The impact of environmental threats on the occurrence of respiratory illnesses in children: Evidence in Ouagadougou (Burkina Faso)

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Introduction

Acute respiratory infections are the leading cause of worldwide mortality in children 5 years or younger (Duflo et al. 2008). In particular, in Africa, pneumonia remains a major cause of death for children under 5 years old: Rudan and colleagues (Rudan et al. 2008) estimate that 35 million cases of pneumonia occur in this age class, causing 18% of deaths among them, that being almost 750,000 deaths. Hence, reducing this burden in Africa remains a major priority.

Many of the formative studies provided correlations between respiratory infections in children and indoor air pollution (Bruce et al. 2002). The use of biomass fuels is particularly pointed out because it produces high levels of indoor pollution (Dasgupta et al. 2004; Smith 2003). This type of pollution is linked to the occurrence of respiratory illnesses because it damages respiratory tract and renders children more vulnerable to pathogens (Smith 2003).

However, few population-based studies in African cities have specifically investigated the relationship between respiratory illnesses and environmental living conditions using models that control for confounders, allowing for the study all things being equal. In this communication, we want to address this shortcoming and to analyze the impact of a large range of environmental threats at the household level on the occurrence of respiratory illnesses in children under 5 years of age in Ouagadougou, the capital city of Burkina Faso. We examined whether different environmental risk factors influenced recent childhood cough when considering health determinants at individual and household levels.

Methods

Data. The study was conducted in the Ouagadougou – Health and Demographic Surveillance System (Ouaga-HDSS) (Rossier et al. 2012) (Figure 1). The capital city of Burkina Faso had approximately 2 million inhabitants, representing about 45% of the urban population of the country (INSD and ICF International 2012). The population growth of Ouagadougou is one of the most rapid around the world (Guengant and May 2013). With population growth, the city has experienced a rapid geographical expansion, growing in size from 14 square kilometres in 1960 to 520 square kilometres in 2009 (INSD, 2009). This mostly unplanned and uncontrolled spread of the urban population has reinforced its social and spatial segregation (Boyer and Delaunay 2009). The unzoned neighbourhoods - spontaneous settlements where land has not been officially apportioned and deeded by the government - make up a third of the total area of the city, and approximately 35% of Ouagadougou's households live in those neighbourhoods (Boyer and Delaunay 2009). These settlements do not have access to basic services, including access to water, sanitation, electricity, paved road, etc

The five neighbourhoods followed by the Ouaga-HDSS are located in the northern periphery of the city. The Ouaga HDSS study population is comprised of 86,071 inhabitants (in 2012) and includes all residents of two formal (zoned) neighbourhoods with access to basic urban

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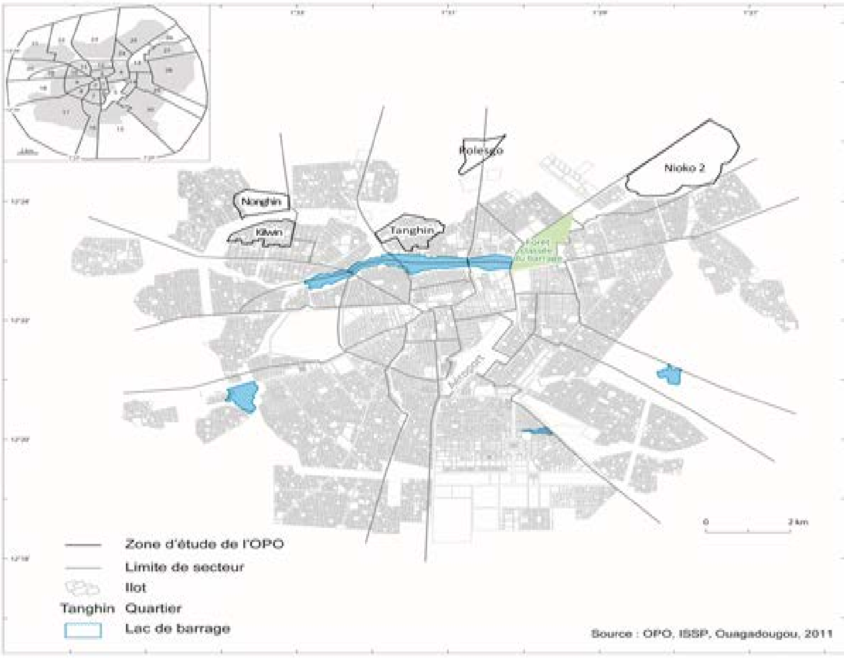
services (Kilwin and Tanghin) and three informal neighbourhoods lacking such services (Polesgo, Nonghin and Nioko-2).

Figure 1: Location of study sites, Ouagadougou Health and Demographic Surveillance System, 2011



Data from the health survey used by this study were collected from a sample of individuals under longitudinal surveillance by the Ouaga HDSS. The health survey was conducted on a sample of residents aged under 5 or over 15 years of age, over-sampling children and the elderly. In all, mothers of 950 children under 5 years were surveyed, living in 736 households. Data were collected on episodes of cough during the two weeks preceding the survey, along with a series of variables on the household living environment, including the household waste management, the management of waste water, the drinking water supply, the composition of the interior floor, etc. These data were finally merged with other data collected by the Ouaga-HDSS platform to provide additional demographic and socioeconomic information on both households and individual respondents.

Statistical analysis. Descriptive statistics were used to summarise the study variables. We then estimated multivariate logit models to assess the effects of different factors relating to access to water on the probability that a household would have reported at least one episode of childhood cough in the 2 weeks preceding the survey, after controlling for demographic and socioeconomic variables. Self-reported cough was used as an outcome measure in this study. An episode of cough was defined according to the most widely accepted definition, that is to say the child has been ill with a cough accompanied by short, rapid breathing.

The model can be expressed as:

$$\ln(q_i/1-q_i)=\beta_0 + \beta_i x_i$$

where q is the probability of at least one occurrence of childhood cough in the ith household, β0 is the baseline constant, βi is a series of unknown coefficients, and xi is an array of independent variables. The estimated coefficients (βi), when exponentiated, are interpreted as the odds of at least one occurrence of childhood cough (qi/1 − qi) for households with certain characteristics relative to the odds of cough in a reference (or baseline) group of households: in other words, relative odds or odds ratios (OR).

All data were analysed using Stata v.11 statistical software. Finally, we used the cluster option to calculate robust standard errors to account for the fact that the observations are clustered into neighbourhoods and that the observations may be correlated within neighbourhoods, but would be independent between neighbourhoods. In theory, our analytical model counts for three levels: the individual level, the household level and the neighbourhood level. However, the relatively small sample size and the limited number of neighbourhoods surveyed make it impossible to use a multilevel analytical approach.

Preliminary results

Of the 825 children in the analysis without missing data, 41,5% were reported to have a cough during the two weeks prior to the survey. The estimated OR from the different models are presented in Table 1, according to environmental threats and socioeconomic factors. Preliminary results show that, as expected, the energy used for cooking has an important impact on the occurrence of cough in children. This living conditions at the household level is not the only environmental factors that affects the occurrence of respiratory illnesses in children. The drinking water supply and the wastewater management have also significant effects. In addition, we also note that, as expected, the season is associated with the occurrence of cough.

This multivariate analysis is a first step: more must to be done to better understand these relationships. However, these first results provide important information for policy makers regarding the prevention of respiratory illnesses among the children of the African dwellers.

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Table 1: Occurrence of cough according to various characteristics and effects (Odd Ratio) of different factors on childhood cough, Ouaga-HDSS, 2010

Variables	Frequency (%)	Proportion with cough	Odd ratio (p value)
Energy used for cooking		**p=0.005****	
Gas cooker	8.62	37.84	1.13 (0.776)
Improved stoves	18.89	30.86	**R**
Not improved stoves	72.49	44.69	1.51 (0.066)~
Place of food preparation		**p=0.621**	
Internal kitchen	8.16	44.29	**R**
Outdoor kitchen and outside	91.84	44.24	0.66 (0.252)
Drinking Water Supply		**p=0.006****	
Household taps	16.55	30.99	**R**
Public water taps	68.18	44.96	1.95 (0.026)*
Other sources	15.27	37.40	1.84 (0.093)~
Solid waste management		**p=0.032***	
Waste collection system	14.22	35.25	1.27 (0.408)
Empty fields	75.87	43.93	**R**
Other	9.91	31.76	0.48 (0.019)*
Waste water management		**p=0.1185**	
Septic tanks	19.11	42.68	**R**
Street and other	80.89	41.21	0.80 (0.321)
Type of toilets		**p=0.287**	
No improved sanitation	5.48	48.94	1.16 (0.706)
Improved sanitation	94.52	41.06	**R**
Sharing of toilets		**p=0.826**	
Yes	32.17	42.03	**R**
No	67.83	41.24	0.93 (0.734)
Interior flooring		**p=0.101**	
Tile and cement	93.24	40.75	**R**
Dirt and other	6.76	51.72	1.43 (0.283)
Number of person per room		**p=0.642**	
1-2 persons	34.38	39.32	**R**
3-4 persons	51.52	42.76	1.06 (0.737)
5 persons or more	14.10	42.15	0.91 (0.738)
Season		**p=0.000****	
February-May	68.88	45.85	**R**
June-August	31.12	31.84	0.52 (0.001)**
Neighbourhood of residence		**p=0.000****	
Kilwin	22.38	35.42	**R**
Nonghin	36.83	42.09	0.74 (0.320)
Tanghin	15.73	38.52	0.78 (0.423)
Polesgo	7.34	20.63	0.25 (0.003)**
Nioko-2	17.72	59.21	1.61 (0.147)
Child's malnutrition		**p=0.052~**	
Malnourished	95.22	56.10	1.53 (0.245)
Not malnourished	4.78	40.76	**R**
Age of child (full years)		**p=0.048***	
0 -1 year old	37.41	45.79	**R**
2 – 4 years old	62.59	38.92	0.71 (0.035)*
Sex of child		**p=0.884**	
Male	51.98	41.26	**R**
Female	48.02	41.75	0.99 (0.957)
Age of mother		**p=0.790**	
15-24 years old	22.73	40.51	**R**
25-34 years old	55.94	42.50	1.11 (0.587)
35-49 years old	21.33	39.89	1.01 (0.988)
Mother's school attendance		**p=0.199**	
Never went to school	62.35	39.81	**R**
Went to school	37.65	44.27	1.46 (0.042)*
Total	**858**	**41.49**	**858**
Number of clusters (households)	**-**	**-**	**678**

Notes: Results are weighted. ** Significant at 1 %; * Significant at 5 %; ~ Significant at10 %. R: reference category