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Access to drinking water and health of populations in Sub-Saharan Africa

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A R T I C L E   I N F O

A B S T R A C T

Water is at the center of the plant and animal life, the foundation upon which the health of human settlement and development of civilizations rely on. In tropical regions, 80% of diseases are transmitted either by germs in the water, or by vectors staying in it. In Sub-Saharan Africa, statistics show particularly high levels of unmet needs of populations in access to drinking water in a context of socioeconomic development. For this purpose, this study aims to determine the influence of access to drinking water on the health of populations in Sub-Saharan Africa. Using data from Demographic and Health Surveys (DHS) from Cameroon, Senegal and Chad, it is clear from the descriptive analysis that 60% (Cameroon), and 59% (Chad) of the cases of childhood diarrhea in these two countries are due to the consumption of dirty water. In terms of explanatory analysis, we note that when a household in Cameroon, Senegal or Chad does not have access to drinking water, children under 5 years old residing there are respectively 1.29, 1.27 and 1.03 times more likely to have diarrhea than those residing in households with easy access to drinking water. In view of these results, it is recommended to increase access to drinking water in particular by reducing disparities between the rich and poor people.

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R É S U M É

L'eau est au centre de la vie animale et végétale, socle sur lequel reposent la santé du peuplement humain et le développement des civilisations. Dans les régions tropicales, 80 % des maladies sont transmises, soit par des germes contenus dans l'eau, soit par des vecteurs qui séjournent dans l'eau. En Afrique subsaharienne, les statistiques mettent en évidence des niveaux particulièrement élevés des besoins non satisfaits des populations dans l'accès à l'eau potable dans un contexte de précarité socioéconomique. À cet effet, la présente étude a pour objectif de déterminer l'influence de l'accès à l'eau potable sur la santé des populations en Afrique subsaharienne. Il ressort de l'analyse descriptive des données des enquêtes démographiques et de santé (EDS) du Cameroun, du Sénégal et du Tchad que 60 % (pour le Cameroun) et 59 % (pour le Tchad) des cas de diarrhée chez les enfants de ces deux pays sont dus à la consommation d'une eau non potable. Sur le plan explicatif, l'on note que, lorsque l'un des ménages camerounais, sénégalais ou tchadien n'a pas accès à l'eau potable, leurs enfants de moins de cinq ans ont respectivement 1,29, 1,27 et 1,03 fois plus de risque de contracter une diarrhée que ceux des ménages ayant facilement accès à l'eau potable. Au regard de ces résultats, il est recommandé d'accroître l'accessibilité à l'eau potable, en réduisant notamment les disparités entre les pauvres et les riches.

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1. Introduction

Water is certainly, among all the natural elements, the one, which is the most essential to people's life. Several studies agree that water is indispensable for economic development. However, water is responsible for several infectious diseases and thus, constitutes one of the major causes of mortality in low-income countries. In Sub-Saharan Africa, access to water remains a major concern for states and populations. Difficulties in accessing water are significant health issues, particularly in terms of diarrheal morbidity and malnutrition in children under 5 years [1,2]. Thus, recent studies have shown that diarrheal infections, which are mainly caused by the use of unsafe drinking water, were responsible for approximately 2.2 million deaths in 2001; two people over five lack drinking water in Sub-Saharan Africa. A baby of this part of the world is 520 times more likely to die from diarrhea than a baby in Europe [3]. In Cameroon, ECAM 2007 shows that 54.7% of the households do not have access to drinking water. The anthropometric results of Demographic and Health Surveys (DHS) indicate that 22.6% of the children suffering from diarrhea in 2004 consume water from an unprotected well. The situation is less different in Chad. Indeed, DHS 2006 [4] showed that 36% of Chadian households consume drinking water. This proportion varies from 30% in rural areas to 57% in urban ones. In N'Djamena, 61% of the households have access to drinking water. In the same survey, 27% of the children under 5 years suffered from diarrhea during the two weeks preceding the survey. The prevalence of diarrhea was particularly important in young children 6–11 months (40%). As in Senegal, the situation is almost similar to those of the above-mentioned two countries. In fact, the results of ESAM 2005 [5] indicate that 33.2% of the households have access to drinking water through an inside-house tap, while 32.8% use water from wells. Also, 93.5% of Senegalese spend at least 30 min to get water and come back. Moreover, this situation remains recurrent in many parts of the country, especially in rural areas.

As we approach the 2015 deadline set by the Millennium Development Goals (MDGs) of halving the proportion of people with no sustainable access to safe drinking water, it is important that we wondered about the lack of access to drinking water and their health issues. Thus, this paper provides an analysis of interactions between access to water (drinking water) and the health of populations in three countries in sub-Saharan Africa. To achieve this goal, the study attempts to verify the hypothesis that access or not to a source of drinking water or a water point influences health (diarrheic prevalence) of African populations. Specifically, it consists in estimating:

(i) the prevalence of diarrhea due to the inaccessibility of drinking water by households of the West and Central Africa countries retained;

(ii) the risk incurred by an outstanding children under 5 years to get diarrhea because of the lack of access of their parents to drinking water in these regions of Africa.

On the methodological level, this discussion is based on data from DHS conducted in these three countries. This article focuses on three points, namely: the social and institutional context, the methodology and the main results.

2. Social and institutional context

Regarding the Cameroonian context, with a population of 17 463 836 inhabitants in 2005 (GPHC), this country of Central Africa covers an area of 475 442 km^2. Its sex ratio is 92.6% and there are more than 230 ethnic groups. Its population is 55% urban while during the two last decades, it was mostly rural, 62% [6]. Today, it appears as one of the most urbanized countries in Sub-Saharan Africa because it features a balanced urban framework with two main areas: Yaoundé and Douala. The growth of the urban population is around 6% per year, while the total population increased by only 2.7%, with growth peaks in Yaoundé (7%) and Douala (6, 5%) [6]. Thus, the basic demographic indicators are typical of those of a developing country, with relatively high fertility and mortality rates. High mortality rates are usually due to bacterial infections, amoebiases, viral hepatitis, polio and other diseases related to the chemical and bacteriological quality of the water. Thus, between 2003 and 2006, intestinal helminthiases have affected more than 10 million of Cameroonians [6]. The burden of disease related to water and sanitation failure is 70%. It was observed that in 2008 these diseases accounted for nearly 21% of household income and represented an outflow of foreign currency in the order of 149.572 billion FCFA [6]. However, we note that, at the institutional level, Cameroon has, since December 2005, two new entities. These were created in order to enhance water provision across the country. This is the Cameroon Water Utilities Corporation (CAMWATER) and the operating company (Camerounaise des Eaux – CDE). Created by Decree No. 2005/494 of 31 December 2005, CAMWATER relies under the technical supervision of the Ministry of Water and the financial support of the Ministry of Finance. Thus, Cameroon has 103 urban drinking water stations and more than 3000 stations and rural water points. Urban stations are managed by CDE Company, while station management and rural water points are the responsibility of users themselves (village committees), under the supervision of MINEE. The coverage remains very low: 30% in urban areas and 40% rural. Thus, the need for water in both rural and urban areas is very important.

Contrary to Cameroon, the other central African country, which covers an area of 1 284 000 km^2, presents a large part of its territory in a desert zone. Such a context is unsuitable for agriculture and therefore causes the proliferation of several water-related diseases due to low rainfall. Data from GPHC 2009 estimate the Chadian population to 11 175 915 inhabitants, with a growth rate of 3.6%. The results of the 2006 DHS [4] showed that 36% of Chadian households consume drinking water. This proportion varies from 30% in rural areas to 57% in urban. In N'djamena, 61% of the households have access to drinking water. Among newborn babies under 2 months, 75% received breast milk with water only. The results show

that 27% of the children under 5 years suffered from diarrhea during the two weeks preceding the survey. The prevalence of diarrhea is particularly important among young children of 6–11 months (40%), as one of the major causes was the lack of drinking water.

With regard to Senegal, it is a Sahelian country that enjoys a large coastline on the Atlantic Ocean. This West African country covers an area of 193 000 km^2 for 9 858 482 inhabitants in 2002 according to the GPHC. Islam is the main religion in the country. Its population is predominantly rural (58.5%), more than half of urban residents (54.0%) live in the urban area of Dakar, which is fuelled by strong migration [7]. Although drinking water in Senegal is an ongoing concern of the Senegalese authorities, access to basic community services, including drinking water, remains unequal between areas of residence. Indeed, as rural dwellers, urban ones have a relatively similar access to drinking water. Thus, 92% of the Senegalese population is located on average to less than a half hour's walk from the point of connection to the mains water supply provided by SONEES [7]. However, there are significant disparities between areas of residence because less than a hundred people are struggling to get or fetch water in less than 30 min from her home, while more than 8% of the rural population live in this situation. Other cities are a little better stocked than the rural, even though more than three hundred people are located to more than a half

hour's walk from their water points. To meet their water needs, people use several sources (taps, wells, etc.). This has no effect on their health. Indeed, the results of DHS (2005) [5] indicate that diarrheal diseases are, directly or indirectly, a leading cause of death among young children in Senegal. Therefore, it is clear from these results that in 2005, 22% of these children had suffered from diarrhea in the two weeks preceding the survey. The diarrhea prevalence is particularly high among young children aged 6–23 months (about 32% to 34%). But in order to remedy this, the WHO advices to use a prepared solution at home with drinking water.

3. Methodology

3.1. Analysis method

The methods used in this study are descriptive and explanatory analyses. In a first step, we used a bivariate analysis to estimate the prevalence of diarrhea due to the unavailability of drinking water to households in Central African countries, where the time taken to get or fetch water will be evaluated using the Chi^2 statistic and its significance level (5%). Second, the explanatory analysis will be done through econometric methods that consist in taking into account all the variables in order to assess the specific effect of each independent variable on the

Table 1
Occurrence of diarrhea among children under five, depending on various variables.

Variables	Prevalence of diarrhea					
	Cameroon		Senegal		Chad	
	N	%	N	%	N	%
Access to water						
Drinking water	328	40.44	1005	93.5	379	42.02
Unsafe drinking water	483	59.56	70	6.51	545	58.98
Both	811	100.0	1075	100.0	924	100.0
Chi^2	0.071[*]		0.271[ns]		0.018[**]	
Time spent to fetch water						
Less than 30 min	627	77.31	859	79.91	485	52.49
More than 30 min	184	22.69	216	20.09	439	47.51
Both	811	100.0	1075	100.0	924	100.0
Chi^2	0.167[ns]		0.895[ns]		0.590[ns]	
Sex of HH[*]						
Male	683	84.22	942	87.63	821	88.85
Female	128	15.78	133	12.37	103	11.15
Both	811	100.0	1075	100.0	924	100.0
Chi^2	0.026[**]		0.111[ns]		0.035[**]	
Living standards of HH[*]						
Low	446	54.99	788	73.30	289	31.28
Average	170	20.96	237	22.05	136	14.72
High	195	24.04	50	4.65	499	54.0
Both	811	100.0	100.0	100.0	924	100.0
Chi^2	0.000[**]		0.007[**]		0.431[ns]	
Place of residence						
Urban	261	32.18	141	13.12	393	42.53
Rural	550	67.82	934	86.88	531	57.47
Both	811	100.0	1075	100.0	924	100.0
Chi^2	0.000[**]		0.004[**]		0.350[ns]	

%: percentage or proportion; N: total; ns: non-significant at 5%.
[*] HH: household head.
[**] Significant at 5%.

Table 2
Relative risk of occurrence of childhood diarrhea for children under five (results of logistic models).

Explanatory variables	Prevalence of diarrhea		
	Cameroon	Senegal	Chad
Access to water	**	**	**
Drinking water	(r)	(r)	(r)
Unsafe drinking water	1.29**	1.27**	1.03**
Time spent to fetch water	ns	ns	ns
Less than 30 min	(r)	(r)	(r)
More than 30 min	1.02ns	0.97ns	0.99ns
Sex of HH[*]	**	ns	**
Male	(r)	(r)	(r)
Female	1.19*	1.31ns	0.815**
Living standards of HH	**	**	**
Low	0.52**	1.31*	1.01ns
Average	0.69**	1.09ns	1.10**
High	(r)	(r)	(r)
Place of residence	**	**	**
Urban	(r)	(r)	(r)
Rural	1.09**	1.83**	1.11**
Total	**4185**	**3728**	**3111**
Chi^2	**62.45****	**15.88****	**63.63****
−2 ln likelihood	**−2023.186**	**−2230.92**	**−4096.57**

ns: non-significant at 5%; r: reference modalities.
[*] HH: household head.
[**] Significant at 5%.

dependent variable and explain the variation of the latter. This will help to understand the mechanisms through which access to water affects the health of children. The interpretation of the results will focus on the risks faced by children having diarrhea.

3.2. Variables

The dependent variable is the prevalence of diarrhea among children at the time of the survey, while access to drinking water is captured by the source of drinking water (or drinking water point) and the time to stock up. However, it seems appropriate to check whether access to water, apart from other factors that could play an intermediary role, has a specific effect on the health of children. Intermediate variables used for this purpose are as follows:

(i) family characteristics, such as the level of education of the household head, gender, household size and the standard of living of the household in which the child lives;
(ii) the demographic characteristics of the child, such as age and sex.

3.3. Data

This study uses data from the DHS conducted in Senegal and Chad in 2005 [8], and Cameroon in 2004 [9]. Information about the population's access to drinking water is contained in the household file, whereas the measurement of the diarrheic incidence is in the child file.

4. Results and discussion

4.1. Descriptive results

Table 1 shows that access to drinking water is significantly associated, with a 5% threshold of confidence, with the occurrence of diarrhea in Cameroon and Chad. Thus, 60% and 59% of children have diarrhea when they consume unsafe drinking water. We note, however, that whatever the country, the occurrence of diarrhea was not significantly related to the time taken to fetch drinking water.

The chi^2 test also shows that there is a link between the level of living of the household and the occurrence of childhood diarrhea in Cameroon and Senegal. Thus, 73.3% of the occurrence of diarrhea in Senegal affects households with low standards of living against 4.65% in the case of rich households. This is almost similar to the case of Cameroon. Table 1 also shows that the place or area of residence is significantly related to the occurrence of childhood diarrhea in Cameroon and Senegal. Indeed, a relatively high proportion – 67.82% (Cameroon) and 86.88% (Senegal) – of children under 5 years, who live in rural area, had diarrhea (respectively, 32.18% and 13.12% for those dwelling in urban zones).

4.2. Results of multivariate analysis

Table 2 presents the results of multivariate analyzes for Cameroon, Senegal, and Chad. Of the two variables used to operationalize the population's access to drinking water, i.e. water and the time taken to get or fetch drinking water, only the first one is a significant factor for the occurrence of

diarrhea for children under 5 years in Cameroon, Senegal, and Chad. All things being equal, examination of Table 2 indicates that the lack of access to drinking water negatively affects the risk of diarrhea in children in these three countries. From the regression results, it appears that when a household in Cameroon, Senegal, and Chad does not have access to drinking water, children residing there are 1.29, 1.27 and 1.03 times, respectively, more likely to get diarrhea than those dwelling in households with easy access to drinking water. However, although there is no significant relationship between the time taken to fetch drinking water and the occurrence of childhood diarrhea, we note that children living in households that spend more than 30 min to fetch drinking water in Cameroon are more likely to get diarrhea than those who live in households for which access to drinking water is done in less than 30 min.

Besides these two variables above, it should be noted that the standard of living of the household and the place of residence in which the child is located influence children's health. Therefore, Senegalese children living in households with low standards of living are 1.31 times more likely to get diarrhea compared to those living in households with high living standards. In addition, the risk of diarrhea for children is higher in rural than in urban areas. Thus, whatever the country, children living in rural areas are 1.09 (Cameroon), 1.83 (Senegal) and 1.11 (Chad), respectively, more likely to get diarrhea than children living in rural areas.

5. Conclusion

The aim of this study was to analyze the relationships between access to drinking water and population health through survey data. It appears from this study that access to drinking water affects population health, especially children. Indeed, analyzes suggest a positive relationship between the lack of access to drinking water and the occurrence of childhood diarrhea in Cameroon, Senegal and Chad. However, analyses reveal the absence of any link between the time spent to get or fetch water and the risk of occurrence of diarrhea. Everything leads us to believe that the risk of occurrence of diarrhea is much more related to the lack of access to drinking water, the living standards of households and the place of residence. Then, this work can be considered as a first tentative to explain the relationship between people's health and access to drinking water.

Disclosure of interest

The authors have not supplied their declaration of conflict of interest.

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