



HAL
open science

Use of health care among the urban poor in Africa: Does the neighbourhood have an impact?

Georges Kone, Richard Lalou, Martine Audibert, Hervé Lafarge, Stéphanie dos Santos, Jean-Yves Le Hesran

► **To cite this version:**

Georges Kone, Richard Lalou, Martine Audibert, Hervé Lafarge, Stéphanie dos Santos, et al.. Use of health care among the urban poor in Africa: Does the neighbourhood have an impact?. 2013. halshs-00878946

HAL Id: halshs-00878946

<https://shs.hal.science/halshs-00878946>

Preprint submitted on 31 Oct 2013

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



CENTRE D'ETUDES
ET DE RECHERCHES
SUR LE DEVELOPPEMENT
INTERNATIONAL

SERIE ETUDES ET DOCUMENTS DU CERDI

Use of health care among the urban poor in Africa:

Does the neighbourhood have an impact?

Georges Kone, Richard Lalou, Martine Audibert,

Hervé Lafarge, Stéphanie Dos Santos, Jean-Yves Le Hesran

Etudes et Documents n° 19

CERDI
65 BD. F. MITTERRAND
63000 CLERMONT FERRAND - FRANCE
TEL. 04 73 17 74 00
FAX 04 73 17 74 28
www.cerdi.org

The authors

Georges Kone, Institut de Recherche pour le Développement/Aix-Marseille Université, LPED, 13331,

Richard Lalou, Institut de Recherche pour le Développement/Aix-Marseille Université, LPED, 13331,

Martine Audibert, Clermont Université, Université d'Auvergne, CNRS, UMR 6587, CERDI, F-63009 Clermont Fd

Hervé Lafarge, University of Paris Dauphine

Jean-Yves Le Hesran, Institut de Recherche pour le Développement/Aix-Marseille Université, LPED, 13331,

Stéphanie Dos Santos, Institut de Recherche pour le Développement/Aix-Marseille Université, LPED, 13331,

Corresponding author: martine.audibert@u-clermont1.fr

La série des *Etudes et Documents* du CERDI est consultable sur le site :
<http://www.cerdi.org/ed>

Directeur de la publication : Patrick Plane Directeur de la rédaction : Catherine Araujo Bonjean Responsable d'édition : Annie Cohade ISSN : 2114 - 7957

Avertissement :

Les commentaires et analyses développés n'engagent que leurs auteurs qui restent seuls responsables des erreurs et insuffisances.

Abstract

The aim of this paper is to evaluate the relative influence of neighbourhood and individual practices of care utilization in Dakar (Senegal). The data from a research program on urban malaria, made in Dakar, Senegal between 2008 and 2009. The sample was based on a two-stage sampling. A questionnaire survey covered 2952 households, of which we have selected those that have at least one case of fever ($n = 1272$) with one of their children under ten years two weeks before the passage of investigators. The analytical model of the use of health services developed by R. Andersen has been adapted for our conceptual framework. Our results showed's like many West African cities, self-medication is a common practice among all households in Dakar, especially the poorest. The non-use of health services is positively associated with individual characteristics such as education level, the level of social network and the level of health literacy of the mother / guardian of the sick child ($p < 1\%$).

Some characteristics of the neighborhood of residence, however, increase the use of health services among the poor (health care provision is nearest larger and better quality). Similarly, the cost of use is no longer a major obstacle when people perceive a high environmental risk (presence of stagnant water and mosquito abundance). The district of residence may help remove the financial barrier, and reduce inequalities in access, when resource space.

Keyword: Dakar, malaria, access to health care, poverty, neighborhoods, equity

Note: this study is part of a project financed by an ANR (French National Research Agency) grant (n°ANR-07-SEST-001)

Introduction

Improving access to health care for vulnerable populations is clearly a poverty alleviation policy in developing countries. Despite many political commitments (Alma Ata (1978)¹, the Bamako Initiative (1987)², the Millennium Development Goals (MDGs) (2000)³), the poor still do not have an easy access to high-quality health care (Audibert M. et al., 1999; Brunet-Jailly, 1999; Cissé et al., 2004; Haddad & Fournier, 1995). The number of consultation per person per year in West Africa is less than 0.6 while the WHO standard recommends one consultation per person per year (Ridde & Queuille, 2010). However, health expectations have become more pressing with changing lifestyles and increasing school enrolment rates. Growing inequities in access to health care have become increasingly less accepted by the populations and expectations regarding the government are rising.

To increase access to healthcare for poor people, governments have adopted various strategies in the last few decades. After a period of free health care in the 70s and 80s that did not withstand the hazards of state budgeting, the implementation of a health care payment policy has made high-quality care more available but has also increased inequities. Since the mid-2000s, financial access has been the key issue in the strategies for strengthening health systems. Depending on countries and diseases, strategies have recommended either to subsidize health providers allowing them to reduce fees (for certain services or population categories) or to develop equity funds that supersede targeted populations (such as poor or elderly people) to bear health care costs. Nevertheless, the effects of these health financial policies did not meet expected results. Free health care has become potential savings opportunities for non-poor households while uncertain subsidies have disrupted the management of providers (Ridde & Queuille, 2010). These policies eventually aim at changing the context of poor populations (subsidies for health care providers) or their personal capacities to access to health care (third-party payment) but without taking into account the respective roles of the living context and individual characteristics in health care decision-making.

Research on determinants of health care demand is based on two main theoretical approaches: a “public health” and a “liberal” approach. These studies—mostly influenced by a public health rather than an economic approach—have focused on the concepts of need and access and overlooked health care demand (WHO, 2000).⁴ Public health perspectives consider that health care demand is not a choice but a response to an absolute need. Barriers may include an overly wide cultural distance between patients and modern medicine (making them underestimate the utility of a resort to modern medicine), an economic distance between the patient’s low income and the health provider’s invoice, or a “geographic” distance. In this line, the government’s role is to reduce these distances so that the patient’s needs are met.

¹ The purpose was to increase the availability of free primary health care

² The aim was to strengthen the availability of high-quality health care through a community financial contribution while securing access for the most impoverished populations.

³ These have focused on the commitment of governments and partners in the fight against poverty, the reduction of infant mortality and malaria control.

⁴ It is clear that when WHO experts (2000 Report) suggested an analysis of the health system, they identified four main functions including providing services, creating resources, financing and general administration. They did not analyse the demand.

Thus the proposed strategy is mostly context-based (lower fees, availability of care) or individual-based (third-party payment).

Liberal economists have a different approach. Their perspective tends to overlook the necessity of health care needs and consider patient-consumers as basically rational. Thus patients seek to maximize their well-being given the individual's utility function defined by personal characteristics. In other words, a patient may decide to consume health care services if the utility is greater than the one related to another use of his/her resources (Grossman, 1999; Newhouse, 2010). From this perspective and despite on-going debates, the government must apply itself to support free markets. Within this approach, Amartya Sen's original position considers that the government's role is to create a context that provides a real opportunity set of possible choices for the most deprived populations (Sen, 1993; 1999).

Most studies focusing on the impact of health payment policies on health care use have adopted more or less one or another of these logics. Analyses were conducted to assess the relationships between health care use and individual/household socio-economic characteristics relative to barriers to meeting the needs. However, the roles that context and individuals play have not been clearly showed through these perspectives. Some recent and less orthodox studies have used specific conceptual frameworks to address these two levels of determinants (Andersen, 1995; Chaix & Chauvin, 2002; Davidson et al., 2007; Diez-Roux et al., 1997; Diez Roux, 2007; Smiley et al., 2010). Our study on urban health care use is based on this latter approach.

The socio-spatial context usually studied using the urban and rural divide. However each of these settings is not homogeneous and the urban area is particularly complex in this respect.⁵ Given the recent and fast growth⁶ of urban space in Africa, its restructuring is an on-going process between a "stabilized pole" including an "artificialized" space with functional networks for facilities and public services, and a formalized social space (the wage system and school education) and an "insecure pole" which comprises a partly "natural" space and a relocated and informal social space that lacks collective equipment and public services (Faye & Thioub, 2003; Goerg, 2003). The African city is not only "dual" but also plural with segregations identified between different neighbourhoods or larger housing areas. The neighbourhood people live in is a place where they have access to resources and exchange practices and ideas. Thus, the neighbourhood shapes behaviours and is also the result of behaviours. On the one hand, residents' behaviours are influenced from the outside through the neighbourhood's physical and administrative features. On the other hand, the neighbourhood is also shaped by its residents and becomes a desired and built living environment (Faye & Thioub, 2003; Goerg, 2003). As a space that is "seized", the neighbourhood eventually becomes a vector of social identity (Goerg, 2003). In these conditions, the studies that are based on an approach too focused on individual factors may have a limited explanatory power (Carpentier & Ducharme, 2003; Chaix & Chauvin, 2002; Davidson et al., 2007; Diez-Roux et al., 1997; Stierle et al., 1999).

⁵ The same is true for the rural area where distances, on a cultural and geographical (in terms of time) level, have decreased significantly.

⁶ Dakar's population has increased from 500,000 to 2,500,000 inhabitants today, in less than a generation.

This paper aims to assess the neighbourhood and individual's relative influence on health care use in Dakar. We assume that the low use of health care among the poor is partly due to the lack of opportunities provided in their living context. To achieve this, we have analysed health care use among children aged 2 to 10 years presenting with fever for malaria from the poorest and richest households.

The analysis of interconnections between individual and context determinants of health care use in urban area should contribute to: i) improve the relevance of theoretical approaches to demand behaviours in Africa, ii) better understand behaviours of urban populations in that region, iii) to enhance the relevance of policies promoting health care access for the most deprived populations.

Context of the study area

Senegal's Human Development Index (HDI) places this West African country at the 157 rank out of 177 (UNDP 2008). Nearly half of Senegal's households (42.6%) live below the poverty line (ANSD et al., 2007).

Malaria is a major cause of morbidity and mortality in Senegal, particularly among children under five years of age (WHO, 2009). To increase the use of new treatments against malaria, Senegal has adopted policies to subsidize antimalarial drugs thanks to the financing from the Global Fund in 2006. A low-cost combination therapy based on artemisinin and amodiaquine was available in public health centers and private pharmacies (300 FCFA for infant and child dosage and 600 FCFA for adult dosage). Two years after the establishment of this subsidy policy, there are still inequities of access to health care (ANSD & al., 2011; Ndiaye & Ayad, 2009). The Demographic and Health Survey conducted between 2010 and 2011 shows that only half of febrile children (52%) have used health services in Dakar metropolis (ANSD & al., 2011).

Urban malaria remains a public health issue. During the rainy season, episodes of fevers are common in both urban and rural areas. Fevers—mostly considered as malaria-related with a presumptive or confirmed diagnosis—have always resulted in high drug consumption, particularly anti-malarials. Today it is a certainty that the malaria vector adapts better to the urban environment than what has been claimed by studies in the 80s and 90s (Diallo et al., 2012; Pages et al., 2008).

Founded in 1857, the city of Dakar is the product of colonization like many other African capitals. The Dakar metropolis was built and developed according to segregation patterns that are still observed today. Dakar has been marked by brutal urban management policies which include the eviction of native villages and the confinement of rural populations that have invaded Dakar in peri-urban precarious settlements as a result of the farm crisis. The colonial elite have turned these urban margin settlements and its dwellers into actors of the marginalized society (Faye & Thioub, 2003; Piermay, 2003). This type of segregation of Dakar's urban space has kept on being established since the Independence of Senegal proclaimed in 1960.

Conceptual framework

The Andersen's conceptual model of health care use is the most appropriate to study context factors. Andersen uses two levels to classify the variables likely to affect health care use decision-making. It takes into account both individual and context determinants of health care use. Then it divides each of these two categories into predisposing, enabling or need factors (Andersen, 1995).

Studies on the demand for health care in developing countries have mostly used a microeconomic framework based on neoclassical theory (Audibert M. et al., 1999; Cissé et al., 2004; Haddad & Fournier, 1995). Therefore we believe that using Andersen's conceptual model will contribute to enrich discussions, just like previous studies carried out in Latin and North America (Andersen et al., 2002; Aremu et al., 2008; Carpentier & Ducharme, 2003; Diez-Roux et al., 1997; Diez Roux, 2007; Himes & Rutrough, 1994; López-Cevallos & Chi, 2010; Marpsat, 1999; Pickett & Pearl, 2001; Smiley et al., 2010).

Methods

Data collection

Data were collected in Dakar (Senegal) between 2008 and 2009 as part of a research program on urban malaria. This program, named Actu-Palu, had two objectives: i) to highlight and describe the urban contexts that have favoured the resurgence and development of malaria in Dakar; and ii) to assess the capacity of the living context to mitigate or increase people's vulnerabilities, which hinder health care use. In this regard, the project has focused on urban settings where attitudes, perceptions, and health practices have been shaped.

A survey was conducted among the population of the Dakar metropolitan area. The sample was based on two-stage sampling. In the first stage, clusters or Census Districts (CDs) were randomly selected within strata defined for the 2002 General Population and Housing Census (RGPH). After carrying out a principal component factor analysis of socio-demographic and economic data from the 2002 RGPH, 5 types of CDs (see map) were obtained using the dynamic cloud classification (k-means methods). The first three types are primarily from the commune of Dakar. Type 1 (blue) includes CDs made up of households with good living conditions; type 2 (green) comprises middle-class households; and type 3 (orange) comprises poor households. Type 4 (pink) and type 5 (yellow) are CDs made up of poor households, mainly from Pikine Ancien (type 4) and from Pikine Extension (type 5). The area covered by the survey includes 40 arrondissement communes (CAs) from the 4 communes of Dakar metropolis. The population of the four communes is estimated at 1,983,093 inhabitants and the number of households at 270,669 in 2002 (ANSD et al., 2006). All of the 40 CAs are made up of approximately 2000 CDs, with an average population of 1037 inhabitants (141 households and 86 compounds per CD).

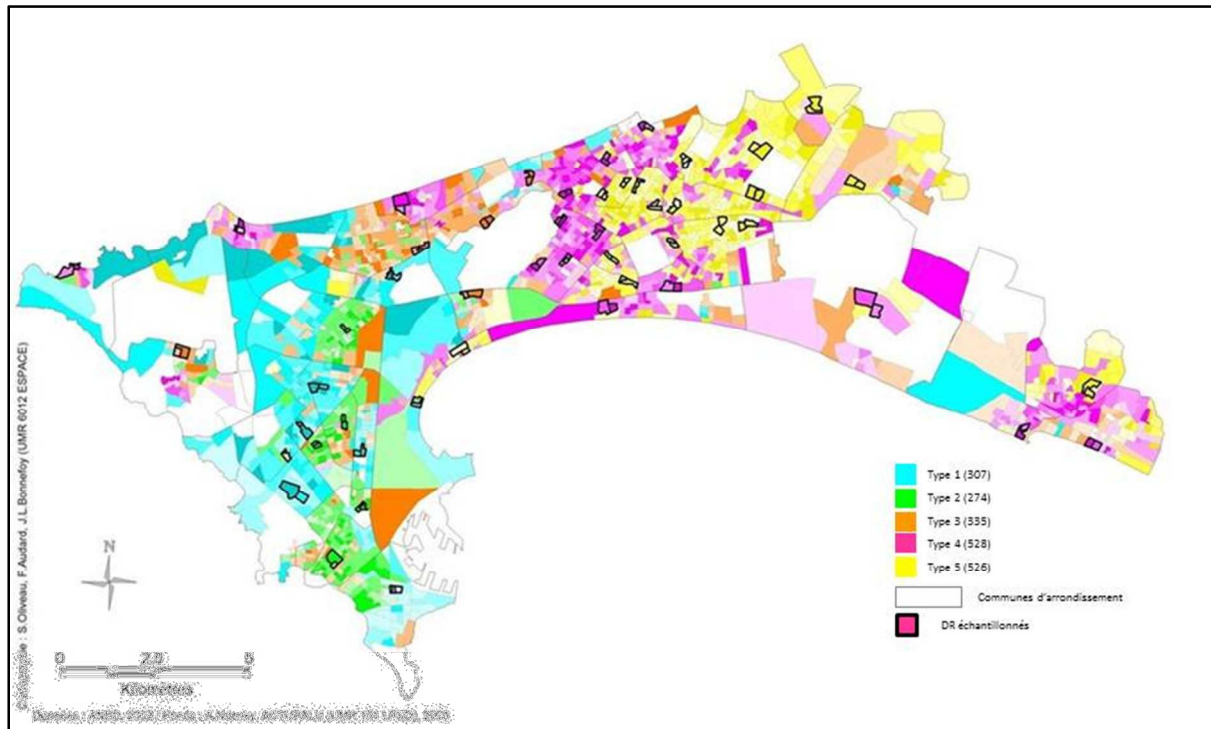
In total, 50 clusters (neighbourhood or equivalent CDs) were selected from the entire Dakar metropolitan area (map 1). A list of households was drawn up from a census of the

households in each of these clusters; a sample of 60 households per CD was randomly selected in the second stage. The total sample included 3000 households.

The three questionnaires used for the survey were based on data collection tools that have been used and validated in France and sub-Saharan Africa by research teams from the French National Institute of Health and Medical Research (INSERM) and the Research Institute for Development (IRD) working on health care (Chauvin & Parizot, 2009; Franckel & al., 2008; Ouédraogo et al., 2007; Souares et al., 2009). The household questionnaire includes four modules that address characteristics of household members, housing, household environment, and household economic status. The women's questionnaire documents women's socio-demographic and cultural characteristics (education, professional activity, mobility, perceptions about neighbourhood services), participation in and use of social networks, knowledge and attitudes about malaria and health in general, perceptions about medicines and health care facilities in the neighbourhood. It ends with questions on health care seeking behaviour during the last episode of fever for children between 2 and 10 years. To be selected, the reported illness must have ended at the time of the interview and must have occurred in the 30-day period preceding the interviewer's visit. The neighbourhood questionnaire was used to collect quantitative data on the neighbourhood's collective facilities, environment, and history of settlement. The surveys took place during the period of high malaria transmission (15 September–22 December 2008); the rainy season was characterized by extreme flooding in Dakar that year.

The household questionnaire was administered to the head-of-household, when available. The women's questionnaire was administered to the mother or guardian of the child who had an episode of fever during the preceding month and has recovered at the time of the survey. The neighbourhood questionnaire was filled out during focus groups, with key informants from the neighbourhoods.

Map 1: Location of the 50 sample clusters, Actu-Palu, 2008



Source: Authors

Definition of variables

The use of health care is generated by a health problem. This study deals with children between 2 and 10 years presenting with a simple fever.

Health care use is defined as a recourse to a public or private health provider. A “non-resort” to health care refers to a lack of recourse to a modern health service. This includes cases when no treatment whatsoever is administered, which is seldom the case, or when self-medication is used, understood as health care (drugs or other treatments) without any professional prescriptions except from pharmacists. Although resorting to traditional healers may be quite common in developing countries, reporting this type of recourse remains very low in urban settings (about 5% according to the literature on health care in developing countries).

Self-medication was set as the dependent variable in our analysis model (yes=1) compared to recourse to health care (no=0).

The independent variables (individual, context and living neighbourhood characteristics) are classified according to Andersen’s conceptual framework.

The individual and household predisposing factors include the proportion of children aged less than 10 in the household, the level of education (no education, primary, secondary and more) and the level health literacy (low versus good) of the sick child’s mother/guardian. The individual and household enabling factors include the household standard of living—very

poor household (yes versus no) and very rich household (yes versus no)—and the level of the mother/guardian's social network (low versus good).

The context predisposing factor is the level of social relationships between the neighbourhood's residents (low versus high). *The context enabling factors* concern the neighbourhood's standard of living—very poor (yes versus no) and very rich (yes versus no) neighbourhood— and the health provision assessed by the density of private pharmacies in the neighbourhood (high versus low). The need for health at the context level is expressed by the level of the neighbourhood's risk of flooding (low versus high), which is an environmental risk giving rise to mosquito breeding sites.

Data analysis

Data analysis was carried out in three stages.

The first stage involved cleaning up the Actu-Palu database and constructing indicators to characterize individuals, households and neighbourhoods. Synthetic indices were constructed (based on the score method) using a principal component analysis for quantitative variables and a factor analysis for discrete variables. Thus we calculated indices for social capital,⁷ knowledge about maternal and child health,⁸ risk of flooding in the neighbourhood (presence of wetlands, flooding in 2005 and 2008), and type of dwelling and property owned by the household. These last two indices, combined with income and overall expenditures per adult equivalent in the household, were used to classify the households and then the neighbourhoods, according to their economic status.

In the second stage, we conducted a bivariate analysis between the independent variables and the dependent variable (see Table 1). This was used to select the variables entered into the model (depending on the significance level for the Chi2).

The third and final stage dealt with the econometric analysis of our model for health care demand, using a multi-level approach. The multi-level analysis made it possible to take all dimensions of Andersen's analytical framework into account and thus better capture the effect of the context on demand for health care (Diez-Roux et al., 1997; Goldstein et al., 2007; Goldstein & Jon, 1996; Woodhouse et al., 1996). The use of the multi-level method required a hierarchical database that takes into account the context level (neighbourhood), and the individual and household level. Hierarchical data allows for a better assessment of the standard deviations of the parameters for context effect (Goldstein, 1995; Kleinschmidt et al., 1995; Palmer et al., 1998). A multi-level logit regression was used to analyse the dependent variable: self-medication (non-use of health care services) versus external recourse (use of health care services). For each block, independent variables were introduced in the model based on the explanatory dimension and according to Andersen's conceptual framework. To measure the effect of context on poor people, we introduced interaction terms between the poor households and rich neighbourhoods, poor households and neighbourhoods with a high level of health facilities, and poor households and neighbourhoods where residents have a

⁷ Using the number of persons who could be turned to in case of need (advice, money, childcare) and visa-versa.

⁸ From answers suggesting how to treat malaria (fumigating, consulting the traditional healer; using a cool wrap; praying).

strong social network. The estimation of the multi-level model begins with an empty model, then a model with individual variables, and, lastly, a full model (individual variables and context variables). For each of the full-model estimations, a single interaction variable was introduced.

The descriptive analysis and construction of indices were done with Stata/SE software, version 11.2 (Stata Corp. Ltd, 2009). The multi-level regression was performed using MLwin 2.10 software (University of Bristol, 2009).

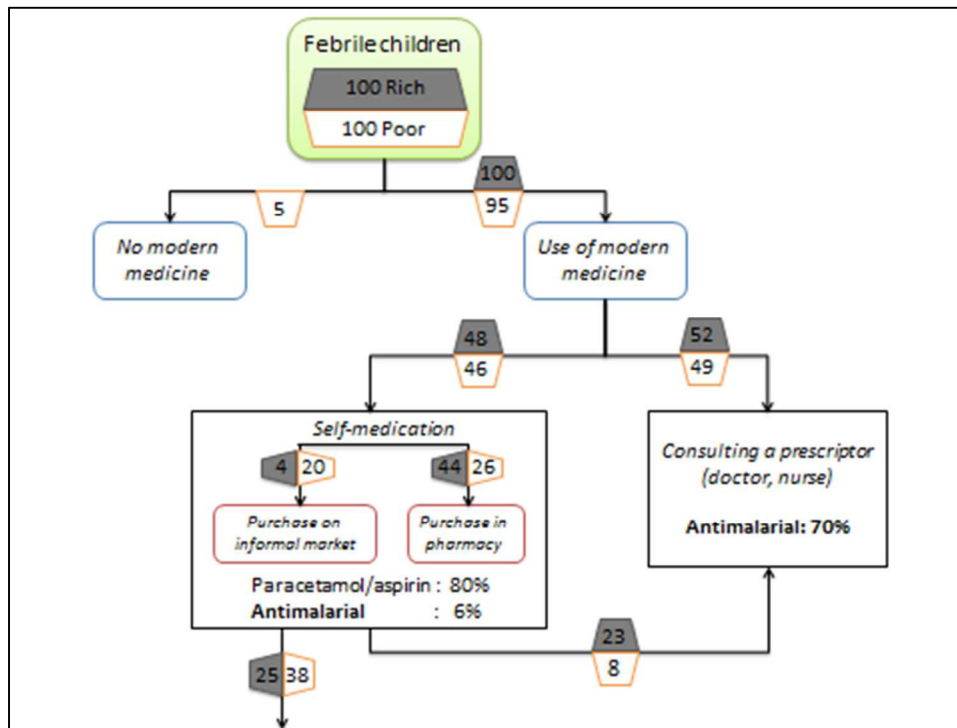
Results

The complete sample includes 2952 households (a response rate of 98.4% households) of which 28,698 individuals, including 7413 children aged 2 to 10 years. A total of 1272 mothers who reported an illness episode with one of their children aged less than 10 years were interviewed. The “neighbourhood” survey took place in the 50 residential neighbourhoods of the surveyed households.

Health care utilization among urban children with fever

The utilization of health care among urban children with fever is charted in Figure 1. Several characteristics about the use of health care in an urban setting can be drawn from these results. Using modern medicine is an established fact: 98% of mothers or guardians report having sought either a consultation or modern drugs. Some 95% of those from the poorest category have adopted this behaviour even though nearly 50% of the mothers and household heads in this category have no education. This result suggests that the residential context has a strong influence on individual behaviours: using modern health care has become “normal” in cities to the extent that even women from families whose characteristics would presuppose more “traditional” behaviour (type of education, poverty, etc.) have adopted this “modern” behaviour.

Figure 1: Health care utilization for rich and poor children with fever (example based on 100 children in each group)



Interpretation: 95 “poor” children and 100 “rich” children sought modern medicine (with or without prescription) as a first recourse.

Source: Authors

For a child with fever, one half of the mothers/guardians consult a doctor or nurse, and the other half get drugs immediately. In this respect, rich and poor people behave in the same way.

The patients who resort to self-medication only rarely buy an antimalarial and rather use a drug for fever (paracetamol or aspirin). These behaviours reflect an empirical recognition of the efficacy of these products, as they probably have a high experience given the constant presence of young children in households.

Rich and poor people do not turn to the same “health care provider”: while nearly almost all rich people turn to pharmacists, more than 40% (20/46) of the poor population use the informal market. Therefore, the behaviour of “rich” people is consistent with the economic rationality of using health care. Culturally close to the modern medicine, rich people save their time and money while minimizing risks (passing by the pharmacist). Recognizing the utility of modern medicine, poor people stay closer to the informal market, which is adapted to their financial constraints.

The outcome of self-medication is more critical. For those who are “rich,” resorting to prescribers as a second recourse was necessary in 48% of cases of self-medication (23/48). Yet, this only occurred in 17% of cases among poor people. Three explanations are possible:

either self-medication is more effective among the poor or poor children are less severely affected (which needs to be clarified), or the poor renounce turning to prescribers.

The cost of health care varies depending on the type of recourse. The average cost of self-medication is 259 FCFA (median cost is 0 FCFA). The average health care cost in a private or public health centre is 5743 FCFA (median cost is 4300 FCFA) but varies between 3649 FCFA if drugs are subsidized and 5900 FCFA otherwise.

Determinants of self-medication: bivariate analysis

Modern self-medication accounts for just under half (44%) of first-line recourse. This non-use of health care services is positively associated with individual characteristics, such as the sick child's mother/guardian's education level, level of social network, and level of health-care knowledge (prob. $\chi^2 < 1\%$, Table 1). By contrast, this non-use is not associated with household characteristics such as economic and life conditions or the proportion of children under 11 years.

There is a significant association between the variables related to residential setting and a household's health care behaviour. Even if the relationship is weak, self-medication is more common in neighbourhoods with a high density of pharmacies (51% vs. 49%) and in neighbourhoods primarily inhabited by rich households (53% vs. 47%, see Table 1). Even more evident was a lower level of self-medication in neighbourhoods with high environmental risk (39% vs. 61%), in neighbourhoods with a high level of neighbourly relations (45% vs. 55%), and in neighbourhoods mainly inhabited by poor households (38% vs. 62%).

Table 1: Description of variables by use of self-medication.

Individual variables	Self-medication as first recourse to health care (N=1272)			
	Modality	No (n=716)	Yes (n=556)	Chi2 Prob
Proportion of children under 11 years in the household	Average (SD)	0.35	0.34	0.409
	None	63.22	36.78	
Education level of sick child's mother	Primary	55.84	44.16	0.000
	Secondary or higher	43.95	56.05	
Level of mother's social network	Low	58.52	41.48	0.006
	High	49.85	50.15	
Level of mother's health literacy	Low	62.21	37.79	0.001
	High	52.81	47.19	
Rich household	No	56.48	43.52	0.631
	Yes	54.00	46.00	
Poor household	No	54.62	45.38	0.183
	Yes	58.35	41.65	
Neighbourhood variables (contextual)				
High density of pharmacies in the neighbourhood	No	58.94	41.06	0.002
	Yes	49.13	50.87	
Neighbours' network (relationship between neighbourhood residents)	Low	61.51	38.49	0.041
	High	54.74	45.26	
Risk of flood in neighbourhood	Low	44.19	55.81	0.000
	High	60.78	39.22	
Poor neighbourhood	No	52.65	47.35	0.001
	Yes	61.97	38.03	
Rich neighbourhood	No	58.10	41.90	0.004
	Yes	47.47	52.53	

Sources: Authors

Bivariate analysis of the data shows the presence of statistically significant relationships between the context variables and the use of health care services by households in Dakar; the multi-level analysis should confirm the robustness and net intensity, all other things being equal, of context effects.

Determinants of self-medication: *multi-level analysis*

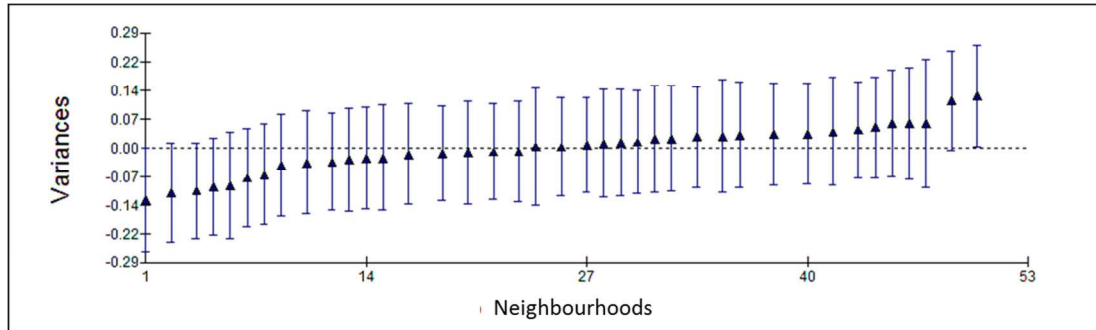
The results for the empty model give an estimated variance between neighbourhoods of: $\hat{\sigma}_{u0}^2 = 0.008$ and a variance between individuals from the same neighbourhood of: $\hat{\sigma}_e^2 = 0.238$. These two variances are significant at the 5% level. They indicate an overall trend that individual characteristics are dominant and that behaviours differ more between households from the same neighbourhood than between neighbourhoods. For this, we noted that 3.25%⁹ of the total variance for self-medication is ascribed to the difference between neighbourhoods (specificity).

⁹The percentage of variance that is ascribed to a "neighbourhood effect" is calculated using the following formula:

$$\frac{\hat{\sigma}_{u0}^2}{\hat{\sigma}_{u0}^2 + \hat{\sigma}_e^2} = \frac{0.008}{0.008 + 0.238} = 0.0325$$

Graph 1 shows the variance for self-medication within each of the neighbourhoods. This graph points out that self-medication varies considerably between the neighbourhoods. Moreover, we noted that the dispersion of self-medication is about the same in all the neighbourhoods (Annex 1).

Graph 1: Distribution of the variance for self-medication in neighbourhoods in Dakar.



Source: Authors

Table 3 show that education ($p < 1\%$), social network ($p < 10\%$), and health literacy ($p < 5\%$) of the sick child's mother/guardian are positively associated with self-medication as a first resort. Febrile children whose mothers have an education level equal to or higher than secondary are twice as likely to be treated through self-medication as a first resort than children whose mothers have not been to school (OR=1.93 [1.63–2.29]). Similarly, children whose mothers belong to a dense social network (vs. a weak social network) or those who have a high health literacy (vs. a low level) are more likely to be treated by self-medication (respectively, OR=1.25 [1.09–1.43] and OR=1.35 [1.19–1.52]). As previously found, the effect of the household's economic status is not significant ($p < 15\%$). The use of self-medication in case of fever among children is similar among rich households relatively to other households.

The residential context affects health care use through pharmacy density ($p < 5\%$), the intensity of neighbourly relations ($p < 5\%$), and environmental risk ($p < 1\%$). Households located in neighbourhoods with a high density of pharmacies or in neighbourhoods with significant interaction between neighbours have a higher probability of using self-medication (respectively, OR=1.40 [1.21–1.61] and OR=1.36 [1.18–1.57]). However, households located in neighbourhoods with an environmental risk (risk of flooding) are more likely to consult a doctor as a first recourse (OR=0.52 [0.43–0.61]).

The interaction variables show that the poor households are less likely to use self-medication when they live in a rich neighbourhood ($p < 15\%$; OR=0.662) or in a neighbourhood with numerous health facilities ($p < 1\%$; OR=0.560). In both cases, they will use health care more than if they lived in neighbourhoods that are poor or have little health care facilities. Conversely, poor households living in a neighbourhood with a strong social network (relationships between neighbours) are more likely to use self-medication than poor households in other contexts ($p < 10\%$; OR=1.093). Therefore, these results demonstrate that there is a neighbourhood effect in health care utilization in Dakar and point out some of its mechanisms at play.

Table 2: Multi-level logistic regression for models on the use of self-medication in Dakar (N=1272)

Individual Variables	Modality	Empty Model		Individual Model		Full Model	
		Coef.(SD)	OR [95%IC]	Coef.(SD)	OR [95%CI]	Coef.(SD)	OR[95%CI]
Proportion of children under 10 years in the household	Average			0.081 (0.424)	1.084[0.70–1.66]	0.254(0.431)	1.289 [0.84–1.98]
	None			Ref	1.000	Ref	1.000
	Primary			0.268 (0.13) **	1.307 [1.15–1.49]	0.237(0.131) *	1.267 [1.11–1.44]
	Secondary and higher			0.66 (0.169) ***	1.935 [1.63–2.29]	0.587(0.173) ***	1.799 [1.51–2.14]
Education level of sick child's mother	Low			Ref	1.000	Ref	1.000
	Dense			0.22 (0.135) *	1.246 [1.09–1.43]	0.239(0.137)*	1.270 [1.11–1.45]
Level of mother's social network	Low			Ref	1.000	Ref	1.000
	High			0.28 (0.124) **	1.323 [1.16–1.50]	0.3(0.125) **	1.350 [1.19–1.52]
Level of mother's health literacy	No			Ref	1.000	Ref	1.000
	Yes			-0.225(0.227)	0.799[0.63–1.00]	-0.308(0.232)	0.735 [0.58–0.93]
Rich household	No			Ref	1.000	Ref	1.000
	Yes			-0.078(0.123)	0.925 [0.81–1.04]	-0.008(0.126)	0.992 [0.87–1.12]
Poor household	No					Ref	1.000
	Yes					0.334(0.144) **	1.397 [1.21–1.61]
High density of pharmacies in neighbourhood	Weak					Ref	1.000
	Dense					0.312(0.143) **	1.366 [1.18–1.57]
Relationship between neighbours (neighbourhood social network)	Weak					Ref	1.000
	High					-0.664(0.172) ***	0.515 [0.43–0.61]
Neighbourhood flood risk level	Not poor					Ref	1.000
	Poor					0.062(0.149)	1.064 [0.92–1.23]
Poor neighbourhood	Not Rich					Ref	1.000
Rich neighbourhood	Rich					-0.195(0.193)	0.823 [0.67–0.99]
Interaction with the poverty level variable (Poor household)							
Poor household living in rich neighbourhoods	No					Ref	1.000
	Yes					-0.450(0.378) *	0.662
Poor household living in neighbourhoods well-equipped in health facilities (Pharmacies)	No					Ref	1.000
	Yes					-0.757(0.274)***	0.560
Poor household living in neighborhoods with a strong social network	No					Ref	1.000
	Yes					0.438(0.285) *	1.093
Constant				-0.239(0.075)***	-0.703(0.21)***	-0.627(0.263)***	
Variance				0.120(0.056)***	0.075(0.048) ^(*)	0.00(0.000)	

*** p < 0.01; ** p < 0.05; * p < 0.10; (*)p<0.15

Discussion

The results show that choosing whether to resort to self-medication or modern health care at the onset of fever among young children depends mainly on their mothers' characteristics, but also—significantly—on the characteristics of the neighbourhood where she lives.

Individual determinants

The descriptive analysis (Table 1) has shown that as a first resort, people from Dakar, whether rich or poor, use self-medication as much as using a health facility in the event of fever among children (Chi², non-significant). Similarly, it was noted that poor households are more likely to limit themselves to a sole self-prescribed treatment (OR=1.5, $p<0.05$).

According to the multi-level model, there is a significant association between the household's wealth and first-line recourse to a consultation. This relationship increases when controlling for socio-demographic and context factors. Rich people use modern health care more frequently than poor people in response to a health problem. This result is consistent with findings in the literature on health care demand in low-income countries (Akin et al., 1995; Lalou, 2009 ; Stierle et al., 1999) and suggests that some poor people may forgo this option for financial reasons.

Contrary to the results presented in several empirical studies conducted in rural settings ((Audibert M. et al., 1999; Haddad & Fournier, 1995), and (Akin et al., 1995; Lavy & Quigley, 1993; Stierle et al., 1999)), the mother's education and her integration into social networks contribute to greater use of self-medication. This situation could be explained by the fact that fever among children is a frequent health problem and is generally considered to be benign (at least at the onset of the illness). Moreover, these forms of self-medication occur in cities where drugs are more accessible. Lastly, due to the fairly low cost of treating simple fever, mothers probably rely on social networks more for sharing experiences and information than for financial assistance, which could facilitate a resort to a health care facility. This social-network effect on health behaviours does not vary depending on a household's economic status. In fact, poor households living in neighbourhoods where residents frequently engage in neighbourly relations are more likely than other households to treat their febrile children themselves.

Neighbourhood determinants

The significance of a household's location has been well documented in the analysis of health care use (Andersen et al., 2002; Aranda et al., 2011; Aremu et al., 2008; Béland et al., 2002; Carpentier & Ducharme, 2003; Choi, 2009; Costa et al., 2003; Davidson et al., 2007; Diez Roux, 2007; López-Cevallos & Chi, 2010; Marpsat, 1999; Santos et al., 2012), particularly by comparing urban and rural settings. Our analysis sought to go into more detail by studying the effect of context on health behaviours on an intra-urban scale—the neighbourhood. Overall, our results show the existence of a context effect on the use of health care in the case of febrile children in Dakar. Although relatively low in comparison to the

effects of children and mother characteristics (3.4% of the total variance is explained by the context variables), this effect is significant at the 5% level. In addition, this result is consistent with Pickett's meta-analysis (2001) based on 25 studies using a hierarchy model (Pickett & Pearl, 2001). Even if the individual variables explain a high percentage for the total variance for a very large number of health indicators, the context effects frequently play a statistically significant and non-negligible role in their explanation (Palmer et al., 1998).

Using the full hierarchy model, we have attempted to understand the mechanisms at play in residential neighbourhoods regarding the use of self-medication. On the basis of the literature, the neighbourhood can simultaneously be a space of risk, services, and social resources. The presence of "natural" elements—such as abundant vegetation and permanent or temporary stagnant water—exposes residents to infections and, more specifically, vector-borne diseases. Additionally, the neighbourhood, while not a specific area of health activity in Dakar, does offer health care that is fairly dense and diversified. Lastly, the neighbourhood sometimes promotes relationships for sharing or mutual assistance between residents. In this study, the variables largely responsible for the context effect are health care supply in the neighbourhood, social relationships between neighbours, the neighbourhood's socio-economic level, and the environmental risk.

Based on an economic rationale, the high density of public and private health facilities is frequently associated with a high presence of private pharmacies. This association is particularly visible in the central neighbourhoods of the city of Dakar. Half the time, there is an association between neighbourhoods with numerous health facilities and a high density of pharmacies. Conversely, no neighbourhood with a low medical supply had a high number of pharmacies. Based on these findings and our results, we believe that poor households take advantage of neighbourhood resources and use health facilities more. However, this statistical association suggests that the most impoverished households also face greater constraints than other households, due to geographical distance and low health literacy. Rich households can choose self-medication to avoid the opportunity costs of a medical consultation (transportation time and wait time in the health facility). They also have sufficient health literacy to reduce the risks associated with self-prescribing. Lastly, and contrary to the poor households, the rich households have greater freedom of movement and can more easily find quality health care outside their living environment (Ndonky & Lalou, *en cours*).

We found that poor households living in neighbourhoods that were economically well-off are more likely to pursue a consultation in the event of a febrile child. There are several explanations for this situation:

Greater availability of quality supply reduces the geographic distance between patient and professional. The cost of seeking care is lower, thus more frequent among poor people. This elasticity does not come into play for rich people for whom the cost is not a barrier. The behaviour of poor people resembles that of the rich. This interpretation is supported by numerous studies that show that the quality of health care in an urban setting is an important factor in the use of health care (Lavy & Quigley, 1993; Mariko, 2003; Sahn & Stifel, 2000; Stierle et al., 1999).

However, it might also be thought that the neighbourhood acts as a producer of social norms for its residents. Hence poor people behave similarly to their neighbours, reassured by the claimed efficacy of a behaviour adopted by similar people from an economic and social point of view.

Neighbourhoods with a dense social network are more located in Dakar's suburbs, where there is a higher concentration of poverty in the urban space. In addition, the health demand mainly concerns primary health care that does not incur catastrophic expenditures. In other words, households, whether rich or poor, mobilize their neighbourly relationships not so much to receive financial assistance, but to get health advice and thus reduce any uncertainties related to self-medicating. This approach is all the more common when the household is poor and uninformed about health issues.

Lastly, the study showed that the environmental risk, all other things being equal, promotes turning to a health care facility as a first resort. The objective existence of natural spaces in a neighbourhood (wetlands, swamps, thick vegetation) near built-up areas, recurrent flooding, and unsanitary public constructions (open channels for wastewater drainage) would support the perception of a health hazard driving people to consult health care professionals for fever alone.

Neighbourhoods with an environmental risk are mainly located in the eastern-central and eastern areas of the Dakar metropolis (Annex 2). In these neighbourhoods, market gardening is widespread along water points and ponds (locally known as *niayes*), and the risk of flooding is higher.¹⁰ The nearly constant presence of water and vegetation cover is conducive to the development of the mosquito and its breeding sites. Studies have already shown the presence of *Anopheles arabiensis* in specific areas of Dakar, such as the *niayes* (S. Diallo et al., 2000; Drame et al., 2012; Machault et al., 2009; Trape et al., 1992). Other studies have revealed adaptation of malaria vectors to urban settings—particularly in polluted water—and indigenous transmission in several African cities (Awolola et al., 2007; Chinery, 1984; Diallo et al., 2012; Robert et al., 2003; Sattler et al., 2005). Lastly, some entomological studies appear to indicate that heavy rain (and the subsequent flooding) has a positive influence on the development of malarial mosquitoes in cities (Machault et al., 2009; Pages et al., 2008). All these observations indicate an indigenous malaria transmission in Dakar that is characterized by high inter-annual and spatial variability; this spatial heterogeneity was detected at the urban neighbourhood scale. Therefore, it is logical that sick people living in neighbourhoods of high environmental risk and who are aware of the threat to their health are more inclined to consult health care professionals rather than self-medicate.

If confirmed by others, these results would show that cultural distance to modern medicine for the urban poor is no longer a barrier: the objective risks are clearly understood, as well as the usefulness of seeking care. Progress in universal primary education and the urban lifestyle are probably the main causes of this cultural change. Urban populations in Dakar are ready to seize the opportunities that the older and more affluent and influential neighbourhoods enjoy.

¹⁰ Dakar experienced intense flooding in 1996, 2005, 2008 (the year of our study), 2010, and 2012.

Our results are consistent with the views of Amartya Sen that suggest that social inequalities (particularly for health) can be reduced by strengthening poor individual's *capabilities*, in other words, by increasing the opportunities provided by their living environment as well as their ability to use them effectively (through human and social capital). Therefore, we might ask whether specific government efforts to provide community facilities in poor neighbourhoods both in terms of health care supply and other public services would not be more likely to produce more widespread and sustainable health care seeking behaviours among the poor than exemption policies that are not very comprehensible, functional, or manageable, leading them to be—ultimately—discredited.

Conclusion

This study on health seeking behaviours in cases of fever among children in urban settings shows that a household's economic characteristics and the mother's education level strongly influence health practices. However, the household's residential context reveals modifying effects on these care-seeking behaviours, particularly among poor people. Its influence plays out in three ways: firstly, the residential context provides residents with a fairly varied and diverse quality health care supply; and secondly, it shapes representations of risk attributed to the symptom. In a high-risk environment (stagnant water), the need for reassurance is higher in the event of fever. Seeking modern care as a first resort is more frequent, even among mothers whose individual characteristics would predict using self-medication. This result shows an accurate perception of the risks and utility of modern health care, regardless of the household's economic status and education level. The third way residential setting has an impact is that poor people living in affluent neighbourhoods visit medical facilities more frequently even though this social category chooses to self-medicate in any other circumstance.

As with many West African cities, self-medication is a widespread practice in all households in Dakar, and particularly among the city's poorest people (Gobbers, 2002). However, it corresponds to different rationales between rich and poor people. Typically, we can describe the following behaviours: i) Rich people, who are culturally, economically, and geographically close to modern medicine, adopt a rational attitude consistent with their knowledge about health. If the person responsible for the child's health believes that the fever does not pose a high risk and if the person is sure that he/she can consult a professional as a second resort in case of worsening symptoms, then using drugs purchased at the pharmacy as a first resort becomes logical; it saves on the cost of the consultation and makes it possible to get free advice from the pharmacist and purchase an accredited drug. ii) The poor, who have less proximity to modern medicine, adopt a rational attitude with respect to this characteristic. They choose to self-medicate as it is a less expensive option, and all the more so since neighbourhood influences make this practice acceptable and socially familiar. However, some neighbourhood characteristics increase poor people's use of health services. Visits to health facilities increase when health care supply is closer, more available, and higher quality, comparable to rich neighbourhoods. Similarly, the cost of using health care no longer poses a

major barrier when people believe there is a high environmental risk (presence of stagnant water and an abundance of mosquitoes). When the residential neighbourhood is a space providing resources, it can help lift the financial barrier and lessen unequal access.

In conclusion, it appears that greater social diversity within residential neighbourhoods would have a similar impact, although these results are less clear-cut. Nevertheless, this final issue deserves further research.

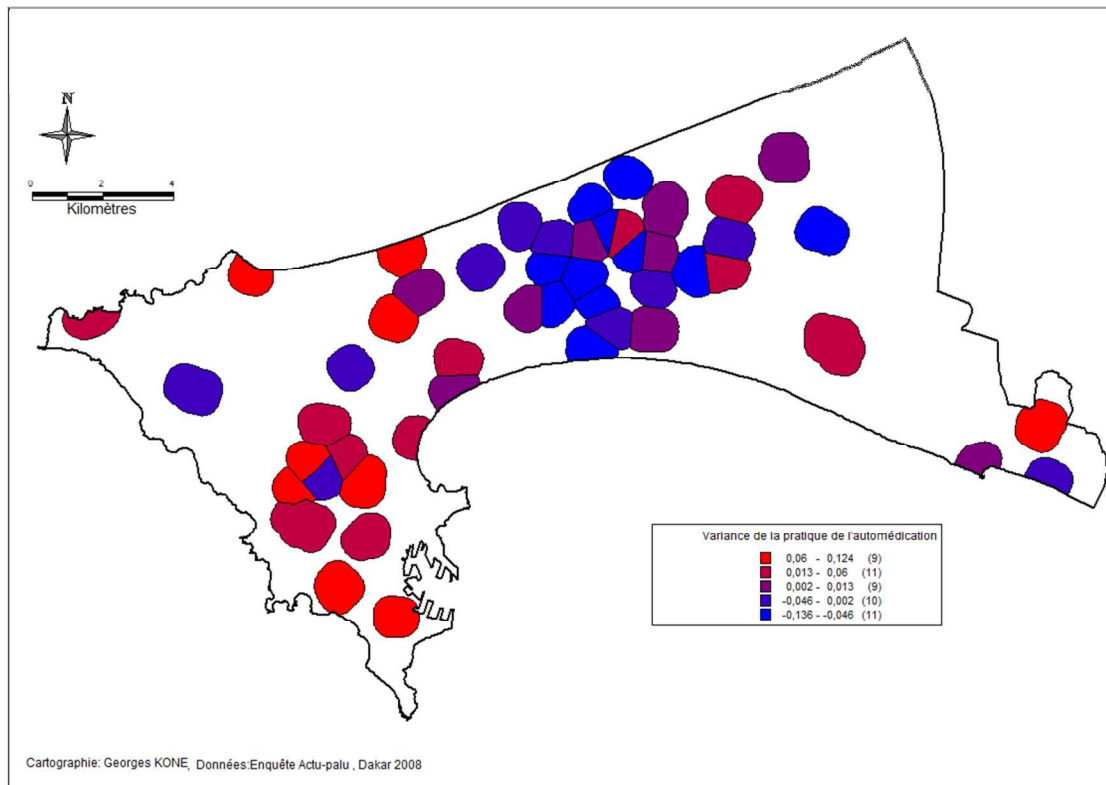
References

- Akin, J.S., Guilkey, D.K., Hazel, & Denton, E. (1995). Quality of services and demand for health care in Nigeria: A multinomial probit estimation. *Social Science & Medicine*, 40, 1527-1537.
- Andersen, R.M., Yu, H., Wyn, R., Davidson, P.L., Brown, E.R., & Teleki, S. (2002). Access to medical care for low-income persons: how do communities make a difference? *Med Care Res Rev*, 59, 384-411.
- ANSD, & al., e. (2011). Enquête Démographique et de santé à Indicateurs Multiples EDS V-MICS 2010-2011. (p. 55 p): Calverton, Maryland, USA: Centre de Recherche pour le Développement Humain (Sénégal), MEASURE DHS et ICF Macro. .
- Aranda, M.P., Ray, L.A., Snih, S.A., Ottenbacher, K.J., & Markides, K.S. (2011). The Protective Effect of Neighborhood Composition on Increasing Frailty Among Older Mexican Americans. *Journal of Aging and Health*, 23, 1189-1217.
- Aremu, O., Lawoko, S., & Dalal, K. (2008). The Influence of Individual and Contextual Socioeconomic Status on Obstetric Care Utilization in the Democratic Republic of Congo: A Population-based Study. *Int J Prev Med*, 3, 278-285.
- Audibert M., Mathonnat J., I., N., & M.C., e.H. (1999). The determinants of health care demand amongst the Senoufo of the Cote d'Ivoire. *Health and System Science*, 2, 111 - 126.
- Béland, F., Birch, S., & Stoddart, G. (2002). Unemployment and health: contextual-level influences on the production of health in populations. *Social Science & Medicine*, 55, 2033-2052.
- Brunet-Jailly, J. (1999). Santé en capitales : la dynamique des systèmes de santé des capitales ouest-africaines. Abidjan: CEDA.
- Carpentier, N., & Ducharme, F. (2003). Les approches prédictive et explicative dans l'étude de l'utilisation des services: L'exemple de la gérontologie sociale. *Ruptures, Revue interdisciplinaire en santé*, 9, 112 - 116.
- Chauvin, P., & Parizot (Eds.) (2009). *Les inégalités sociales et territoriales de santé dans l'agglomération parisienne: une analyse de la cohorte SIRS*. Paris.
- Choi, J.Y. (2009). Contextual effects on health care access among immigrants: Lessons from three ethnic communities in Hawaii. *Social Science & Medicine*, 69, 1261-1271.
- Cissé, B., Moatti, J.-P., & Luchini, S. (2004). Recouvrement des coûts et demande de soins dans les PED. *Revue française d'économie*, 111-149.
- Costa, G., Marinacci, C., Caiazzo, A., & Spadea, T. (2003). Individual and contextual determinants of inequalities in health: the Italian case. *Int J Health Serv*, 33, 635-667; discussion 743-639.
- Davidson, P.L., Carreon, D.C., Baumeister, S.E., Nakazono, T.T., Gutierrez, J.J., Afifi, A.A., et al. (2007). Influence of contextual environment and community-based dental education on practice plans of graduating seniors. *J Dent Educ*, 71, 403-418.
- Diallo, Ndam, N.T., Moussiliou, A., Dos Santos, S., Ndonky, A., Borderon, M., et al. (2012). Asymptomatic carriage of plasmodium in urban Dakar: the risk of malaria should not be underestimated. *PLoS one*, 7, e31100.
- Diallo, S., Konate, L., Ndir, O., Dieng, T., Dieng, Y., Bah, I., et al. (2000). Malaria in the central health district of Dakar (Senegal). Entomological, parasitological and clinical data. *Sante*, 10, 221 - 229.
- Diez-Roux, A.V., Nieto, F.J., Muntaner, C., Tyroler, H.A., Comstock, G.W., Shahar, E., et al. (1997). Neighborhood environments and coronary heart disease: a multilevel analysis. *Am J Epidemiol*, 146, 48-63.

- Diez Roux, A.V. (2007). Neighborhoods and health: where are we and where do we go from here? *Rev Epidemiol santé publique*, 55, 13-21.
- Drame, P.M., Machault, V., Diallo, A., Cornelie, S., Poinsignon, A., Lalou, R., et al. (2012). IgG responses to the gSG6-P1 salivary peptide for evaluating human exposure to Anopheles bites in urban areas of Dakar region, Senegal. *Malaria Journal*, 11, 72.
- Faye, O., & Thioub, I. (2003). Les marginaux et l'Etat à Dakar. *Le Mouvement social*, 93-108.
- Franckel, A., & al., e. (2008). Contexte villageois et recours aux soins dans la région de Fatick au Sénégal. *Population (French Edition)*, 3, 531-553.
- Goldstein, H. (1995). Hierarchical Data Modeling in the Social Sciences. *Journal of Educational and Behavioral Statistics*, 20, 201-204.
- Goldstein, H., Bonnet, G., & Rocher, T. (2007). Multilevel Structural Equation Models for the Analysis of Comparative Data on Educational Performance. *Journal of Educational and Behavioral Statistics*, 32, 252-286.
- Goldstein, H., & Jon, R. (1996). Improved Approximations for Multilevel Models with Binary Responses. *Journal of the Royal Statistical Society. Series A (Statistics in Society)*, 159, 505-513.
- Haddad, S., & Fournier, P. (1995). Quality, cost and utilization of health services in developing countries. A longitudinal study in Zaïre. *Social Science & Medicine*, 40, 743-753.
- Himes, C.L., & Rutrough, T.S. (1994). Differences in the use of health services by metropolitan and nonmetropolitan elderly. *J Rural Health*, 10, 80-88.
- Kleinschmidt, I., Hills, M., & Elliott, P. (1995). Smoking behaviour can be predicted by neighbourhood deprivation measures. *J Epidemiol Community Health*, 49 Suppl 2, S72-77.
- Lalou, R. (2009). Vulnérabilités et équité des soins - paludisme. In IRD/LPED (Ed.).
- Lavy, V.C., & Quigley, J.M. (1993). Willingness to Pay for the Quality and Intensity of Medical Care; Low- Income Households in Ghana. Working Papers.
- López-Cevallos, D.F., & Chi, C. (2010). Health care utilization in Ecuador: a multilevel analysis of socio-economic determinants and inequality issues. *Health Policy and Planning*, 25, 209-218.
- Machault, V., Gadiaga, L., Vignolles, C., Jarjaval, F., Bouzid, S., Sokhna, C., et al. (2009). Highly focused anopheline breeding sites and malaria transmission in Dakar. *Malaria Journal*, 8, 138.
- Mariko, M. (2003). Quality of care and the demand for health services in Bamako, Mali: the specific roles of structural, process, and outcome components. *Soc Sci Med*, 56, 1183-1196.
- Marpsat, M. (1999). La modélisation des " effets de quartier " aux États-Unis: Une revue des travaux récents. *Population (French Edition)*, 303-330.
- Ndiaye, S., & Ayad, M. (2009). Enquête Nationale sur le paludisme 2008-2009. Calverton, Maryland, USA: Centre de Recherche pour le Développement Humain (Sénégal) et ICF Macro. (p. 147 p).
- Ndonky, A., & Lalou, R. (en cours). Y a-t-il un effet de contexte spatial sur le recours aux services de santé en cas de fièvre à Dakar?
- Ouédraogo, D., Piché, V., & Dos Santos, S. (2007). *Dynamique migratoire, insertion urbaine et environnement au Burkina Faso*. Ouagadougou: Presse universitaire de Ouagadougou.
- Pages, F., Texier, G., Pradines, B., Gadiaga, L., Machault, V., Jarjaval, F., et al. (2008). Malaria transmission in Dakar: a two-year survey. *Malaria Journal*, 7, 178.

- Palmer, R.F., Graham, J.W., White, E.L., & Hansen, W.B. (1998). Applying Multilevel Analytic Strategies in Adolescent Substance Use Prevention Research. *Preventive Medicine*, 27, 328-336.
- Pickett, K.E., & Pearl, M. (2001). Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology and Community Health*, 55, 111-122.
- Piermay, J.-L. (2003). L'apprentissage de la ville en Afrique sud-saharienne. *Le Mouvement social*, 204, 35-46.
- Sahn, D.E., & Stifel, D.C. (2000). Poverty Comparisons Over Time and Across Countries in Africa. *World Development*, 28, 2123-2155.
- Santos, C.a.S.T., Strina, A., Amorim, L.D., Genser, B., Assis, A.M.O., Prado, M.S., et al. (2012). Individual and contextual determinants of the duration of diarrhoeal episodes in preschool children: a longitudinal study in an urban setting. *Epidemiology and Infection*, 140, 689-696.
- Smiley, M.J., Diez Roux, A.V., Brines, S.J., Brown, D.G., Evenson, K.R., & Rodriguez, D.A. (2010). A spatial analysis of health-related resources in three diverse metropolitan areas. *Health Place*, 16, 885-892.
- Souares, A., Lalou, R., Sene, I., Sow, D., & Le Hesran, J.-Y. (2009). Factors related to compliance to anti-malarial drug combination: example of amodiaquine/sulphadoxine-pyrimethamine among children in rural Senegal. *Malaria Journal*, 8, 118.
- Stierle, F., Kaddar, M., Tchicaya, A., & Schmidt-Ehry, B. (1999). Indigence and access to health care in sub-Saharan Africa. *Int J Health Plann Manage*, 14, 81-105.
- Trape, J., Lefebvre-Zante, E., Legros, F., Ndiaye, G., Bouganali, H., Druilhe, P., et al. (1992). Vector density gradients and the epidemiology of urban malaria in Dakar, Senegal. *Am J Trop Med Hyg*, 47, 181 - 189.
- Woodhouse, G., Yang, M., Goldstein, H., & Jon, R. (1996). Adjusting for Measurement Error in Multilevel Analysis. *Journal of the Royal Statistical Society. Series A (Statistics in Society)*, 159, 201-212.

Annex 1: Distribution map of the variance of the practice of self-medication across Dakar neighbourhoods.



Annex 2: Distribution map of Dakar neighbourhoods according to flood risk

