Influence of the immediate environment and demographic factors on the comorbidity and gravity of diarrhea and fever in children in areas of the Ouagadougou – Health and Demographic Surveillance System – Burkina Faso

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Problem and objectives

The environmental hazards have experienced a considerable development (Chevalier and al., 2003). The combination of environmental, social and economic conditions exposes populations to many health problems (malaria, diarrhea, acute respiratory infections, etc.) (Dongo and al., 2008). It is estimated that 24% of the global disease burden and 23 % of all deaths are due to environmental factors (WHO, 2010).

Africa is urbanizing faster than the rest of the world (UN -Habitat, 2011). The rapid population growth in African cities is mostly the result of rural poverty and a high level of fertility in urban areas (McMichael, 2000). In African cities growing, children are at risk of a variety of environmental threats, whether poor housing, overcrowding, contamination of drinking water and individual and alimentary hygiene (Keiser et al., 2004). One of the characteristics of the health is the comorbidity among children under 5 years (Becker and al., 1991; Fenn and al., 2005). The comorbidity is increasingly recognized as an important public health problem in modern societies (Van Oostrom and al., 2012). Current research suggests that terminally ill children often suffer from several diseases (Fenn and al., 2005). A symptom of disease can sometimes be associated with many signs related to each other, reflecting the gravity. Severe diarrhea, for example, weakens a child increases the likelihood of having a fever. The co-occurrence of diarrhea and fever, two symptoms associated by water contamination, may cause discomfort, pain, complications related to dehydration in children, and an increased risk of death (Briand and al., 2000; Mulholland, 2005). Although comorbidity is a risk factor for mortality observed in demographic and health surveys (DHS) in Africa, the literature focuses essentially on the comorbidity of malaria and acute respiratory infections (INSD , 2004; Masangwi and al, 2010).

Moreover, the issue of comorbidity and disease gravity remains little examined about environmental health. We know that children are the most susceptible population to environmental factors (Chevalier and al., 2003). Thus, the environment may act in a particular

way on the comorbidity and gravity of some symptoms, such as diarrhea and fever. The effects of the environment, for example, could be specific depending on whether the child has one or more symptoms of diseases. Not taking into account the comorbidity could skew a priorization of public health interventions to reduce child mortality (Fenn and al., 2005). The data of the Ouagadougou-Health and Demographic Surveillance System is an opportunity to explore this problem. The objective is to evaluate empirically the influence of the immediate environment and demographic factors on the comorbidity and gravity of diarrhea and fever, two major health problems in children in Africa.

Data and analysis methods

The analysis uses data from the Ouagadougou – Health and Demographic Surveillance System (Rossier et al., 2012). Established in 2008, the observatory follows approximately 80,000 residents in five peripheral neighborhoods north of Ouagadougou (Kilwin, Tanghin, Polesgo, Nonghin Nioko and 2). The population followed by the observatory is distributed fairly among formal areas and informal areas (approximately 40,000 people in each area). The objective of the Ouagadougou – Health and Demographic Surveillance System is to analyze the problems of the most vulnerable people in the city and to experience pioneering programs that will have beneficial effects on health and well-being. The Ouagadougou – Health and Demographic Surveillance System provides rich data to deepen various themes, including comorbidity and gravity of symptoms in children. We used cross-sectional data from the survey on the health and behavior therapy for illness conducted in 2010, and the household survey (conducted in 2009). The investigation into the health and therapeutic behavior in case of illness was conducted among a sample of 950 children under 5 years in the five neighborhoods of the Ouagadougou – Health and Demographic Surveillance System. The sample was randomly selected to infer conclusions on all areas of the Ouagadougou – Health and Demographic Surveillance System. The sample of the Ouagadougou – Health and Demographic Surveillance System confers an advantage compared to clinical samples because it limits the selection bias. The child questionnaire has collected data on fever, diarrhea, convulsions, including anthropometric data during two weeks before the interview. The household questionnaire has collected on demographic, socio -economic and environmental data. However, the weakness of the Ouagadougou – Health and Demographic Surveillance System data could be affected by the selectivity problems inherent in cross-sectional data, as well as those related to sample size (950 children in the database).

To generalize the data from the sample to the population of the Ouagadougou – Health and Demographic Surveillance System, it was attributed to each selected observation his weight in the population. Analyses focused on 803 children due to the exclusion of 147 observations with missing values. Missing values are distributed randomly, their exclusion from the analysis don't introduce a selection bias in the sample. To identify the problems of collinearity, a measure of the change in the variance of each of the explanatory variables has been done, which gives us confidence about the absence of multicollinearity.

In this analysis, comorbidity is defined as the simultaneous occurrence of two symptoms (diarrhea and fever) in the same child. The gravity refers to the number of symptoms in

children. The gravity of symptoms can distinguish four sub-populations: children without symptom, children with a symptom (diarrhea or fever), children with two symptoms (diarrhea and fever without convulsion), and children with three symptoms (diarrhea, fever and convulsion). To investigate the comorbidity and gravity of symptoms, it was built from a composite indicator of diarrhea, fever and convulsions. We used an ordered logit model to evaluate the effects of environmental and demographic factors on comorbidity and gravity of symptoms were estimated, controlling the level of education of the mother, standard of living, ethnicity, and area of residence of the child (model 1). A Wald test was then performed to determine whether the environmental and demographic variables are jointly significant effect on morbidity and gravity of diarrhea and fever. To test the hypothesis of interaction between the unhealthiness of the household and child gender, an interaction variable was included in the model 2. Thereafter, an additional model (model 3) has taken into account the nutritional status of the child (severe malnutrition). As the variable nutritional status is potentially endogenous, we considered the model for additional with caution due to reverse causality. An increased risk of diarrhea or fever risk may cause a poor nutritional status. A graph of standardized residuals was thus made to see if severe malnutrition introduced into the model does not cause an imperfect adjustment. The homogeneous distribution of residues reassures that severe malnutrition is not the cause of an imperfect adjustment.

References

Aoussi, E. F., K. A. Tanon, E. Ehui, et al. "Paludisme et infection à VIH en Afrique subsaharienne: encore un couple maudit?" Santé publique **21**(3): 174-177.

Becker, S., R. E. Black et K. H. Brown (1991). "Relative effects of diarrhea, fever, and dietary energy intake on weight gain in rural Bangladeshi children." The American journal of clinical nutrition **53**(6): 1499.

Bhrolcháin, M. N. et T. Dyson (2007). "On Causation in Demography: Issues and Illustrations." Population and Development Review **33**(1): 1-36.

Briand, S., M. Leyrit, V. Lauwers, et al. (2000). "Représentations de la diarrhée aiguë de l'enfant chez les mères d'une banlieue de Quito." Santé publique **12**(1): 21-30.

Caron, C. et M. Rutter (2006). "Comorbidity in child psychopathology: Concepts, issues and research strategies." Journal of Child Psychology and Psychiatry **32**(7): 1063-1080.

Chevalier, P., S. Cordier, W. Dab, et al. (2003). "Santé environnementale." Environnement et santé publique: 59-86.

Connor, D. F., G. Edwards, K. E. Fletcher, et al. (2003). "Correlates of comorbid psychopathology in children with ADHD." Journal of the American Academy of Child & Adolescent Psychiatry **42**(2): 193-200.

Dongo, K., F. Kouamé et B. Koné (2008). "Analyse de la situation de l'environnement sanitaire des quartiers défavorisés dans le tissu urbain de Yopougon a Abidjan, Côte d'Ivoire." VertigO-la revue électronique en sciences de l'environnement(Volume 8 Numéro 3).

Dos Santos, S. et T. K. LeGrand (2007). "Accès à l'eau et mortalité des enfants à Ouagadougou (Burkina Faso)." Environnement, Risques & Santé **6**(5): 365-371.

Fenn, B., S. S. Morris et R. E. Black (2005). "Comorbidity in childhood in northern Ghana: magnitude, associated factors, and impact on mortality." International Journal of Epidemiology **34**(2): 368-375.

Henry, S. J. F. et S. Dos Santos (2012). "Rainfall variations and child mortality in the Sahel: results from a comparative event history analysis in Burkina Faso and Mali." Population & Environment: 1-29.

INSD (2004). Enquête démographique et de santé du Burkina Faso INSD et ORC Macro**:** 348.

Keiser, J., J. Utzinger, M. C. De Castro, et al. (2004). "Urbanization in sub-saharan Africa and implication for malaria control." The American journal of tropical medicine and hygiene **71**(2 suppl): 118-127.

Masangwi, S. J., N. Ferguson, A. Grimason, et al. (2010). "Household and community variations and nested risk factors for diarrhoea prevalence in southern Malawi: A binary logistic multi-level analysis." International journal of environmental health research **20**(2): 141-158.

McMichael, A. J. (2000). "The urban environment and health in a world of increasing globalization: issues for developing countries." Bulletin of the World Health Organization **78**(9): 1117-1126.

Mulholland, K. (2005). "Commentary: Comorbidity as a factor in child health and child survival in developing countries." International Journal of Epidemiology **34**(2): 375-377.

ONU-Habitat (2011). L'état des villes d'Afrique: Gouvernance, inégalités et marchés fonciers urbains. Naïrobi, ONU-Habitat**:** 2.

Rhee, S. H., J. K. Hewitt, J. M. Lessem, et al. (2004). "The validity of the Neale and Kendler model-fitting approach in examining the etiology of comorbidity." Behavior genetics **34**(3): 251-265.

Rossier, C., A. Soura, B. Baya, et al. (2012). "Profile: The Ouagadougou Health and Demographic Surveillance System." International Journal of Epidemiology **41**(3): 658-666.

Sodemann, M., M. S. Jakobsen et K. Mollbak (1999). "Malaria parasitemia and childhood diarrhea in a peri-urban area of Guinea-Bissau." American Journal of Tropical Medecine and Hygiene **61**: 336-338.

Sy, I., M. Tanner, G. Cisse, et al. (2011). "Vulnérabilité sanitaire et environnementale dans les quartiers défavorisés de Nouakchott (Mauritanie): analyse des conditions d'émergence et de développement de maladies en milieu urbain sahélien." VertigO-la revue électronique en sciences de l'environnement **11**(2).

Valderas, J. M., B. Starfield, B. Sibbald, et al. (2009). "Defining Comorbidity: Implications for Understanding Health and Health Services." The Annals of Family Medicine **7**(4): 357-363.

Van Oostrom, S. H., H. S. J. Picavet, B. M. Van Gelder, et al. (2012). "Multimorbidity and comorbidity in the Dutch population-data from general practices." BMC Public Health **12**(1): 715.

Van Weel, C. et F. G. Schellevis (2006). "Comorbidity and guidelines: conflicting interests." Lancet **367**(9510): 550-550.

Vaupel, J. W. et A. I. Yashin (1985). "Heterogeneity's ruses: some surprising effects of selection on population dynamics." The American Statistician **39**(3): 176-185.

WHO (2010). Public Health and Environment in the African Region: Report on the work of WHO (2008-2009). Geneva, WHO**:** 52.