The Impact of Primary Health Care Services on Under-Five Mortality in Rural Niger

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Background. Despite large investments in basic primary health care in sub-Saharan Africa over the past two decades, quantifying the contribution of national programme efforts to the reduction of infant/child mortality in the region has proven difficult. This study takes advantage of the phased implementation of the national Rural Health Improvement Program in Niger and conveniently timed survey data to reassess programme impact on under-five mortality during the 1980-1985 period.

Methods. Health service use and under-five mortality rates for children born in the 5 years prior to the 1985 survey are compared for three groups of villages: villages served by a dispensary, villages served by village health teams (VHT), and villages without access to modern primary care services. Multi-level regression analyses using both household- and community-level variables are undertaken in estimating the magnitude of effects.

Results. Children residing in villages proximate to health dispensaries were approximately 32% less likely to have died during the study period than children without access to modern health services. Village health teams were not, however, associated with significantly lower mortality probabilities. Formal tests for endogeneity indicated that these effects were not the result of non-uniform/non-random allocation of resources.

Conclusions. The findings are largely supportive of the key premise underlying selective primary health care interventions—that packages of basic services can be effectively mounted nationally in poor countries and have a significant impact over a short time period. In Niger, less than optimal implementation of VHT appears to have reduced the magnitude of the impact achieved.

Keywords: child mortality, primary health care, programme impact, Niger

Infant and child mortality levels have fallen substantially in much of sub-Saharan Africa over the past decade or so.1,2 While national child survival, maternal-child health, and related programme efforts have undoubtedly contributed to lower infant-child mortality in the region, there is surprisingly little conclusive evidence available on the question of the share of mortality decline that may be attributed to such programmes.3-7

In a recent review of the available evidence, Ewbank and Gribble3 concluded that while the national health programmes of most countries include interventions that have been shown to reduce mortality in small test programmes, few strong statements could be made about the overall effectiveness of the large-scale, primary health care programme efforts in the region.

The inconclusive evidence on this question may be attributed to several factors. Firstly, most of the research attention has focused on individual interventions (e.g. Expanded Programme on Immunization, Childhood Diarrhoeal Disease programmes, malaria control, etc.) as opposed to the combined impact of interventions comprising primary health care programmes.5,7 Determining the net impact of packages of health services is, however, crucial to the issue at hand in view of the possibility that gains realized through single interventions might be offset by continued high levels of exposure to other risk factors for mortality.
in low-income country settings; that is, through 'replacement mortality'.

Secondly, many of the studies that have considered packages of services were undertaken in small geographical areas in a limited number of settings (primarily in Senegal and The Gambia) where long-term research initiatives have been put in place. The generalizability of these findings to national-level programmes and/or to other settings in the region is uncertain.

Finally, some of the larger, national-level studies that have been conducted (e.g. in Liberia and Zaire) were unable to use comparison or control groups for various reasons, making it difficult to attribute observed changes in mortality to the programmes under study. Indeed, due to proliferation of limited-scale project efforts and the rapid expansion of basic Maternal and Child Health (MCH) services in sub-Saharan Africa, maintaining controlled experimental conditions in programme impact studies in the region has proven difficult.

The present study takes advantage of national survey data collected in Niger in 1985 to re-examine the question of impact of national-level primary health care programmes on childhood mortality in sub-Saharan Africa. In the late 1970s, the Nigerian Ministry of Health embarked on a national initiative, the Rural Health Improvement Program (RHIP), to extend the coverage of primary health care services throughout rural Niger. The effort focused on upgrading existing health dispensaries and deploying trained village health teams (VHT) to unserved villages. During the 1978–1984 period over 8000 village health workers were trained, and by 1985 approximately 45% of rural villages were being provided with primary care services either through dispensaries or VHT.

The phased implementation of the Nigerian programme provides a convenient natural quasi-experiment from which to assess programme impact. In the study reported in this article, data from the 1985 National Morbidity and Mortality Survey (NMMS) are used to assess the impact of differential access to health services through the comparison of service use patterns and under-five mortality levels among villages provided different levels of health services.

DATA AND METHODS

The NMMS was a national survey conducted by the Ministry of Health during April–May 1985. The primary purpose of the survey was to provide detailed information on the health status of women and children, health practices and use of health services. A total of 1470 women of reproductive age who had been pregnant at least once during the 5 years prior to the survey were chosen for the survey using a stratified, two-stage cluster sampling procedure. A total of 49 clusters (i.e. villages, city blocks/neighbourhoods or settlement camps) and 30 eligible respondents residing in each sample cluster were randomly chosen for the survey. Clusters were allocated to three sampling strata (i.e. urban, rural and temporary settlements) on the basis of level of access to primary care services and proportionally to the estimated distribution of population across strata. The analyses reported here are based upon the 953 eligible respondents interviewed in the 35 rural clusters covered in the survey.

Survey interviews were conducted by female interviewers using a standardized questionnaire. Information was gathered on all pregnancies occurring in the 5-year period preceding the survey, morbidity and mortality information for each child, maternal and child health care practices and use of health services in connection with the last-born child of each respondent, village and household environmental conditions, and socioeconomic and demographic background factors.

The principal outcome considered is the survival status of children born in the 5 years preceding the survey. A total 2075 births were reported by survey respondents during this period, of which 1632 (78.7%) were reported as having survived to the survey date and 443 (21.3%) as having died. Because of serious deficiencies in the recall of dates of births and deaths on the part of survey respondents, analyses involving survival times were not attempted. The functional form of the dependent variable used was a binary (0,1) outcome indicating whether children born during the 5-year reference period for the study had survived to the survey date. As a sensitivity test, several survival analyses were run for the subset of cases for which ages at birth and death were reported to determine whether this specification of the outcome variable would bias the findings. The estimates of the parameters of primary interest were largely unaffected and, accordingly, the simple binary outcome was used in the analyses in order to maximize statistical power.

Access to health care services was defined in terms of geographical proximity to different levels of health services. Villages were classified into three categories: (1) villages located ≤5 km from a dispensary, (2) villages located >5 km from a dispensary, but in which a village health team (VHT) had been deployed, and (3) villages located >5 km from a dispensary and without a VHT. Nine (n = 9) clusters were randomly chosen to represent villages in the first category, n = 19 clusters.
TABLE 1 Operational definitions of variables used in the analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual/Household Level</th>
<th>Community level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy</td>
<td>1 if respondent could read French/local language; 0 otherwise</td>
<td>1 if there is a dispensary within 5 km of village; 0 otherwise</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>1 if Dzerma; 0 otherwise</td>
<td>1 if the village has a village health team (VHT); 0 otherwise</td>
</tr>
<tr>
<td>Maternal age</td>
<td>1 if age 35 or above at birth of child; 0 otherwise</td>
<td>1 if a primary school is located in the village; 0 otherwise</td>
</tr>
<tr>
<td>Marital status</td>
<td>1 if married/in union; 0 otherwise</td>
<td>1 if the village is located on a main road; 0 otherwise</td>
</tr>
<tr>
<td>Husband/partner’s occupation</td>
<td>1 if agriculture; 0 otherwise</td>
<td>1 if a store is located in the village; 0 otherwise</td>
</tr>
<tr>
<td>Home construction materials</td>
<td>1 if wood or concrete; 0 otherwise</td>
<td>1 if farm equipment is commonly used in village; 0 otherwise</td>
</tr>
<tr>
<td>Source of drinking water</td>
<td>1 if pump or spring; 0 otherwise</td>
<td>1 if there is usually a sufficient supply of seeds available during planting season in the village; 0 otherwise</td>
</tr>
<tr>
<td>Radio</td>
<td>1 if household owned a radio; 0 otherwise</td>
<td></td>
</tr>
<tr>
<td>TV</td>
<td>1 if household owned a TV; 0 otherwise</td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td>1 if household owned means of transportation; 0 otherwise</td>
<td></td>
</tr>
<tr>
<td>Meals yesterday</td>
<td>1 if family ate 3 or more meals on prior day; 0 otherwise</td>
<td></td>
</tr>
<tr>
<td>Dispensary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VHT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Store</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

the second category, and n = 7 the third. The effectiveness of this operationalization in defining levels of exposure to modern MCH services is demonstrated empirically below.

In order to control for the effects of potentially confounding factors, a series of variables with documented statistical associations with childhood mortality in the research literature were considered in multivariate analyses. These variables and their operational definitions are described in Table 1.

The determinants of child mortality are conceptualized as occurring at different levels; that is, as consisting of factors operating at the level of nations, regions, villages, households and individual children. In the present analysis, we consider factors measured at two levels: villages and children. We ascertained through the testing of alternative statistical models that it was unnecessary to adjust for the ‘nesting’ of children within households (i.e. that a three-level model was unnecessary). Conventional logit regression procedures were used in the analysis.

Several statistical estimation problems must be addressed in order to model child survival outcomes as a function of access to health care services. One problem concerns the possible endogeneity of the location of health services and health outcomes. While an observed statistical relationship between measures of health service access and health outcomes in empirical studies might signify a positive impact of health services, such a relationship might also be explained by the location of health services near sub-populations that were predisposed to better health e.g. in areas with populations of higher socioeconomic status. It may be demonstrated that where programme resources are distributed neither uniformly nor randomly with respect to factors that are important determinants of outcomes under study, estimates of programme impact will be inconsistent and possibly biased. As part of the analysis, we formally test for endogeneity following procedures proposed by Guilkey et al.

A second problem concerns the estimation of standard errors for regression parameters where variables have been measured at two or more levels. Because community-level factors are common to all subjects within a given community, observations within each community are not independent. The failure to compensate for this lack of independence results in incorrect estimates of standard errors of regression coefficients for community level variables, and thus biased statistical tests. In the analyses presented below, we correct the standard errors of community-level parameters in the final model for lack of independence following the procedure proposed by Huber.

FINDINGS

Sample Characteristics

Table 2 provides summary socio-demographic information on the sample. The profile of households is typical of a rural, West African population. Agriculture
Table 2 Distribution of independent variables, by level of access to health services

<table>
<thead>
<tr>
<th>Level of Access to Health Services</th>
<th>Total</th>
<th>Dispensary</th>
<th>VHT*</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of villages</td>
<td>35</td>
<td>9</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>Number of births</td>
<td>2075</td>
<td>517</td>
<td>1123</td>
<td>435</td>
</tr>
<tr>
<td>Literacy (% literate)</td>
<td>5.0</td>
<td>8.7</td>
<td>3.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Ethnicity (% Hausa)</td>
<td>80.3</td>
<td>89.9</td>
<td>68.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Maternal age (% age 35+)</td>
<td>6.6</td>
<td>7.0</td>
<td>6.9</td>
<td>7.1</td>
</tr>
<tr>
<td>Marital status (% married)</td>
<td>97.3</td>
<td>96.9</td>
<td>97.6</td>
<td>96.8</td>
</tr>
<tr>
<td>Husband’s occupation (% agriculture)</td>
<td>77.1</td>
<td>54.0</td>
<td>87.1</td>
<td>78.9</td>
</tr>
<tr>
<td>Home construction (% wood/concrete)</td>
<td>58.6</td>
<td>48.9</td>
<td>62.2</td>
<td>60.9</td>
</tr>
<tr>
<td>Source drinking water (% pump/spring)</td>
<td>51.3</td>
<td>56.9</td>
<td>54.8</td>
<td>35.6</td>
</tr>
<tr>
<td>Radio (% owning)</td>
<td>19.4</td>
<td>30.9</td>
<td>14.9</td>
<td>17.5</td>
</tr>
<tr>
<td>TV (% owning)</td>
<td>19.9</td>
<td>31.1</td>
<td>14.7</td>
<td>19.8</td>
</tr>
<tr>
<td>Transport (% owning)</td>
<td>41.8</td>
<td>56.9</td>
<td>35.5</td>
<td>40.2</td>
</tr>
<tr>
<td>3 meals yesterday (% yes)</td>
<td>33.3</td>
<td>51.8</td>
<td>20.9</td>
<td>43.4</td>
</tr>
<tr>
<td>Primary school (% yes)</td>
<td>51.4</td>
<td>89.9</td>
<td>42.1</td>
<td>28.6</td>
</tr>
<tr>
<td>Main road (% yes)</td>
<td>20.0</td>
<td>33.3</td>
<td>5.3</td>
<td>42.9</td>
</tr>
<tr>
<td>Store (% yes)</td>
<td>28.6</td>
<td>55.6</td>
<td>15.8</td>
<td>28.6</td>
</tr>
<tr>
<td>Machines (% yes)</td>
<td>74.3</td>
<td>77.8</td>
<td>73.7</td>
<td>71.4</td>
</tr>
<tr>
<td>Seeds (% yes)</td>
<td>51.4</td>
<td>55.6</td>
<td>42.0</td>
<td>71.4</td>
</tr>
</tbody>
</table>

* Village health team.

NB: denominators for computation of percentages for individual/household level variables was the number of live births and for community-level variables the number of villages.

provides the primary means of subsistence. Households possess relatively few durable assets, with less than 20% of households owning even a radio. Women in this population have relatively low levels of education, with less than 5% of sample women reporting being literate. Fertility levels are also typical of the region, with an estimated total fertility rate (TFR) of 6.4 during the 5 years prior to the survey. Births to women less than 20 years of age accounted for about 8% of all births occurring during the reference period for the survey, and those to women 35 years of age or older 18%. Nearly all respondents (97%) reported being currently married or in union.

An important observation from Table 2 is that the characteristics considered vary in a systematic manner across access-to-health-care categories. In general, the populations of villages proximate to dispensary-based health services were of higher socioeconomic status and villages with VHT of lower socioeconomic status than villages without access to modern health services. This general pattern holds for most of the variables considered.

Thus, it is clear that dispensaries and VHT were placed in communities neither uniformly nor randomly. For logistical, infrastructural, and possibly political reasons, dispensaries appear to have been located in villages that were predisposed to lower child mortality. The VHT, on the other hand, appear to have been deployed in communities that were predisposed to higher mortality, although level of health risk was not a formal criterion used in site selection (community support and location within 15 km of a dispensary were the primary criteria used in selecting sites for VHT deployment). One challenge in measuring the impact of primary health care improvements in Niger during the period studied adequately is to take into account the non-random deployment of programme resources.

Use of Health Services

To what extent are differentials in physical access to health care services reflected in service use patterns? The evidence presented in Table 3 indicates that proximity to a dispensary is associated with significantly higher use of MCH services. Women residing near a dispensary were between two and five times more likely to have received antenatal care services in connection with their most recent birth, to have had the delivery attended by trained health personnel, to have received nutrition and health education consultation, and to have been able to explain how to mix oral rehydration solution (ORS) than women residing in villages with neither a dispensary nor a VHT. Children
residing in such villages were approximately three times more likely to have been at least partially immunized and to have had a health card, and twice as likely to have had their most recent episode of diarrhoea referred to a health worker than children in 'control' villages. The magnitude of differentials between villages with VHT and villages with neither a dispensary nor a VHT are less pronounced. Only for birth attendance by trained personnel, immunization, and maternal knowledge of ORS were sizeable differences observed. It should be noted, however, that for these indicators the levels observed for villages with VHT approximated those found in villages proximate to dispensaries.

These figures might reflect a tendency of VHT to have concentrated on certain activities and/or programmes (e.g. birth attendance and EPI) in the early stages of the rural health service expansion effort in Niger. Nevertheless, that the deployment of dispensaries and VHT is associated with higher service use rates (for at least some services) is evident from these data. Equally clear, however, is that there is considerable room for improvement in programme coverage levels, as only in the case of birth attendance by trained personnel did coverage levels exceed 50% in villages covered by programme health services.

Infant/Child Mortality Levels
The unconditional probability of a child born during the 5 years prior to the NMMS having died by the survey date was 0.213, or just over 1 in 5. In the absence of sufficient sample size and birth history data that would permit the direct estimation of infant/child mortality rates, the 'preceding birth technique' was used to convert these probabilities into conventional mortality measures.

Unconditional probabilities of last and penultimate births surviving to the survey date were 0.8940 and 0.7228, respectively. The estimated probabilities of dying by exact ages one and 5 years (lq0 and 5q0) under four different sets of assumptions regarding the underlying age pattern of mortality using the 'preceding birth technique' are shown in Table 4, along with 'direct' retrospective estimates derived from 1992 Niger Demographic and Health Survey (DHS) birth history data for the 1980–1985 reference period.

The indirect estimates of the infant mortality rate range from 129/1000 live births under the Brass African Standard model to 159/1000 for the UN General model. Taking into account the direct estimate from the 1992 DHS, we believe that an estimate in the middle to upper part of this range is reasonable for rural Niger during the reference period for this study.

Except for the UN West African model, the indirect estimates of the under-five mortality rate are in considerably higher (289 per 1000). However,
TABLE 4  Estimated probabilities of dying by selected ages, rural Niger, 1980–1985

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0.143</td>
<td>0.129</td>
<td>0.159</td>
<td>0.152</td>
<td>0.138</td>
</tr>
<tr>
<td>5</td>
<td>0.221</td>
<td>0.227</td>
<td>0.220</td>
<td>0.289</td>
<td>0.321</td>
</tr>
</tbody>
</table>


in view of the tendency of systems of model life table to underrepresent the high levels of childhood (i.e. ages 1–4 years) relative to infant mortality found in many sub-Saharan African populations and the estimates from the Niger DHS, we are inclined to assign greater weight to the estimate from the West African model. Thus, our ‘preferred’ estimates would put the infant mortality rate in the 140–150 range and the under-five mortality rate in the 290–320 range during the period studied. The vagaries of indirect estimation procedures aside, it may be concluded with virtual certainty that infant/child mortality levels in rural Niger were quite high during the period studied. The drought and famine that struck the Sahelian region during 1984–1985 and a measles outbreak in Niger in 1985 undoubtedly contributed to high infant-child mortality during this period. The extent to which survival probabilities were mediated by primary health care services is addressed in the analysis below.

Programme Effects on Childhood Mortality

The unadjusted proportions of children born in the 5 years prior to the survey who had died by the survey date were 0.191 in villages served by a dispensary, 0.203 in villages served by VHT, and 0.267 in villages with neither dispensaries nor VHT. A series of regression models using different combinations of the independent variables described in Table 1 (and interactions among variables) were tested. The results of the most parsimonious regression model that included the two access to health care dummy variables (Dispensary and VHT) are shown in Table 5.

Three individual-level and three community-level factors emerged as significant determinants of child mortality when the effects of other factors considered were controlled. Of primary importance for the purposes of the present study is that the presence of a dispensary in a village was associated with significantly lower probabilities of mortality (odds ratio [OR] = 0.68; 95% confidence interval [CI] : 0.49–0.94). The effect of the presence of a VHT was not, however, significant (OR = 0.80; 95% CI : 0.58–1.09).

The effects of the other variables included in the final model were more or less as anticipated. Among individual-level variables, maternal literacy was associated with lower probabilities of child mortality, an effect observed in many prior studies both in sub-Saharan Africa and elsewhere. Older maternal age was associated with higher mortality, a finding that is also consistent with previous studies. Interestingly, however, adjusted under-five mortality rates were lower among Dzerma children, a minority ethnic group.

At the village level, the presence of farm machinery/equipment and access to seeds to plant the next seasons' crops, used as measures of community wealth, were associated with lower levels of child mortality. The interaction between these variables was the only significant interaction effect observed, with the presence of both increasing the likelihood of child mortality. This result probably reflects the fact that either factor alone operates to reduce child mortality levels, but the presence of both is redundant and does not serve to further reduce mortality levels.

The final step in the analysis was the conduct of tests for endogeneity to determine whether the non-random allocation of programme resources might have biased the regression results reported in Table 5. Following the procedure proposed by Guilkey et al. two logit regression equations predicting location of a dispensary and a VHT, respectively, in sample villages were estimated using the community-level variables described in Table 1 as independent variables. The predicted values from these equations were then added to the regression equations used to generate the results shown in Table 5 as additional independent variables and t-tests performed to assess the significance of the added terms.
Neither parameter emerged as significant, indicating that although programme resources clearly were distributed neither uniformly nor randomly, this does not account for the programme effects observed in Table 5. This test result also indicates that more complex random-effects models are not necessary in the present analysis.

DISCUSSION
Given the scarcity of resources in developing country settings and the multiple competing demands for them, information on the relative effectiveness of programmes competing for resources is needed to guide resource allocation decisions. In line with initiatives in other developing regions, sizeable investments have been made in sub-Saharan African countries over the past two decades in national public health programmes aimed at reducing high levels of infant-child mortality. Direct evidence as to the impact of these programmes is, however, relatively scarce, and much of the available evidence comes from small-scale studies with limited geographic scope and uncertain generalizability to national-level programmes. The present study attempted, at least partially, to fill this information gap.

Although limited due to a relatively small sample size, the findings of the study are largely supportive of the key premise underlying selective primary health care interventions in low-income countries; namely that packages of basic primary health care services can be effectively mounted at the national level so as to have a significant impact on infant-child mortality over a fairly short period of time. Our estimates indicate that during the 1980–1985 period, children residing in Nigerian villages proximate to a dispensary were 32% less likely to have died than children residing in villages without access to modern health care services. The inclusion of individual- and village-level control variables in multivariate analyses, as well as formal tests for endogeneity, suggest that these findings were not the result of dispensaries having been located in villages that appear to have been predisposed to lower mortality.

The findings with respect to the impact of deployment of VHT are somewhat less encouraging. Adjusted under-five mortality levels for children residing in villages served by a VHT were not significantly different from children in villages without access to modern health care services. The failure to observe an impact of
VHT deployment is not due to insufficient statistical power of the study (power is estimated at 0.9). It is worth noting, however, that although mortality levels for villages served by VHT were not significantly different from villages without access to modern primary care services, neither were they significantly different from villages served by dispensaries.

The observation of a significant effect of services provided by dispensaries but not through the deployment of VHT in the case of Niger is seemingly accounted for by differences in levels of programme coverage attained. In villages served by a dispensary, it would appear that a core 40–60% of women availed themselves of MCH care services during the period studied, while service coverage exceeded 40% only for birth attendance in villages with VHT, although immunization coverage for childhood vaccine preventable diseases approached 40%. However, under the assumption that differentials in non-programme determinants of mortality among villages were adequately accounted for in the multivariate analyses, the findings are not inconsistent with the notion that reductions in mortality levels of a magnitude comparable to that observed in villages served by a dispensary could be obtained through the deployment of VHT given comparable levels of programme coverage.

Is the level of programme impact inferred from the present study plausible? In the context of the Nigerian Rural Health Improvement Program in the early 1980s, the major contributors to reduced mortality are likely to have been (1) reduced incidence of neonatal tetanus due to birth attendance by trained health workers, (2) reduced incidence of childhood vaccine preventable diseases due to EPI control efforts, and (3) improved case-management of childhood diarrhoeal disease.

Tetanus is a major cause of neonatal death in many African countries, and tetanus mortality rates in Africa are apparently among the highest anywhere in the world.\textsuperscript{1,32} Death rates due to neonatal tetanus in the range of 10–20 per 1000 live births are apparently not unusual in African countries,\textsuperscript{32} with some estimates being as high as 70 per 1000.\textsuperscript{33} In one of the few available intervention impact studies in Africa, Dan et al.\textsuperscript{34} estimated that the training of traditional birth attendants in aseptic delivery procedures in a small number of villages in Senegal resulted in a reduction in the neonatal death rate of over 50% in comparison with the rates observed in control villages. Higher estimates of intervention effectiveness have been obtained in studies elsewhere.\textsuperscript{35} Even at lower levels of effectiveness, a significant number of infant deaths are likely to have been averted in Niger during the period covered by the present study given the estimated coverage of attended births of over 60% in villages served by dispensaries or VHT.

With regard to vaccine preventable diseases, programme efforts to control measles alone might account for a large share of the mortality reduction implied by the present study. Previous research suggests that, for a variety of reasons, case-fatality rates for measles are especially high in West Africa.\textsuperscript{1,36} Small-scale studies in Benin, Guinea Bissau, and Zaire provide estimates of mortality reductions associated with measles immunization efforts of between 30% and 50%.\textsuperscript{14,37,38} Given this and estimates of EPI programme coverage in the 40–50% range (although the specific coverage rate for measles vaccination could not be reliably ascertained from the available data), it is entirely plausible to conclude that a significant number of childhood deaths were averted during the period studied, even if the Nigerian programme operated at lower levels of efficiency than the programmes observed in the studies cited above. Measles immunization may have been especially important in rural Niger during the period studied in view of the measles epidemic that struck the country in early 1995. Control efforts for the other vaccine preventable diseases during the study period, pertussis and diphtheria in particular, are likely to have averted additional deaths, although quantifying the magnitude of the potential impact is difficult given the limited data available from the region.

Finally, diarrhoeal disease is thought to be an especially pernicious public health problem in sub-Saharan Africa. A recent review of empirical evidence from the region suggests a median incidence of 4.9 episodes per year among children under 5 years of age and the region and a median point-prevalence of 10%, among the highest rates found anywhere in the world.\textsuperscript{39} Although data for large populations in the region are scarce, global estimates indicate a median of 38% of all deaths among children under 5 years of age as being associated with diarrhoea,\textsuperscript{39} a figure that may well be higher in sub-Saharan Africa given the relatively high levels of childhood malnutrition found in the region.\textsuperscript{1} Hospital-based studies of ORT interventions in Angola, Malawi, and Nigeria found reductions in case-fatality rates for diarrhoeal patients of between 39–95%.\textsuperscript{40} and population-based studies in Bangladesh have observed declines in infant mortality rates of between 1–8% and in childhood mortality rates of between 4–14% thought to be attributable to hospital- and treatment centre-based ORT interventions.\textsuperscript{41,42} In view of this, and although again we have no basis from which to assess the relative effectiveness of diarrhoeal disease control efforts in Niger during the period studied, it is quite likely that a substantial number of childhood deaths...
were averted in villages proximate to a dispensary given that nearly 60% of last diarrhoeal episodes had been referred to a hospital or dispensary.

Thus, the estimated mortality impact of dispensary-based primary health care services in rural Niger appears to be plausible. It should be borne in mind, however, that the apparent mortality reductions were accomplished in an environment of very high initial mortality levels. Effects of the magnitude observed in the present study may not be generalizable to new initiatives in many countries of the region, where substantial reductions in infant-child mortality have already taken place. It is also possible that the effects of access to health services were exaggerated in the present study by the 1984–1985 famine and the severe measles outbreak in Niger in 1985. However, insofar as infant-child mortality levels remain high in many parts of the region, the findings of this study suggest that initiatives to mobilize additional resources for the expansion and improvement of basic primary care services in the region are likely to result in demonstrable gains in child survival.

REFERENCES


*(Revised version received October 1995)*