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INDIVIDUAL AND ENVIRONMENTAL INFLUENCE ON INFANT AND CHILD MORTALITY IN RURAL SIERRA LEONE: A MULTIVARIATE ANALYSIS

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INTRODUCTION

Research on the determinants of infant and child mortality, particularly in the developing world, points to a number of factors – demographic, socioeconomic and environmental – that influence infant and child survival chances (Mosley and Chen, 1984; Fica-Talamanca, 1984).

The total number of children a woman bears in her lifetime, the timing and spacing of her pregnancies have major impact on each of her children's survival chances (Wolfers and Scrimshaw, 1975; Goldberg and M'bodji, 1985; Hull and Gubhaju, 1986). Goldberg and M'bodji (1985) investigated this relationship in rural Senegal and observed that while the length of the previous interval between births is positively related to poor child growth, longer subsequent intervals seem to be associated with poorer child growth. Hull and Gubhaju (1986) noted that the length of the preceding birth interval is more important than maternal education and place of residence in explaining infant and child mortality in Java and Bali.

Maternal age is crucial to child survival (Omran and Standley, 1981; Butz, et al., 1982; DaVanzo, 1984). These studies have identified the existence of an age band in the fertile life of a woman during which reproductive risks are at a minimum. Both prior to, and after this band, fetal and infant deaths are higher.

There are two main reasons why breastfeeding practices are of major interest in infant mortality studies. First, breastfeeding can affect child survival through

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its role in nutrition intake, because it affords protection against infections (Huffman, 1984; Huffman and Lamphere, 1984). Second, breastfeeding has been shown to influence fertility through its association with sexual abstinence. In societies where cultural norms prohibit sexual intercourse for nursing mothers, and little contraception is practiced, breastfeeding and its postpartum variables play a major role in determining fertility level (Oni, 1985).

The association between child survivorship and maternal education has been widely discussed in the literature (Caldwell, 1979; Caldwell and McDonald, 1981; Farah and Preston, 1982; Ware, 1984). There is now clear evidence of a negative relationship between the two variables, although the amount of education required to produce a significant reduction in mortality varies from culture to culture. Maternal education can affect child survival by influencing her choices and increasing her skills in health care practices related to contraception, nutrition, hygiene, preventive care and disease treatment. For fathers the situation is different. Although paternal education is less important than maternal (D'Souza and Bhuiya, 1982), it is a strong determinant of household income and may influence attitudes and thus preferences in choice of consumption goods, including child care services.

Household income is found to be inversely related to mortality but correlates with education (Flegg, 1982; DaVanzo, 1984). Income is likely to influence the level of mortality indirectly through its effects on the rate of consumption of items affecting health such as food, housing, sanitation, medical care and education. Paternal and maternal occupations also affect mortality (Suchindran and Adlakha, 1985). Paternal occupation influences mortality through its effects on income and consumption. The effect of maternal occupation on mortality depends on the type of economic activities the mother performs. Women may work in the informal sector, in which case it may be possible to take young children along, or in the formal sector where children are probably not allowed. Thus, Ware (1984) has argued that women's work will have a negative impact on child care when the activity is incompatible with simultaneous childrearing or where there is no substitute child care. In this regard, an adverse effect of formal employment for mothers is the necessary abandonment of breastfeeding.

But demographic and socioeconomic factors do not operate in isolation, they interact with environmental factors which further perpetuate mortality differentials

in the population. Muganzi's (1984) study of infant mortality in Kenya demonstrates that mother's characteristics and environmental factors such as hospital use, housing, and malaria prevalence have significant independent effects on infant mortality. Cesar, et al. (1986) noted that environmental factors such as available piped water in the house, access to toilet and type of housing were associated with childhood mortality variation in Brazil. Access to piped water in the household is likely to be of most direct benefit in lowering child mortality by reducing exposure to water-borne diseases particularly diarrhoea and dysentery (Merrick, 1985). In Colombo, Schultz (1985) found that health services, infrastructure and climate had negative effects on child mortality.

Access to medical facilities play a significant role in child survival prospects. In many developing nations, available medical facilities are concentrated in big towns or cities. The rural health centers are generally characterized by poor services due to inadequate service delivery points, resources and staffing. Preston (1978) cites Kerala State in India as a community where substantial reduction in mortality has been achieved through equitable distribution of services. Meegama (1980) also provides an account of how inadequate health facilities in rural Sri Lanka (Estates) have contributed to high mortality compared to urban areas.

This study examines the effects of individual and environmental variables on infant and child mortality in rural Sierra Leone. The individual variables are those connected with the characteristics of the mothers whose babies have died; and the environmental variables are those associated with the social environment within which these mothers live.

SIERRA LEONE

Located on the western coast of Africa between Guinea and Liberia, Sierra Leone is a small country of roughly 28,000 square miles, with a total population of 3.6 million, a crude birth rate of about 48 per 1,000 and a total fertility rate of over 6 – that means an average of six children born to every woman of child bearing age. More than 70 percent of the population are rural residents who depend largely on subsistence agriculture. Indicators of mortality conditions in Sierra Leone show that mortality and morbidity levels are quite high. One of the earliest

estimates of mortality was provided by Harding (1948). Using data from registration records, Harding obtained an infant mortality rate of 417 per 1,000 for a Kissi village in the Eastern Province. Based on a sample survey data, Gamble (1961) estimated infant mortality rate of 171 per 1,000 for Lunsar Town in the Northern Province. A study conducted in Segbwema area of the Eastern Province showed an infant and child mortality rate of 455 per 1,000 (Wilkinson, 1965).

Several studies in the last two decades have also provided estimates of infant and child mortality patterns. Dow (1971), in a National Fertility Survey of 5,952 women conducted in 1969-70, obtained an infant mortality rate of 206 per 1,000 for Sierra Leone. Blacker et al. (1980) used data from the 1974 pilot census in 1973 to obtain an infant mortality rate of 248 for the entire country. The World Health Organization and the Sierra Leone Ministry of Health (1980) survey of infant and childhood mortality conducted in the Western Area between 1973 and 1975 provided an estimate of infant mortality rate of 240 per 1,000. Analyses based on data from a National Nutrition Survey conducted in 1977 by the Sierra Leone Government revealed an infant-child mortality rate of over 300 per 1,000 for the provinces, and 200 per 1,000 for Freetown, the capital city (USAID, 1978). Kandeh's (1979) study of five chiefdom headquarters in the Bo District, Southern Province obtained an infant mortality rate of 155 for Bo Town and 178 for the other four chiefdom headquarters. In a study of mortality levels and patterns in Sierra Leone, conducted between 1980 and 1981, Kandeh and Dow (1987) obtained infant and child mortality rates of 355 and 220 for high and low mortality chiefdoms, respectively. Infant mortality rates have also been estimated by the United Nations (1986) to have fallen from 239 deaths per 1,000 live births in the early 1950s to 226 per 1,000 in the early 1970s and to 215 during the period 1975-1980. The above estimates clearly indicate that mortality levels in Sierra Leone continue to be high.

A number of studies have attempted to investigate the causes and characteristics of infant and child mortality in Sierra Leone. Some studies (Dorjahn, 1976; Kandeh, 1979) have found the expected urban-rural differences in mortality within the rural population. The World Health Organization and the Sierra Leone Ministry of Health study (1980) showed that infant mortality is higher among infants born to younger and older women; and women who marry at later ages. Issac and Feinberg (1982) noted that child survivorship to 18 months does not

depend on maternal age and marital form (monogamous vs. polygamous). Kandeh's (1986) investigation into the causes of death among infants and children revealed that tetanus accounted for 68 percent of neonatal deaths; measles and diarrhoea were the leading causes of death in the last six months of infancy, and also accounted for roughly 40 percent of all early childhood deaths. Kandeh identified childbirth and childcare practices for tetanus, and malnutrition for measles and diarrhoea, respectively, as the major factors affecting these causes of death.

In the case of childbirth, West (1979) noted earlier that at least 70 percent of all deliveries in Sierra Leone are carried out by traditional birth attendants (untrained midwives). According to West, the deliveries which are usually made in unhygienic surroundings, and the practice of severing the umbilical cord with instruments that are not properly cleaned or completely sterilized tend to expose the mother and the new born baby to infection. The National Nutrition Survey (USAID, 1978) revealed that nearly 25 percent of all children up to 5 years of age in the country suffer from severe malnutrition which is attributed to poverty, ignorance, food taboos, diseases and unhygienic environment in general.

MATERIAL AND SAMPLING

This study utilizes data from the fertility and family planning survey in rural Sierra Leone (a sample survey based on four chiefdoms in the Moyamba District), sponsored by the International Development Research Centre (IDRC) in Canada, and conducted in 1979 by the Mathematics Department, Njala University College, University of Sierra Leone. The target population of the survey was all currently married women aged 15-49. The basic objective of the sample design was to achieve a probability sample from this population, that is, a sample design which gave a measurable non-zero probability of selection to every woman in the target population.

No lists exist of currently married women aged 15-49 years in the population. Thus, some form of generating coverage of the target population had to be devised. The Taxpayer's register lists all those eligible to pay local tax every year, together with their addresses at the time the register is compiled. This register and the Electoral register are in fact the only available lists of adults in the population, and,

except where consideration is given to area sampling, they constitute the only available sampling frame.

The sample size for this study was fixed at 2,000 achieved interviews with eligible females, since no information existed on the number of interviews that could be expected from a given number of contact points in the Taxpayer's list. The sampling strategy involved three stages of selection. The primary sampling units were the enumeration areas, of which there were approximately 2,800 in the country, each containing roughly 500-1,500 persons. Since women comprised the target population, total female population was adopted as a measure of size of selection and, because of the variation in size, units were selected with probability proportional to measure of size. Twenty units (PSU's) were selected by systematic sampling from the list of enumeration areas covering four chiefdoms (Dasse, Kamajei, Kori, and Kowa) in the Moyamba District.

The secondary stage units (SSU's) were villages and towns. Two were chosen from each selected enumeration area with probability proportional to female population. The design required a uniform overall sampling fraction, and, as the preceding stages were drawn with probability proportional to size, this required the selection of a constant number of names at the final stage. The strategy was to fix the number of interviews to be achieved in each of the 40 villages or towns selected; thus, a target sample of 2,000 interviews meant 50 interviews with eligible females per unit. Names (sampling points) were then selected from the Taxpayer's list for each village or town by systematic sampling, treating the list as circular. The selected names served to identify particular households. If there were more than one eligible female in the household, a Kish selection procedure was adopted (Kish, 1965).

Information was collected on personal characteristics of the respondent and her husband, fertility behaviour and desires, breastfeeding practices, religious and socioeconomic characteristics, infant and childhood deaths, etc. Of the 2,000 women in the sample, 1,600 reside in places fewer than 500 persons, 200 reside in places with 500-1,999 inhabitants, and 200 in places of 2,000+ inhabitants.

VARIABLES

Fifteen variables are used in this analysis. The dependent variable is infant and childhood mortality based on the ratio of infant and childhood deaths to live births corresponding to each mother in the sample. This measure suffers from a number of limitations. Among the major ones are underreporting due to memory bias (Shryock et al., 1976) and omission of some children such as those who died soon after birth and older children who may have left home. The three background variables are mother's tribal and religious affiliations, and size of current place of residence. The five socioeconomic variables are maternal occupation and education, paternal occupation and education, and family annual income. The income variable is likely to be underreported as a result of either poor estimation or for cultural reasons. Culturally, rural people are reluctant to disclose the full extent of their wealth for fear of being bewitched by relatives and neighbors or earmarked for taxation by local authorities. Four demographic variables are used: maternal age, age at first marriage, number of live births, and duration of breastfeeding of the most recent child. Maternal age is usually plagued by a number of problems including age misreporting, heaping and shifting, some of which may arise from memory lapse, age preference or socio-cultural customs. Such biases may lead to understating the true magnitude of the observed mortality differentials. The two environmental variables are type of health facility (health center/dispensary, trained midwifery, untrained midwifery) and water supply (piped, river/stream, well) available in the community.

RESULTS

The analysis begins with a simple description of patterns of infant and child mortality ratios for women aged 15-49 years in rural Sierra Leone, as shown in Table 1. The mortality ratio for the total sample is 250 per 1,000. There are substantial differences in infant and child mortality ratios among subgroups of background variables. Non-Mendes have lower mortality ratios (198 per 1,000) than the Mendes (256 per 1,000). Mortality ratios for Catholics and Muslims are almost identical but lower than those for Protestants. Residence in the largest rural places exhibits the lowest ratio (173 per 1,000) compared to those in the smallest (259 per 1,000) and medium (264 per 1,000) size rural places.

Table 1. Infant and Child Mortality by Selected Characteristics for Rural Women in Sierra Leone (1/1,000)

Characteristic	Mortality ratio	No. of women
Total Sample	0.250	1,690
Background Variables		
Mother's tribe		
Mende	0.250	1,507
Non Mende	0.198	183
Mother's religion		
Catholic	0.242	308
Protestant	0.267	482
Muslim	0.243	894
Residence population		
<500	0.259	1,340
500- 1,999	0.264	160
2,000+	0.173	190
Demographic Variables		
Mother's age		
<20	0.197	78
20-29	0.223	571
30+	0.268	1,041
Age at marriage		
<16	0.242	913
16-20	0.255	581
21-25	0.273	125
26+	0.260	71
Live births		
1-3	0.215	832
4-6	0.257	563
7+	0.334	295
Duration of breastfeeding		
<6 months	0.356	263
6-12 months	0.253	492
13-24 months	0.194	691
25+ months	0.286	244
Socioeconomic Variables		
Mother's education		
None	0.259	1,478
1-4 years	0.193	105
5-7 years	0.194	43
8+ years	0.175	66

Table 1 (Continued)

Characteristic	Mortality ratio	No. of women
Father's education		
None	0.260	1,335
1-4 years	0.210	159
5-7 years	0.199	81
8+ years	0.216	115
Household income[1]		
<Le 500	0.258	1,387
Le 500-Le 999	0.218	207
Le 1,000+	0.195	97
Mother's occupation		
Modern sector[2]	0.286	192
Farming	0.257	1,212
Traditional sector[3]	0.194	286
Father's occupation		
Modern sector[2]	0.254	236
Farming	0.243	1,203
Traditional sector[3]	0.277	251
Environmental Variables		
Health care services		
Health center/dispensary	0.242	361
Trained midwifery	0.369	159
Untrained midwifery	0.236	1,169
Water supply		
Piped	0.242	445
River/stream	0.271	670
Well	0.231	575

1. At the time of survey, Le 1.00 = US$0.80.
2. Modern sector jobs include teaching and other professional occupations, civil service, sales, clerical work, etc.
3. Traditional sector jobs include housekeepers, cooks, maids, etc.

Demographic characteristics: mother's age, age at marriage, number of live births and duration of breastfeeding also reveal mortality differentials. Mortality ratios increase from 197 per 1,000 for mother's less than 20 years of age to 268 per 1,000 for those who are 30 years of age and over. Similarly, number of live births are positively related with mortality ratios. The distribution of infant-child mortality ratios by mother's age at marriage follows an inverted U-shaped form, increasing from 242 per 1,000 for mothers married at below 16 years of age to 273 per 1,000 for those married between ages 21 and 25, and declining to 260 per 1,000 for mothers married at 26 years and over. In contrast, the distribution of infant-child mortality ratios by duration of breastfeeding has the expected U-shaped form, decreasing from 356 per 1,000 for mothers who breastfed their most recent child for less than six months to 194 per 1,000 for those who breastfed for 13-24 months, and then increasing to 289 per 1,000 for those who breastfed for longer than 24 months.

Mortality ratios vary among different socioeconomic groups. Mortality ratios decline with increase in mother's education; ranging from 259 per 1,000 for mothers without education to 175 per 1,000 for those with 8 or more years of schooling. Also, mortality ratios decrease with father's education up to 7 years of schooling but slightly increase beyond that. The data also reveal that mothers engaged in traditional sector jobs have lower mortality ratio than those engaged in farming or modern sector jobs. On the other hand, mortality ratio of children whose fathers perform traditional sector jobs is slightly higher than those whose fathers are farmers or modern sector workers. With regards to income, mortality ratio of children in households with an income of 1,000 leones and over is about 25 percent lower than that of children in households with an income less than 1,000 leones.

Finally, households in rural communities with trained midwifery services show higher mortality ratios than those with either health centers/dispensary or untrained midwifery services. Rural households who use rive treams for their water supply show a slightly higher mortality ratio than thei ounterparts who use either piped water or wells.

A. Multivariate Analysis

Table 2 summarizes the results of multiple regression an lysis for the entire

Table 2. Regression Coefficients of Selected Variables on Infant and Child Mortality

Variables	Beta coeff.	t-value
Background Variables		
Mother's tribe		
Mende	0.043*	1.791
Non Mende	RC	
Mother's religion		
Protestant	− 0.104	−0.475
Muslim	− 0.110	−0.538
Catholic	RC	
Residence population		
<500	RC	
500-1,999	0.482	0.002
2,000+	− 0.089**	−2.544
Demographic Variables		
Mother's age		
<20	RC	
20-29	0.038	1.051
30+	0.033	0.883
Age at marriage		
<16	RC	
16-20	0.021	1.315
21-25	0.035	1.211
26+	0.025	0.687
Live births		
1-3	− 0.040**	−2.334
4-6	RC	
7+	0.073***	3.382
Duration of breastfeeding		
<6 months	RC	
6-12 months	− 0.093***	−4.072
13-24 months	− 0.162***	−7.433
25+	− 0.837***	−3.164
Socio-economic Variables		
Mother's education		
None	RC	
1-4 years	− 0.041	−1.265
5-7 years	− 0.070	−1.467
8+ years	− 0.087**	−2.169

Table 2 (Continued)

Variables	Beta coeff.	t-value
Father's education		
None	RC	
1-4 years	− 0.008	−0.294
5-7 years	− 0.005	−0.137
8+ years	− 0.016	−0.513
Household income[1]		
<Le 500	RC	
Le 500-Le 999	− 0.007	−0.306
Le 1,000+	− 0.059	−1.664
Mother's occupation		
Modern sector[2]	0.029	1.170
Farming	RC	
Traditional sector[3]	− 0.026	−0.210
Father's occupation		
Modern sector[2]	− 0.005	−0.217
Farming	RC	
Traditional sector[3]	0.022	0.853
Environmental Variables		
Health care services		
Health center/dispensary	− 0.024	−0.568
Trained midwifery	0.150***	4.962
Untrained midwifery	RC	
Water supply		
Piped	− 0.035	−0.966
River/stream	0.009	0.471
Well	RC	
Intercept	0.275	
R-square	0.093	
F-value	5.516***	

* Significant at 0.10 level
** Significant at 0.05 level
*** Significant at 0.01 level
RC: stands for reference category.

1. At the time of survey, Le 1.00 = US$0.80
2. Modern sector jobs include teaching and other professional occupations, civil service, sales, clerical work, etc.
3. Traditional jobs include housekeepers, cooks, maids, etc.

sample of 2,000 women. Of the background variables, place of residence and mother's tribal affiliation are statistically significant for the sample, exerting negative and positive effects on mortality ratio respectively. A negative sign on the place of residence dummy variable indicates relatively lower mortality ratio in largest rural places; a positive sign on the tribal dummy variable means that Mende women have experienced higher mortality ratio than non-Mendes.

Among the socioeconomic variables, mother's educational level (8+ years of schooling) and family annual income (Le 1000+) show a negative influence on mortality ratio. Of the demographic variables, duration of breastfeeding and number of live births exert strong effects on infant-child mortality ratio and operate in the direction one would expect – longer duration of breastfeeding negatively influence mortality while larger number of live births positively affect mortality. Maternal age, and age at marriage positively affect mortality ratio although their coefficients are not statistically significant. With regards to environmental variables, only trained midwifery service is statistically significant but with the 'wrong' sign (i.e., positive). The variables, access to health center and piped water, even though not significant, exhibited negative effects on mortality ratio. This suggests that infant and child mortality might be reduced through improving medical facilities and providing clean piped water.

B. Multiple Classification Analysis

The multiple classification analysis (MCA) is further used to assess the net effects of significant variables in the multiple regression analysis (Table 2) on infant and child mortality ratio adjusted for other factors in the model. The analysis of variance technique is used to assess the significance of two-way interaction effects of these variables before applying MCA to demonstrate the effect of each variable on mortality ratio net of other variables. The results, presented in the Appendix show that no two-way interactions were significant (detailed interactions not shown: none were significant at the 0.10 level).

Table 3 gives the results of the multiple classification analysis. The squares of eta and beta for a variable indicate the proportions of the total variance explained by the unadjusted and adjusted effects of that variable, respectively.

Table 3. Multiple Classification Analysis of Infant and Child Mortality by Selected Variables

Variable	N	Unadjusted		Adjusted	
		Ratio	Eta	Ratio	Beta
Mother's education			0.08		0.06
None	1,475	0.26		0.26	
1-4 years	105	0.19		0.22	
5-7 years	45	0.19		0.20	
8+ years	66	0.18		0.18	
Breastfeeding duration			0.19		0.18
<6 months	263	0.36		0.35	
6-12 months	491	0.25		0.26	
13-24 moths	691	0.19		0.19	
25+ months	244	0.29		0.27	
Health care services			0.13		0.17
Trained midwifery	159	0.37		0.38	
Health center/disp.	361	0.24		0.29	
Untrained midwifery	1,169	0.24		0.22	
Residence population			0.09		0.12
<500	1,339	0.26		0.27	
500-1,999	160	0.26		0.23	
2,000+	190	0.17		0.15	
Live births			0.14		0.14
1-3	832	0.22		0.22	
4-6	562	0.26		0.26	
7+	295	0.33		0.33	

Multiple R^2 = 0.086

Multiple R = 0.293

Grand Mean = 0.25

Using beta[2] as the criteria, duration of breastfeeding, health care facilities, number of children ever born, and current place of residence are more closely related to infant and child mortality ratio than maternal education. For instance, the proportion of total variance in mortality explained by duration of breastfeeding is nine times as large as that explained by mother's education net of other variables in the model. Table 3 also reveals that after adjusting for other variables, the greatest reduction in mortality ratio occurs for mothers who have attained at least 8 years of schooling, breastfed their most recent child for 13-24 months or are currently living in the largest rural places.

C. Logistic Regression Analysis: Birth Order

Infant and child mortality is a process which changes over time. Factors affecting the death of the first child may differ from those affecting later deaths. The previous regression models ignore this aspect of mortality. They simply predict the proportion of infant and child mortality experience of rural women, thus assuming that the effect of each independent variable apply equally to each death. The logit model describes each progression from one death to the next in terms of a separate set of probabilities, so the several progressions need not be influenced by the same factors in the same ways. Thus, it is possible to gain a much more insight into how various factors affect infant and child mortality.

The results of the logit analysis (Table 4) show that infant and child mortality increased from 207 per 1,000 for first births to 292 per 1,000 for fifth births. That mortality increases with parity is supported by other studies (Somoza, 1980; Suchindran and Adlakha, 1985). The factors which determine infant and child mortality vary with birth order. Of the significant variables, place of residence and sex of the child exert negative and positive effects on mortality respectively, for all parity levels; breastfeeding duration is significant for the first, third and fifth births; and maternal age at marriage for first births only. That male children have a higher mortality rate than female children at all parities is consistent with evidence from a number of studies (Kandeh, 1979; Somoza, 1980; Mott, 1980; Muganzi, 1984).

Table 4. Logistic Regression Coefficients of Selected Variables by Birth Order

Variables	Parity 1	Parity 2	Parity 3	Parity 4	Parity 5
Mother's tribe					
Mende	.015	.073	.054	−.217	−.110
Mother's religion					
Muslim	−.052	−.053	−.067	.034	.127
Residence pop.					
2,000+	−.707***	−.542***	−.583***	−.715***	−.166**
Mother's age	.001	.004	−.014	−.004	−.017
Age at marriage	.050***	.009	.021	.015	.029
Breastfeeding	−.017**	−.006	−.029***	−.007	−.047***
Sex – Male	.131***	.013**	.133*	.153*	.196*
Mother's educ.					
Some school	−.102	.096	.131	.085	.020
Father's educ.					
Some school	.132	.059	−.026	.029	−.135
Mother's occup.					
Modern sector	−.191	.108	.168	.011	.131
Father's occup.					
Modern sector	.088	−.140	−.039	−.096	−.196
Household income					
Le 1,000+	.199	−.161	.098	−.351**	−.466**
Health services					
Health center/ dispensary	.024	−.193	.199	.354	−.144
Water supply					
Piped	−.069	130	−.192	−.178	.087
Intercept	−2.51***	−2.07***	−7.99*	−.967**	.064
Goodness of Fit					
Chi-Square	1,398.2	1,177.0	955.6	746.7	535.0
D. F.	1,392	1,116	862	645	449
No. of responses	1,461	1,165	893	674	472
No. of deaths	303	259	225	180	138
Mortality rate	.207	.223	.252	.267	.292

* Significant at 0.10 level
** Significant at 0.05 level
*** Significant at 0.01 level

DISCUSSION

The results suggest that variables such as maternal education, duration of breastfeeding, number of live births, place of residence, family income, health care facilities, sex of the infant, and mother's tribal affiliation play a dominant role in infant and child survival chances in Sierra Leone. These variables are suggesting that an integrated approach to reducing mortality in the rural sector could be more effective by manipulating the individual and environmental variables simultaneously.

The evidence suggests that infants born to mothers with some education are subject to higher survival chances compared to those born to mothers with no education. As education increases beyond 7 years of schooling, the effect of increased education on reduced mortality becomes more pronounced. The linkage between increased maternal education and reduced mortality is that education gives women the power and confidence to take decision-making in their own hands. Caldwell (1979) has argued that three factors are of importance in this regard: (1) a reduction in fatalism in the face of children's ill health; (2) a greater capability in knowing where facilities are and in securing the attention of medical personnel; and (3) the power to ensure that greater share of the available resources is devoted to the children. Maternal education is not only consistent with increased survival chances of children but also with reduced fertility (Cochrane, 1979; Ahmad, 1985; Bailey, 1986). Examining the relationship between female education and fertility in rural Sierra Leone, Bailey (1986) identified six years of schooling as the critical level of female educational attainment beyond which fertility begins to decline. Women below and above the threshold level exhibited the expected positive and negative effects of education on fertility, respectively, even after controlling for a variety of factors known to affect fertility. In Sierra Leone and possibly in other parts of Tropical Africa, females do not have equitable access to education and virtually everywhere males are given priority for education. For instance, Thomas (1983) noted that in Sierra Leone, school enrollment for girls (13.5 percent) is far below that for boys (24.5 percent). Thus, any policy option that enhances female education and enrollment will not only increase the number of surviving children a mother may have but it will also reduce the number of children she is likely to bear in her lifetime.

The number of children a woman has given birth to is related to infant and child mortality. The literature suggests that higher parity women are likely to experience higher mortality of their children because those women do not give themselves ample time to recover from one pregnancy before embarking on another. With weakened body system coupled with malnutrition, prevalent in rural areas of the less developed nations, such women are more likely to experience maternal and child mortality. This study lends support to the assertion. For example, the results show that relative to women with four to six live births, women with fewer than four live births have experienced lower mortality than those with at least seven. Higher parity is often associated with shorter birth intervals and little or no contraceptive use.

The assumption that children who are breastfed for more than six months have higher chances of survival than those breastfed for less than six months is supported by this study. The four categories of breastfeeding duration show that breastfeeding up to 24 months increases infant and child survival chances and beyond that it begins to show a reduced effect on survivorship. This phenomenon may be explained in terms of the volume of mother's milk, which after a certain period of time, does not provide all the required nutrients for the infants who at the same time become vulnerable to the infected food, contaminated water and unhygienic environment in general. In this respect, DaVanzo (1984) has argued that breastfeeding is much more beneficial in places where water and sanitation are poor and that the promotion of breastfeeding will have its greatest effect in those places.

Mother's current place of residence affects her child's survival chances. This analysis shows that rural places of 2,000 or more people are associated with lower mortality presumably due to the presence in these communities of amenities such as schools, health center/dispensary, maternal and child health centers, postal service or piped water; all of which directly or indirectly impinge on infant and child survival chances.

This study also shows that households with income of at least 1,000 leones per annum exhibit lower mortality than other households. Higher incomes enable families to afford better nutrition and better medical care which may reduce the fatality rates from most diseases including tetanus, measles, and diarrhoea which

account for most infant and child deaths in Sierra Leone (Kandeh, 1986). Higher incomes also affect mortality through their influence on the rate of consumption of items affecting health such as housing, sanitation, quality of water, clothing, transportation to medical facilities and markets for consumption goods and food, information about proper nutrition, hygiene, contraception, and immunizations, and education.

With regards to environmental variables, only trained midwifery variable showed a significant positive influence on mortality. This is surprising because the expectation is that trained midwifery services are relatively safer than untrained midwifery services and hence are more likely to reduce maternal and infant mortality. The positive sign on the trained midwifery dummy variable is probably suggesting that women with particularly difficult pregnancies might be more likely to have gone to a trained midwife for birthing assistance. This could lead to a strong positive association between infant mortality and trained midwifery variable. In contrast, women undergoing easy pregnancies and apparently routine births would utilize less skilled midwife resources because they do not have a need for more highly trained help. Thus, suggesting a relatively lower infant mortality – untrained midwife association.

The shortage of health facilities and personnel in the country also accounts for the high level of infant and child mortality. Information on the distribution of health facilities and personnel by Provinces for 1980 is presented in Table 5. According to this information, the distribution of the number of persons per physician is 22,000 to 1 for the entire nation but ranges from 5,000 to 1 in the Western Area (containing Freetown, the capital city) to 57,000 to 1 in the Northern Province. Similarly, the distribution of persons per nurse/midwife shows Western Area with the lowest ratio (1,000 persons per nurse/midwife) and Northern Province with the highest (9,000 persons per nurse/midwife). The number of persons per hospital is 73,000 for the country and the average distance traveled to a hospital is about 40 kilometers for the nation. Again the Western Area has the lowest ratios of these indices compared to the Provinces. The inferior quality of facilities and personnel in the Provinces coupled with high treatment and transport costs, and inadequate supply of essential drugs probably accounts for the higher mortality level in the Provinces than in the Western Area.

Table 5. Distribution of Health Facilities and Personnel by Administrative Area: 1980

Admin. Area	A	B	C	D	E	F
Sierra Leone	45	4	1.00	73	40.2	22
Western Area	647	1	2.86	38	7.4	5
Southern Province	33	5	0.97	72	46.5	32
Eastern Province	64	7	0.62	81	35.8	44
Northern Province	32	9	0.65	104	56.8	57

Key : A = Number of persons per square kilometer
B = Number of persons per Nurse/midwife (, 000)
C = Number of hospital beds per 1,000 persons
D = Number of persons per hospital (, 000)
E = Average distance traveled to a hospital (kilometers)
F = Number of persons per Physician (, 000)

Source: Adapted from Table 5.9, Kandeh and Dow (1987: 97).

RECOMMENDATIONS

Some recommendations for reducing infant and child mortality in rural Sierra Leone are suggested:

1. Maternal educational attainment beyond primary school level exhibited a significant negative effect on mortality. About 81 percent of the total population of Sierra Leone had no formal schooling (Kandeh and Dow, 1987). The Western Area has the lowest percentage (27 percent). A need exists for the expansion of educational opportunities in rural areas, especially for girls up to and beyond primary school level. This will require that education be made compulsory. The Free Education Policy (free primary and secondary education) declared by the Sierra Leone Ministry of Education in 1987 will help to increase the proportion of girls actually enrolled in schools. Such compulsory school requirement will eliminate child marriages or change the cultural perception of marriageable age,

increase age at marriage for females, and facilitate the acquisition of information on family planning, exposure to mass media and printed matter about modern contraception and their proper use. Also compulsory education may equip females to increase their skills in healthcare practices related to contraception, nutrition, hygiene, preventive care and disease treatment that may eventually lead to increased child survival chances.

2. For mothers who have had no formal schooling, nonformal/informal education in the form of IEC (Information, Education, and Communication) programs on maternal and child health, family planning and nutrition will provide the awareness and motivation required to space births and reduce levels of fertility and mortality amongst them.

3. We also noted that longer duration of breastfeeding reduced mortality significantly. Effort should be made to promote and encourage longer periods of breastfeeding for the health of the baby and for child spacing. This could be accomplished through prenatal education in maternal and child health care clinics and through home economics classes in schools. For mothers who are employed outside the home and in occupations not compatible with child caring, partial breastfeeding for extended durations is suggested (Huffman, 1984).

4. In addition to breastfeeding duration, child spacing can be achieved through contraceptive use. At the time of the survey, there were eight family planning clinics in the country, all located in urban centers (Freetown, Port Loko, Makeni, Lunsar, Moyamba, Bo, Kenema, and Koidu). But the rural people are the cnes, who, more than anything else urgently need family planning services either as a health measure in the form of child spacing to reduce maternal and child mortality or as a means to discourage recourse to traditional family planning methods that may be relatively unsafe or unworkable (Clausen, 1984). Family planning programs should therefore be expanded to the rural areas. Such expansion may require the Government to play a more active role in family planning activities by initiating its own family planning services through community-based local agents; mobile clinics; and the integration of contraceptive services into the maternal and child health system and the community development system (McNamara, 1977).

5. Higher incomes showed reduced effects on mortality. Thus, increasing the

productivity of rural farmers and expanding their earning power or opportunities will generate more income for these families. It is through this increase in income that rural families will be able to afford access to better health care, education, and living standards, which are likely to reduce infant and child mortality and in turn lead to a smaller family size.

6. The information in Table 5 suggest a severe shortage of medical facilities and personnel in the Provinces which are predominantly rural. The present healthcare delivery system which is largely provided by the Government (at least 75 percent of all health facilities are managed by the Sierra Leone Government) and requires high treatment and transport costs and movement over long distances by the population is not efficient and has not been able to arrest the problems of infant and child mortality and the general health of the rural people. Efforts should therefore be made to find new and better ways of healthcare delivery to the rural population. The promise seems to lie in Primary Health Care with emphasis on immunization, environmental health, training of traditional midwives, simple malaria prevention (WHO, 1982) and health education. Support for this argument may be found in the apparent success of the Makeni Primary Health Care Program in the Bombali District, Northern Province, where intervention strategy adopted by the program has led to a sizeable reduction in the levels of infant mortality (Kandeh and Dow, 1987). The program which started in 1978, is based largely on community participation, constant monitoring of immunization and environmental health, and outreach activities. The success of the Makeni Program suggests that with greater community participation, it is possible to reduce the current high levels of infant and child mortality through preventive and outreach programs much more effectively than the present emphasis on curative care offered by the health care institutions.

APPENDIX

Analysis of variance of infant-child mortality by mother's education, duration of breastfeeding, health care services, number of live births, and residence population

Source of variation	Sum of squares	DF	F value	Level of significance
Main Effect	13.52	12	13.19	0.001
Mother's educ.	0.61	3	2.40	0.067
Breastfeeding	5.09	3	19.87	0.001
Health	3.47	2	20.33	0.001
Residence pop.	1.34	2	7.85	0.001
Live births	2.72	2	15.94	0.001
Two-way Interactions	5.05	53	1.12	0.269
Explained	18.58	65	3.34	0.001
Residual	138.69	1,623		
Total	157.27	1,688		

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影響獅子山國鄉村嬰幼兒死亡之個人與環境因素的多變項分析

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(中文摘要)

本研究利用對獅子山國 15 ～ 49 歲已婚鄉村婦女進行生育與家庭計畫調查所得之資料，分析個人與環境因素對獅子山國嬰幼兒死亡的影響。

本研究採多變項迴歸分析，結果發現：胎次高、男性、以及出生於低收入家庭的嬰幼兒較容易死亡，而母奶哺餵時間長、母親教育程度高、以及居住在人口較多地方的嬰幼兒則比較不容易死亡。本研究亦發現自來水設施與醫療保健服務對嬰幼兒死亡有預期的影響，雖然該影響在統計檢定上未達顯著水準。最後本文根據研究發現提出一些建議。

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INDIVIDUAL AND ENVIRONMENTAL INFLUENCE ON INFANT AND CHILD MORTALITY IN RURAL SIERRA LEONE: A MULTIVARIATE ANALYSIS

(ABSTRACT)

Data from a sample of currently married women aged 15-49 years in rural Sierra Leone during a fertility and family planning survey, are used to investigate the influence of individual and environmental factors on infant and child mortality in Sierra Leone.

The method of multivariate regression analysis was performed to distinguish the effects of these variables. Higher birth orders, male births and low family income were associated with high mortality. Duration of breastfeeding, maternal education and larger rural places showed negative effects on mortality. Although the variables, piped water and health center/dispensary services were not significant, they exhibited the expected negative influence on mortality. Recommendations for reducing mortality are suggested.