (0.25 – 0.77)			
Sex of child						
Female			0.89 (0.73 – 1.08)			
Male			1			
Mother's age						
15 - 18			0.71 (0.41 – 1.28)			
19 - 23			0.91 (0.66 – 1.27)			
24 - 28			1			
29 - 33			1.17 (0.86 – 1.59)			
≥ 34			1.49 (1.07 – 2.08)			
Mother's age at birth of first child						
18 years or less			1.14 (0.90 – 1.45)			
19+			1			

Marital status			
Single	0.37 (0.16 – 0.89)		
Divorced	0.61 (0.40 – 0.93)		
Married	1		
Mother's education			
No education		1.75 (0.58 – 5.34)	
Primary		1.53 (1.09 – 2.17)	
Secondary or higher		1	
Mother's occupation			
Not working		1.04 (0.52 – 2.06)	
Agric. self empl./agric. empl./ household & domestic/unskilled manual occupations		1.09 (0.53 – 2.24)	
Clerical/sales/services/skilled manual		1.11 (0.57 – 2.18)	
Prof./Tech./Manag.		1	
Wealth index			
Poorest		1.67 (1.06 – 2.63)	
Poorer		1.96 (1.28 – 3.00)	
Middle		1.53 (1.01 – 2.31)	
Richer		1.19 (0.81 – 1.77)	
Richest		1	
Received tetanus toxoid injection during pregnancy			
No			1.51 (1.06 – 2.16)
Yes			1
Place of delivery			
Home			0.85 (0.58 – 1.24)
Hospital facility			1
Received prenatal care by doctor			
No			1.26 (0.80 – 1.97)
Yes			1
Region of residence			

	Empty	Migration status	Demographic	Socio-economic	Health care	Community
North Central						0.79 (0.46 – 1.34)
North East						0.98 (0.57 – 1.69)
North West						0.85 (0.49 – 1.46)
South East						1.13 (0.65 – 1.98)
South South						0.82 (0.45 – 1.48)
South West						1
Community full immunization						
No						1.05 (0.79 – 1.41)
Yes						1
Community hospital delivery						
Low						1.09 (0.79 – 1.51)
Middle						1
High						0.60 (0.41 – 0.87)
Community mother's education						
Low						1.10 (0.82 – 1.47)
Middle						1
High						1.03 (0.75 – 1.41)
Random effects	**Empty**	**Migration status**	**Demographic**	**Socio-economic**	**Health care**	**Community**
Community-level						
Variance (SE)	0.253 (0.074)**	0.019 (0.083)	0.000 (0.000)	0.000 (0.000)	0.028 (0.164)	0.062 (0.095)
VPC (%)	6.6	0.5	0	0	1	1.6
Explained variation (PCV) (%)	Reference	92.5	100	100	88.9	75.5
Mother-level						
Variance (SE)	0.316 (0.317)*	0.533 (0.184)**	0.323 (0.153)*	0.437 (0.159)**	0.000 (0.000)	0.489 (0.204)*
VPC (%)	8.2	13.9	8.9	11.7	0	12.7
Explained variation (PCV) (%)	Reference	-68.7	-2.2	-38.3	100	-54.7
DIC	4808	3022	3007	2973	1354	1329

Note: Data source: 2003 Nigeria Demographic and Health Survey

*p< .05; **p< .01; ***p< .001

VPC = Variance partition coefficient; DIC: Deviance information criterion; PCV: proportional change in variance; SE = Standard error: OR = Odds ratio; CI = Confidence Interval.