Effect of Water Supply on Child Survival. A Study of Qualitative and Quantitative Data from Ouagadougou (Burkina Faso)

Stéphanie Dos Santos Beauchamp[•] and Thomas K. LeGrand[*]

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Discussant: Jennifer Johnson-Hanks, *University of California, Berkeley*

Abstract

This study uses longitudinal life-history data to examine the effects of improvements in water supply and other factors on child survival in Ouagadougou, the capital city of Burkina Faso. As expected, event-history models show that the estimated beneficial effect of improved access to clean water largely disappears once controls for other covariates (in particular, mother's education) are introduced into the equation. Qualitative data collected in 2003 are then employed to better understand the domestic uses of water and its social representations, and to explain the absence of a strong, positive effect of the availability of piped water on childhood mortality in the statistical results. In particular, the importance of hygienic knowledge as a product of formal education is discussed. While schooling may be necessary to gain biomedical knowledge, it is nevertheless be insufficient to significantly alter daily hygienic water-use practices, which are more the result of an acculturation process to new ways of thinking and behaving.

Note: The text below is a long abstract of the original French-language study that will soon appear as a chapter in the first author's PhD thesis.

[•] Département de Démographie. Université de Montréal. CP 6128, succ. Centre-Ville. Montréal (QC). H3C 3J7. Canada. tel (514) 343-6610 ext. 1963; fax (514) 343-2309. s.dos.santos@umontreal.ca

[*] Département de Démographie. Université de Montréal. CP 6128, succ. Centre-Ville. Montréal (QC). H3C 3J7. Canada. tel: (514) 343-7262; fax: (514) 343-2309. tk.legrand@umontreal.ca

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Introduction

The International Drinking Water Supply and Sanitation Decade (1981-1990) did not achieve its expected results in terms of community health and, in particular, of child health. A sixth of the world's population still does not have access to a safe water point located within a kilometer of their homes and, according to WHO estimates, 5 to 10 million people die annually in the world from water-related diseases. The major pathological symptom of unsafe water-related morbidity is diarrhea and infectious gastro-entritis, the sixth most important cause of death in the world. Water-borne diseases are also a major cause of mortality for children under five, alongside of pneumonia, malaria, and measles. Approximately 2 million children die each year from diarrheal diseases, translating to 5,000 child deaths per day (WHO, 2002). In addition, water-related problems are exacerbated in a context of poor urban planning and management.

This study seeks to contrast the estimated quantitative effects of water supply on the survival of children aged under five with the results of an analysis of qualitative data on the uses and representations of water. This case study focuses on Ouagadougou, the capital city of Burkina Faso. The main objective of this study is to highlight the complexity of the relationship between water and health; a complexity that is not adequately captured by simple statistical variables such as "water source" that are commonly used in research on the topic.

Context: Access to water and child health in Ouagadougou

Water access in Ouagadougou

Located in the arid Sahelian region of West Africa and characterized by a high annual population growth rate estimated at 5 to 6%, Ouagadougou is the capital city of one of the poorest countries in the world (per capita income: 220 US$). The city population has been growing at an estimated annual rate of 5-6%, and this is growth has severely tested the capacity

of the *Office National de l'Eau et de l'Assainissement* (ONEA – the National Office for Water and Sanitation), to expand the water supply network. In this context, the ONEA has developed an unusual water management system called "shared water management". The ONEA system is based on the pragmatic approach that places priority on the provision of clean water to the greatest number of the population through public water taps or protected boreholes located in neighborhoods, rather than through fully or semi-privatized water connections. As a result, in contrast to similar cities in the sub-region, Ouagadougou has the lowest access to piped water[1] in dwelling units: only 23% of the households in Ouagadougou have access to piped water at home, compared to 40% in Bamako (capital of Mali) and 33% in Niamey (capital of Niger). However, with regard to overall access to clean water, 97% of households in Ouagadougou have access to clean water in their neighborhood (table 1).

Table 1. Percentage distribution of households by source of drinking water in Ouagadougou and in some other sub-Saharan African capital cities

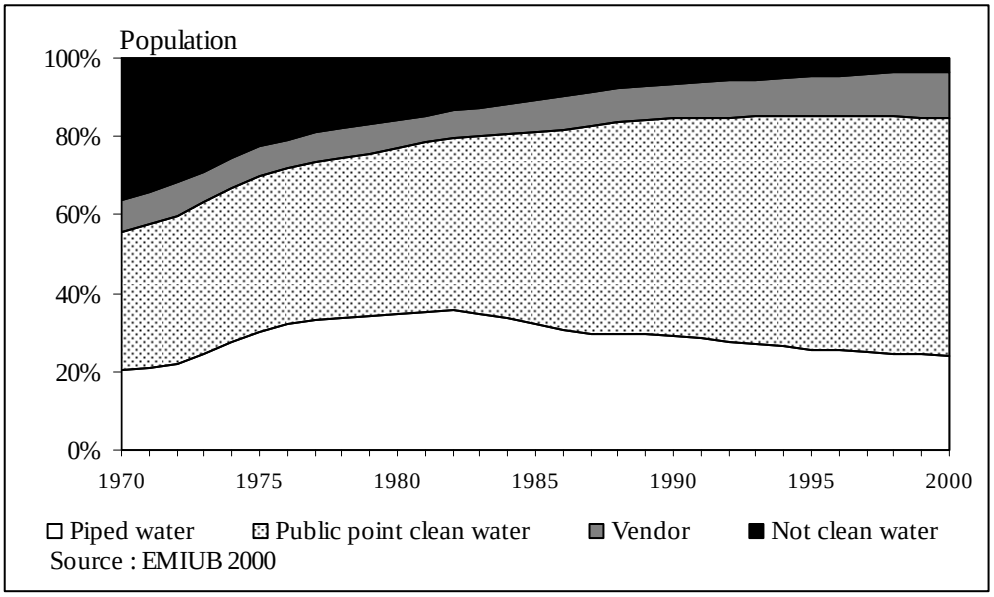
	Pump	Public tap	Vendor	Private pipe at residence/ yard	Shared pipe in yard	Not clean water	Total
Ouagadougou[1]	7.6	45.3	20.9	15.3	7.5	3,4	100,0
Abidjan[2]	27.0			70.9		2.1	100.0
Bamako[3]	-	44.4		40.0		15.6	100.0
Niamey[4]	1.7	28.5	32.2	33.2		4.4	100,0
Lomé[5]	14.3			17.5	49.9	18.3	100.0

Sources: 1: EMIUB 2000; 2: DHS Côte d'Ivoire 1998-99; 3: DHS Mali 2001; 4: DHS Niger 1998; 5: DHS Togo 1998.

Due both to this policy and to the rapid expansion of the Ouagadougou urban area, there has been a decline in the percentage of households with direct access to piped water at home or within the household compound over the last 15 years in Ouagadougou, and conversely a rise in access to clean water at fixed public locations within neighborhoods (Figure 1).

[1] All over the text, "piped water" refers to at last one tap in the plot or in the dwelling.

Figure 1. Percent distribution of source of drinking water in Ouagadougou: 1970-2000



Child health in Ouagadougou

Infant and child mortality in Ouagadougou, estimated at 119 per thousand in 2003, is one of the highest in the sub-region (Table 2). In addition, diarrhea prevalence remains high, reflecting the importance of water-related diseases in the city. According to 2003 DHS data, 24% of children aged under five had an episode of diarrhea during the two weeks preceding the survey. This level of prevalence is one of the highest in the sub-region and was estimated to increase during the last ten years in this city. Data from the Yalgado Ouédraogo National Hospital indicates that 22.4 % of under five children deaths were caused by diarrhea in 1991 (Malan, 1993).

Table 2. Levels and trends of childhood mortality in Ouagadougou and in some other sub-Saharan African capital cities

	Infant Mortality Rate 1q0	Child Mortality Rate 4q1	Under-five Mortality Rate 5q0
Ouagadougou [1]			
- 2003	69	53	119
- 1998-99	70	68	133
- 1993	83	74	150
Abidjan - 1998-99 [4]	80	42	118
Bamako - 2001 [3]	94	44	134
Niamey - 1998 [2]	70	84	147
Cotonou - 2001 [5]	56	35	89

Sources 1: DHS Burkina Faso; 2: DHS Niger 1998; 3: DHS Mali 2001; 4: DHS Côte d'Ivoire 1998-99; 5: DHS Benin 2001.

Conceptual Framework

Improved water supply can potentially affect child survival through four different pathways. First, the distribution of clean water can prevent the propagation of certain disease pathogens that are carried by water such as cholera or typhoid (Prost, 1996); Payment and Hunter, 2001). Secondly, access to more quantities of clean water allows for better hygiene, thus reducing the risks of diseases such as diarrhea, certain skin diseases, and trachoma in particular (Esrey *et al.*, 1991 ; Zerihun, 1997). Thirdly, contact with unclean surface water environments (e.g., ponds), which are favorable to the development of certain parasites or insect-borne diseases such as malaria, is reduced (Bradley, 1977). Finally, by reducing the time and energy spent on the daily task of collecting water, women can devote themselves more to other activities, such as child care or income-generating activities (Esrey, 1994).

Even if the advantages of improved water supply seem to be self-evident, the statistical findings on relationship between the mortality reduction and water distribution has been the subject of contention (Van Poppel and Van der Heijden, 1997) (Prost, 1996). Methodological considerations have often been advanced to explain these divergent findings (Blum and Feachem, 1983); (Esrey and Habicht, 1986). In particular, given the multiple factors related to mortality causes, water supply can only be but one of several factors, whose real effect is not easy to isolate. Oftentimes, the statistical significance of the effect of water source disappears once confounding variables like education are added to the equation. Moreover, other factors in the environment, for example, other means of contracting diseases – may act to neutralize the beneficial effect of clean water supply. In addition and perhaps most importantly, linkages between water use and health may go beyond a simple relationship between two dichotomous variables. People's use of water in their homes is not only dependent on the availability of piped water but also on their awareness of hygienic knowledge and practice.

Data and Methodology

Based on unusual data and methods than used by most studies to date, we try to understand the relationship between water and health in Ouagadougou. We use both qualitative and quantitative data, in order to, first, examine estimated effect of water on child mortality after controlling for range of plausible covariates, and second, explore the meanings of these findings and more generally of how water source may influence child health, making use of qualitative data on perceptions and actions with regard to water and child health.

Quantitative methodology: event-history analysis

The quantitative data come from the *Enquête Migration, Insertion Urbaine et Environnement au Burkina Faso* (EMIUB), a multi-level family-life type survey, conducted in 2000 by the *Unité d'Enseignement et de Recherche en Démographie* (UERD) of the University of Ouagadougou, the Department of Demography of the University of Montreal, and the CERPOD (Poirier *et al*., 2001). These data are especially suitable for this study because they allow us to link a mother's residential history (characteristics of her lodging unit over time) with the survival of her children. Since the EMIUB included a complete event-history module on residence, it allows for a dynamic analysis of water-related time-varying covariates. Traditional studies, particularly those using DHS surveys, can only consider the type of water supply for the mother at the time of the survey, which is used as a determinant of earlier child mortality. However, if for example a child's access to water changes as a result of a residential move from a house with piped water to one without, one can hypothesize that the child's exposure to water-related mortality equally changes. Event-history methods are used to account for these changes over time. Specifically, the type of water access is considered as time-varying covariate.

We used a piecewise exponential model to estimate the effect of the type of water supply on the risk of dying before age five in this population. This model is an exponential hazard rate model where the constant rate is allowed to vary within pre-defined time-segments (Blossfeld and Rohwer (2002) for details). Many studies in developing countries have found that the impact of environmental factors are unevenly distributed among various age groups (Blum *et al.*, 1983 ; Esrey *et al.*, 1986). In particular, water supply affects mortality at relatively higher child ages rather than immediately after the birth (Van Poppel *et al.*, 1997). In Stata, the command "stpiece" automates the definition of time pieces. In our models, three periods of time were defined, namely the neonatal period (the first month of life), infancy (1 to 11 months) and the childhood (12 months to 5 years old). In addition, the option "tv" specifies variables whose effects are thinking to be non proportional and may vary between time pieces. This is especially the case for the water supply variable. Lastly, the Stata "cluster" option is used to control for the effects of dependence across observations between children of the same mother.

The data contain birth histories for 3,751 women: 17,544 births and 3,268 deaths among their children. The population at risk in our study is only composed by the children whose mother

reported a residence in Ouagadougou during the first 5 years of these children's live and during the period 1970-2000. This population does not correspond just to children whose mother was in Ouagadougou at the survey date. Table 3 shows the population at risk by the children's place of birth and the place at which the mother was surveyed.. A total of 3,449 children aged 0-4 years lived in Ouagadougou at least three months during 1970-2000. These family-life data allow us to better specify the population at risk rather than using transversal data.

Table 3. Distribution of children by mother's place of residence at the time of the children's birth and at the date of the survey (1970-2000)

	Burkina Faso	Ouagadougou (percent)
Birth in Ouagadougou and mother in Ouagadougou at the survey	2,991	2,991 (86.7)
Birth out of Ouagadougou and mother in Ouagadougou at the survey :	833	
- a period of childhood in Ouagadougou	332	332 (9.7)
- never lived in Ouagadougou	501	
Birth in Ouagadougou and mother out of Ouagadougou at the survey	87	87 (2.5)
Birth out of Ouagadougou and mother out of Ouagadougou at the survey:	12,385	
- a period of childhood in Ouagadougou	39	39 (1.1)
- never lived in Ouagadougou	12,346	
TOTAL	16,298	3,449 (100.0)

Table 4 presents additional information on the set of children under study. Of the 3,449 relevant children in the data, 282 died before age 5 years. Children who are still alive at the survey date, who had moved from Ouagadougou prior to the survey, or who had left their mother's residence before age 5 years old (and for whom information on water source is limited) were right censored. There are also 371 cases of children born outside of Ouagadougou, whose observations began only once they arrived in Ouagadougou (before age 5).

Table 4. Outcomes of children in the data

	Population at risk
Died prior to age 5	282
Right censored by migration or fostering	1,001
Right censored: survived to age 5	2,166
TOTAL	*3,449*

Table 5 presents summary statistics on the variables used in the regression models. A number of bio-demographic variables have consistently been shown to affect the probability of child death; these include the child's sex, birth order and multiple births. We included these variables and dummy variables for time periods to control for any effects they might have on

child mortality. In addition, a number of variables to capture socioeconomic and cultural factors are also included in the models; these include the mother's religion, and ethnic group, schooling attainment, and a household wealth index[2]. Finally, a control for household waste disposal is also used, as it reflects health knowledge, hygienic behavior and also socioeconomic status.

Qualitative methodology

The qualitative data were obtained from 49 respondents (37 regular informants and 12 key informants) through 34 individual semi-structured in-depth interviews and two focus group discussions.[3] The 20 regular informants used in the in-depth interviews were all women. These were randomly sampled from the pilot Demographic Surveillance System for Ouagadougou run by UERD, taking into account three selection criteria: neighborhood, having or not having piped water in the house or courtyard, and being the household head or wife of the household head. The participants in the focus group discussions were recruited through informal networks. Two female interviewers who are native speakers of the Moore language (the dominant local language spoken in the city) conducted the interviews and discussions. These were tape-recorded, translated into French and transcribed by the same interviewers during the two days following each of the interviews. The texts were then coded into a suitable format for analysis using the NUD*IST software.

The qualitative data analysis was carried out in three phases. First, each interview was carefully worked through in order to understand the logic of each conversation. The second phase was the collective analysis of themes, which permitted the piecing together coherence of themes across interviews. Third, interviews and discussions were analyzed in terms of their meaning (semantic approach) in order to discover the empirical criteria that structure the semantic universes and, in particular, the language identifiers for specific groups.

[2] We have constructed an index as a measure of mother's welfare based on the housing characteristics (annex 1 for details).

[3] The first author of this study spent all of calendar year 2003 in Ouagadougou to design and oversee the qualitative data collection effort. She was heavily involved in all stages of the fieldwork and data analysis, and was responsible for coding the data in Nud*ist.

Table 5. Variables included in the piecewise exponential models with total number of children and percent distribution

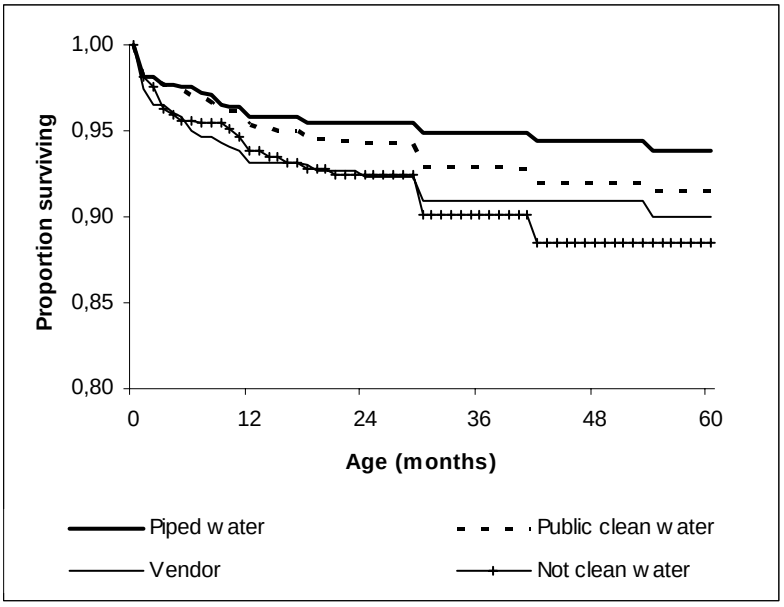
	Number of children	%
Source of drinking water (v)		
Piped water into dwelling or plot	715	19.7
Public point of clean water	2 089	60.6
Vendor	342	9.9
Not clean water	303	8.8
Sex		
Male	2 943	51.7
Female	2 753	48.3
Multiple births		
Yes	89	2.6
No	3 360	97.4
Birth order		
1	851	24.7
2^e-5^e	2 062	59.8
6^e et +	536	15.5
Period (v)		
1970-1979	261	7.6
1980-1989	878	25.4
1990-2000	2 310	67.0
Religion		
Muslim	2 110	61.2
Other (mainly Christian)	1 339	38.8
Ethnic group		
Moose	2 632	76.4
Other	813	23.6
Place of mother's birth		
Ouagadougou	1 185	34.3
Other urban	406	11.8
Rural : < 10 years spent in Ouagadougou(v)	711	20.6
Rural : >= 10 years spent in Ouagadougou(v)	810	23.5
Abroad	337	9.8
Mother's education		
No education	2 162	62.7
Primary incomplete	628	18.2
Primary complete	143	4.2
Secondary +	516	14.9
Household wealth index (v)		
Lowest	171	5.0
Second	1 778	51.5
Middle	1 144	33.2
Highest	356	10.3
Household waste disposal(v)		
Public discharge	1 005	29.1
Private service	797	23.1
Burning	348	10.1
Other	1 299	37.7

(v) Time-varying covariate whose value can change through the period at risk.

Quantitative results

Descriptive results Figure 2 displays Kaplan-Meier survivor functions for children according to the water access of their mother. Although the number of events is small, the effect of water access is fairly clear. Children with piped water in their dwelling or in their housing compound had significantly higher survival rates than did those without access to clean water (p=0.009). Differences between the survival curves of children with piped water access and those who water is delivered by a vendor were also significant (p=0.038).

Figure 2. Survival of children by drinking water access (Kaplan-Meier plot)



Even if the positive effect of piped water access appears to be clear, it is mostly evident only after infancy and especially after age 2.

Regression results Table 6 presents the estimated effects (in hazard ratios) of type of water access and other control variables on infant and child mortality. Four different regression models are estimated. The first model estimates the gross effects of water access on child mortality, controlling only for the bio-demographic variables and time period. The second model adds to these the cultural and socio-economic variables of the mother listed earlier. The two last models are similar, except that they allow the effect of water access to differ by the children's ages.

The results show that, after controlling for time and biodemographic variables (model 1) the effect of piped water access is substantial, in the expected direction, and more or less statistically significant. Especially, children whose drinking water is purchased from vendors or comes from not clean water sources are about two times more likely to die before age 5, compared to children with direct access to piped water. However, model 2 shows that when mother's cultural and socio-economic variables are introduced into the regression as control variables, this effect largely disappears and becomes insignificant. Mother's education alone is sufficient to render the effects of water source insignificant (results not shown). This finding is similar to those of other studies in other parts of the globe (Hobcraft *et al.*, 1984) which also found little or no significant effect of water supply on childhood mortality after controlling for socio-economic factors.

As expected, model 3 shows that the effect of water supply differs by the child's age. The protective effect of piped water access is generally strongest and most significant after infancy. However, these effects again become statistically insignificant once the socioeconomic, religious and cultural covariates are included in the regression (model 4).

Table 6. Hazard ratios of child mortality from piecewise exponential models

	Model 1	Model 2	Period of childhood	Model 3	Model 4
Source of drinking water [(v)] (piped water)					
Public point of clean water	1.36	1.01			
			< 1 month	1.03	0.74
			1-11 months	1.20	0.87
			12-59 months	2.14 **	1.63
Vendor	1.70 *	1.43			
			< 1 month	1.32	1.12
			1-11 months	1.92 *	1.61
			12-59 months	1.82	1.52
Not clean water	1.80 **	1.09			
			< 1 month	0.96	0.58
			1-11 months	1.81	1.09
			12-59 months	2.95 ***	1.83
Sex (male)					
Female	0.85	0.86		0.85	0.86
Multiple births (yes)					
No	0.31 ***	0.31 ***		0.32 ***	0.32 ***
Birth order (2-5)					
1	0.93	0.99		0.93	0.99
6 et +	1.28	1.26		1.28	1.26
Period [(v)] (1990-2000)					
1970-1979	1.61 **	1.47 *		1.61 **	1.47*
1980-1989	1.05	0.99		1.05	0.98
Religion (Muslim)					
Other (mainly Christian)		0.62 ***			0.62 ***
Ethnic group (*Moose*)					
Other		0.64 *			0.63 *
Place of mother's birth (Ouagadougou)					
Other urban		0.70			0.70
Rural : < 10 years spent in Ouagadougou[(v)]		0.99			0.99
Rural : >= 10 years spent in Ouagadougou[(v)]		0.78			0.78
Abroad		0.98			0.98
Mother's education (secondary +)					
No education		2.44 **			2.43 **
Primary incomplete		2.29 **			2.30 **
Primary complete		1.57			1.57
Household wealth index [(v)] (higher)					
Lowest		2.52 *			2.55 *
Second		1.45			1.47
Middle		1.55			1.57
Household waste disposal[v] (private service)					
Public discharge		1.78 **			1.78 **
Burning		1.26			1.27
Other		1.29			1.30
Baseline					
< 1 month	0.04 ***	0.02 ***		0.05 ***	0.02 ***
1-11 months	0.01 ***	0.00 ***		0.01 ***	0.00 ***
12-59 months	0.00 ***	0.00 ***		0.00 ***	0.00 ***

*** : p < 0.01 ; ** : p < 0.05 ; * : p < 0.1.
Reference category in parenthesis.
(v) Time-varying covariate which value can change through the period at risk.

Qualitative explanations for these results

The analysis of the qualitative data helps to provide further explanatory insights, particularly on the relation to water management within the household and water-related hygienic practices.

First of all, there is no standard use of water even when tap water is available in the house. Issues related to the domestic water management (abundance/control) or use (priority, quantity for each usage, storage, etc.) are important in and of themselves; quite apart from having data on availability (infrastructure, quantity and quality of water distributed) at the macro (the city) or meso (residential area) level. For example, even if a tap is available in the dwelling, it does not necessary mean that water is not draw from another sources, from public point clean water or purchased from vendors, due to intermittent flows and long outages of piped water supplied at home. In addition, clean water is not always clean. Even if the water is clean when it leaves the water center, cracked pipes and water cutoffs can lead to contaminated water that comes out of the tap. Moreover, water can become contaminated during storage in the house (Wright *et al.*, 2004), even if drinking water is obtained from a tap in the dwelling: in Ouagadougou, almost three quarters of the households which have water connection inside the compound or the dwelling unit still store water to have a sufficient amount of water available during the non-supply periods or for limiting the water wastes. And this stored water can become contaminated in numerous ways.

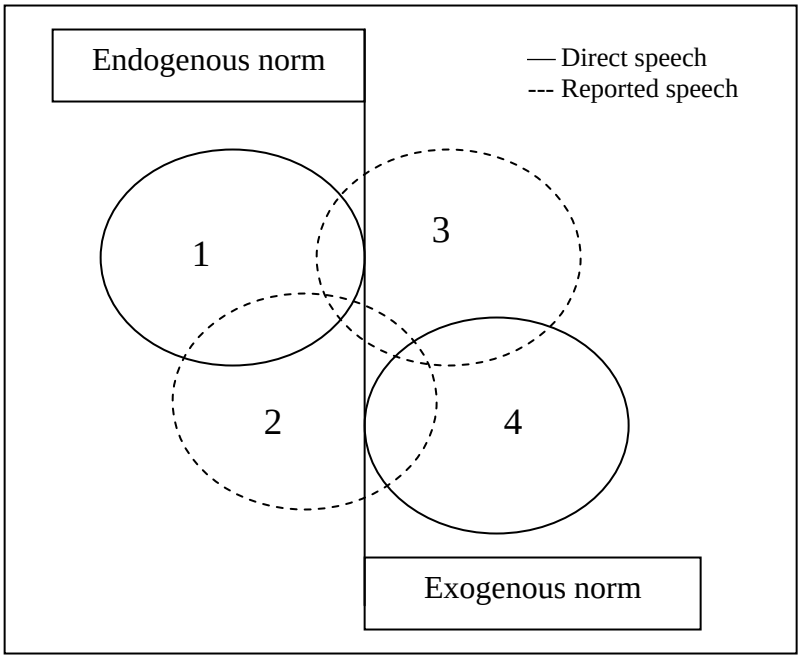
Secondly, it is necessary to understand the health-related knowledge and practices of the local population and to examine what they imply for hygiene in the biomedical sense. So, hygienic knowledge as a product of formal education has to be precisely examined.

In order to assess the extent to which knowledge of hygiene has been assimilated by the population (in terms of both awareness and practice), it is necessary to examine the significance of notions of *dirty/clean* and *disease transmission*. An example from the qualitative data serves to illustrate this point. A mother was observed to say that she washes her hands with soap in order to avoid “the disease catching her”. From this, one could mistakenly conclude that this woman has mastered the notion of hygiene. However, this same mother explained later in the interview why she believed that her child’s feces are not harmful to her, because it is her own child and because the child is still breastfeeding.

Simply stated, there are two types of knowledge relevant to explain relations between water and health; this is similar to the distinction made in anthropological literature with regard to two types of etiology (Charmillot, 1997 ; Bonnet, 2003): the endogenous norm, namely the popular conceptions, and the exogenous norm, that is the biomedical theory.

The analysis of speech collected during fieldwork shows that the social representations of the links between water and health related to the two above norms. Among other distinguishing criteria, two types of expression demonstrate acquisition of these norms by the speakers. The first style, which is direct, is characterized by the use of personal pronouns *"you"* or *"we"* or additionally by affirmatives; it marks acquisition of verbalized knowledge. The second, which is reported speech, is characterized by the personal pronoun *"they"* and the words *"people say that"* or similar phrases such as: *"At the dispensary, it is said that…"*. For purposes of conceptualization, four different types of speeches can be distinguished. It is worth mentioning that, as is evident in figure 2, the typology developed and presented here is flexible and not rigid, as the speeches can be placed at the intersection of these types and hence in the juxtaposition of the circles.

Figure 2. Diagrammatic Representation of Water and Health Relationships from Speech Analysis



In the first and fourth types of speech, expressed knowledge are not questioned by the speakers, they do not ask doubting questions about the subject : the relations between water and health are expressed as obvious and normal, referring to the endogenous norm for the first type, and to the exogenous norm for the fourth type. The individuals from whom these criteria were developed did not share many characteristics in common. Simply stated, the type 1 were more commonly used either by young rural uneducated people who had been in Ouagadougou since only recently, or by the men or women older than 50 years who have been living in the city for a long time but have never been to school and have had little contact with the exogenous norm (through health campaigns, visits to the health clinic, etc.). This type of speech is illustrated by the example given above of the woman who explains why a baby's stool is not harmful to health.

> Woman from downtown, 53 years, street-vendor, no education, non native (rural), has lived in Ouagadougou for 40 years:
>
> *"Yes, sometimes I listen to chats on the radio, when I am not working. However, that water gives rise to disease; it is you, the educated people, who say that. Otherwise, me, I have never seen that. That there are some things, that there is disease, in water? No, I have never seen that. I was born and grew up in the village. When I was young, we used to drink water from the creek and we never had any problem. At that time, we never heard that water caused problems. But now and before are not the same thing."*

> Woman from non-zoned periphery, 25 years, street vendor, no education, non native (rural), has been in the city for 1 year.
>
> *"Concerning disease, the question of whether I am clean or not does not arise. When disease is there, whether you are clean or not, it is there, that is all! Disease does not choose whether you are clean or not, it just catches you (….). We do not do anything to prevent ourselves from catching disease. There is nothing we can do about it!"*

In contrast, type 4 is used by highly educated and often young (under 35) speakers who grew up completely or almost entirely in the city.

> Woman from non zoned periphery, 33 years old, assistant in a popular child day care centre (she also prepares bags of water to sell in the street), secondary schooling, native.
>
> *"Concerning the washing of hands, in any case I never joke with it. Before "attaching"[4] water, you wash your hands well with soap. Then you rinse well. Then, before you settle down to "attach" water, you rinse again with filtered water. This is a decision that I took. And as soon as I am ready to work, children come and make fun of me. Because personal hygiene, even if it is not for you, but that of people who come and pay you 10 CFA, their*

[4] « Attaching water » is an expression in Ouagadougou that means to prepare little bags of cold water to sell in the street.

life is in your hands! Would you use your own money to buy disease? Therefore, with regard to hygiene, I do not joke. (……). I filter because the dirt in the water can lead to many diseases. Also, you can look at water and never discover the dirt, but still the water can give rise to disease."

On the other hand, the two other types of speech (with dotted lines in the figure) do not refer strictly neither to the endogenous norm, namely popular conceptions, nor exogenous norm, the biomedicine, but manifest awareness of mixed knowledge. In the second type of speech, the speakers no longer say *"you do this"* but *"in the village, it is said that"*, which implies an external reference when the endogenous norm is evoked.

Man from downtown, 23 years, manager of a water kiosk, secondary schooling, other urban, has been in the city for 7 years.

"People say: when it is clear, it means that it is pure, it is nice. But we do not know if this water does not contain dirt. It could be nice and yet contain dirt."

With regard to the third type, the speech makes reference to the exogenous norm, but in an indirect sense. This is what was transmitted in school, by health workers or through radio, and often makes reference to the Western standard, the White man's values.

Woman from non zoned periphery, 27 years, street-vendor, secondary schooling, native.

"I heard that if somebody passes stool in the open, the germs will not die. Then if the wind transports this to your water, and you drink the water, then even you yourself will catch disease. (…..). We learnt it at school, and over the radio."

In the two last cases above, these responses do not show a strong acquisition of knowledge but reveal, on the contrary, questions both on the endogenous norm, which is challenged, as well as on the exogenous norm which is kept at a distance. The individuals ask themselves questions concerning knowledge that they are exposing. In fact, type 3 forms the majority of the social representations by the population of Ouagadougou and illustrates the slow acculturation of the popular cognitive system of the links between water and health through hygienic practices. In addition, it is common to find that during the same interview, type 1 and 3 responses are intermingled.

Woman from downtown, 36 years old, food seller in a school, uneducated, native.

"Even you, you know that cleanliness means that bad diseases will be kept away from children. If a child is dirty, diseases will affect him or her. You know how children

behave, in order to eat, they do not look for water with which to wash themselves, they wipe themselves with their dirty clothes and dip their hand in the food. However, if it happens that his or her clothes are clean, even if he or her does not wash hands before eating, it would be better (…..). I have heard talks over the radio on health and cleanliness. They advise us to make an effort and ensure that the compound is clean, that even we ourselves should be clean. If it is food, we must ensure that it is clean before it is eaten, especially if it is a child. It is said that if a disease catches a child, if the child is clean, it will not be serious. But if the child is dirty, it will be serious."

To reduce germ theory to a single variable, namely education, appears insufficient because it assumes a radical change of the cognitive system. However, the message content of health education is often neither accepted nor rejected as such, but partially interpreted, giving rise to a new form. The mere fact that types 1 and 3 were the most frequently cited speeches demonstrates this slow acquisition of the exogenous norm. This acquisition could be possible within a long time-period, much longer than just a few years of primary school.

Conclusions

Water is broadly thought to be a key determinant of health and survival. Yet often in statistical studies a strong effect is not found. This may be caused by inadequate modeling of the effect, inadequate data, of that access to clean water in and of itself does not have a real strong effect – that the conceptualization around how water affects health is too partial.

In this study, results of the quantitative analysis show that the estimated effect of the type of water supply diminishes as other socio-demographic variables, and particularly mother's education, are introduced into the model.

In fact, while water uses depend on water supply, in terms of water quantity available in the household and, in some degree, water quality consumed (Howard and Bartram, 2003), hygienic practices specifically depend on perceptions and more generally social representations related to water and health.

It is therefore necessary to go beyond superficial statements often repeated from the IEC health campaigns in order to understand the assimilation of certain culturally foreign concepts regarding hygiene. While education may be necessary to gain biomedical knowledge, it was found to be often insufficient to significantly alter daily hygienic water-use practices, which are more the result of an acculturation process to new ways of thinking and behaving.

References

Blossfeld H.-P., Rohwer G., 2002, *Techniques of Event History Modeling. New Approaches to Causal Analysis*, London, Lawrence Erlbaum Associates, 310 p.

Blum D., Feachem R. G., 1983, "Measuring the impact of water supply and sanitation investments on diarrhoeal diseases : Problems of methodology", *International Journal of Epidemiology*, vol. 12, p. 357-365.

Bonnet D., 2003, "Transmissions, préventions et hygiènes en Afrique de l'ouest, une question anthropologique", *in: Les maladies de passage*, dir. par D. Bonnet et Y. Jaffre, Paris, Karthala (Médecine du Monde), p. 5-26.

Bradley D., 1977, "Health aspects of water supplies in tropical countries", *in: Water, wastes and health in hot climates*, dir. par R. Feachem et al., Chischester, John Wiley and Sons, p. 3-17.

Esrey S. A., 1994, *Multi-country study to examine relationships between the health of children and the level of water and sanitation service, distance to water and type of water used*, Montréal, Mc Gill University.

Esrey S. A., Habicht J. P., 1986, "Epidemiologic evidence for health benefits from improved water and sanitation in developing countries", *Epidemiological Review*, n°8, p. 117-128.

Esrey S. A., Potash J. B., *et al.*, 1991, "Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma", *Bulletin of WHO*, vol. 5, n°69, p. 609-621.

Hobcraft J. N., McDonald J. W., *et al.*, 1984, "Socio-economic factors in infant and child mortality : a cross-national comparison", *Population studies*, vol. 38, p. 193-223.

Howard G., Bartram J., 2003, *Domestic Water Quantity, Service Level and Health*, Geneva, WHO.

Poirier J., al., 2001, "Projet d'étude des stratégies de reproduction des populations sahéliennes à partir de l'enquête "Dynamique migratoire, insertion urbaine et environnement au Burkina Faso"", *Cahier québécois de démographie*, vol. 30, n°2, p. 289-309.

Prost A., 1996, "L'eau et la santé", *in: Populations et environnement dans les pays du Sud*, dir. par Gendreau et al., Paris, Karthala, p. 231-251.

Van Poppel F., Van der Heijden C., 1997, "The effect of water supply on infant and childhood mortality: a review of historical evidence", *Health Transition Review*, vol. 7, p. 113-148.

Wright J., Gundry S., *et al.*, 2004, "Household drinking water in developing countries : a systematic review of microbiological contamination between source and point-of-use", *Tropical Medicine and International Health*, vol. 9, n°1, p. 106-117.

Zerihun N., 1997, "Trachoma in Jimma Zone, South Western Ethiopia", *Tropical Medicine and International Health*, vol. 2, n°12, p. 1115-1121.

Annex 1 Variables include in the wealth index and their weight

	Percent	Weight
Walling material		
Cement	35.0	1
Stone	0.6	1
Mud	63.5	0
Other	0.9	0
Roofing material		
Corrugated iron with ceiling	11.3	1
Concrete	0.2	1
Corrugated iron without ceiling	87.7	0
Other	0.8	0
Flooring material		
Marble	0.3	2
Ceramic tiles	4.2	2
Cement	90.9	1
Earth	4.6	0
Type of lighting fuel		
Electricity	31.6	2
Paraffin lamp	67.9	0
Other	0.5	0
Type of cooking fuel		
Electricity	0.2	1
Gas	5.0	1
Petroleum	0.5	1
Charcoal	2.1	0
Firewood	91.7	0
Other	0.6	0