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USING INDIRECT METHODS TO UNDERSTAND THE IMPACT OF FORCED MIGRATION ON LONG-TERM UNDER-FIVE MORTALITY

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Summary. Despite the large numbers of displaced persons and the often-lengthy periods of displacement, little is known about the impact of forced migration on long-term under-five mortality. This paper looks at the Brass Method (and adaptations of this method) and the Preceding Birth Technique in combination with a classification of women by their migration and reproductive histories, in order to study the impact of forced migration on under-five mortality. Data came from the Demography of Forced Migration Project, a study on mortality, fertility and violence in the refugee and host populations of Arua District, Uganda and Yei River District, Sudan. Results indicate that women who did not migrate in a situation of conflict and women who repatriated before the age of 15, had children with the highest under-five mortality rates compared with women who were currently refugees and women who repatriated after the age of 15.

Introduction

Despite the large numbers of displaced populations and the often-lengthy periods of displacement, there is little understanding of the health status of long-term displaced populations. Long-term is defined here as at least 6–12 months because this is when emergency phases of forced migration situations typically end. In large part the lack of knowledge is due to poor methods of measurement, making it difficult to obtain reliable demographic indicators such as mortality rates. Good demographic data are needed to better understand the plight of the displaced and to provide better assistance. Rates of under-five mortality are important because they indicate the welfare of a particularly vulnerable group, young children. Because children comprise a large proportion of displaced populations and because they suffer high mortality, it is imperative that their health needs be addressed. Precise information on under-five mortality could give donors and relief workers an idea of how best to allocate their resources and plan health intervention programmes. Estimates could also be used to evaluate the effectiveness of existing programmes and serve as a check against surveillance data. Under-five mortality has often been used to classify the phase of a forced migration emergency and is often quoted as an indicator of the severity of a forced migration situation. In general under-five mortality is an important measure, because it is widely accepted as an indicator of social welfare and overall health.

Current methods of obtaining under-five mortality are considered poor in displaced populations. They tend to rely upon hospital and burial data and estimates of population, all of which are acknowledged to be inaccurate. The results are generally believed to be underestimates of mortality because deaths (numerators) are often undercounted and population counts (denominators) are overestimated (Keely *et al.*, 2001). Sample surveys in displaced populations are often poorly conducted and documented, representative samples are hard to draw and comparisons are often impossible because of inconsistent methodology (Boss *et al.*, 1994). Overall there is an acknowledgement by those working with displaced populations that methods need to be standardized and improved (Keely *et al.*, 2001).

Indirect techniques

Indirect methods have long been used in developing countries where vital registration systems are non-existent or of poor quality. Indirect techniques can be used when the measures in question (i.e. mortality and fertility rates) are not easily available or reliable but when other data can be obtained and converted into the needed measures. The information needed for indirect methods are most often obtained from sample surveys, as was done for this paper. Household sample surveys do not have the selection bias that may affect hospital and burial site data though they do have survivor bias. They supply numerators and denominators, which render individual population counts unnecessary. The derived estimates could be compared with rates before the population fled or to rates in the host population. They could be used by relief workers to assess a situation, track mortality trends over time and serve as a check against surveillance data. In this paper two indirect techniques are used to obtain information on under-five mortality in the study populations: the Brass Method and the Preceding Birth Technique. A key reason for choosing these methods is their simplicity. Simple methods are needed, because many persons working with displaced population do not have either the time or the background to conduct sophisticated statistical tests.

The Brass Method

The Brass Method (Brass, 1964, 1975) is widely used in censuses and sample surveys in developing countries to obtain estimates of child mortality. In this method women are asked a few simple questions on their date of birth or age and their total numbers of live-born children still alive, dead and ever born. Typical Brass questions are the following: (1) When were you born? (month/year) *or* What is your age?

(2) How many sons/daughters have you given birth to who are now living at home?
(3) How many sons/daughters have you given birth to who are now living elsewhere?
(4) How many sons/daughters ever born alive are now dead?

From question one, women are classified into five-year age intervals starting with 15–19 and ending with 45–49. In the second and third questions the focus is on live-born children living at home and away from home. The distinction is made to improve recall bias. Question four obtains information on children born alive who later died. The Brass questions focus on live births and thus exclude miscarriages and stillbirths. It is often advantageous to record the numbers for questions two to four separately for sons and daughters so that sex ratios by age of the mother and sex-specific child mortality can be tabulated (UN, 1983).

The proportion dead of children ever born to a group of women depends upon the distribution of children by length of exposure to the risk of dying and upon the mortality risks themselves. The length of exposure to the risk of dying is the distribution in time of the births. By allowing for the effects of this distribution the proportion dead can be converted into a conventional mortality measure expressing their average experience (UN, 1983). Because the age of the mother serves as a proxy for the exposure time to mortality for her children, the proportion dead for women of a particular age group can be converted into the probability of dying by specific childhood ages. Estimates derived from women aged 15–19, for example, typically represent the probability of dying by age one. The conversion to a probability of dying is performed through the use of a multiplier, which adjusts for non-mortality factors that influence the value of the proportion dead. These non-mortality factors represent the age pattern of fertility. It is the age pattern of fertility that determines the distribution of children to a group of women by the length of exposure to the risk of dying (UN, 1983). An equation for the conversions is presented below:

$$q(x) = k(i)D(i).$$

In this equation i represents a five-year age group, and x denotes a specific childhood age. The symbol $D(i)$ represents the proportion dead of children to women in a specific five-year age group, $q(x)$ is the probability of dying by a specific childhood age and $k(i)$ is the multiplier. The equation states that a probability of dying by an exact childhood age is related to the proportion dead of children ever born by a factor k. The equation for the multiplier k is:

$$k(i) = a(i) + b(i)(P(1)/P(2)) = c(i)(P(2)/P(3)).$$

In this equation $k(i)$ depends on the fertility patterns of younger women and coefficients developed from model fertility schedules. In the equation i once again denotes a five-year age group, P represents parity, and 1, 2 and 3 refer to the ages 15–19, 20–24 and 25–29 respectively. When the multipliers developed by Trussell (1975) are used, the coefficients a, b and c are estimated from model fertility schedules developed by Coale & Trussell (1977) and the Coale–Demeny Model Life Tables. (A model life table is the expression of the typical mortality experience derived from a group of observed life tables (UN, 1983); the Coale–Demeny Model Life Tables were derived from 192 life tables for actual populations. The life tables are broken down into four mortality patterns: North, South, East and West.) The Trussell multipliers are based upon a wider range of model situations than multipliers developed by Sullivan (1972) or Brass (1975) and for this reason will be the multipliers used in this paper.

Some basic assumptions of the Brass Method are that fertility and childhood mortality have remained largely constant in the recent past. Under conditions of changing fertility the ratios of average parities (needed for the calculation of the multiplier) will not accurately represent the experience of any cohort of women. They will also not provide a good index for the distribution in time of births to women in each group. It can be assumed that fertility has not declined significantly for the study population in this paper. (According to census and DHS data, fertility has declined only slightly in Uganda from 1969 to 1995. The 1969 Census, the 1991 Census, the 1995 DHS and the 2000/2001 DHS reported the total fertility rate (TFR) to be 7·1, 7·1, 6·9 and 6·9, respectively. Unfortunately no comparable data are available for Southern Sudan.)

The assumption of constant mortality is often a problem because under-five mortality is declining in many countries. Coale & Trussell (1977) have shown that each estimate from a specific five-year age group of mothers corresponds to a specific number of years before the survey. For example, estimates obtained from women aged 15–19 generally reflect infant mortality for a time of 1 to 1·5 years before the survey. This time period is invariant with respect to the speed of mortality change, so long as the rate of change is constant over time. The equation for the time period is as follows:

$$t(x) = a(i) + b(i)(P(1)/P(2)) + c(i)(P(1)/P(2)),$$

where P represents parity, i is a five-year age group and a, b, and c are coefficients.

Advantages of the Brass Method are that it only requires a few relatively simple questions, and it is not subject to errors due to misdating because the method does not rely on any dates of birth or death (except the date of birth or age of the mother). The method does have some limitations. Estimates from this method do not yield any insight into the age pattern of mortality because each $q(x)$ refers to a different time period. The method also would probably not capture mortality peaks because of its aggregate nature and as mentioned previously does not yield very recent estimates of mortality. The method only obtains information from surviving mothers so children who have lost their mothers are not included in the analysis. Based upon these strengths and limitation the Brass Method would best be applied to long-term displaced populations but not recently displaced populations.

The Preceding Birth Technique

The Preceding Birth Technique was developed by Brass & Macrae (1984, 1985) and is notably for its simplicity in both data collection and analysis. The questions commonly used for the Preceding Birth Technique are the following: (1) When was your most recent birth? (month, year) (2) Is that child alive or dead? (3) When was the birth before the last one (or the most recent but one)? (month, year) (4) Is that child alive or dead?

Originally the method was proposed as a means to obtain information on the survival status of the preceding child from women of at least parity two at the time of or just after an institutional delivery. However the questions can also easily be incorporated into a survey. The Preceding Birth Technique has been adapted for use in antenatal clinics (Woelk *et al.*, 1993; Bairagi *et al.*, 1997), women at home after childbirth (Bicego *et al.*, 1989) or to women who have given birth in the last two years (David *et al.*, 1990). The method has also been used in refugee populations (Madi, 2000).

With a few simple questions on the survival status of the preceding child, it is possible to get an estimate of the probability of dying by approximately age two, $q(2)$. The exact age x can be calculated using a simple formula:

$$x = 0{\cdot}8(i) + a,$$

where 0·8 is a constant, i is the mean birth interval length and a is the mean age of the last-born child, respectively. The mean age of the last-born child must be added because births in the last two years are being studied so the reference point is not the birth of the last child. In other words, the exposure time of the preceding birth is increased by the mean age of the most recent child. To calculate the time before the survey to which the estimate refers, the following equation can be used:

$$t(x) = 0{\cdot}667(i) + a.$$

To obtain a measure of $q(5)$, interpolation and extrapolation using model life tables can be performed. First the values of $q(2)$ can be interpolated to a selected model life table to find the appropriate level of mortality. Using the appropriate level, values of $q(5)$ can be extrapolated (UN, 1983; David *et al.*, 1990). The time period to which the estimate refers can also be calculated.

The Preceding Birth Technique has great potential for use in forced migrant populations because of its economy in both data collection and analysis. It also yields relatively recent estimates of mortality. The method, however, shares some of the same disadvantages as the Brass Method. It has a limited ability to capture relatively short-term changes in mortality if the method is repeated over time, but would probably not capture sharp peaks of mortality because preceding births are distributed over time. The technique does not yield information on the age pattern of mortality and only obtains information from biological children.

Fieldwork

Data for this paper came from the Demography of Forced Migration Project (DFMP), a study aiming to document mortality, fertility and health outcomes in the refugee and national populations of Arua District, Uganda and Yei River District, Sudan. Fieldwork for this project was conducted between September 1st 1999 and March 4th 2000. These particular study populations were selected because the Uganda–Sudan border has seen many mass movements of people over the past few decades. Many of the Ugandans in Arua were formerly refugees in Yei River District, Sudan in the 1980s. Most have repatriated back to their homes so they have a complete migration history (from home to exile and back to home). Currently many

Sudanese from Yei River District have become long-term refugees in Arua District, so the former hosts have now become the hosted.

Civil war between North and South Sudan has been ongoing since 1983. The key factors in the war are the northern government's desire to impose Islam, including *sharia* law, on the southerners who follow traditional religions or Christianity, and its desire for the South's resources, including fertile land, gold and oil. The civilian population of the south has been devastated by human rights abuses and lack of development.

The selected study populations are rural with little infrastructure or development. Because of the war South Sudan has seen little development and has little infrastructure. Many Sudanese refugees in Uganda face harsh living conditions and live on unfertile land that previously had been uninhabited. Other Sudanese refugees live in more of a town setting and try to do trade or piece-meal work. Many of the Ugandans had also faced hardships as refugees in South Sudan, but Arua District has recently been peaceful. It must be mentioned that all groups within this study population are very poor.

The study employed a retrospective and cross-sectional survey approach to obtain information on fertility, mortality, migration and other individual, household and community factors. The questionnaire had eight modules: background/household economics, pre-migration history, migration history, post-migration, background, child health, reproductive health, security and the security migration history. Modules were asked to both men (aged 20–55) and women (aged 15–49) except for the child health module, which was only administered to women. The migration history and security history modules contained a new instrument: the migration history matrix format.

A major limitation of the study in general is survivor bias. Information was collected only from surviving men and women. This is a limitation in terms of this particular paper because information concerning the survival status of orphans was not available. It is possible that the under-five mortality differs between orphans and non-orphans.

Possible ways to include orphaned children in a future study would be to ask adults taking care of the orphans about the survival status of the orphan's siblings. Alternatively orphaned children could be included in a birth history analysis along with a respondent's biological children. Yet another option would be to ask respondents about the survival of their siblings and about all children ever born to sisters who reached the age of 15.

Classification used to study the impact of forced migration on under-five mortality

To study the impact that migration has upon long-term child mortality women were divided into several categories based upon where they spent most of their reproductive years. The categories were based upon a migration history and respondents' answers to the following two questions: (1) Now, I would like to ask you about your home and the places you have lived in. Have you always lived in (name of current place of residence), since birth? (2) Do you consider (name of current place of residence) to be your home?

Home is a concept that is difficult to define in many cultures, so what constituted 'home' was left largely to the respondents. From qualitative research it was discovered that home was generally considered the place where an individual spent his or her childhood and where his or her parents were settled. Women were first dichotomized by whether or not they have ever left home. (Respondents who moved but considered the new place of residence to be home were not included in this analysis. These respondents moved for voluntary reasons.) The categories were further broken down according to the places where women spent most of their reproductive years (ages 15–49). A simple differentiation between 'home' and 'away from home' was made. Women were not categorized by reasons for leaving home because most respondents mentioned several reasons involving both war-related and economic factors. Many women have made multiple moves during their lifetimes but because the sample sizes are not large enough, the number of movements was not used to classify women.

A classification of women based upon the correspondence of reproductive years and migration history made it possible to understand if and how migration impacts cumulative child mortality. Based upon the classification scheme above women were classified into five categories: 'stayees', 'displaced before age 15', 'returnees before age 15', 'returnees after age 15' and 'displaced after age 15'. 'Stayees' are women who never migrated. They are women who did not leave their homes in Sudan despite the conflict there or women who did not leave their homes in Uganda during the years of turmoil in Arua District. 'Displaced before age 15' are women who became refugees or internally displaced persons (IDPs) before the age of 15. All their reproductive years occurred after leaving home. 'Returnees before age 15' are women who left home and repatriated before age 15. All their reproductive years have occurred after returning home. 'Returnees after age 15' are women who migrated and returned home after the age of 15. These women had reproductive years at home, away from home and at home again. 'Displaced after age 15' are women who became refugees or internally displaced persons after the age of 15 and who are currently displaced. These women had reproductive years at home and away from home. See Table 1 for a summary of the classification.

Application of the Brass Method and adaptations of the Brass Method

Using data from the DFMP the Brass Method was tested along with adaptations of the Brass Method. Tables 2 and 3 present data for the number of women and children ever born. Numbers in some of the cells are small, which reduces the power of subsequent statistical tests. The average parities in Fig. 1 are calculated by dividing the number of children in a cell by the number of women in the corresponding cell. Average parities may be expected to increase with mother's age unless there has been an increase in fertility over the recent past. Parities for this study sample always increase with age with an exception of a few cells. The reason for these exceptions is probably the small number of women in some of the cells.

Proportion dead

The proportion dead of children ever born was calculated by dividing children ever born by children who died for women in each age group (see Table 4 and

Table 1. A description of the classification of women by migration and reproductive histories

Category	Number	Description
Stayees	485	Women who never migrated. All their reproductive years were spent at home.
Displaced before age 15	399	Women who migrated and had all their reproductive years after leaving home. (These women are currently refugees.)
Returnees before age 15	482	Women who migrated, repatriated and had all their reproductive years after repatriating.
Returnees after age 15	519	Women who migrated and had reproductive years at home, away from home and home again.
Displaced after age 15	618	Women who had reproductive years at home and away from home. (These women are currently refugees.)
Total	2503	

Fig. 2). Several of the confidence intervals for the proportion dead cross zero partly because of the small numbers of women and children in those particular cells.

A chi-squared test for the homogeneity of all five categories was calculated and indicated that there was heterogeneity between some of the categories. A series of 2 by 2 chi-squared tests revealed the only significant differences among the categories (at $p<0{\cdot}05$) were for the age groupings 20–24, 30–34 and 35–39.

Within the age category 20–24 there were significant differences between: ‘displaced before age 15’ and ‘displaced after age 15’; ‘displaced before age 15’ and ‘returnees after age 15’; ‘stayees’ and ‘displaced after age 15’; ‘stayees’ and ‘returnees after age 15’.

Within the age category 30–34 there were significant differences between: ‘stayees’ and ‘displaced after age 15’; ‘stayees’ and ‘displaced before age 15’; ‘returnees before age 15’ and ‘displaced after age 15’; ‘returnees after age 15’ and ‘displaced after age 15’.

Within the age category 35–39 there were significant differences between: ‘stayees’ and ‘returnees after age 15’; ‘stayees and ‘displaced after age 15’.

The q(x) *estimates*

The proportion dead was converted into the probability of dying by the procedures mentioned earlier. The estimates derived from this method and the corresponding time references are presented in Table 5.

Discussion of the estimates

As mentioned earlier, the Brass Method does not yield robust estimates of recent mortality (based upon information from women aged 15–19 and 20–24) because of an

Table 2. Number of women in the study populations

Age of mother	Total	Stayees	Displaced before age 15	Returnees before age 15	Returnees after age 15	Displaced after age 15
15–19	483	158	171	85	32	37
20–24	463	117	127	89	74	56
25–29	528	77	44	95	139	173
30–34	375	37	29	85	92	132
35–39	276	38	7	43	84	104
40–44	142	20	3	34	38	47
45–49	144	29	3	27	39	46
Total	2411	476	384	458	498	595

Table 3. Number of children ever born (CEB) and children who died

Age of mother	Total		Stayees		Displaced before age 15		Returnees before age 15		Returnees after age 15		Displaced after age 15	
	CEB	Dead	CEB	Dead	CEB	Dead	CEB	Dead	CEB	Dead	CEB	Dead
15–19	181	20	63	5	61	7	31	5	14	2	12	1
20–24	788	96	170	25	197	31	175	22	152	12	94	6
25–29	1895	336	243	33	140	21	382	72	520	90	610	120
30–34	2097	484	217	51	144	25	466	99	518	105	643	95
35–39	1684	339	254	68	38	8	281	65	489	84	622	114
40–44	896	190	100	17	17	1	218	57	283	60	278	55
45–49	995	265	212	52	28	10	168	51	251	72	336	80
Total	8536	1730	1259	251	625	103	1721	371	2227	425	2595	471

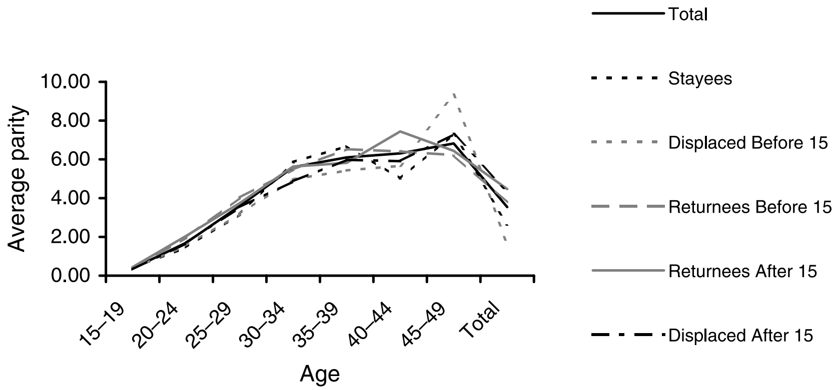

Fig. 1. Average parities by age group and category.

age effect and socioeconomic selection bias. In addition there are often small numbers of births to women in the 15–19 year age group. Therefore estimates of *q*(1) will not be interpreted here. Estimates of *q*(2) will be interpreted because the numbers are adequately large and the proportion dead calculations upon which the estimates were based contained significant differences between the categories. The *q*(2) estimates ranged from 0·07 to 0·16. Children of 'displaced before age 15' and 'stayees' had high mortality at 0·16 and 0·15 respectively while children of 'displaced after age 15' and 'returnees after age 15' had low mortality at 0·07 and 0·08. Estimates of *q*(2) refer to a time period between 2·5 and 3·0 years ago. The estimates for *q*(3) ranged from 0·14 to 0·20. These estimates, however, are based upon proportion dead values, which were not significantly different from one another. Estimates of *q*(5) ranged from 0·15 for children of 'displaced after age 15' to 0·24 for children of 'stayees'. These estimates refer to time periods of 6·1 to 7·2 years before the survey. Children of 'stayees' also had the highest *q*(10) estimate at 0·29 while children of 'returnees after age 15' had the lowest estimate at 0·17.

The most consistent result from these estimates is that children of 'stayees' tend to have higher *q*(*x*) values than children of women in other categories. Children born to women 'displaced after age 15' seem to have lower mortality than children of women in the other categories. Children of 'returnees before age 15' also seem to have high mortality. Before conclusions will be drawn a few alternative techniques will be presented in order to clarify and substantiate these findings.

Alternative methods

Despite the fact that 2503 women were interviewed, the numbers of children born and dead were quite small for some age groups. Surveying more than 2500 women may be difficult for many NGOs so it is important to look at simple adaptations of the Brass Method which can account for small cell sizes.

In order to get a proportion dead estimate based upon a relatively large number of children born and dead, the age categories 25–29, 30–34 and 35–39 were added together. (Those age groups were selected because they had the largest numbers of

Table 4. Proportion dead and 95% confidence intervals

Age	Total	Stayees	Displaced before age 15	Returnees before age 15	Returnees after age 15	Displaced after age 15
15–19	0·11	0·08	0·12	0·16	0·14	0·08
	(0·065, 0·156)	(0·013, 0·146)	(0·035, 0·195)	(0·032, 0·291)	(− 0·040, 0·326)	(− 0·073, 0·240)
20–24	0·12	0·15	0·16	0·13	0·08	0·06
	(0·099, 0·145)	(0·094, 0·200)	(0·107, 0·208)	(0·077, 0·175)	(0·036, 0·122)	(0·014, 0·113)
25–29	0·18	0·14	0·15	0·19	0·17	0·20
	(0·160, 0·195)	(0·093, 0·179)	(0·091, 0·200)	(0·149, 0·228)	(0·141, 0·206)	(0·165, 0·228)
30–34	0·23	0·24	0·17	0·21	0·20	0·15
	(0·213, 0·249)	(0·179, 0·291)	(0·112, 0·235)	(0·175, 0·250)	(0·168, 0·237)	(0·120, 0·175)
35–39	0·20	0·27	0·21	0·23	0·17	0·18
	(0·185, 0·239)	(0·213, 0·322)	(0·081, 0·340)	(0·182, 0·281)	(0·138, 0·205)	(0·153, 0·214)
40–44	0·21	0·17	0·06	0·26	0·21	0·20
	(0·185, 0·239)	(0·096, 0·244)	(− 0·053, 0·171)	(0·203, 0·320)	(0·164, 0·260)	(0·151, 0·245)
45–49	0·27	0·25	0·36	0·30	0·29	0·24
	(0·239, 0·294)	(0·187, 0·303)	(0·180, 0·535)	(0·234, 0·373)	(0·231, 0·343)	(0·193, 0·284)

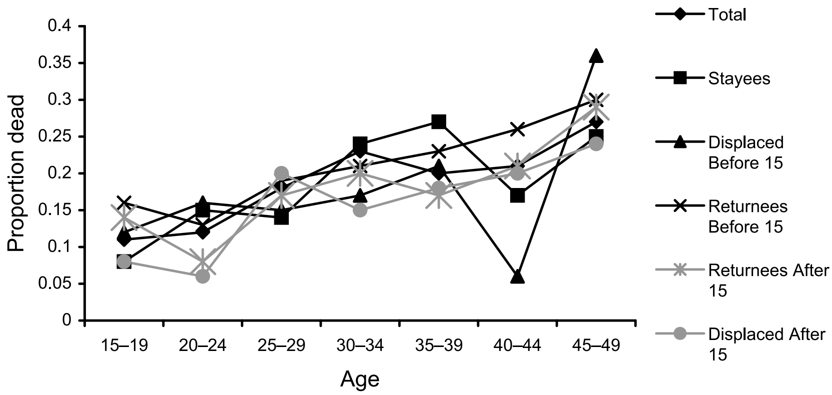

Fig. 2. Proportion dead of children ever born by age and category.

children ever born and children dead.) The proportion dead for these combined categories, i.e. the 'aggregate proportion dead values', are presented in Fig. 3.

Chi-squared tests were performed to test for significant differences between the proportions. Differences between the categories just missed being significant at $p<0{\cdot}05$. Nevertheless these findings substantiate the suggestion that children of 'stayees' and children of 'returnees before age 15' have higher mortality than children to women in the other groups. It is also evident that children of 'displaced before age 15' have the lowest child mortality. (These proportion dead estimates cannot be converted into $q(x)$ values because they are based upon the sum of ages from 25–39 and are not based upon five-year age groups.)

Another possible adaptation of the Brass Method is to look at mortality levels. The Coale–Demeny Model Life Tables contain different estimates of $p(x)$ values depending upon the level and age pattern of mortality. ($p(x)$ represents the number of persons who would die within the indicated age interval out of the total number of births assumed in the table. Values of $q(x)$ are equal to $1-p(x)$). Levels of mortality can be obtained by interpolating each $q(x)$ value to the model life tables. These levels are presented in Table 6. Levels of mortality can then be averaged for each category after weighing each level by the corresponding number of children. The average level of mortality can then be used to interpolate back into the model life tables to obtain an estimate of $q(5)$. These results are presented in Table 7.

These results once again confirm that children of 'stayees' and 'returnees before age 15' have the highest mortality. Children of displaced women and 'returnees after age 15' had an equal $q(5)$ value of 0·17.

Adaptation of the Preceding Birth Technique

The Preceding Birth Technique was adapted so that estimates from each migration–reproductive history category could be obtained. Analysis was restricted to women of at least parity two who have given birth within the two years preceding the date of the interview. Because of this restriction the total sample size of women dropped to 734.

Table 5. Probabilities of dying by specific ages time references

Age	x	Total		Stayees		Displaced before age 15		Returnees before age 15		Returnees after age 15		Displaced after age 15	
		$q(x)$	$t(x)$	$q(x)$	$t(x)$	$q(x)$	$t(x)$	$q(x)$	$t(x)$	$q(x)$	$t(x)$	$q(x)$	$t(x)$
15–19	1	0·10	1·4	0·06	1·7	0·10	1·4	0·16	1·1	0·14	1·2	0·08	1·2
20–24	2	0·12	2·7	0·15	3·0	0·16	2·7	0·13	2·5	0·08	2·7	0·07	2·5
25–29	3	0·18	4·4	0·14	4·5	0·15	4·5	0·19	4·4	0·17	4·8	0·20	4·3
30–34	5	0·24	6·4	0·24	6·1	0·18	6·5	0·21	6·7	0·20	7·2	0·15	6·5
35–39	10	0·21	8·6	0·29	7·9	0·22	8·7	0·24	9·2	0·17	9·8	0·19	8·9
40–44	15	0·22	11·0	0·18	10·0	0·06	11·1	0·26	11·8	0·21	12·6	0·20	11·4
45–49	20	0·27	13·9	0·26	13·0	0·36	14·0	0·31	14·7	0·28	15·4	0·24	14·3

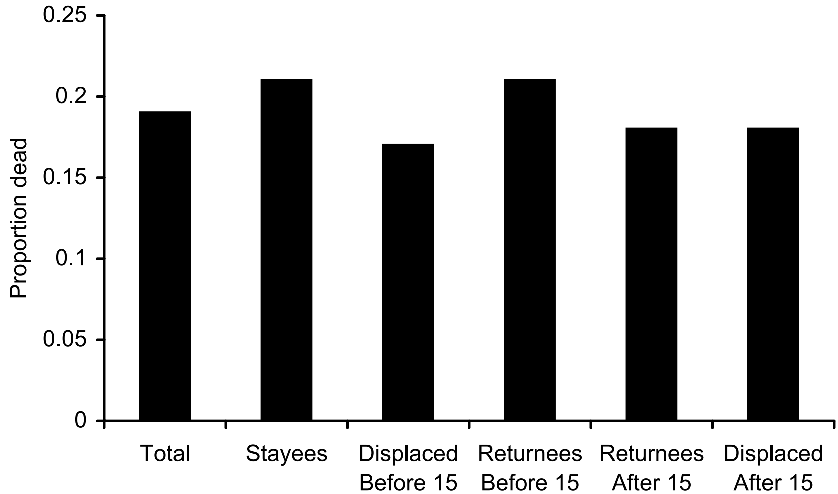

Fig. 3. Proportion dead estimates based upon aggregated numbers.

Obtaining estimates of q(x) *and* t(x)

Information on the proportion dead of the preceding (second to last) child was obtained from the fourth question in the series of Preceding Birth Technique questions presented earlier. The age of the last birth is simply the age of the youngest child at the time of the survey. The age of the youngest child was obtained by subtracting Q620 from the interview date. The mean age of the last birth was then obtained by averaging the ages (in months) of the youngest children. Birth intervals were calculated by subtracting Q620 from Q625. The median birth interval was obtained by selecting the value at the fiftieth percentiles of the frequency distributions.

The proportion dead values ranged from 0·10 for children of women ‘displaced before age 15’ to 0·13 for ‘returnees before age 15’. A chi-squared test, however, revealed that differences between the categories were not significant. Though the results are not significant they generally appear to be similar to results obtained from the Brass Method. Mean ages of the last birth ranged from 10·4 months to 11·9 months, and the median birth intervals ranged from 29·7 months to 35·6 months. The value for the ‘total’ category was 32·5 months. Displaced women had the longest birth intervals, perhaps suggesting that displacement may lead to lower fertility. The 1995 and 2000/2001 Uganda DHS reported the mean birth interval for women who had a birth in the last five years to be 31·8 months for Northern Uganda. Most women in the DFMP had slightly longer birth intervals.

Based upon the information presented in Table 8, x and $t(x)$ were calculated and presented in Table 9. The time to which these estimates refer ranged from 2·64 to 2·92 years before the survey. The age to which the estimates referred ranged from age 2·97 to 3·31.

Because the x values are not typical values used for studying child mortality, interpolation was used to obtain estimates of $q(3)$ and $q(5)$. Values of $q(x)$ were interpolated to the Coale–Demeny West Model to find the corresponding level of

Table 6. The probabilities of dying and the corresponding levels

Age	x	Total		Stayees		Displaced before age 15		Returnees before age 15		Returnees after age 15		Displaced after age 15	
		$q(x)$	Level	$q(x)$	Level	$q(x)$	Level	$q(x)$	Level	$q(x)$	Level	$q(x)$	Level
15–19	1	0·10	15·21	0·06	18·68	0·10	15·21	0·16	10·95	0·14	12·26	0·08	16·88
20–24	2	0·12	15·36	0·15	13·59	0·16	13·05	0·13	14·75	0·08	17·96	0·07	18·68
25–29	3	0·18	12·77	0·14	14·79	0·15	14·25	0·19	12·75	0·17	13·25	0·20	11·84
30–34	5	0·24	10·55	0·24	10·55	0·18	13·49	0·21	12·21	0·20	12·63	0·15	14·9
35–39	10	0·21	12·93	0·29	9·80	0·22	12·54	0·24	11·75	0·17	14·61	0·19	13·73
40–44	15	0·22	13·02	0·18	14·63	0·06	20·50	0·26	11·52	0·21	13·41	0·20	13·79
45–49	20	0·27	11·86	0·26	12·22	0·36	8·72	0·31	10·42	0·28	11·50	0·24	12·28

Table 7. Average levels and interpolated $q(5)$ values

Category	Average level	Interpolated $q(5)$
Stayees	12·64	0·19
Refugees before age 15	13·61	0·17
Returnees before age 15	12·22	0·19
Returnees after age 15	13·54	0·17
Refugees after age 15	13·59	0·17
Total	12·47	0·19

Table 8. Information for the Preceding Birth Technique

	Total	Stayees	Displaced before age 15	Returnees before age 15	Returnees after age 15	Displaced after age 15
Sample size (N)	734	125	72	156	179	195
Proportion dead (PD)	0·12	0·12	0·10	0·13	0·13	0·10
Mean age of last birth in months	11·3	11·4	10·4	11·9	11·0	11·3
Median birth interval in months	32·5	32·8	33·0	29·7	32·0	35·6

Table 9. Estimates from the Preceding Birth Technique

	Total	Stayees	Displaced before age 15	Returnees before age 15	Returnees after age 15	Displaced after age 15
x (years)	3·11	3·14	3·07	2·97	3·05	3·31
$q(x)$	0·12	0·12	0·10	0·13	0·13	0·10
$t(x)$ (years)	2·74	2·77	2·70	2·64	2·70	2·92

mortality. Once the level was found interpolation was used to find estimates of $q(3)$ and $q(5)$. These values are presented in Table 10. The interpolated values once again suggest that children of displaced women have the lowest mortality. Children of returnees had the highest mortality, and children of ‘stayees’ had middle range values.

Comparisons with DHS data

Unfortunately there is no gold standard to compare the estimates obtained in this study. However some data from Demographic and Health Surveys (DHS) are presented here. The Uganda DHS 1995 lists 147·3/1000 as the $q(5)$ for Uganda from

Table 10. Interpolated values of $q(3)$ and $q(5)$

Category	Level	$q(3)$	$q(5)$
Stayees	15·94	0·12	0·13
Displaced before age 15	17·11	0·10	0·11
Returnees before age 15	15·53	0·13	0·14
Returnees after age 15	15·53	0·13	0·14
Displaced after age 15	17·11	0·10	0·11
Total	15·94	0·12	0·13

1990 to 1995, and 190/1000 as the $q(5)$ value for Northern Uganda from 1985 to 1995 (Macro International, 1995). The Uganda DHS 2000/2001 listed 151·5/1000 as the $q(5)$ value for Uganda from about 1995 to 2000, and 178/1000 as the $q(5)$ value for Northern Uganda from 1990 to 2000. These estimates cannot be used as a gold standard because of slightly different time references and because they refer to a much wider population than was included for this study.

Conclusions

Based upon the results from the Brass Method, the adaptations of the Brass Method (the aggregated proportion dead results and the interpolated $q(5)$ values) and the Preceding Birth Technique, several conclusions can be drawn. Of the five categories, it is clear that children of 'returnees before age 15' have the highest mortality. Children of 'returnees before age 15' may have relatively high mortality because women who become displaced and return home before the age of fifteen may be adversely affected by so many large-scale migrations at a young age, when they are still growing and developing. This toll could later affect their pregnancies.

Children of 'stayees' also appear to have relatively high to medium mortality. 'Stayees' are women who never migrated despite turmoil in their region. There could be a selection effect involved in which 'stayees' are women who were not physically able to move or who lacked the resources to move. (Many people migrated with few possessions, however, and the majority migrated on foot.) A more probable reason is that women who remain behind in a situation of warfare or conflict undergo long periods of deprivation and may be victims of violence. Their children would suffer for the same reasons. In addition pregnant women who are deprived for long periods of time, may have adverse pregnancy outcomes or give birth to pre-term or low birth weight babies.

In the methods presented, children of women 'displaced before age 15' often had the lowest mortality. These women were able to leave a dangerous situation before their childbearing years began and perhaps were able to benefit from assistance and asylum granted in the host country. They probably had enough time to fully adapt to the conditions in the host country before they had children. The children of 'displaced after age 15' and 'returnees after age 15' had low or middle range mortality values.

The results indicate that not migrating in the face of threat may have an adverse impact on children. It is clear that the humanitarian community needs to focus not only on providing aid to refugees and displaced persons but also to those who remain behind. Of course because of uncooperative governments or extremely dangerous situations, it is often difficult or impossible to help those within unfriendly borders. Understanding that mortality levels are high for children in countries of conflict perhaps can be used as a humanitarian argument to allow aid to be delivered. These results also indicate that becoming displaced and then repatriating at a young age can have negative consequences on subsequent births. This would indicate the need for carefully conducted repatriation campaigns. The fact that refugees have lower mortality suggest that, contrary to what might be expected, migration may be a very positive action when the situation in the country of origin is dire. The aid and protection provided to refugees may also have a beneficial impact.

These findings have important policy implications. They stress the importance of delivering relief aid when possible to those who do not leave a situation of turmoil. They also stress the need for carefully designed and monitored repatriation programmes. The fact that children of women who are currently refugees have the lowest mortality is a sign that relief aid may be beneficial and that safety could be a key factor in under-five mortality.

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