

Environmental factors and childhood fever in areas of the Ouagadougou – Health and Demographic Surveillance System – Burkina Faso

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Problem and objectives

Unhealthy environments are responsible for a significant proportion of morbidity and mortality worldwide.^{1, 2} The World Health Organization estimates that the global burden of disease from environmental factors is 24%, and these factors are responsible for 23% of all deaths each year. Preventing environmental risks could reduce the number of child deaths by nearly 4 million every year, mostly in developing countries.¹

In African cities, infectious diseases like malaria, acute respiratory infections and diarrheal diseases contribute to a longstanding critical health situation.³ The growth of African cities in the last three decades as also led to profound changes in the local environmental context. Rapid population growth, combined with a lack of access to basic sanitation services (access to clean water, management of household waste and water, etc.) and poor housing conditions, have had a harmful effect on the health and wellbeing of urban populations.⁴ Understanding the links between environmental risk factors and public health is essential for the development of effective policies and programs, and ultimately to the future wellbeing of West African urban populations.

The determinants of child health are both diverse and complex.⁵⁻⁷ Several studies suggest that environmental factors play a decisive role in the incidence of numerous pathologies including malaria, diarrheal diseases and acute respiratory infections.⁸⁻¹¹ Published literature on the topic reveals the importance of factors such as access to water, sanitation and hygiene for child health in cities in developing countries.^{12, 13} Improvement in these environmental dimensions could lead to a substantial reduction in the spread of diseases.¹⁴ Other studies on urban areas, including one in Cameroon in 2007 and another in Mauritania in 2011, have brought to light other environmental factors that may affect child health, such as soil composition and the quality of the child's play area.^{11, 15}

However, population-based studies on the relationship between immediate environment and childhood fever remain scarce and fragmented. Data from the Demographic and Health Surveys (DHS) and the Multiple Indicator Cluster Surveys (MICS), incorporate only a limited number of environmental variables (access to water, wastewater management and garbage), limiting researchers' ability to examine in detail many aspects of the environment-health relation.^{7, 14} When more specific surveys exist, they tend to be based on the DHS or MICS questionnaires and also contain little detailed information on local environmental conditions. This is the case, for example, with the survey data used by Sy and colleagues in Mauritania.¹¹

The analysis of these issues raise both conceptual and methodological/data problems, especially in regard to the population-based analysis of the causal linkages between environmental exposures and health problems among children.^{8, 9} These difficulties arise both from the fact that the relevant dependent variables (health, fever, diarrhea, etc.) are multifactorial and that the dependent variables (access to water, sanitation, hygiene) are broad and poorly measured.

The specific effects of the environment on health is more difficult to analyze than the socioeconomic factors that mediate these linkages, and interrelations between socioeconomic status and the local environment may be hard to take into account.^{6, 16} Wealthy households can relocate to a residence in a healthier neighborhood. Wealthy people may also take steps to improve their surrounding environments. Better educated mothers may be more likely to proactively reduce the presence of pathogens and or their vectors in their homes by doing things such as making sure her children sleep under a mosquito net. Better educated mothers may also seek effective medical care more quickly than their less educated counterparts, when their children fall ill. Such socioeconomic factors may also affect the nutrition and vaccination statuses of the child, thereby influencing the incidence of various illnesses. Not taking these socioeconomic factors into account introduces several biases into any analyses of these issues. For instance, an effect of the environment may be highlighted, when the phenomenon is in fact a result of omitted demographic and socioeconomic variables.^{16, 17} On the other hand, studies show that the children of rural-urban migrants are at higher risk of poor health than the children of the urban-born. Children born in slums to migrant mothers have even a higher risk of death.¹⁸⁻²⁰ Neglecting the complex effects of migration can also thus bias empirical findings.

Several studies recognize the role that neighborhood environment plays in individual behavior change, even though it is not always easy to separate the effects of the neighborhood itself from the socioeconomic factors that characterize it.^{21, 22} The influence of local social groups, the proximity of health infrastructures and tools in a given neighborhood, as well as the perceptions of health by residents are known to be associated with neighborhood effects.²³ Taking into account to possible impact of aspects of the local communities has not been not an essential part of urban health research,²⁴ most notably in studying the links between household environmental conditions and the facilities available in the neighborhood (e.g., waste management systems or wastewater management). Many studies have focused on the poorer health conditions in informal neighborhoods and slums,^{17, 25} which are neighborhoods characterized precisely by their lack of basic urban infrastructure (water, electricity and sanitation).²⁶ Social cohesion – mutual trust and neighborhood cooperation – can also have beneficial effects on health and survival, and for the overall well-being of populations.²⁷ The estimated effects of neighborhoods sometimes persist even after controlling for children's' socioeconomic factors.²³

The goal of this study is to contribute to environmental health research by analyzing childhood fever in five neighborhoods on the periphery of Ouagadougou, the capital of Burkina Faso. The empirical analysis controls for demographic and socioeconomic factors of the local population – factors including the wealth of the household and of the child's mother, as well as the neighborhood of residence. A better understanding of the effect of the environment itself on health should help inform public policies aiming to reduce childhood morbidity and mortality in urban West Africa.

Context, data and methods

This analysis is based on data collected in the Ouagadougou Health and Demographic Surveillance System (Ouaga HDSS). The capital of Burkina Faso, Ouagadougou, is located in the Sahel, and in 2006, had approximately 1.5 million inhabitants²⁸ representing about 40% of the urban population of the country.²⁹ Due to urban population growth, the city has experienced a rapid geographical expansion, from 14 square kilometers in 1960 to 520 square kilometers in 2006.³⁰ This unplanned and uncontrolled spread has reinforced social and spatial segregation of the urban population.³¹ The “unincorporated” neighborhoods (those informal settlements where land has not been officially apportioned and deeded by the government) make up a third of the total area of Ouagadougou.³² Approximately 35% of Ouagadougou's households are located in these informal areas.³¹ With 64% of residents born in rural areas,³³ these informal neighborhoods are populated mostly by migrants and are characterized by a lack of infrastructure and access to basic urban services (water, sanitation, schools, health clinics and electricity).³²

The neighborhoods in this study are located at the northern periphery of the city. The study population is comprised of 86,071 inhabitants (as of 2012) and is divided between two formal neighborhoods with access to municipal services (Kilwin and Tanghin) and three informal neighborhoods lacking such access (Polesgo, Nonghin and Nioko 2).³⁴ Between February and August 2010, a survey on health and care-seeking behavior was conducted. This survey collected cross-sectional data on the health of 950 children under the age of 5 from 736

households. This sample was randomly selected and is representative of all children in the Ouaga HDSS. Data was collected on episodes of fever during the two weeks preceding the survey. Baseline demographic and socioeconomic data is available for every household in the study as well each individual respondent. Information was also collected on household environment, including household waste management, management of wastewater, drinking water supply, the composition of the interior floor and use of mosquito nets.

Many studies use bivariate analyses for this type of study, failing to control for the effects of various relevant factors on the variables of interest.^{17, 35} To address these shortcomings, we conduct multivariate analyses. Logit models are used to estimate the effects of immediate environmental factors, controlled by demographic and socio-economic variables, on the probability that a child had a reported fever in the two weeks preceding the survey. The regressions are estimated using information on 825 children under 5 years. Missing observations were withdrawn from the sample. To ensure the non-selectivity of these missing observations, model-tests were conducted and showed that the missing data were not disproportionately related to certain modalities of explanatory variables.

Moreover, if the socioeconomic variables act via proximate factors (environment), once the environmental variables are in the regression, we would expect to see effects of socioeconomic variables diminish. However, socioeconomic variables are sometimes measured with fewer errors which can have an effect on other omitted variables (access to health care, nutrition, etc.) which pass through mechanisms other than the immediate environmental context. To better understand the net effects of the environment of other potential impacts, variables were introduced by group into the models. The introduction of variables by block allows for a comparison between the different equations. First, Model 0 considered the gross effect of each independent variable. Then, Model 1 took into account all the environmental variables. Model 2 considered all demographic and socio-economic variables in addition to model 1. Model 2 takes into account the bias in the estimation of the effect of the environment. Finally, Model 3 three integrated all variables in Model 2 with the child's area of residence. This approach also helps to identify the interactions between the environment and the area of residence. To better assess the impact of variables on the probability of having a fever, predicted probabilities were calculated from Model 3, setting the value of each of the dichotomous variables to 0 and 1.

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