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CONTRIBUTION OF HOUSEHOLD ENVIRONMENT FACTORS TO URBAN CHILDHOOD MORTALITY IN MOZAMBIQUE
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ABSTRACT

Objectives: **Household environment factors are known to be associated with child mortality in urban and rural areas of many developing countries. In Mozambique, no study to date has addressed this relationship. This study is aimed to access the contribution of household environment factors to urban childhood mortality in Mozambique.**

Design: **Retrospective follow-up study.**

Setting: **Urban Mozambique.**

Subjects: **One thousand and forty eight children born in urban areas of Monzambique within five years of the 1997 Demographic and Health Survey.**

Methods: **Cox regression analysis was performed on a sample of 1048 children born in urban areas of Mozambique within five years of the 1997 Demographic and Health Survey.**

Results: **Children of mother's who lived in households with no toilet facility or with well as a source of drinking water had a high risk of dying compared to children who lived in households with flush toilet and piped water.**

Conclusion: **Type of toilet facility and source of drinking water play an important role in the risk of childhood mortality in urban areas of Mozambique and the relationship seems to be mediated partly by demographic and socioeconomic factors.**

INTRODUCTION

Many demographic studies have documented the child survival advantage associated with urban compared to rural residence in contemporary developing world(1-7). However in countries such as South Korea and Sri Lanka(8), Indonesia and Ghana(9), Egypt(10), the Philippines (11) and Brazil(12,13), a negative relationship between urban residence and child survival appeared after controlling for other socioeconomic and demographic factors.

In recent years, there has been growing recognition that a variety of threats exist to child health and survival in cities of the developing world (14,15). These include increased incidence of diarrhoeal disease, due to water shortage or contamination(16); earlier exposure to measles infections due to household crowding(17); low nutritional intake and chronic malnutrition due to high food costs(18) and high risks of accidents or injury due to maternal stress or depression(19), or poor housing(20).

In the last two decades many studies in low-income countries have shown evidence of the relation between other specific determinants and child mortality. It is known that within the bio-demographic determinants: (i) male children experience higher mortality than female children(21,22); (ii) children of teenage mothers have relatively high mortality compared to those of mothers in their twenties(22-24); (iii) that mortality is higher in children born after a birth interval that is less than 2 years(2-4,8); (iv) that first-born and higher order (2+) births have higher mortality(23,24).

In addition, maternal education has been considered among the most important determinants of child survival in developing countries (25-27). However, some studies have suggested that the role of maternal education in child survival is least striking in sub-Saharan Africa (28-30). Although maternal education is an important determinant, there is a growing recognition of the importance also of environmental conditions on child welfare. It is suggested that factors like notable and convenient supplies of water, sanitation and health care services are also important to improve child welfare in low-income countries, especially in sub-Saharan Africa(31-33). The objective of this study was to investigate the contribution urban childhood mortality in Mozambique.

MATERIALS AND METHODS

Data and sample descriptions: The data used in this study comes from the Demographic and health Survey which was conducted between march and July 1997 in Mozambique. The sample included 8779 women aged 15-49 years., information on birth history was collected as well as information concerning personal and household characteristics, health service utilization and child health at the time of the survey. From this data collected, a retrospective child file has been generated consisting of all children born to sample women, each live birth and each subsequent child health outcome contains information on the household and each parent. With this information, child records constitutes the basic analytic sample.

The 8779 women interviewed during the survey contributed a total of 25752 births. Technical details regarding the surveys and its sampling have been reported in the official Mozambique Demographic and Health Survey Report(34). The non-response rate was 4.5%.

For the purpose of this study, analysis was restricted to children born within five years of the survey (n=1048) to mother's living in urban areas at the time of the interview. Multiple births were excluded from the analysis, since these children experience substantially higher mortality that is associated principally with their multiplicity.

We restricted the sample to birth in the five years to ensure that the household variables provide an accurate picture of the actual living conditions during the period that children were exposed to the risk of death and also in an attempt to obtain a large sample but at the same time minimize potential recall bias(35). Further restriction to children born within three years of the survey would have provided information also on some indicators of health service utilisation (maternal antenatal care and vaccination); however for a considerably smaller sample.

Specification and measurement of independent variables:

(a) Demographic variables:

Age of the child: In this analysis only child mortality (12-59 months) is considered.

Sex of the child: Sex of the child is defined as male or female.

Maternal age at the child's birth: Maternal age (in years) was classified into the following groups: 15-18,19-23, 24-28, 29-33, and 34 or older.

Preceding birth interval and birth order: These two variables were merged together into one variable to enable the inclusion of first births in the analysis and grouped as follows: (i) first births, (ii) birth order 2-4 and short birth interval (<24 months); (iii) birth order 2-4 and medium birth interval (24-47 months); (iv) birth order 2-4 and long birth interval (48+ months); (v) 5+ birth order and short birth interval (<24 months); 5+ birth order and medium birth interval (2447 months); 5+ birth order and long birth interval (48+ months).

(b) Household environmental variables:

Three variables were used in the analysis of household environmental conditions: toilet facility, source of drinking water and type of floor material. Three categories were created for toilet facility: (i) flush toilet (own flush toilet, shared flush toilet); (ii) traditional toilet (traditional pit toilet and latrine) and (iii) no facility. For source of drinking water four categories were created: (i) piped water (piped into own residence, piped into neighbour's residence); (ii) public tap; (iii) well (well in residence, well in neighbour's residence, public well); (iv) others (spring, river, lake, dam, rainwater). For main floor material two categories were used: (i) earth, and (ii); others (rudimentary wood, adobe tiles, brick, cement).

(c) Socio-economic variable:

Maternal education: This variable was categorised as (i) no education, (ii) primary education and (iii) secondary and above.

Methods: To estimate the effects of the independent variables on child mortality, we used Cox regression analysis (36) in SPSS (37). Results were expressed as mortality rate ratios (RR) with 95% confidence intervals. Respondents with missing values were excluded from the analysis. There were few missing values; 1.4% (15) for type of toilet facility, 1.0% (10) for source of drinking water and 1.1% (12) for type of floor material (Table 1).

First, a bivariate analysis was performed and secondly groups of variables were entered into multivariate models to study the impact of their inclusion on the urban childhood mortality, and the statistical significance of the variable in relation to the other variables. The first model (I) included household environment variables; the second (II) included also demographic variables, and the third model (III) included in addition maternal education as a socioeconomic variable.

RESULTS

The overall childhood mortality level for urban areas of Mozambique in the five years within the survey was 31/1000. Table 1 shows the distribution of the co-variates used in the Cox regression analysis. There was a statistical significant association between the three household environment variables and childhood mortality in the bivariate analysis (results not shown).

Results of the multivariate analysis are shown in Table 2. Model 1 includes variables at household level only. Children who lived in households with no toilet facility had a risk of dying of 2.68 (1.05-6.85) compared to children who lived in households with flush toilet. On the other hand, compared to children whose mother's lived in households with piped water, children of mother's living in households with well as a source of drinking water had a risk of dying of 1.63 (1.10-2.42) (Table 2).

Table 1

Descriptive statistics of co-variates used in the regression models on childhood mortality in Mozambique

Variable	No.	(%)
Household environmental variables		
Toilet facility (n=1033)		
Flush toilet	99	9.6
Traditional toilet	640	61.9
No toilet facility	294	28.5
Source of drinking water (n=1033)		
Piped water	505	48.7
Public tap	251	24.2
Well	266	25.6
Others	16	1.5
Type of floor (n=1036)		
Earth	352	34
Other	648	66
Demographic variables (n=1048)		
Sex of the child		
Male	525	
Female	523	
Mothers age at the child's birth (n=1048)		
15-18	160	15.3
19-23	310	29.6
24-28	222	21.2
29-33	192	18.3
34+	164	15.6
Birth order/birth interval (n=1048)		
First births	210	20
2-4 & short bi<24 months	85	8.1
2-4 & medium bi 24-47 months	299	28.5
2-4 & long bi 48+ months	138	13.2
5+& short bi <24 months	57	5.4
5+& medium bi 24-47 months	192	18.3
5+& long bi 48+ months	67	6.4
Socio-economic variables		
Mother's education (n=1048)		
No education	181	17.2
Primary education	754	72.0
Secondary education and more	113	10.8

Table 2

Rate ratios (RR) with confidence interval (CI)) for the likelihood of childhood mortality in relation to the independent variables

Variable	Model 1		Model 2		Model 3	
	RR	CI	RR	CI	RR	CI
Household environmental variables						
Toilet facility						
Flush toilet	1.00			1.00	1.00	
Traditional toilet	2.20	(0.88-5.47)	2.14	(0.86-5.33)	1.80	(0.71-4.60)
No toilet facility	2.68	(1.05-6.85)	2.25	(1.00-6.53)	2.30	(0.87-611)
Source of drinking water						
Piped water	1.00		1.00		1.00	
Public tap	0.95	(0.62-1.47)	0.96	(0.62-1.48)	0.92	(0.58-1.47)
Well	1.63	(1.10-2.42)	1.57	(1.05-2.32)	1.48	(0.97-2.26)
Other	1.30	(0.50-3.38)	1.14	(0.40-2.96)	1.19	(0.45-3.17)
Type of floor						
Earth	1.15	(0.80-1.60)	1.16	(0.75-1.58)	1.14	(0.77-1.68)
Other	1.00		1.00		1.00	
Demographic variables						
Sex of the child						
Male			1.00		1.00	
Female			0.79	(0.57-1.09)	0.80	(0.57-1.12)
Age of the mother at the child's birth						
15-18			1.24	(0.75-2.60)	1.18	(0.69-2.04)
19-23			1.14	(0.71-1.84)	1.19	(0.72-1.95)
24-28			1.00		1.00	
29-33			0.80	(0.45-1.43)	0.79	(0.42-1.47)
34+			1.60	(0.95-2.68)	1.60	(0.92-2.78)
Birth order/birth interval						
First births			1.72	(1.01-2.94)	1.72	(1.01-2.94)
2-4 & short bi<24 months			2.66	(1.43-4.93)	2.65	(1.43-4.92)
2-4 & medium bi 24-47 months			1.00		1.00	
2-4 & long bi 48+			0.42	(0.12-1.10)	0.41	(0.11-1.11)
5+ & short bi<24 months			3.09	(0.59-6.02)	3.00	(1.58-5.99)
5+ & medium bi 24-47 months			1.56	(0.90-2.72)	1.54	(0.81-2.72)
5+ & long bi 48+			0.64	(0.22-1.84)	0.62	(0.22-1.84)
Maternal education						
No education					1.17	(0.56-2.49)
Primary education					1.06	(0.45-2.47)
Secondary education and above					1.00	

In Model 2, demographic variables were added to the household environmental variables, type of toilet facility and source of drinking water were still statistically significantly associated with child mortality. Children of mothers who lived in households with no toilet facility had a risk of dying of 2.55 (1.00-6.53) compared to those who lived in households with flush toilet. Children living in households which the source of drinking water was well had a risk of dying of 1.57 (1.05- 2.32).

In this model first births, birth order 2-4 and short birth interval (<24 months) and birth order 5+ and birth interval (<24 months) were significantly associated with child mortality.

In Model 3, mother's education was added and only birth order/birth interval was associated with child mortality. Birth order 2-4 and short birth interval (<24 months) and birth order 5+ and birth interval (<24 months) were significantly associated with child mortality.

DISCUSSION

In this study, we limited the analysis to childhood mortality (12-59 months), since theoretically there may be reason to assume that childhood mortality has more relation to household environment factors than infant mortality. Results of the multivariate analysis found that type of toilet facility (no toilet facility) and source of drinking water (well) had a strong relationship to urban childhood mortality in Mozambique. The same results were already found in the bivariate analysis (results not shown).

The importance of household environmental variables in child mortality has been found in other urban areas of developing countries. For instance, in urban areas of Eritrea, children born in households with good environment (with both flush toilet and piped water) had 59% and 44% lower mortality during the postneonatal and childhood periods, compared to children born to households with poor environment (with no flush toilet or piped water), respectively (4). Furthermore, in Nepal, the risk of death was found to be 44% lower among children born to households which used piped water than among children born to households using water from a river or lake even after controlling for other socio-economic and demographic factors (38). The study also indicated that the risk of death was 64% lower among infants born to households which had their own toilet facility than among children born to households, which did not have such a facility.

Our results showed that first births and children of high birth order (5+) had higher risk of dying than births of intermediate order, a finding seen in other studies (39,40). It is suggested that the higher risk of death among first births may be related to the biological influence of primiparity and young maternal age, namely that many first births occur before the woman has reached full physical and reproductive maturity. On the other hand, competition for resources and transmission of infectious diseases are suggested as contributing to the risk of mortality among higher birth order deaths(41). Furthermore, results showed a strong relation between the length of the previous birth interval and childhood mortality. Children who were born after a short birth interval (less than 24 months) had higher risk of death compared to children who were born after an intermediate interval (24-47 months). These results have also been found in other studies (2-4, 23, 25). In Sri-Lanka, Trussel and Hammerslough (23) found a substantial effect on the length of previous birth interval on infant and childhood mortality even after controlling for age of mother and birth order as well as other factors (socioeconomic). In another study, Hobcraft *et al*(42) found that a short previous birth interval raised the risk of mortality even after the post neonatal period.

In Model 2 controlling for demographic variables reduced slightly the risks of urban childhood mortality related with type of toilet facility and type of source of drinking water although they continued to be statistically significant. When the socioeconomic variable of maternal education was introduced in Model 3, the statistical significance of the association between urban childhood mortality with no toilet facility and well source of drinking water was removed although a similar gradient remained. This may indicate that part of the effects of the household environment variables works through maternal education. The effect of household environment on health may be conditioned by other characteristics and behaviours of both the household and the community (4,21,38). For instance, the effect of water supply and toilet facilities on child mortality may vary between individuals or localities depending on education of parents, household income and child-feeding practices (38). In our study mother's education could be seen as a marker of the socioeconomic status of the household, since household income information was not collected in the survey.

Results of the relationship between maternal education and childhood mortality in this study, were not statistically significant although a gradient was observed. (Table 2). In a previous study that investigated the relation between parental socioeconomic position and neonatal, postneonatal and childhood mortality using the same data but for children born within ten years of the survey, a statistical association was only found between maternal education and postneonatal mortality (1-11 months) (43). Although maternal education has been considered an important determinant of child mortality, a growing body of studies have indicated that the relation is somewhat weak in sub-Saharan Africa compared with findings in other Third World regions (29,30,43). Nonetheless, our results concerning maternal education should be interpreted with caution.

Breast feeding and use of health services are other important variables when studying the relationship between childhood mortality and household environment conditions. The two variables were not included in our main analysis since information was collected only for children born within three years of the DHS survey, and would have produced a much smaller sample with lower statistical power. In Mozambique, breast feeding is universal and according to the DHS official report, 95% of children born in urban areas within three years of the DHS survey were breastfed (34). In relation to the access and utilization of health services there is an overwhelming urban advantage. For instance, the DHS survey official report found that for children born within three years of the survey 85% of children in urban areas were fully immunized compared to 36.4% in rural areas; 40% of children with diarrhoea were taken to the hospital in the last two weeks of the survey compared to 30% in rural areas and 65% of children sought care for respiratory infections in urban areas compared to only 28% in rural areas(34).

Data in the DHS survey are not ideal to use for studying the impact of health service utilization on childhood mortality (12-59 months) in urban areas, since that information is collected only for children alive at the time of the survey. However, the importance of access and utilization of health services to child survival is well known(44).

The routine civil registration system of Mozambique is weak and, there is high under-reporting of both births and deaths, making it difficult to have reliable estimates of causes of death by urban setting. However, in a study of registered and autopsied deaths in Maputo City in 1994, diarrhoeal diseases (a disease typically related to household environmental conditions) was the 3rd cause

of death in the age group 0-5 years, after perinatal disorders and malaria(45).

Limitations of the study: Recall errors may have occurred in the survey that may have affected our results. It is known that older women or women with many children tend to under report events further back in time. Furthermore children who died shortly after birth may also have been omitted. However, DHS data quality assessments have found that errors are minimal in most cases(4,43,46,47).

Access to water supply and toilet facilities was observed at the time of interview, while data on the survival of children relate to a period some years before the interview. Some children may have been exposed to a different environment from that at the time of interview because people's access to water and sanitation may have changed mainly after the end of the civil war in 1992. However until the time of the interview in 1997, no major changes were made in either water or sanitation systems in urban areas. Furthermore, other factors (e.g. access to and use of health services) which could not be optimally studied with the present data may have had effects on childhood mortality.

CONCLUSIONS

Childhood mortality was associated with type of toilet facility and type of source of drinking water in urban Mozambique. Children whose mother's lived in households with no toilet facility or with well as a source of drinking water had a higher risk of dying compared to children of mother's who lived in households with flush toilet and piped water respectively. Controlling for demographic variables (sex of the child, mother's age at the child's birth, birth order and birth interval) reduced the risks slightly and controlling for maternal education removed the significance of the relation between childhood mortality, type of toilet facility and type of source of drinking water. However, other factors not possible to study in the present data set (e.g. breast feeding, health service access and utilization and household income) are also likely to contribute to the observed urban childhood mortality.

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