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Research Article

Study of Factors Associated with the Open Defecation (OD) in Dakar semi-urban Area in Senegal

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Abstract

Introduction: Open defecation remains a major problem of environmental health around the world, impacting almost one billion, which many sub-Saharan African countries are confronted with. This study sets out to examine the factors linked to the practice of open defecation (OD) within the semi-urban area of Dakar in Senegal.

Method: It is about an analytical and transversal study, carried out in June 2018 among households situated in the health districts of Mbao, Keur Massar and Guédiawaye. A two-stage stratified random sampling had been performed and data entered on tablets using CS Pro software and descriptive analysis and regression performed with R 3.4.4 software.

Results: A total of 533 households were surveyed. Heads of household had an average age of 52.6 years + - 13.8, were male in 59.8%, married in 78.8%, and uneducated in 15.2%. The majority of households (54%) consisted of more than 10 people. Regarding sanitation, three households did not have toilets and 23% of shared households shared their toilets.

The prevalence of open defecation (OD) at least once during the year was estimated at 17.0%, including 2% who practiced it every day.

The factors linked to the practice of open defecation (OD) were the non-drinkability of water (ORaj = 2.57 [1.56-4.13]), the characteristic of housing with a home floor not made of ceramic tiles (ORaj = 1.93 [1.18-3.14]) and toilet cleaning less than seven times per week (ORaj = 3.43 [1.42-8.28]).

Conclusion: Eliminating open defecation will mean improving access to safe drinking water, improving housing characteristics and regular toilet maintenance.

Keywords: Water, Hygiene, Sanitation, Open defecation, Semi-urban

Introduction

Africa has experienced strong population growth, particularly in regional capitals after independence in the 1970s with a rural exodus to urban centers housing administrative and economic services leading to an expansion of the urban fabric and the creation of semi-urban areas [1,2], visualized by an increase in population.In the case of Senegal, the population increased from 4,958,085 inhabitants in 1976to 13,508,715 in 2013. However, this population is unequally distributed between its capital and the rest of the territory [3], indeed the region of Dakar (capital) with a population of 3,137,196 inhabitants, or nearly a quarter of the total population (23.2%) spread over 0.28% of the area [4], is experiencing a problem of space to which is added the nature of its site characterized by the proximity of the water table. This rapid population expansion, accentuated by the construction of the Dakar - Diamniadio highway in 2008, reinforced a demand for land that has become unsustainable in semi-urban areas, which concerns the localities of Guédiawaye, Mbao, Keur Massar, with the creation of urban slums being nearby the source of the problem of supply and demand for sanitation. Indeed, the population having not a complete drainage system for wastewater, has opted for non-standard individual sanitation with the risk of infiltration and contamination of groundwater. Globally, according to the Water and Sanitation Progress Report, published jointly by WHO and UNICEF in 2017, one in three people in the world, or 2.3 billion people, do not still have basic sanitation service, 600 million people used limited sanitation service, that is to say improved facilities shared with other households, and 892 million people worldwide practiced open defecation

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again [5]. This report also indicates that in Senegal, significant efforts remain to be made since less than half (48%) of the population has improved latrines (35% rural and 66% urban); 22% use unimproved latrines (31% rural and 9% urban) and 15% practice open defecation OD (25% rural and 2% urban) [5].

Access to adequate sanitation contributes to the improvement of living conditions and the fight against many communicable diseases. Although easily preventable, sanitation-related diseases remain one of the most serious child health problems around the world [6]. Indeed, an unhealthy environment is a source of health risks. An estimated 1.8 million people, mostly in developing countries, die from diarrheal diseases (including cholera) and 88% of this morbidity is attributed to poor sanitation and poor hygiene [6.7]. This health situation has complex impacts on the economy. In fact, Niger loses $148 million each year, which is equivalent to 2.4% of the national GDP [8]. At the sub-regional level, Benin, through an assessment of the impact of access to water and sanitation, found that it was losing US $ 79 million each year due to premature deaths and US $ 3.1 million from health care [9]. In order to understand the WASH situation in the Senegalese capital, this situational study on sanitation in the Dakar suburbs and the factors associated with the practice of open defecation is proposed. This diagnosis will help to better orient interventions aiming at reducing disparities and improving people's access to sanitation in the semi-urban area of Dakar.

Study Framework

The region of Dakar is located in the peninsula of Cape Verde, limited to the east by the region of Thiès and by the Atlantic Ocean in its northern, western and southern parts and coversan area of 550 km^2 for a population of 3,137,196 inhabitants, that is a density of 5,704 inhabitants / km^2 [4]. The study was carried out in the three districts of the semi-urban area of the Dakar region that are Keur Massar, Guédiawaye and Mbao which are characterized by a high population density with respectively 18,187 inhabitants / km^2 for a population of 545,603 inhabitants, 12,688 inhabitants / km^2 for a population of 355,525 inhabitants and 11,717 inhabitants / km^2 for a population of 374,944 inhabitants against a national average density of 65 inhabitants per km^2. The lack of industrial activity and service zones means that this zone mainly houses low- income economic activities, mainly informal sector activities such as market gardening, arboriculture, commerce, crafts, fishing and livestock which account for nearly 85% of the working population [4,10]. In terms of health, there are gaps in the structure of a health center, with reference to the National Health and Social Development Plan NHSDP 2019-2028, knowing that each district has only one and that the standard is one center for 100,000 inhabitants [11].

Methodology

Type of study: This was a cross-sectional, descriptive and analytical study at the household level, conducted from June 18 to 28, 2018 in the semi-urban area of the Dakar region

Study population: The study population consisted of all residents for at least six months, with the household sampling unit having a child under the age of five. Statistical units bythe head of household (Male or Female) or other respondent aged at least 18 years.

Sampling: The sample size was calculated by Schwartz's formula ($N = Z\alpha\ ^2P\ [1-P] / i^2$) for a prevalence (**P**) of 50%, with a reduced deviation (**Zα**) of 1.96 for α = 5% and a precision (**i**) of 0.05. Thus the calculated size N was 384, taking into account the refusal rate and for more power, the size was increased to a minimum of 400 individuals.

A two-stage stratified random sample had been carried out. Firstly, there was the identification of the piezometers (sampling points for physico-chemical and microbiological analyzes of the water table) located in the districts drawn proportionally on a database of 79 piezometers located in the districts of the area study provided by the hydrogeology team of the science faculty of Cheikh Anta Diop University in Dakar. Secondly, according to the number of neighborhoods (water point) per health district, a stratification was carried out and made it possible to obtain the number of households needed per health district and per selected neighborhood. Then the selection of households was made step by step with a sampling step of five right-left concessions and so on.

Data collection: Before data collection, the investigators were trained, 12 in number, 3 of whom are officers from the hygiene services. The questionnaire was adapted from the Sanitation, Focus-Opportunity-Ability-Motivation (SaniFOAM) framework [12]. This questionnaire was then loaded into Android tablets using Cs Pro software, which enabled data to be entered instantly.

Data analysis: At the end of the survey, the data were extracted, before being analyzed using R 3.4.4 software. The quantitative variables were described by the average with its standard deviation and the qualitative variables by the frequency. For the analytical study, the Khi 2 test and Fisher's test were used with an alpha risk of 5%. To take into account confounding factors, a multivariate analysis was performed. The latter used a simple logistic regression model, taking into account in the initial model all the variables whose p is less than 0.25 in the bivariate analysis. The comparison of the models was performed by the likelihood ratio test with a top-down procedure [13]. The relevance of the model was studied by the test of Hosmer and Lemeshow. The measure of association was the adjusted odds ratio and its confidence interval was 95% [14].

Ethics: An investigation authorization has been issued by the health authorities. The free and informed consent of each person to be surveyed was obtained before the interview. These people could stop the interview at any time and even withdraw from the study without prejudice. Anonymity was respected and the results were kept confidential.

Results

Descriptive study

The study involved a total of 533 people spread over three health districts of Guédiawaye (26.6%), Keur Massar (58.7%) and Mbao (14.5%). The average age of heads of household was 52.6 years (13.8 years) and a median of 52 years. They weremen in 59.8% with one, predominantly married with 78.8% and have at least a secondary school level (31.5%). A quarter (25.3%) of household heads were unemployed and the poorest socio-economic well-being quintile was the most represented with 29.3% of households (Table I).

The study found a toilet availability within households of 99.4% of which manual flush toilets with sealed pit were the most observed with 89% and traditional toilets represented 0.2%.

The proportion of shared toilets was 23% or in 122 households. Among which toilets shared with more than two households were predominant with 68.9%. Referring to the improved toilets, they were present in 76.5% of households.

On the day of the survey, 2.8% of households did not have a functioning toilet, that is 15 of the 533 households and over the past six months, this proportion was 34%, i.e. in absolute terms of 181 households, one of which main reasons was that the pit was full in 82.4% (150/181). Of this proportion of non-functional toilets (34%), the majority of households,
131 of the 181 (72%) continued to use the same toilet. The prevalence of open defecation at least once during the year was 17%, of which 2% did so almost every day.

Household use of improved water source represented 97.0% or 517 households, predominantly domestic service water with 92.5%. The presence of a hand washing device was observed in 52.5% of households. The proportion of individuals who routinely washed their hands with soap after defecation was 86.7% of the population, or 462 households (Table II).

Analytical study

The final multivariate regression model retained integrated the following variables because of their significance: the non-drinkability of water (ORaj = 2.57 [1.56-4.13]), the characteristic of housing with a home floor not made of ceramictiles (ORaj = 1.93 [1.18-3.14]) and toilet cleaning less than seventimes per week (ORaj = 3.43 [1.42-8.28]). The model also found insignificant variables such as the source of water for drinking and the washing of hands after toilet (Table II).

Discussion

The study covered a total of 533 households spread over three health districts, Guédiawaye with a proportion of 26.8%, Keur Massar with 58.7% and Mbao 14.5%. The average age of the heads of household was 52.6 ± 13.8 years, indicating thatthe households belonged to the group of economically active persons [15]. Male heads of households accounted for 59.8%, which reinforces the belief that men are generally considered to be heads of households. The average size per household was 11.3
± 6 people. These figures are superimposable with the study by Faye A et al, carried out in the rural community of Ngohé [16]. Heads of married households accounted for 78.8% and had at least a secondary education level which predominated in 31.5% and 15.2% had no education. The study had shown that 25.3% of heads of households had no income-generating activity and nearly half of them (48.8%) worked in the informal sectors of construction, agriculture, breeding and fishing. This high proportion can be explained by the facts that this study area is located in part in the Niayes area characterized by the practice of market gardening, poultry farming and the proximity of the north coast of Dakar [17].

The study found 99.4% toilet coverage in households. This rate is higher than the various results of studies carried outin Senegal and Africa [18-20]. In this mixed zone with both urban and rural characteristics and an increasingly urbanized population most often opts for a water-tight (89%) and septic (8.4%) pit sanitation system that is more expensive in the absence of a wastewater drainage system. This urbanization is accompanied by the creation of slums and the coexistence of several households within the same concession who share the same toilets and the study found a 23% share with other households.

The proximity of the water table and the virtual absenceof a wastewater evacuation system are incriminated in the contamination of groundwater by infiltration despite the useof so-called improved toilets with the existence of a sealed pit. The study found the presence of 76.5% of improved latrines / toilets not shared with strong disparities between the different districts of Guédiawaye (81.1%), Keur Massar (78.6%) and Mbao (59.7%). This indicator is higher than that of the national level which was around 49.3% with 58.1% in urban areas and 39.8% in rural areas according to the continuous EDS 2017 as well as the multiple indicator cluster survey ofthe Dakar region which found 68.6% [21] in 2016. On the other hand, this result is lower compared to the study by Beck
[18] which found for the entire region of Dakar 93% improved toilets. This difference could be explained by the fact that in our study, the department of Dakar (100% improved toilets)was not included [4].

Toilet use by respondents with or without an improved toilet was 91.9%. The availability of functional toilets until the day of the survey was 97.2% and the existence of a non-functionality in the last 6 months was 65.9%%.

The practice of open air defecation (OD) was found in 17% interviewed, of which 1.9% practiced it systematically every day. While OD is also significant in this area compared to the national survey (EDS 2017) which found 1% of OD in urban areas [22], this is circumstantial with dirty and poorly maintained toilets or when the pit is full while waiting to find the means of payment for a private emptying service. It was most often done in houses under construction or abandoned. One carried out in rural India had found a similar trend despite high access (72%) to toilets, the OD also remained high (29%) [23].

If access to sanitation and more specifically to quality latrines is an important factor in terms of health, the link is not systematic, which tends to indicate that one should not only focus on the coverage of access to sanitation but also on the use of latrines and the reduction of exposure to defecation.

The study of the determinants of the practice of open defecation made it possible to identify that the use of unsanitary or non-potable water within the household was significantly associated with it (ORaj = 2.57 [1.59-4.13]). Having tap water did not significantly influence OD practice (P = 0.145). Similarly, hand washing after the toilet was not associated with the practice of OD (P = 0.202). The floor of the dwelling remains an important variable whatever the household, the chances of practicing OD are significantly higher in households with a floor made of materials other than tiles (ORaj = 1.93 [1.18-3, 14]). Toilets are often the image of housing, the low incomes of heads of household and the high rate of unemployment resultin the use of poor building materials for latrines which do not provide enough privacy and convenience could encourage the practice of OD.

The frequency of latrine / toilet cleaning is also associated with the OD (P = 0.006). In fact, households that cleanedless than 7 times per week had 3.43 (CI _ 95% [1.42– 8.28]) more risk of practicing OD compared to households thatmaintained toilets more than 7 times a week. Low income levels may also encourage the sharing of latrines, a common practice inthe study area, with half of the latrines being shared by more than one household. Sharing latrines goes hand in hand with dirty latrines [24]. Dirt in latrines may be one of the factors that explains why some households had a latrine but did not use it, Busienei's study [25] on OD in Kenya found more than three quarters of surveyed people who said that human excreta on latrine floors and filled or blocked latrines encouraged OD.

Conclusion

The study revealed that the factors associated with the practice of open defecation in the semi-urban area of Dakar were mainly related to environmental hygiene as a whole (non-potable water, housing characteristics and toilet maintenance).

It is obvious that development policies are not always followed by strategies for expanding basic urban services for the benefit of populations living in the unfavorable suburbs of large cities. A gift that was mainly dedicated to rural areas. It is necessary to strengthen in the expansion zones of the big cities the strategies of promotion of environmental health associated with communication strategies for a change of behavior with a focus on hygiene.

Limits

However, this study has limitations. The measurement of certain behaviors such as hand washing at the exit of the latrine and the practice of OD could be over or underestimated because even if they do not do it the respondents may tend to respond with the affirmative for washing and negation for DAL. It is also difficult to verify whether these practices are systematic.

Conflict of interest

This work does not present any conflict of interest.

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APPENDICES

Table I : Breakdown by personal characteristics of heads of household

		Absolute frequency (n)	Relative frequency (%)
Health district	Guédiawaye	143	26.6
	Keur Massar	313	58.7
	Mbao	77	14.5
Sex	Male	319	59.8
	Female	214	40.2
Marital status	Maried	420	78.8
	Widow (er)	73	13.7
	Single	23	4.3
	Divorced/Separate	16	3.0
	Cohabitation	1	0.2
Instruction level	No education	81	15.2
	Koranic education	152	28.5
	Primary	124	23.3
	Secondary and above	168	31.5
	DNK	8	1.5
Household size	< 10 people	245	46.0
	10 people and more	288	54.0
Main activity of the head of household	Informal sector (Agriculture, farming, fishing, building)	260	48.8
	Administrative / employee	46	8.6
	Technician	17	3.2
	Senior executive	14	2.6
	Domestic worker	2	0.4
	Other	59	11.1
	None	135	25.3
Socio-economic well-being quintile	The poorest	156	29.3
	The second poorest	60	11.3
	The average	106	19.9
	The second richer	137	25.7
	The richest	139	13.9
Home floor	Ceramic tiles	279	52.3
	Other material cement, carpet...	254	47.7

Table II : Environmental characteristics of households

			Absolute frequency (n)	Relative frequency (%)
Availability of latrines / toilets		No	3	*0.6*
		Yes	530	*99.4*
Type of latrines / Toilets available		Manual flush toilets (MFT)/ watertight pit toilet	475	*89.0*
		Septic tank toilets	45	*8.4*
		VIP double pit latrine	3	*0.6*
		Single pit VIP latrines	3	*0.6*
		Double ventilated latrines (DVL)	2	*0.4*
		Ecological toilets (Ecosan)	1	*0.2*
		Traditional latrines	1	*0.2*
		No toilet / latrine	3	*0.6*
Sharing latrines / toilets with other households		No	408	*77.0*
		Yes	122	*23.0*
Number of households sharing toilets / Latrines N=122		With 1 household	28	*22.9*
		2 households and more	84	*68.9*
		DNK	10	*8.2*
Type Latrines/Toilets	**Improved toilets**	Manual flush toilets (MFT) watertight pit toilet	362	*68.0*
		Septic tank toilets	39	*7.1*
		VIP double pit latrine	3	*0.6*
		Single pit VIP latrines	2	*0.4*
		Double ventilated latrines (DVL)	1	*0.2*
		Ecological toilets (Ecosan)	1	*0.2*
		Total	**408**	***76.5***
	Shared unimproved toilets	Manual flush toilets (MFT) watertight pit toilet	112	*21*
		Septic tank toilets	7	*1.3*
		Double ventilated latrines (DVL)	1	*0.2*
		Single pit VIP latrines	1	*0.2*
		Traditional latrines	1	*0.2*
		No toilet/latrine	3	*0.6*
		Total	**125**	***23.5***
Latrines currently operational		No	15	*2.8*
		Yes	518	*97.2*
Existence of non-funtionality of latrines/toilets in the last 6 months		No	351	*65.9*
		Yes	181	*34.0*
		Do not know	1	*0.2*
Main reason for the non-functionality of the toilet (N=181)		The super structure has collapsed	11	*6.0*
		The pit was full	150	*82.4*
		The pit has collapsed	8	*4.4*
		Others	13	*7.1*
		Latrines/Toilets	131	*72.4*

			Absolute frequency (n)	Relative frequency (%)
Main place of defecation during the last 6 months of non-functioning toilets/Latrines (N=181)	still used			
	At a neighbor's house / family		34	*18.8*
	Open defecation		9	*5.0*
	Others		7	*3.9*
Number of latrine / Toilet cleanings per week	7 times and more		25	*4.7*
	Less than 7 times		508	*95.3*
Open defecation practice	**Yes**	Always	10	*2.0*
		Most of the time	1	*0.2*
		Sometimes	14	*2.6*
		Rarely	65	*12.2*
		Total	**90**	***17.0***
	No		**443**	***83.0***
Potability assessment of drinking water	Yes		343	*64.4*
	No		190	*35.6*
Main source of drinking water	**Improved source**	Running water in the house (tap)	493	*92.5*
		Public drinking fountain	19	*3.5*
		Bottle water	3	*0.6*
		Protected wells	2	*0.4*
		Total	**517**	***97.0***
	Unimproved source (Unprotected wells, others)		**16**	***3.0***
Type of water source intended for consumption	**Service water** (Tap, fountain, Bottle)		515	*96.6*
	Groundwater (tradtional pump, well)		18	*3.4*
Existence of hand washing near the toilets	Yes		280	*52.5*
	No		253	*47.5*
Systematic hand washing with soap after defecating	Yes		462	*86.7*
	No		71	*13.3*

Table III: Multivariate analysis of the determinants of open defecation

	OD (Yes)					
	Yes		Total	**OR b** [IC 95%]	**P value**	**OR aj** [IC 95%]
	n	**%**	**N**			
Potability						
Yes	42	*12.2*	343	Ref	**< 0.001**	Ref
No	48	*25.2*	190	2.42 [1.53-3.84]		2.57 [1.59-4.13] *
Source of water for drinking						
Other sources (Well, Pump)	1	*4.7*	18	Ref	0.145	Ref
Tap water (home, fountain)	99	*17.3*	515	4.04 [0.53-3.76]		4.57[0.59-35.28]
Housing floor						
Ceramic tiles	36	*12.9*	279	Ref	**0.008**	Ref
Other materials	54	*21.2*	254	1.82 [1.15-2.89]		1.93 [1.18-3.14]*
Hand washing after toilet						
Yes	71	*15.3*	462	Ref	0.202	Ref
No	19	*26.7*	71	2.01 [1.12-3.6]		1.51 [0.80-2.85]
Number of toilet cleanings per week						
7 times and more	11	*44.0*	25	Ref	**0.006**	Ref
Less than 7 times	79	*15.5*	508	4.27[1.87 – 9.74]		3.43 [1.42 – 8.28]*

***Significance of the odd ratio**