Migration and Child Mortality in rural Nyanza Province: Evidence from the Kisumu Health and Demographic Surveillance System (KHDSS) in Western Kenya

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Abstract

This study used longitudinal data from the Kisumu Health and Demographic Surveillance System (KHDSS) and event history models to examine the relative risk of death associated with migration of young children from urban and rural settings into the surveillance area. In Kenya early childhood mortality is one of the critical challenges that public health practitioners and development agencies have been grappling with for the past one and half decades. Although the introduction of Primary Health Care (PHC), the Expanded Program on Immunization (EPI) and the Integrated Management of Childhood Illness (IMCI) have contributed to some improvement in child health outcomes, the levels of infant and child mortality remain unacceptably high in Kenya, and vary significantly across the Provinces. In addition to the regional differences, there are also significant rural-urban differentials in child mortality rates with children residing in urban areas having a better chance of surviving the first five years of life compared with rural children.

The Demographic Surveillance Area (DSA) is predominantly rural and situated in Nyanza Province, one of the Provinces with the worst child survival outcomes in Kenya. The area is also characterized by high population mobility, high mortality resulting in low life expectancy at birth, and widespread poverty. The existence of urban-rural child mortality differentials raises the question whether migrating from urban settings into the study area could be detrimental to the health and survival of young children.

The objective of this study therefore was to explore the relationship between mortality and child migration by examining the level of mortality amongst migrant and non-migrant children from the 2004 birth cohort in the KHDSS.

The empirical evidence from the data analyzed, however, do not support the hypothesis that child migration could be detrimental to the survival of children. This is especially true of children who have moved into the surveillance area from urban settings.

Problem Statement/Background

In Kenya, early childhood mortality is one of the critical challenges that public health practitioners and development agencies have been grappling with for the past one and half decades. In spite of the introduction of Primary Health Care (PHC), the Expanded Program on Immunization (EPI) and the Integrated Management of Childhood Illness (IMCI), overall 77 infants out of every 1,000 live births die before the age of one year and for those who survive the first year of life another 41 out of every 1,000 die before the age of five (CBS Kenya, 2003). Grim as the childhood mortality statistics at the national level look, the level of mortality in some of the Provinces is more troubling. For example, in Nyanza Province infant and under-five mortality rates increased from 94 and 149 deaths per 1,000 live births in the late 1980s to 133 and 205 deaths per 1,000 live births, respectively, a decade later (CBS Kenya, 1990, 1999, 2004). In addition to the regional differences, there are also significant rural-urban differentials in child mortality rates; in general, children residing in urban areas have a better chance of surviving the first five years of life compared with rural children (CBS Kenya, 2004).

Situated in Nyanza Province, one of the Provinces with the worst child survival outcomes in Kenya, the demographic surveillance area (DSA) of the Kisumu Health and Demographic Surveillance System (KHDSS) has a high rate of both in-migration and out-migration from and to neighboring and distant villages, towns and cities. The propensity to migrate varies by age and sex. Comparatively the female migrants tend to leave the DSA earlier than male out-migrants. The age specific rates showed the bimodal age distribution found in many populations, where the primary peak usually occurs among the young adult population and a secondary peak among children moving with their parents (Adazu et al, 2005). For instance, 15% of the under-five population in the DSA in 2003 experienced at least one migration event.

The DSA is also characterized by persistent high infant and child mortality. A number of studies on child survival in the DSA have reported infant and child mortality rates much higher than estimates for other Provinces in Kenya (Spencer et al 1987, McElroy, 2001, Adazu et al., 2005).

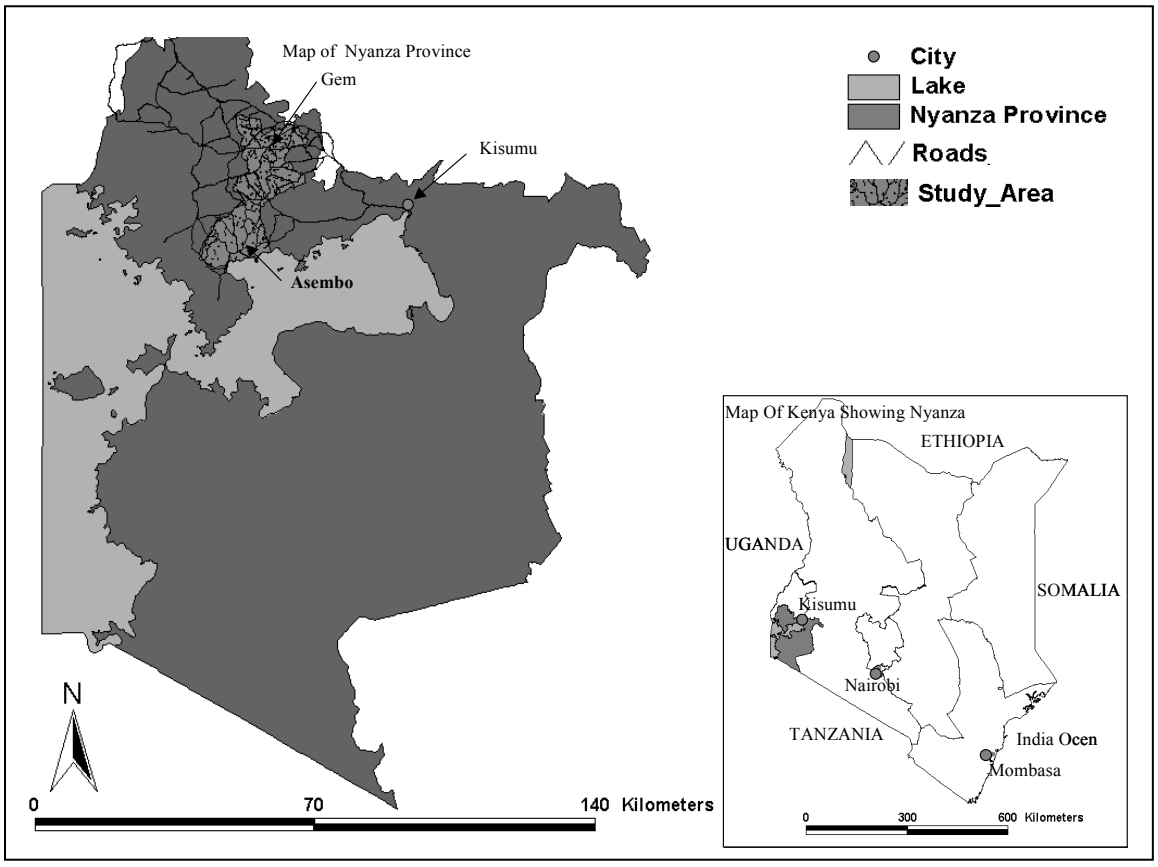
Most research on child migration focused on older children who have left home to work in settings that are potentially hazardous or abusive. Several other studies elsewhere investigated the impact of migration on child survival (Brockerhoff, 1990, 1994, 1995; Ssengonzi, De Jong and Stokes, 2002; Stephenson, Mathews & McDonald, 2003; Kiros and White, 2004; Kevin and Thomas, 2007), but most of these studies focused on the role of parents' migration, especially the migration status of mothers, as mothers are generally more involved in childcare. As a result there is little empirical evidence on the health consequences of early childhood migration.

Our main objective in this study is to explore the relationship between mortality and child migration by examining the level of mortality amongst migrant and non-migrant children in the DSA. We aim to answer the question: Do children who migrate from elsewhere into the DSA have elevated risk of early childhood mortality compared with non-migrant children? The amount of child migration in this part of the country is substantial and knowledge of its impact on child health outcomes could inform child health programs and interventions.

A discussion of the theoretical basis of child migration and survival should be made before all else. It will help to contextualize the study and to provide insights which empirical evidence would either confirm or refute. The literature cited in the 'discussion' section of the paper would be useful for this purpose.

The Study Area

Figure 1: Map of the Study Area



The Demographic Surveillance Area (DSA) is in the Nyanza Province, one of the eight administrative regions of Kenya (Figure 1). The DSA covers 217 villages, spread over a land area of about 500 km2. The population is predominantly rural, culturally homogeneous (over 95% are members of the Luo tribe) and lives in dispersed settlements. Subsistence farming is the mainstay of the local economy. Rainfall is seasonal with the heaviest rains usually falling from March through May followed by a short dry period in August and a minor wet season between September and November. The crops cultivated for local consumption include maize, sorghum and cassava. Some households also raise poultry, goats, sheep and cattle, and others engage in petty trading. Poverty is widespread and employment opportunities are limited, partly contributing to many young adults temporarily out-migrating to the urban areas to seek employment.

The Kisumu Health and Demographic Surveillance System (KHDSS) was launched in September 2001 by the Centers of Disease Control and Prevention (CDC) and the Kenya Medical Research Institute (KEMRI) with the objective of providing timely demographic, morbidity, and socioeconomic data. Details of the KHDSS design and methods have been published elsewhere (Adazu et al, 2005). The core of the KHDSS consists of house-to-house interviews conducted on a rolling basis through three rounds in each calendar year. The first round of data collection each year runs from January to April, the second from May to August and the last round from September to December. During each round of data collection a team of trained community interviewers visit every household in the DSA to record morbidity episodes that occurred two weeks prior to the interview, and demographic events (pregnancies, births, deaths, and migrations) that occurred after the last visit. In addition to these surveys, household socioeconomic and educational status surveys are conducted annually to complement the morbidity and demographic data

Only individuals who have resided in the DSA for at least four calendar months or children born to resident mothers are registered. At the time of registration all residents and households are assigned unique identification numbers that makes it feasible to link individuals to their respective households and children to their parents, if the parents are registered in the KHDSS

2.3 Definition of a Migrant

In the context of the KHDSS, the boundaries of the study area constitute the boundary for defining migration. An individual is considered to have out-migrated if that individual was previously registered in the DSS but moved to a destination outside of the study area and stayed there for at least four calendar months. An in-migrant is someone who has moved into the study area from a place outside of the study area and remained in the study area for at least four calendar months. This individual could be someone who was previously registered in the KHDSS and moved away or someone who is coming into the area for the first time.

The KHDSS also tracks changes in places of residence within the boundaries of the surveillance area and these types of movements are called trans-migrations. A trans-migrant is an individual who moved from one compound to another within the DSA and stayed in the destination compound for at least four calendar months. For each move, data are collected on the date, reason and the nature of the origin and destination of the move are collected.

The KHDSS was reviewed and approved by the institutional review boards of both the Centers for Disease Control and Prevention in Atlanta (GA, USA) and Kenya Medical Research Institute in Nairobi, Kenya. The heads of all compounds participating in the surveillance gave informed written consent for the participation of their families in KHDSS.

i. Data and methodology

We used the piece-wise constant exponential hazard model, a multivariate event history model, to examine the relative risk of death between migrant and non-migrant

children in the DSA. This model takes into consideration duration and it does not require the hazard of death to be constant nor monotonic throughout the whole period as required by other event history models [such as?] . With this model the period of observation is divided into smaller intervals. The hazard is allowed to vary across intervals but within an interval the hazard is assumed to be constant.

For this analysis we selected all children born in 2004 and observed each child from the time he/she came into the surveillance area up to December 31, 2006 or until the day he/she exited from the area through death or out-migration. We linked each child to the parents, where possible, and the household in which the child is registered using the permanent identification numbers and extracted information on the characteristics of the parents and the households. We then used the date of entry into the KHDSS and the last date of observation (exit date for those who died or left and December 31, 2006 for those who were alive and present) to compute duration of exposure for each child. The duration window was divided into sub-spells of 120 days and the data transformed from one record per child to multiple records per child. For children who migrated out of the DSA and returned at a later date earlier than December 31, 2006, the periods spent outside of the surveillance area were excluded from the analysis.

ii. Variables

The dependent variable in the multivariate analyses was the hazard of death, which was modeled as a function of migration, the age and sex of the child, maternal age, and education, household socioeconomic status and home-based water treatment. Migration was treated as a fixed covariate and represented by two dummy variables, urban-in-migrant and rural-in-migrant. Urban-in-migrant was coded one if the place of origin was reported as urban and zero otherwise. Similarly the rural-in-migrant dummy variable was coded one if the origin of migration was reported as a rural area and zero otherwise.

The age of the child (measured in days) was treated as a continuous time varying covariate. The duration window was divided into sub-spells of 120 days with the age of the child computed as at the beginning of each sub-spell. Sex is a categorical variable and was represented by a dummy variable which was coded as one if the child was a boy and zero otherwise. The age of the mother was also treated as a categorical variable and represented by a dummy which was coded one if the mother was a teenager at the time she gave birth to the child and zero otherwise.

We represented household socioeconomic status by two dummy variables, namely thatch roof and mud house.. By Kenyan standards, corrugated roofing sheets (called mabati in the local parlance) are quite expensive and those who can afford mabati roof are generally considered to be of higher socioeconomic status while thatch roof is associated with lower socioeconomic status. Brick or cement-block houses are also associated with high socioeconomic status whilst mud houses are generally associated with low socioeconomic status.

Although level of educational attainment is quite low among the resident population of the DSA, only a small number of people have never attended school. As a result there were very few mothers in the sample that had no education at all. We therefore collapsed the mothers with no education at all or primary education into one category and mothers with post-primary school education into another category. In the

multivariate models children whose mothers had post-primary education were used as the reference category.

Results:

Descriptive Analyses

Summaries of the distribution of deaths by selected covariates are shown in Table 1. A total of 6,447 children born in the year 2004 were registered in KHDSS by December 31, 2006. Out of this number 1,499 (23.3%) were born elsewhere and later migrated into the KHDSS and the rest came into the DSA through birth. In general mobility is quite high among the population of the DSA and the 2004 birth cohort was no exception. By the end of the observation period (December 31, 2006), 20.1% of the cohort had out-migrated. Among the children who came in through migration, 445 (29.7%) out-migrated, 101 (6.7%) died, and 953 (63.6%) were alive and still residing in the DSA. Comparatively a smaller proportion (17.3%) of the births out-migrated and a larger proportion (16.2%) died. We further stratified the in-migrants by place of origin (Table 1). In addition to the migrant/non-migrant differences, there were also significant differences by origin of migration. Lower mortality was observed among the children from urban origins (5.5%) compared with those who came from rural origins (8.5%) or those who were born in the DSA.

Table 1: Distribution of the children by selected background characteristics

	Total	*Present*	*Exited*	*Died*
Variabl	*Number*	*Number (%)*	*Number (%)*	*Number (%)*
Entry Type				
Birth	4948	3295 (66.6)	854 (17.3)	799 (16.2)
Rural in-migrant	624	389 (62.3)	182 (29.2)	53 (8.5)
Urban in-migrant	875	564 (64.5)	263 (30.1)	48 (5.5)
Sex of child				
Female	3188	2088 (65.5)	651 (20.4)	449 (14.1)
Male	3259	2160 (66.3)	648 (19.9)	451 (13.8)
Housing Structure				
Mud	4929	3285 (66.7)	921 (18.7)	723 (14.7)
Permanent	504	331 (65.7)	117 (23.2)	56 (11.1)
Semi-permanent	617	379 (61.4)	170 (27.6)	68 (11)
Missing	397	253 (63.7)	91 (22.9)	53 (13.4)
Roofing material				
Mabati (corrugated zinc sheets)	2636	1682 (63.8)	639 (24.2)	315 (12)
Thatch	3413	2313 (67.8)	569 (16.7)	531 (15.6)
Missing	398	253 (63.6)	91 (22.9)	54 (13.6)
Level of Education of mother				
No Education	234	146 (62.4)	47 (20.1)	41 (17.5)
Primary	4957	3291 (66.4)	925 (18.7)	741 (15)
Secondary	820	578 (70.5)	179 (21.8)	63 (7.7)
Missing		233 (53.4)	148 (33.9)	55 (12.6)
Age of Mother				
Teenager	1666	880 (52.8)	572 (34.3)	214 (12.9)
Non-teenager	4781	3368 (70.4)	727 (15.2)	686 (14.4)
Source of drinking water				
Safe Source	1090	712 (65.3)	227 (20.8)	151 (13.9)
Unsafe source	5357	3536 (66)	1072 (20)	749 (14)
Home-based water treatment				
Treated	3156	2104 (66.7)	650 (20.6)	402 (12.7)
Untreated	3291	2144 (65.2)	649 (19.7)	498 (15.1)
Household head source of income				
Farming	3478	2253 (64.8)	744 (21.4)	481 (13.8)
Salary	345	252 (73.1)	66 (19.1)	27 (7.8)
Any other business	2922	1743 (66.4)	489 (18.7)	392 (14.9)
Total	**6447**	**4248 (65.9)**	**1299 (20.1)**	**900 (14)**

The results in TTeenage mothers contributed significantly to the 2004 birth cohort in the DSA (Table 1). In the context of Nyanza Province, this is not an unexpected

occurrence. Indeed teenage childbearing is a common phenomenon in Kenya, especially in the Western, Rift Valley, Coast, and Nyanza Provinces (KDHS 2003). For instance, in the 2003 Kenya DHS, Nyanza Province ranked third in the proportion of teenage mothers, trailing only Western and Coast Provinces. The proportion of deaths among the children of teenage mothers (12.9%) was not remarkably different from that of the children of non-teenage mothers (14.4%). The portion of children of teenage mothers lost to follow up was twice that of children of non-teenage mothers, reflecting the high prevalence of out-migration among female teenagers in the surveillance area.

In the cohort of children selected for this study 3.7% were born to mothers with no education at all, 76.8% to mothers with primary school education and 12.7% were children of mothers with post primary school education. In the DSA, as in many other places, children of educated mothers had a better chance to survive compared with children whose mothers' had no education, survival chances increasing with the level of education. For instance, the proportion of deaths among the children whose mothers' had at least secondary education was approximately half of that for the children whose mothers' had primary education.

Slightly more than half (55%) of the children were born in households whose heads' main source of income was farming. Comparatively [the word is overused! Please replace it] there was no significant difference in mortality amongst children from the farming and non-farming households. Although there were few children from households whose heads were salaried employees, their proportion of deaths was significantly lower than that in households whose heads' main source of income was farming or any other business.

Three out of every four children from the sample were living in mud houses, reflecting a high level of poverty in the DSA. Approximately 56% of the children were living in houses with grass-thatched roofs. Although *mabati* (corrugated roofing sheets) is quite expensive, it is comparatively cheaper than bricks or cement-blocks, which explains why more people in the DSA preferred roofing their mud houses with *mabat*i. Hence the huge differential in the proportion of children living in mud houses and thatch roofed houses. From the results in Table I, mortality was slightly higher among children who were residing in mud houses or houses roofed with thatch.

Only 17.7% of the children selected for this study came from households that draw water from safe sources — for instance, boreholes and protected wells and springs; (49%) came from households that treated their water through boiling it; 25.8% came from households that were reported to boil their water; and about 12% came from households which used chlorine or chlorine-based compounds to treat water.

b. Multivariate Analysis

In Table II we present the results of the multivariate event history models that we employed to access the relation between child migration and mortality net of duration of residence at the DSA and other socio-demographic risk factors. The association between migration and mortality observed in the bivariate analysis persisted after controlling for the duration of residence in the DSA (Table II, Model I). The differences in the risk of death between migrant and non-migrant children in this model were statistically significant and remarkably huge. For instance, the hazard of death was reduced by 25% for children who migrated from other rural areas into the DSA and 50% for those whose

origins of migration were reported as urban. We then controlled for the effects of maternal age, sex, and age of the child by incorporating these variables in the analysis (Model II). As expected, age of the child had a significant effect but sex again was not a good predictor of mortality. The direction of the migration-mortality relationship did not change after controlling for the child's demographic risk factors. There was, however, an increase in the hazard ratios for both rural and urban origins as well as a shift in the level of significance for rural origins, suggesting that age partly contributed to the differences in risk of death observed between migrant and non-migrant children in Model I.

Table II: Distribution of Relative Hazard of Death by Migration Status & other Selected Covariates (Including neonatal Deaths)

	Model I		*Model II*		*Model III*		*Model IV*	
Variable	**Hazard Ratio**	***Std. Err.***	***Hazard Ratio***	***Std. Err.***	***Hazard Ratio***	***Std. Err.***	***Hazard Ratio***	***Std. Err.***
Rural in-migrant	0.75**	0.11	0.92	0.13	0.93	0.14	1.09	0.16
Urban in-migrant	0.50***	0.07	0.64***	0.1	0.68***	0.1	0.76*	0.12
Sex of child (Male)			0.97	0.06	0.97	0.06	0.96	0.07
Age at start of interval			0.38***	0.03	0.38***	0.03	0.43***	0.03
Teenage mother			1.13	0.09	1.1	0.09	1	0.09
Post-primary education					0.56***	0.07	0.59***	0.08
Thatch roofed house					0.93	0.07	0.93	0.08
Mud house					1.08	0.1	1.07	0.11
Untreated water					1.14**	0.08	1.12	0.08
Farming					0.94	0.06	0.93	0.07
Salary					0.60**	0.12	0.58**	0.13
No of Deaths	900		900		900		777	
No of Children	6447		6447		6447		6324	
No of Observations	38,167		38,167		38,167		38,043	
Log Chi Squared	28.96		293.44		340.87		234.11	
Degrees of Freedom	2		5		11		11	

***=significant at 90% CI; **=significant 95% CI; *** significant at 99% CI**

The socioeconomic status of a child's household, the immediate environment in which the child is being raised, and the availability of safe water in the household are important proximate determinants of child health outcomes. To test whether a child's immediate environment, the household socioeconomic status and safe water modified the child migration-mortality relationship, we further incorporated the level of education of the mother, the type of house in which the child resided, home-based water treatment, and the proxy variables for occupation of the household head in our analysis (Model III). There was a slight increase in the hazard ratios for the migration variables but the overall migration-mortality relationship did not change when we controlled for these other risk factors. Children of teenage mothers were more likely to die compared with children

whose non-teenage mothers, though the difference was not statistically significant. On controlling for duration of residence in the DSA and household socioeconomic status, it was found that children from households that did not treat their water had a significant higher risk of dying compared with those from households that treated their water. Untreated water was associated with 14% increase in the hazard of death. There was no significant difference in mortality amongst children from farming and non-farming households. Children from households whose heads were salaried employees had a relatively lower risk of death. After controlling for duration of residence and other socio-demographic factors, the type of roof and housing construction materials were no longer significant predictors of mortality although thatch roof and mud houses were associated with a higher risk of death.

Over 90% of the in-migrant children came into the DSA after the neonatal period; thus they were not at risk of neonatal mortality. So we further controlled for this by excluding all the children who died at the neonatal stage from the cohort and re-run the analysis (Table II, model IV). From the results of this analysis, in-migration from rural origins was associated with 10% increase in the hazard of death among children who survived the neonatal period. However, the difference was not statistically significant. Urban migration was associated with 26% reduction in the hazard of death. As in the previous models, maternal education and a child's age were good predictors of childhood mortality. Children whose mothers' had at least secondary school education were less likely to die compared with children whose mothers had primary or no education.

Discussion

Most of the research on child migration focused on older children who left home to work in settings that are potentially hazardous or exploitative. In this study we investigated the survival chances of very young migrant children in a rural population in western Kenya, using data from the Kisumu Health Demographic Surveillance System (KHDSS), an ongoing longitudinal surveillance survey. The results showed that child migration was not a risk factor for mortality. Indeed, in-migrant children from urban areas had a lower risk of mortality compared with non-migrant children. The migrant survival advantage persisted after we controlled for the age of the child and household socioeconomic status. It is plausible that the relative low risk of death among the urban-migrant children is partly due to migrant selectivity. Some of the frail children of urban migrant parents might have died at the places of origin and only the robust ones survive to migrate.

Almost all migrant children came into the DSA in the company of their mothers. It is probable that differential child raising practices between migrant and non-migrant mothers also contributed to the differences in the risk of death. Exposure to urban settings increases access to the mass media, which in turn increases access to information. Access to information on child-care enhances knowledge and a better understanding of the causes of early childhood mortality. Having been exposed to the urban environment, urban-to-rural migrant mothers are more likely to have had access to information on better child-care. Urban-rural migrant mothers are therefore more likely to adopt modern child raising practices, cleaner food preparation and storage, and improved hygiene practices compared with rural non-migrant mothers. Consequently, urban-rural migrant mothers may be more likely to seek modern medical care for their children in the event of

ill health. We were however unable to tease out the mechanisms through which migration acted to influence mortality in this study due to the limited covariates in the data.

Numerous studies have repeatedly shown that higher maternal education decreases child malnutrition (Wolfe & Behrman, 1982; Barrera, 1990; Thomas et al, 1990), increases the chance of a child being immunized (Pebley, Goldman and Rodriguez, 1996) and the use oral re-hydration therapy when the child has diarrhea (Coreil & Genece, 1988; Galvao et al, 1994), and improves child survival (Guilkey & Riphahn, 1998; Blakely et al, 2003). The results of this study also attest to the importance of mother's education to child survival. Maternal education stood out as a good predictor of childhood mortality net of migration and the age of the child. Being the child of a mother with post-primary school education was associated with over 40% reduction in the hazard of early childhood mortality. The better survival chances of children of educated mothers might be a result of better knowledge of childcare and easy access to and utilization of modern health care services (Frankenberg, 1995). Literacy enables parents to easily gather information about causes and ways to prevent illnesses from written sources thereby increasing their repertoire of knowledge about child health. Literate parents can read written instructions from medical personnel for treating childhood illnesses. Education might also influence child health outcomes through empowerment of parents, particularly women, to demand better health services for their children from medical and health personnel.

Availability of safe water and adequate sanitation, combined with good personal hygiene practices, are critical for the survival of young children, yet in the DSA very few households have access to safe water. For instance, only 17.7% of the children selected for this study came from households that reported drawing water from safe sources, namely boreholes and protected wells and springs. Where there is no pipe water, home-based water treatment and safe storage techniques have been shown to improve water quality and dramatically reduce the incidence and prevalence of diarrhea, deaths associated with diarrhea, and the spread of other deadly water born diseases (Crump et al., 2005). In the DSA, many households do not treat their water. Controlling for migration status, age, and other household socioeconomic factors like housing structure, untreated water was associated with 15% increase in the hazard of death among the sampled children. The marginal effect of home-based water treatment may be due to the method of treatment. Very few households used chlorine or chlorine-based compounds to treat their water. Recontamination after treatment could also be another factor weakening the positive effect of water treatment on child survival.

A household's ability to provide for the health needs of its members and to mobilize resources in times of life-threatening emergencies depends on the financial situation of the head, especially in households where the head is the sole breadwinner. Of the proxy variables for the occupation of the head of the household in our analysis, salaried employee was associated with lower mortality, underscoring the importance of access to regular cash income in a predominantly subsistence economy as in the surveillance area. Although our data did not allow us to explore the mechanism(s) through which the main source of income of the household head influences the survival chances of children, evidence from studies done in similar settings in Africa and Asia have shown that utilization of preventive services such as immunization (Debpur et al., 2005), and curative services such as polyclinics and hospitals (Khe,et al, 2005) are

associated households' economic circumstances. Unsurprisingly, the survival advantage of children from households whose heads were salaried employees is attributable to easy access to both preventive and curative healthcare service and improved nutrition.

This study has demonstrated the value of collecting longitudinal surveillance data and the value of such data for exploring and testing hypotheses. The findings of this study have also underscored the need of expanding the number of covariates to include more socioeconomic traits such as remittances, socio-demographic traits such as parity and marital status, and population-based information on healthcare and health services utilization. The collection of a wider array of socioeconomic and health data in a surveillance setting like the KHDSS, combined with the intrinsic temporal richness of the longitudinal data, could significantly contribute to our understanding of the factors influencing child health outcomes.

5. Conclusion

The empirical evidence from the data we used for this study did not support our hypothesis that child migration could be detrimental to the survival of children. This is especially true of children who have moved into the surveillance area from urban settings.We also find education to be very strong predictor of early childhood mortality. Children of mothers with secondary or higher education are less like to die compared with those whose mothers have primary or no education at all.

References

Adazu K, Lindblade KA, Rosen DH, Odhiambo F, Ofware P, Kwach J, van Eijk AM, Decock KM, Amornkul P, Karanja D, Vulule JM, Slutsker L. 2005. Health and demographic surveillance rural western Kenya: A platform for evaluating interventions to reduce morbidity and mortality from infectious diseases. *American Journal for Tropical Mecine and Hygeine, 73(6) :1151-1158*

Blakely T, Atkinson J, Kiro C, d'Souza A. Child mortality, socioeconomic position, and one-parent families: independent associations and variation by age and cause of death. Internationla Journal of Epidemiology 32(3): 410-418

Brockerhoff, M, 1990. Rural-to-urban migration and child survival in Senegal. *Demography 27(4): 601-616.*

Brockerhoff, M. 1994. The impact of rural-urban migration on child survival. *Health Transition Review 4:127-149*

Brockerhoff, M. 1994. The impact of rural-urban migration on child survival. *Policy Research Division working paper no, 61: Population Council, New York*

Brockerhoff, M, 1995. Child survival in big cities: The disadvantage of migrants. Social *Science and Medicine 40(10): 1371-1383*

Inequality of child mortality in sub-Saharan Africa. Bulletin of World Health Organization 78(1):30-41

Central Bureau Statistics (CBS) [Kenya]. 1990. Kenya *Demographic and Health Survey* 1989Central Bureau Statistics

Central Bureau Statistics (CBS) [Kenya]. 1999. Kenya *Demographic and Health Survey* 1998

Central Bureau Statistics (CBS) [Kenya]. 2004. *Kenya Demographic and Health Survey 2003*

Crump J, Otieno PO, Slutsker L, Keswich BH, Rosen DH, Hoekstra RM, Vulule JM, Luby SP. 2005. Household based treatment pf drinking water with floculant-disinfectant for preventing diarrhoea in areas with turbid source water in rural western Kenya: cluster randomized controlled trial *BMJ,doi:10.1136/bmj.38512.61868.EO (published 26 July 2005)*

Debpur, Wontuo P, Akazili J, Nyarko P. 2005. Health Inequities in the Kassena-Nankana District in of northern Ghana. Measuring Health Equity in Small Areas Health Findings from Demographic surveillance systems. Indeepth Network :45-65

Frankenberg E, 1995. The effects of access to health care on infant mortality in Indonesia. Health Transit Review.5:143-163

Guilkey D & Riphahn R, 1998. The determinants of child mortality in the Philippines: estimation of a structural model. *Journal of Development Economics. 56:281-305*

Galvao CE, da Silva AA, dos Reis Filho SA, Novochadlo MA, Campos GJ, 1994. Oral rehydration therapy for acute diarrhea in a region of north-eastern Brazil, 1986-1989 (in Portuguese) *Rev Saude Publicia; 33:231-247*

Hoque BA, Chakraborty J, Chowdhury JT, Chowdhury UK, Ali M, el Ariefeen S, Sack RB, 1999. Effects of environmental factors on child survival in Bangladesh: a case control study. *Public Health Vol. 113(2):57-64*

Kevin J. and A. Thomas, 2007. Child Mortality and Socioeconomic Status: An Examination of Differentials by Migration Status in South Africa. *International Migration Review Vol. 41(1): 40-74*

Khe ND, Dung PH, Phuc HD, Minh HV, Thanh NX, Ericson B, Diwan V, Chuc THK. 2005. Health and Healthcare :Equity Aspects in FilaBavi, Vietnam. Measuring Health Equity in Small Areas Health Findings from Demographic surveillance systems. Indeepth Network :45-65 Review.5:143-163

Kiros, G and M. White 2004 Migration, community context and child immunization in Ethiopia. *Social Science and Medicine Vol. 59(12):2603-2616*

McElroy PD, ter Kuile FO, Hightower AW, Hawley WA, Phillips-Howard PA, Oloo AJ, Lal AA, Nahlen BL, 2001. All-cause mortality among young children in western Kenya. VI: the Asembo Bay Cohort Project. *American Journal of Tropical Medicine and Hygiene ??:18-27*

Pebley AR, Goldman N, Rodriquez G, 1996. Prenatal and delivery care and childhood immunization in Guatemala: do family and community matter? *Demography vol 33 pp 2312-247*

Pongou R, Ezzati M, Salomón SA, 2006. Household and community socioeconomic and evironmental determinants of child nutritional status in Cameroon. *BMC Public Health vol. 6 (98)*

Spencer HC, Kaseje DC, Moseley WH, Sempebwa EK, Huong AY, Roberts JM, 1987. Impact of on mortality and fertility of a community-based malaria control program in Saradid, Kenya ANN Trop Med Parasitology 81 (supl 1): 36-45.

Ssengonzi R, De Jong GF and Stokes CS, 2002. The effect of female migration on infant and child survival in Uganda. Population Research and Policy Review 21(5):403-431

Stephenson R, Matthews Z McDonald JW, 2003. The impact of rural-urban migration on under-two mortality in India. Journal of Biosocial Science 35(1(: 15-31

Thomas D, Strauss J, Henriques M, 1990. Child survival, height for age and household characteristics in Brazil. Journal of Development Economics. 33:197-234

Wolfe B & Behrman J, 1982. Determinants of child mortality, health, and nutrition in a developing country. Journal of Development Economics. 11:163-193

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