Under-Five Mortality and the Environment of Health in the Third World: A Nigerian Example

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ABSTRACT The study examines the impact of what is herein called ‘the environment of health’ on pediatric health. The study adopts a multiple regression analysis to identify explanatory values of selected variables in respect of under-five mortality in the third world using the Nigerian example. The under-five mortality trend in Nigeria for 14 years (1988-2001) was selected as focus. The data source is the African development Banks Gender, Poverty and Environmental indicators on African Countries for 2002 and 2003. At the level of individual variables, most of our prior expectations relating to the variable behaviors were validated. The study thus indicated that although these parameters may not work in the same magnitude, they often work in the same direction. It is clear that most deaths associated to the children under the age of five are accounted for by variables in the environment of health and these variables are within the framework of the issues that can be fine tuned by governments and agencies in the health sector planning and programmes. The challenges raised in the study are squarely within the reach of government.

INTRODUCTION

Of all world continents, infant and childhood mortality is highest in Africa particularly in its sub-Saharan region. This may be declining, but the rate remains unacceptably high when on shoulders with other regions of the world. Scholars have made efforts at documenting this trend within the cacophony of the occurrence and incidence of morbidity and deaths, it has been particularly problematic to determine “the relative importance of various diseases and conditions as causes of death of children of different age groups” (Ewbank and Gribble, 1993). The data on causes of death are generally unreliable and more often incomplete. This is related to the general pathetic nature of the African research environment. In Africa, deaths are sad events particularly of children to parents. Such events are often not wanted to be remembered let alone documented. To many an African, the causes of death are immaterial since the result may probably not give back the life that has been moaned by death. More often, researchers have relied on ‘verbal autopsy’ technique to determine the probable causes of death particularly those that were not attended to by trained medical personnel. (See Garinne and Fontaine, 1986 and Gray et al., 1990). The technique relies more on the available clinical, demographic as well as epidemiological evidences to determine the probable causes of death. Of course, the result provides some intelligible guesses into the causes of death that would have been classified as “others”. It is also possible that the result is a false attribution and an eminently spurious correlation.

Perhaps, the cause of disease and death over which not much controversy and doubt exist is the total environment of the patient. Diarrhea, measles, acute respiratory infections and Malaria that today are leading clinical causes of death for children below age 5 years are all repercussions from the built environment of man. When the environment is handled in a manner that is less than sanitary, the reaction is a dose of any of the above ailments that may eventually cause death. The environmental burden of disease is highest in Sub-Sahara African with 26.5% while the average for all LDCs is 18% (Listorti and Douman, 2001). In a related experience, in 1999, about 10.5 million children under five died throughout the world, 36% of this are from the WHO’s Africa region. Even while Ahmed et al. (2000) report that the risk of a child dying before its fifth birth day fell from 25% to 7%, five out of the seven countries that have experienced increases in child mortality are in Africa.

Given this scenario, it is logical to express concern about the role of the total environment on human health particularly as relates to the
helpless infants and children. Thus, the present study examines the impact of what is herein called 'the environment of health' on pediatric health using a Nigerian example. Put simply, this concept is coined to express the collective and individual influence of both the human and physical circumstances under which health care decisions are made and their impacts consumed. This influence gives a more global effect of each of these factors taking together than when their impacts are treated in isolation.

The rest of the paper is divided into five sections. The next section discusses the conceptual and theoretical framework for the study, while the third section explains the types and sources of data, as well as its analytical methods and procedures. The fourth section presents and discusses the result of the analyses while the fifth section draws inferences from and implications of the findings. The last section is a conclusion based on some recommendations for reducing child and infant mortality in the third world countries.

ENVIRONMENT AND CHILD HEALTH: A FRAMEWORK

A meaningful assessment of the state of health of children of any community must begin with a description of the incidence of illness pattern and also the distal factors that lead to this pattern. This is with a view to showing changes that may occur with time and different geo-environmental concerns. On this, Cotran et al. (1994) note that all disease not purely genetic in nature must of necessity, be of environmental origin. ‘Indeed, genetic diseases may also be influenced by the environmental circumstances in which the host is located per unit of time. Accordingly, there are significant differences in the contributions of the different aspects and categories of the environment to the prevailing health scenario. Given the above, and with specific reference to child health, this study adopts the World Bank (2000)’s framework for the determinants of child health outcomes. The framework (Fig.1) is also an adaptation of the strategic framework first presented in 1984 by Mosley and Chen. According to the framework, the survival model of a child is a function of three categories of environment. These are the household communities, which also incorporates household resources, household behaviour, child health outcomes and the community factors. The second domain is the public sector and Market ‘environment’ relating to availability, access to- and prices of- public and non-governmental health services. It also includes the availability, accessibility, prices and quality of food, energy, roads, water and sanitation, etc. The last aspect of the ‘environment’ is that of the government policies and actions which stresses the implication of health, nutrition and population policies on child health. It also include other policies of government as may be related to transport, energy, agriculture, water and sanitation.

It must be noted that in this framework and for the purpose of this study, the environment assumes a total concept transcending the physical domain of the climatic and weather. The environment is conceptualized in a broader connotation as referring “to the totality of the external influences- natural and man made- which impinge on man and affect his well-being” (Howe, 1977). This conception translates to the inclusion of the circumstances of acquiring and use of not only the life support systems (air, water, food and shelter) and the multiplicity of stimuli and hazards which man experiences there from, but also “the more distal role of government policies and actions” (Claeson and Waldman, 2001). The study therefore works on the basic hypothesis that all circumstances leading to childhood and infant deaths in Africa at the individual household and community levels must operate through the pathway of a set of proximate variables that necessarily include -singly or jointly -those indicated in the framework. The relative importance of each of these factors also vary and may work through a complex weave of socio-economic and genetic factors that are simply taken for granted by this framework.

DATA AND METHOD

The focus of the study is the identification of explanatory significance of selected ‘environment’ to the observed trend in the under five mortality in Nigeria. The under-five mortality trend in Nigeria for 14 years (1988-2001) was selected as focus. This is on the belief that under-five mortality will provide ‘the best means of capturing mortality risks during the most vulnerable years of childhood” (Ahmed et al., 2000). The study reflects on the argument that since approximately 12 million children of less than
five years die yearly particularly from poor countries of developing world; and more than half of these deaths are traced to diarrhea, acute respiratory illness, malaria, measles, etc., these are ailments that are, apart from being treatable, they are also preventable given a renewed positive concern for the sanitary conditions of the environment. Hence the study adds a dimension to the conceptual proposition of the environment to include the policy environment so as to reflect the fact that the policy concern for the health of children and adults are specific to human and physical environments and depends on country specific political economy of resource allocation.

### Table 1: Under Five Mortality Trend and Selected Determinants in Nigeria (1988-2001)

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt;5MR(Y)</th>
<th>Exp.HC(X1)</th>
<th>Acc.wtr(X2)</th>
<th>Acc.Hlth(X3)</th>
<th>FIR(X4)</th>
<th>DC/K(X5)</th>
<th>C0.Em.(X6)</th>
<th>TFR(X7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>187.0</td>
<td>1.0</td>
<td>15.9</td>
<td>48.0</td>
<td>63.6</td>
<td>2291</td>
<td>0.14</td>
<td>6.6</td>
</tr>
<tr>
<td>1989</td>
<td>189.0</td>
<td>1.0</td>
<td>15.9</td>
<td>48.0</td>
<td>63.6</td>
<td>2291</td>
<td>0.14</td>
<td>6.6</td>
</tr>
<tr>
<td>1990</td>
<td>190.0</td>
<td>1.0</td>
<td>47.0</td>
<td>51.0</td>
<td>61.9</td>
<td>2376</td>
<td>0.12</td>
<td>6.5</td>
</tr>
<tr>
<td>1991</td>
<td>190.0</td>
<td>0.3</td>
<td>40.0</td>
<td>67.0</td>
<td>60.1</td>
<td>2555</td>
<td>0.12</td>
<td>6.4</td>
</tr>
<tr>
<td>1992</td>
<td>162.9</td>
<td>0.3</td>
<td>40.0</td>
<td>51.0</td>
<td>58.4</td>
<td>2662</td>
<td>0.12</td>
<td>6.4</td>
</tr>
<tr>
<td>1993</td>
<td>162.9</td>
<td>0.3</td>
<td>53.2</td>
<td>50.0</td>
<td>56.6</td>
<td>2760</td>
<td>0.12</td>
<td>6.3</td>
</tr>
<tr>
<td>1994</td>
<td>162.9</td>
<td>0.3</td>
<td>53.6</td>
<td>50.4</td>
<td>54.9</td>
<td>2656</td>
<td>0.12</td>
<td>6.2</td>
</tr>
<tr>
<td>1995</td>
<td>136.8</td>
<td>0.5</td>
<td>54.0</td>
<td>50.8</td>
<td>53.1</td>
<td>2802</td>
<td>0.12</td>
<td>6.1</td>
</tr>
<tr>
<td>1996</td>
<td>149.9</td>
<td>0.6</td>
<td>54.4</td>
<td>51.2</td>
<td>51.3</td>
<td>2772</td>
<td>0.12</td>
<td>6.0</td>
</tr>
<tr>
<td>1997</td>
<td>146.7</td>
<td>0.7</td>
<td>54.8</td>
<td>51.6</td>
<td>49.5</td>
<td>2779</td>
<td>0.11</td>
<td>5.7</td>
</tr>
<tr>
<td>1998</td>
<td>143.3</td>
<td>0.8</td>
<td>54.8</td>
<td>51.6</td>
<td>47.8</td>
<td>2828</td>
<td>0.11</td>
<td>5.8</td>
</tr>
<tr>
<td>1999</td>
<td>140.0</td>
<td>0.8</td>
<td>57.0</td>
<td>51.6</td>
<td>46.0</td>
<td>2833</td>
<td>0.65</td>
<td>5.7</td>
</tr>
<tr>
<td>2000</td>
<td>136.7</td>
<td>0.8</td>
<td>57.0</td>
<td>51.6</td>
<td>44.2</td>
<td>2850</td>
<td>0.65</td>
<td>5.6</td>
</tr>
<tr>
<td>2001</td>
<td>133.3</td>
<td>0.8</td>
<td>57.0</td>
<td>51.6</td>
<td>26.5</td>
<td>2850</td>
<td>0.65</td>
<td>5.5</td>
</tr>
</tbody>
</table>
the environment as the physical, biological, disposable income, behaviour and the availability of quality health care services. This taxonomy approximates the World Bank’s (2000) framework earlier referred to in this study. According to Bradley et al, these four are “among the extremely complex determinants of urban health”. This also includes the modifiers of the effects – health care facilities. Within this framework, a number of studies have attempted to establish a hierarchy of interacting causal variables, more often the analysis of their route from environment to health consequences is arguably more difficult and studies attempting to trace environmental impacts on morbidity and mortality pattern often conclude with a note of caution because of contradictory messages from the data (see Anson, 1988). Access to water and infant or childhood mortality have been explored by Monterio and Benilo (1987) and Merrick (1983). In each and all, household access to an individual water supply is an important variable in infant and child mortality. Indeed in 1992, Victoria, et al found that infants of households using public stand pipes or wells were about 5 times likely vulnerable to death due to diarrhea than those from households with in-house piped water in a district of Brazil. This forms a justification for the inclusion in this study of access to water because studies have shown that deaths from diarrhea and water-related diseases may form the predominant mortality burden for some area. It must be noted that the literature on mortality or morbidity seem to be tilted towards the tangible links of poor physical environment – dwelling, water quality, sanitation parameters—rather than towards analysis of the more complex socioeconomic and psycho social variables. This study contends that the socioeconomic and psychosocial environmental components are equally important and possess significant modifying or aggravating effects on the scenario of morbidity and mortality particularly of children.

By and large, the global strategies for fighting deaths of infants and children have adopted two basic approaches. According to Claeson and Waldman (2000) the first includes technologically dependent approaches for ambitious diseases. These were targeted at achieving no less dramatic (even if) narrow, successes within a short time. Examples include malaria and smallpox programmes. Malaria acidification programme was launched in the 1950s and abandoned in the 1970s for lack of the possibility of achieving the set goal. The smallpox story is probably the most successful global scale public health programme in history. The greatest and most widely acclaimed global strategy against human morbidity and mortality is the adoption in 1977 by the World Health Assembly of the primary health care having as its basic aim being health for all by the year 2000. It has a broad concept of health and a global view of the environment. It is thus more people oriented and community driven in nature. Accordingly, the provision of universal services for maternal and child health, family, planning, improved water supplies and environmental sanitation were among the basic objectives that were expected to be achieved through an equitable distribution of resources, community involvement, an emphasis on prevention and a multi sector approach (see also Walsh and Warren, 1979; Newell, 1998; Ayward et al., 1998).

In accordance with the spirit of this declaration, governments have faced a dilemma of challenges. It is most unlikely that government priorities determined through a number of extraneous forces and a complex political economy would allocate equal attention and/or resources to all the variables that determine health outcome. It is pertinent to advice governmental, non governmental and private interests on the significance of each variable so that resource allocation may be directed at variables in order of their level of explanation or importance.

THE MODEL

Having stated the emphasis in the study, the model is formulated to express the relationship between the dependent variable (under-five Mortality Rate Per thousand live births) and the selected independent variables. Put simply,

\[ \text{<5MR} = f(\text{Exp.H}, \text{Acc.Wtr}, \text{Acc.Hlth}, \text{FIR}, \text{DC/K}, \text{CO}_2 \text{Em}, \text{TFR}) \] \[ \text{.........(1)} \]

The formal regression equation is expressed by substituting equation (1) into the linear multiple regression equation as in equation (2)

\[ \text{<5MR} = \beta_0 + \beta_1 \text{Exp.H} + \beta_2 \text{Acc.wtr} + \beta_3 \text{Acc.Hlth} + \beta_4 \text{FIR} + \beta_5 \text{DC/K} + \beta_6 \text{CO}_2 \text{Em} + \beta_7 \text{TFR} + e \] \[ \text{.........(2)} \]

Where: \( \text{<5MR} = \) under five mortality rate

Exp, Hlth = Expenditure on Health (as % of GDP)

Acc.wtr = Access to potable water (% of total population)

Acc.Hlth = Access to Health care (% of the
total population obtaining Public Health Care In < 1 hr.)

**FIR = Female Illiteracy Rate (% of the female population who can not read/write simple Sentence)**

**DC/K = Daily Calorie per Capital**

**C0 2 Em = Carbon-dioxide Emission**

**TFR = Total Fertility Rate**

**β 0 = Intercept**

**β 1...B 7 = the estimation prediction associated with the influence of the independent on the dependent variables as expressed above.**

**e = is residual error term.**

For this model, the a priori variable behaviour is such that

- Exp.Hlth < 0: i.e. the higher the percentage of expenditure on Health care, the lower the <5 mortality rate.
- Acc.Wtr < 0 i.e. the higher the % population with access to water, the lower the <5 Mortality Rate.
- Acc.Hlth <0 i.e. the higher the level of access to Healthcare, the lower the <5 Mortality Rate.
- FIR > 0 The higher the illiteracy rate among women, the higher the <5 Mortality Rate
- DC/K < 0 the higher the Daily Calorie per capital, the lower the < Mortality Rate
- CO 2 Em > 0 the higher the level of CO 2 Emission, the lower the <5 Mortality Rate
- TFR > 0 i.e. the higher the total Fertility Rate, the lower the <5 Mortality Rate

For each of the dependent variables, the regression coefficient is taken to mean the percentage explanation that can be attributed as the parameter influence to the trend of the under-five mortality.

**ANALYSIS AND FINDINGS**

The result from the multiple regression models as indicated in equations (1) and (2) above is presented in table 2.

Given table 2, it could be seen that our model presents a 'good fit' with a R 2 value of 97% which in essence indicates that about 97% of the explanation of the under-five mortality could be provided by the indicators selected, while the remaining 3% could be attributed to residual variables not considered in this study. Within a 5% significant level, the F-calculated is greater than the critical F – value (table value) which also indicates that the model as specified is useful in the determination of the impact of the selected parameters on the observed under-five mortality in Nigeria (note that the degree of freedom = 7,14).

At the level of individual variables, most of our prior expectations relating to the variable behaviors were validated. For instance, our expected behavior on the impact of government Expenditure on Health, Female Illiteracy rate, Daily calorie per capital, CO 2 Emission and Total fertility rates were validated. This validation also corroborates part of existing literature on the relationship between access to water and its impact on infant and childhood mortality. Within such studies, access and quality has been linked to infant and childhood mortality with household access to an individual water supply emerging as significant among water variables (Bradley et al., 1992). Even with this assertion, there exists conflicting findings within the water-child health literature. While Victoria et al (1992) found that infants from households using public standpipes or wells were 4.8 time more likely to die of diarrhea than those from households with in-house piped water; Merrick (1983) noted that although infant mortality declined by 20% with the advent of increased access to water in Brazil; maternal education accounted for 34 % of the decline. In this study, access to water and health contradicted our expectations that higher access would result in lower under-five mortality, this could be hinged on the fact that access to water may be high, but the water quality even from government taps are poor. This finding in the study is suggesting that access is high enough as to lead to low mortality. We contend here that high access with poor quality is as dangerous for child and adult health as drinking from other sources other than the tap.

To corroborate this position, female illiteracy rate is discovered to possess a positive relationship with under-five mortality. Put together, the findings on access to water and the female illiteracy rate suggests that where access is high with lower

<p>| Table 2: Regression results of determinants of under-five mortality in Nigeria |</p>
<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Coefficient and + - values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>328.4 (1.72)</td>
</tr>
<tr>
<td>Exp. H</td>
<td>- 8.60 (-0.68)</td>
</tr>
<tr>
<td>Acc.Wtr</td>
<td>0.261 (0.99)</td>
</tr>
<tr>
<td>Acc. Hlth</td>
<td>0.95 (2.64)</td>
</tr>
<tr>
<td>FIR</td>
<td>0.18 (0.42)</td>
</tr>
<tr>
<td>DC/K</td>
<td>- 10 (-3.18)</td>
</tr>
<tr>
<td>C. Em</td>
<td>0.95 (.083)</td>
</tr>
<tr>
<td>TFR</td>
<td>6.79 (0.37)</td>
</tr>
<tr>
<td>R2</td>
<td>0.97</td>
</tr>
<tr>
<td>F-cal</td>
<td>25.63</td>
</tr>
<tr>
<td>Critical F-value</td>
<td>2.76</td>
</tr>
</tbody>
</table>
quality maternal education is also not sufficient as to encourage water treatment, etc. the access to health parameter also indicate this relationship. In developing countries of Africa, high access to public health facility does not presuppose high user (see Raheem, 2000). This is because health seeking is related to illness occurrence where as access is expressed as the percentage of the total population not the sick. In relative term, it is not unlikely for a different pattern to emerge after controlling for illness factors. Secondly, the political economy of care use in Nigeria in particular and Africa in general is characterized by pluralistic health care alternatives. This reduces the use of public health care to a matter of choice, even when access among a total population is high. Other variables (Expenditure on Health, female illiteracy Rate, Daily Calorie per capital, Carbon-dioxide emission and total fertility rate are indicative of the weaknesses in the policy environment of developing countries.

To date, expenditure on health in Nigeria remains very low compared to other sectors even in the presence of high domestic ‘lipservice’ to camouflage this failure. Illiteracy is also very high with many mothers ‘lockup’ in rural places with level of ignorance unimaginable of the 21st century. In Nigeria, a conservative estimate puts the percentage increase in vehicular population between 1999 and 2003 at about 500% due largely to various economic and political reforms which allowed a greater access to financial resources as well as the role of mortgage and thrift societies in giving loans to customers for the purchase of cars. The qualities of these cars are easily rated low in many countries when compared on the basis of their combustion and emission rates. This development has also increased carbon-dioxide emission in many folds to the detriment of child and adult health in Nigeria. Finally the fertility characteristics of women is an expression of the number of children an average female can brought forth and experiences have shown that the higher the rate of fertility, the lower the status of health of the offspring and mothers. This may not be unrelated to series of biological and socioeconomic factors of mothers and parents. The finding in the present study also corroborates this.

Lessons for Developing Countries

The recognition by governmental and non-governmental organizations that there were multiple technical and operational challenges to the implementation of child health programmes, especially over the last two or so decades is the first necessary condition to improving health and reducing mortality of children and infants. The third or developing world is a taxonomy guided by the level of poverty, deprivation and exclusions; to this end, programmes at reducing morbidity and mortality among the infants and children must first be such that attempt to reduce poverty or relieve the poor. Narayan et al. (2000) note that ill-health emerged as one of the principal reasons why households become poor and remain poor. Explanations are related to the burden of health care expenditure (see Ettling et al., 1994), the lost income of the sick and the lost income of other household members who care for the sick. To this end, it is safe to conclude that not only poor people are in ill health; ill health also causes poverty. According to WHO (1995), “the world’s biggest killer and the greatest cause of ill-health and suffering across the globe is – extreme poverty., poverty is the main reason why babies are not vaccinated, why clean water and sanitation are not provided, why curative drugs and other treatments are unavailable and why mothers die in childbirth.” (WHO, 1995).

Third world governments should rise to challenges of poverty in their regions particularly as this phenomenon relate to the health care sector. Expenditure on health should be increased significantly and consistently to cover such sundry debts as cost of drugs, consultation and relief during emergencies. Coverage is also an important aspect of the health sector. To improve access and reduce cost of movement to use facilities, health care coverage should be a priority for governments and stakeholders in care provision. The net effect of this approach is likely to reflect positively on the national economic growth in the third world. This is because at least half of the differences in growth rates between the third world Africa and the rest of the world are accounted for by demographic variables (Bloom and Sachs, 1998).

The burden of HIV/AIDS has been excluded deliberately from these analyses for reasons of multicolinearity. The impact of this scourge in under-five mortality is obviously positive and almost no longer necessary to include it as a predictor. The findings here however possess implications for our ability to rise to the
challenges of underdevelopment vis-à-vis the occurrence of HIV/AIDS. In the first instance access to water, Health, Daily Calorie per Capital and Emission of Carbon-dioxide regardless of the relationship in the existing data have implications for the control of HIV/AIDS opportunistic disease like Diarrhea, Pneumonia, Malnutrition, Tuberculosis, and Malaria. It is likely that the present high elevation of HIV/AIDS mortality especially among the under-fives may reverse if improvement in the variables of this study are taken as priorities by governments. There is a clear evidence of this position in UNAIDS estimates that 90% of all HIV related deaths occur in Africa; whereas the USA has one of the highest adult HIV prevalence in the developed world, infant and child mortality rates had declined. For instance between 1981 (when the first cases of AIDS were identified in the USA) and 1998, infant mortality rates in the USA declined from 11.9 to 7.2 per 1000 live births, (see Hoyert et al., 1997; Marthin et al., 1998 and Adetunji, 2000). This decline is related first to the medical advances and available treatment in that region as well as proper management of AIDS related infections. In the third world where the technology is presently short of tackling AIDS in terms of vaccination or treatment, the way out is to design strategies that would reduce deaths from diseases through which HIV/AIDS kill. The health sector reform to improve access to water, access to health care and reduce carbon-dioxide emission may serve an impressive purpose. Moreover, good food is good health. African countries have no good reasons to malnourish their children except for the political will to reform the agricultural sector. This reform would automatically improve the Daily Calorie per Capital available to mothers and children. The net effect on health would be obvious.

CONCLUSION

In this study we have used variables in the environment of health to predict and evaluate the risk of mortality associated with the under-five in Nigeria. We have indicated that although these parameters may not work in the same magnitude, they often work in the same direction. It is clear that most deaths associated to the children under the age of five are accounted for by variables in the environment of health and luckily, these variables are within the framework of the issues that can be fine tuned by governments and agencies in the health sector planning and programmes. We also alluded to the need to see appropriate priority to tackling inequalities in health which relate to coverage and short fall in utilization due to the burden of expenditure (however conceived). Finally, all conditions to putting good diet on the table of an African population are satisfied; what is lacking and urgently required in the political will for doing so.

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