MALARIA JOURNAL

RESEARCH Open Access

Perceived malaria in the population of an urban setting: a skipped reality in Dakar, Senegal

Abdoulaye Diallo[1,2*], Stéphanie Dos Santos[3], Richard Lalou[4] and Jean-Yves Le Hesran[1,2]

Abstract

Background: Urban malaria remains a public health problem. Dakar is located in a low endemic area. However, anti-malarial drugs consumption is reported to be high despite the decline of malaria announced by health authorities. The objective of the present study was to assess the burden of reported malaria attacks (RMAs) in 2008 and to describe care-seeking behaviours in the population of Dakar, Senegal.

Methods: In this cross-sectional study, 2,952 households selected from 50 sites were visited. In each household, a women and a child between two and 10 years old were interviewed about a malaria episode that occurred in 2008. The following information was recorded: age, education level, sex (for children), type of care seeking, method of diagnosis, use of anti-malarial treatment, place of medication purchase, bed net use, malaria-related deaths in the family, and perceptions of the frequency of mosquito bites. After a description of the variables in each subsample, a Pearson's chi-square test was used to compare proportions, and logistic regression was performed to identify the association between RMAs and other covariates.

Results: Among women, 31.8% reported a malaria attack in 2008; among children, the rate of malaria attacks reported by mothers or caretakers was 39.0%. With regard to care-seeking, 79.5% of women and 81.5% of children with a RMA had visited health facilities (HFs). Younger women and children under five years old were more likely to visit a HF ($P<0.001$). Presumptive diagnosis was the primary method that was used to identify malaria in HFs. For those who had visited a HF, the rate of anti-malarial treatment was 77% in women and 60% in children. Finally, 43.6% of women and 42.0% of children declared the use of bed nets. In a multivariate analysis, the malaria-related death of a relative and perceptions of mosquito bites were significantly associated with RMAs in women. In children, age was associated with RMAs.

Conclusion: The frequent perceptions of the occurrence of malaria in the population were confirmed at the HF by the high presumptive diagnosis of health professionals. Despite the decline of malaria that has been announced by health authorities, the population will continue to complain of malaria and seek care directly at private pharmacies. This situation may sustain the circulation of anti-malarial drugs and increase the risk of an emergence of anti-malarial resistance.

Background

Malaria is reported to be more prevalent in rural areas compared to urban settings [1,2]. It is well known that urbanisation is highly associated with the decline of malaria transmission [3]. Indeed, many studies have reported little or no malaria transmission in major African cities, as urban settings are less favourable for vector breeding sites [4,5]. However, despite a low rate of transmission, malaria remains a major public health problem in urban areas, as it currently impacts more than 50% of the African population and is expected to impact at least 60% of the population by 2050 [6]. Moreover, *Anopheles* mosquitoes can potentially breed in polluted urban areas [7,8], which suggests the possibility of an increase in the transmission of malaria.

Dakar area is located in a low transmission area. First two studies in suburbs (Pikine) [9,10] had found in the early 80's an annual entomological inoculation (EIR) rate

* Correspondence: diallaye@yahoo.fr
[1]Institut de Recherche pour le Développement, UMR 216, Mère et enfant face aux infections tropicales, 4 avenue de l'Observatoire, Paris 75270 cedex 06, France
[2]Université Paris Descartes, Sorbonne Paris Cité, Faculté des sciences pharmaceutiques, 4 avenue de l'Observatoire, Paris 75270 cedex 06, France
Full list of author information is available at the end of the article

was 47 in 1979 and 0.4 in 1988. In addition parasite prevalence was 8.8% in children aged 6 months to 6 years [9] and 3.8% in all-age population [10].

Others studies have described malaria transmission in Dakar. In the south and central sanitary districts in 1994–95 and 1996–97, respectively [11,12], *Anopheles arabiensis* aggressiveness was low, and no infected *Anopheles* was collected. In the central area, a parasite prevalence of 1% and an annual incidence of clinical attacks of 2.4% have been recorded. However, during 2005–2006, malaria transmission was assessed in two vegetated areas of downtown Dakar; annual EIRs were 9.5 and 4, respectively, in Bel-air and 3 and 3, respectively, in Ouakam [13].

Despite the low malaria endemicity that was previously reported in Dakar, one study has emphasized the high level of anti-malarial drug consumption for fever [14]. In addition, self-medication with anti-malarial drugs is common in the general population [15,16]. Recent data from the Senegal Ministry of Health have shown a decline in malaria. Morbidity in public health facilities decreased from 17.9% in 2007 to 2.6% in 2008 at Dakar [17]; indeed, 2006–2007 period saw the implementation of artemisinin-based combination therapy (ACT) and rapid diagnostic tests (RDTs) in malaria case management. However, these data are biased, as they consider only public facilities and do not consider data from the private health system. Moreover, these data rely exclusively on RDT results, which have been achieved at only a rate of 52%. Because self-medication is common, an important segment of the population does not visit health services when the people experience episodes of malaria. Therefore, this segment is not recorded in health statistics and constitutes a loss of useful information. This information is needed for assessing the malaria control programmes and for planning future health actions.

In 2008, a three-year, multi-disciplinary research programme was undertaken in Dakar to identify the determinant factors of health care access and the success of new strategies (i e, RDTs and ACT) in malaria control at the population level. The aim of the present work was to assess the burden of malaria attacks reported by approximately 3,000 households in the Dakar area.

Methods

Study area

The study took place in the region of Dakar, Senegal, which comprises the districts of Dakar, Pikine, Guediawaye and Rufisque. In 2002, these four urban districts had a population of 2,168,314 inhabitants and 302,551 households [18]. Based on a 2.5% annual growth rate, the population in the Dakar region was estimated to be 2,493,561 in 2008. Housing types are residential, planned, "spontaneous" legal and "spontaneous" illegal. In the region of Dakar, spontaneous housing represents more than 30% of inhabited areas. The rate of illegal housing is estimated to be 21.7% in the entire region, with 2.9% for the district of Dakar, 42.4% for Pikine and 9.5% for Rufisque [19].

The region of Dakar is in a Sudano-Sahelian climate with a long dry season (October to June) and a short rainy season (July to September). The level of recorded rainfall rarely exceeds 500 mm per annum. However, it has been increasing since 2005 reaching 510 mm in 2008; most of this quantity fell in one week, causing major floods in the suburban areas of Dakar [20]. Due to the proximity of the sea, this coastal area benefits from particularly mild conditions, with a maximum temperature of 27-28°C in September and a minimum of 21-22°C in February.

Study type and population

A cross-sectional survey was performed from October to December 2008. Following the model of household surveys using the Grouped Islets for Statistic Indicators (IRIS) carried out within the SIRS research programme (health, inequalities and social breakdown in France) [21], 3,000 households were to be visited. The eligible households must contain at least one child aged between two and 10 years.

Selection of study sites

The detail of the procedures for the selection of study sites was described in a first paper [22].

The urban environment is known to be a heterogeneous space from both a socio-economic and an environmental perspective. Briefly, the aim of the choice of study sites was therefore to highlight the diversity of the urban zone. It was necessary to have homogeneous zones and the most heterogeneous zones between them.

Selection of the households and the individuals

3000 households selected in 50 sites were to be visited. The field worker picked up a concession within the study zone and moved from one household to the next following sampling procedure. If a concession encompassed several households, the field worker chose the head of the household using the first name ranked alphabetically. Sixty households in each site (3,000 households for the 50 sites) were to be selected. The first criterion for household selection was the presence of at least one two to 10-year-old child. After obtaining family agreement, socio-demographic investigators completed a questionnaire about the household lifestyle, education level, income, and the access mode to healthcare facilities. A second questionnaire was addressed to an adult woman (generally the child's mother) and a two to 10-year-old child. The questionnaire asked the respondents if they had experienced a malaria attack in 2008. For reported malaria attacks (RMAs), the questionnaire

explored the following related events: type of care seeking, method of diagnosis, place of diagnosis, treatment received, and place of medication purchase. Other information was collected, including deaths of relatives perceived or confirmed to have been caused by malaria, preventive measures (the use of a bed net), and perception of the frequency of mosquito bites.

Ethics statement

This protocol was approved by the Ethics Committee of Senegal's Department for Health (SEN 12/08). Information about the objective of the study was given to the head of the household, and verbal consent was requested. For minors, the consent of their legal guardians was requested. This procedure was used because most heads of household could not write. A nurse explained the aims and interest of the study, and then signed a document proving that consent was obtained.

Statistical analysis

The statistical analysis was performed using Stata version 11 (Stata Corp., Texas, USA, 2009). The socio-demographic characteristics (age, sex) of the respondents were described. A Pearson's chi-square test was used to compare proportions. To estimate the association between a RMA and the covariates, a logistic regression analysis was performed in the two groups. The following covariates were considered: age, education level (for women), use of a bed net, sex (for children), malaria-related deaths in the family, and perceptions of the frequency of mosquito bites. Women were divided into four age classes based on quartiles. In children, two age classes were created (<5 years and ≥5 years). A test was considered to be statistically significant if the p-value was less than 0.05.

Results

Prevalence of reported malaria attacks in two groups by study sites

The analysis included 2,451 women and 2,380 children who were selected from 49 sites in the Dakar area. One site (Point E) was not included in the analysis because of an insufficient number of households. The median age was 34 years (range = 15–77) for women and five years (range = 2–10) for children. Among women, 32% reported a malaria attack in 2008; among children, the rate of malaria attacks that was reported by mothers or caretakers was 39% (Table 1).

The rate of RMAs by sites varied between 10% (Maka colobane 1) and 50% (Biscuiterie) in women, and the rate reached as high as 65% (Wakhinane, Baobab, Alioune Sene) in children (Figure 1). In every site, the RMA rate reached at least 10%, which suggests that perceptions of the presence of malaria are widely distributed throughout Dakar.

Table 1 Malaria care-seeking behaviour in women and children, Dakar, 2008

Covariates	Women (2,451)	Children (2,380)
Reported malaria attacks in 2008	31.8% (780/2,451)	39% (930/2,380)
Hospital care-seeking		
Yes	79.5% (618/777)	81.5% (750/920)
No	20.5% (159/777)	18.5% (170/920)
Method of diagnosis	N=558	N=816
Microscopy	6.8%	1.2%
RDT*	8.2%	4.6%
Presumptive	70.6%	80.1%
DNK**	14.3%	14%
Received treatment (Yes)	92.4% (720/779)	95.1% (881/925)
Used anti-malarial drugs (Yes)	68.8% (496/720)	55.7% (492/884)
Place of medication purchase (anti-malarials)	N=486	N=477
Health services	49.8%	47%
Official drugstores	48.7%	51.4%
Shops, market, gift	1.44%	1.7%
Self-medication by an anti-malarial	4.5%	
Self-medication by another treatment	13.5% (94/720)	
Use of a bed net (Yes)	44.8% (1,093/2,438)	42.4% (1,009/2,380)
Death of a relative (Yes)	9.6% (233/2,431)	

DNK**: Do not know.
RDT*: rapid diagnostic test.
N: sample size.

High rates of RMA (> 45%) were found in sites near the city centre and in the suburbs near the marshland (Niayes). In the Niayes area, the permanent humidity allows for gardening activities throughout the year and creates potential breeding sites. The number of RMAs increased gradually in the two groups from April to September, which is at the end of the rainy season (Figure 2).

Use of health facilities

A total of 79.5% of women and 81.5% of children with a RMA had visited a health facility (HF). Younger women were more likely to have visited a HF (trend test for equal odds, $P < 0.001$). Mothers or caretakers of children under five years old were more likely to have referred their children to a HF ($P < 0.001$). Similarly, in children, males were more likely to have visited a HF ($P = 0.009$).

In HFs, presumptive diagnosis was used to identify malaria in 70.6% of women with RMAs. Only 15.0% of

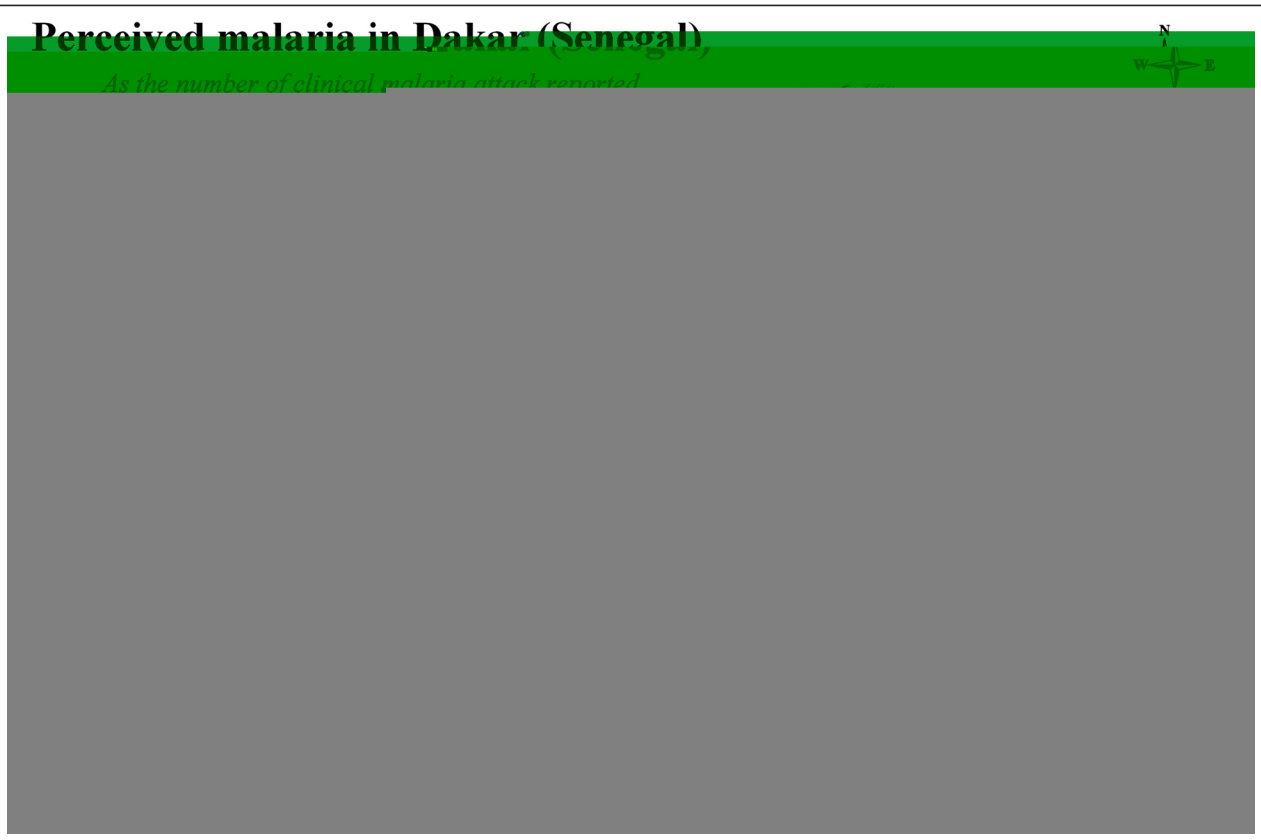

Figure 1 Rate of reported malaria attacks (by women and children) by study sites, Dakar, 2008.

women underwent a blood test (thick smear, or RDT); however, 14.0% of women did not remember if they had had a blood test. In children, 80.0% had undergone a presumptive diagnosis, and approximately 5.8% had had a blood test; 40 (14.0%) respondents were unable to provide information about the diagnostic method.

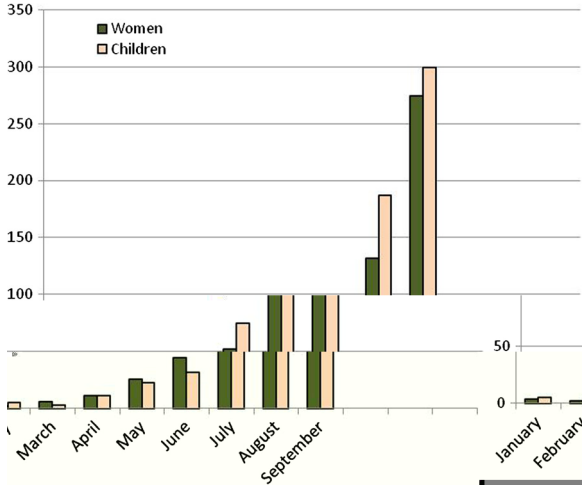

Figure 2 Number of monthly malaria attacks reported by residents (women and children), Dakar, 2008.

Treatment

When visiting a HF, 76.7% (459/598) of women with a RMA had received an anti-malarial treatment (AT). Among women who had not visited a HF, 28.2% (35/123) had taken an AT (P <0.001); 22.4% (36/159) had not taken any treatment. The remaining women had received antipyretic treatment (primarily paracetamol). Four women had received a traditional treatment.

A total of 13.0% (94/720) of women with a RMA declared having self-medicated. Among children who had visited a HF, 60.4% had received an AT; among children who had not visited a HF, 34.4 % had received an AT. Approximately 48.7% of women had purchased an AT in a private pharmacy, while 49.8% of women had purchased an AT in a HF. Only 1.44% of women reported having purchased an AT in a market or shop.

Preventive measures

Bed nets were reportedly used by 44.8% of women and 42.4% of children. Surprisingly, there was no association between a RMA and bed net use in women (P = 0.346) or children (P = 0.716).

Risk factors of reporting malaria attacks in 2008

In women, malaria-related death in the family was significantly associated with a RMA (Table 2) in the univariate and multivariate analysis (Odds ratio = 1.46, P = 0.012). Perception of the frequency of mosquito bites was significantly associated with a RMA. Individuals who reported frequent bites were more likely to have a RMA (trend test for equal odds, P= 0.003) compared to individuals who reported few or no bites. Children under five years old (Table 3) were more likely than older children to have a RMA (Odds ratio = 0.76, P = 0.001).

Discussion

The aim of the present study was to assess the malaria burden as it is experienced by urban dwellers. The data showed that malaria was perceived as a common disease, as one third of surveyed individuals had a RMA in 2008, and most of the respondents reported a RMA after the beginning of the rainy season. This study was primarily focused on women and children between two and 10 years old. Women were more appropriate than men to interview as women are responsible for the daily activ-

Table 3 Association between reporting a malaria attack and covariates in children (logistic regression)

			Univariate analysis		Multivariate analysis	
Variables	**Class**	**N° of malaria attack**	**OR(⁄5%IC)**	**P**	**OR(⁄5%IC)**	**P**
Age						
	<= 5	421	1	0.001	1	0.001
	> 5	509	0.76(0.64-0.90)		0.76(0.64-0.89)	
Sex						
	Male	440	1	0.450	1	
	Female	490	1.06(0.90-1.25)		1.07(0.91-1.26)	0.387
Use of a bed net						
	No	540	1	0.716	**	**
	Yes	390	0.96(0.82-1.14)			

**: covariate not introduced in the multivariate analysis.
N : number.
P : p-value.

rate of *Plasmodium* carriage and the rate of RMAs since presumptive diagnosis was used at health facilities. In addition data collected in an other survey by the same team (unpublished data) showed that malaria is commonly diagnosed among febrile patients in HFs. However these findings should be confirmed by a large study of morbidity using active screening of malaria cases.

The results also showed that presumptive diagnosis is frequently used in HFs (73% for women and 80% for children), despite the implementation of RDTs in September 2007. In Dakar, the rate of presumptive diagnosis is similar to the rate that was described 20 years ago by Faye *et al.* [23]. The rate suggests an over-diagnosis of malaria attacks, which is consistent with two studies. Othnigué [24] found that only 30% of clinically diagnosed malaria cases were positive for *Plasmodium*, and in Thailand, Luxemburger [25] reported that using a clinical diagnosis would result in the prescription of an anti-malarial drug for 30% of non-malaria febrile episodes.

This over-diagnosis in HFs in Dakar could lead to a pernicious effect by stoking perceptions that malaria is common. As a consequence, malaria may be over-diagnosed in febrile patients, which was reported by Ndour [23] in rural Senegal. In this study, 61% of respondents reported fever to be a common symptom of malaria.

Two primary reasons could explain the difficulty of assessing the actual malaria burden in the population. First, most cases of malaria are presumptive. Second, self-medication is common, and self-medication is not reported in health statistics. As a consequence, anti-malarial consumption is enhanced by the high circulation of drugs that are available without prescription in private pharmacies or in informal markets.

In the present study, 80% of individuals had visited a HF. This rate is higher than the rate found by Franckel in a rural area in Senegal, where the use of HFs varied from 5 to 45% [26]. The use of HFs in cases of fever appeared to be a routine practise in the urban population.

The use of HFs decreased with age in women and children. For women, who are often caretakers of children, previous experience of malaria episodes or in HFs allows for self-diagnosis and self-medication, described by Baxerres and Le Hesran [27] in rural Senegal. Family history appears to play a major role in creating perceptions of malaria and could be a determinant of care-seeking behaviour.

In 2003, Ndiaye *et al.* found that 40% of 271 febrile patients had self-medicated before visiting a HF [15]. These data cannot be compared to those found in the present study. No differentiation was made between self-medication as the first intention and self-medication as an exclusive health-seeking behaviour. However, global self-medication appeared to be more important in the population. McCombie [28] reported that the self-purchasing of drugs ranged from 4 to 87%, and half of the cases relied exclusively on self-treatment, usually with anti-malarials.

Perceptions of the frequency of mosquito bites was significantly associated with a RMA; this association may be explained by the fact that individuals know that malaria is transmitted by mosquitoes [29]; therefore, the presence of more mosquitoes is associated with a greater perception of malaria. Another study conducted in pregnant women in Nigeria [30] showed that 78.9% of surveyed women identified mosquito bites as the cause of malaria. Even if the majority of mosquitoes are not *Anopheles*, malaria transmission is still possible, which has been shown by a study that was conducted with the same population. By measuring human antibodies against *Anopheles* saliva, the study showed that contact between humans and mosquitoes occurs frequently in the Dakar area [31].

Recent entomological data in Dakar [13,32] provide evidence of malaria transmission. In addition, *Plasmodium* carriage was found to be important [22]. These results suggest that a part of RMAs (unknown perhaps underestimated) could be actual cases of malaria attacks despite the high use of presumptive diagnosis.

The data showed a lack of evidence for heterogeneity in RMA prevalence between sites. Entomological studies and *Plasmodium* prevalence suggested variation in malaria transmission in Dakar. This discrepancy could be observed because each unexplained fever could be considered to be a malaria attack by individuals, even if there is no condition for malaria transmission in their environment.

Finally, there is a convergence of factors that provide evidence for a malaria risk in the population in Dakar: a high frequency of fever in the rainy season, malaria-related deaths, high rates of mosquito bites, permanent floods in many sites, and presumptive diagnosis in HFs. It is difficult to estimate the actual burden of malaria in the population, but it is clear that perceptions of the occurrence of malaria could persist.

Conclusion

The frequency of perception of occurrence of malaria in the population was confirmed by visiting HFs, where a high presumptive diagnosis rate was reported by health professionals. This perception of malaria could sustain a high consumption of anti-malarial drugs.

Despite the decline of malaria that has been announced by health authorities, the population will continue to complain about malaria and seek care directly from private pharmacies. This situation may sustain the circulation of anti-malarial drugs and increase the risk of an emergence of anti-malarial resistance.

Further studies are necessary to differentiate perceived and real cases of malaria and to identify the actual burden of the disease in urban Dakar. Efforts are needed to sensitize health professionals to use confirmatory diagnostic tools more effectively before they prescribe anti-malarials and to urge the population to avoid seeking care outside HFs.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

AD participated in study design, supervised field operations, carried out the acquisition, the statistical analysis and the interpretation of data and drafted the manuscript. SDS participated in the design and was responsible for the coordination of the project. RL coordinated the project and participated in the design of this study. JYL was responsible for the coordination of the study, participated in the design and supervised the writing of the manuscript. All authors read and approved the final manuscript.

Editing

This manuscript was edited for English language by American Journal Expert (Editorial certificate No F707-33FC-272C-F956-7EB1).

Acknowledgements

This project was funded by the National Agency of Research of the French government (ANR-SEST 2007). The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. We would like to thank the IRD for financial support (AD funding).
We are grateful to all the women, men and children who participated in the study. We thank the Ministry of Health of Senegal for his authorization, the Chiefs of the sanitary districts of Dakar and the nurses of the health facilities in the study sites for their valuable contribution. We would particularly like to thank the field investigators. We thank Marion Borderon and Alphousseyni Ndonky for their particpation in data analysis.

Author details

[1]Institut de Recherche pour le Développement, UMR 216, Mère et enfant face aux infections tropicales, 4 avenue de l'Observatoire, Paris 75270 cedex 06, France. [2]Université Paris Descartes, Sorbonne Paris Cité, Faculté des sciences pharmaceutiques, 4 avenue de l'Observatoire, Paris 75270 cedex 06, France. [3]Institut de Recherche pour le Développement, UMR151, Laboratoire, Populations, Environnement et Développement, Dakar, Sénégal. [4]Institut de Recherche pour le Développement, UMR151, Laboratoire, Populations, Environnement et Développement, Marseille, France.

Received: 5 June 2012 Accepted: 2 October 2012
Published: 8 October 2012

References

1. Sabatinelli G, Bosman A, Lamizana L, Rossi P: **[Prevalence of malaria in Ouagadougou and the surrounding rural environment during the period of maximal transmission].** *Parassitologia* 1986, **28:**17–31.
2. Watts TE, Wray JR, Ng'andu NH, Draper CC: **Malaria in an urban and a rural area of Zambia.** *Trans R Soc Trop Med Hyg* 1990, **84:**196–200.
3. Hay SI, Guerra CA, Tatem AJ, Atkinson PM, Snow RW: **Urbanization, malaria transmission and disease burden in Africa.** *Nat Rev Microbiol* 2005, **3:**81–90.
4. Robert V, Macintyre K, Keating J, Trape JF, Duchemin JB, Warren M, Beier JC: **Malaria transmission in urban sub-Saharan Africa.** *AmJTrop Med Hyg* 2003, **68:**169–176.
5. Keiser J, Utzinger J, Caldas De Castro M, Smith TA, Tanner M, Singer BH: **Urbanization in sub-saharan Africa and implication for malaria control.** *AmJTrop Med Hyg* 2004, **71:**118–127.
6. ONU/Nations Unies: *World Urbanization Prospects. The 2007 Revision*, United NationsDepartment of Economic and Social Affairs (DESA). 2008:32.
7. Vanek MJ, Shoo B, Mtasiwa D, Kiama M, Lindsay SW, Fillinger U, Kannady K, Tanner M, Killeen GF: **Community-based surveillance of malaria vector larval habitats: a baseline study in urban Dar es Salaam.** *Tanzania. BMC Public Health* 2006, **6:**154.
8. Simard F: *Redoutables moustiques anthropisés*, Sciences au sud le journal de l'IRD. 58th edition. Marseille: IRD; 2011:16.
9. Vercruysse J, Jancloes M, Van de Velden L: **Epidemiology of seasonal falciparum malaria in an urban area of Senegal.** *Bull World Health Organ* 1983, **61:**821–831.
10. Trape JF, Lefebvre-Zante E, Legros F, Ndiaye G, Bouganali H, Druilhe P, Salem G: **Vector density gradients and the epidemiology of urban malaria in Dakar, Senegal.** *AmJTrop Med Hyg* 1992, **47:**181–189.
11. Diallo S, Konate L, Faye O, Ndir O, Faye M, Gueye A, Diouf M: **[Malaria in the southern sanitary district of Dakar (Senegal). 2. Entomologic data] (in French).** *Bull Soc Pathol Exot* 1998, **91:**259–263.
12. Diallo S, Konate L, Ndir O, Dieng T, Dieng Y, Bah IB, Faye O, Gaye O: **[Malaria in the central health district of Dakar (Senegal). Entomological, parasitological and clinical data] (in French).** *Sante* 2000, **10:**221–229.
13. Pages F, Texier G, Pradines B, Gadiaga L, Machault V, Jarjaval F, Penhoat K, Berger F, Trape JF, Rogier C, Sokhna C: **Malaria transmission in Dakar: a two-year survey.** *Malar J* 2008, **7:**178.
14. Ministère de la Santé et de la Prévention Médicale C: *Enquête Démographique et de Santé, Sénégal 2005*. Gouvernement du Sénégal: Avril; 2006:359p.
15. Ndiaye P, Tal-Dia A, Diedhiou A, Juergens-Behr A, Lemort JP: **[Self-treatment of fever in the northern district of Dakar, Senegal] (in French).** *Med Trop (Mars)* 2006, **66:**74–78.
16. Bob NS, Diop BM, Renaud F, Marrama L, Durand P, Tall A, Ka B, Ekala MT, Bouchier C, Mercereau-Puijalon O, Jambou R: **Parasite polymorphism and**

severe malaria in Dakar (Senegal): a West African urban area. *PLoS One* 2010, **5:**e9817.
17. Ministère de la Santé et de la Prévention: *Rapport sur la morbidité et la mortalité palustre au Sénégal en 2008*. Dakar: Programme National de Lutte contre le Paludisme; 2010. http://www.pnlp.sn/UserFiles/File/donnee.pdf.
18. Ministère de l'économie et des finances ANdlSedlD: *Ille Recensement Générale de la Population et de l'Habitat de 2002*. Gouvernement du Sénégal; 2008:163p.
19. Ministère de l'urbanisme et de l'aménagement du territoire du Sénégal: *Plan Directeur d'Urbanisme de la région de Dakar, horizon 2025*. Dakar; 2008. http://www.cifal-ouaga.org/niamey/exposes/Module3/Presentation PDU DAKAR HORIZON 2025.pdf.
20. Wade S: *Télédétection des catastrophes d'inondation urbaine: le cas de la région de Dakar (Sénégal)*. 2009:5p.
21. Parizot IPS, Bazin F, Chauvin P: *Santé et recours aux soins dans les quartiers de la Politique de la ville du 20ème arrondissement de Paris*. Paris: INSERM U444; 2004:203p.
22. Diallo A, Ndam NT, Moussiliou A, Dos Santos S, Ndonky A, Borderon M, Oliveau S, Lalou R, Le Hesran JY: **Asymptomatic carriage of Plasmodium in urban dakar: the risk of malaria should not be underestimated.** *PLoS One* 2012, **7:**e31100.
23. Faye O, Ndir O, Gaye O, Bah IB, Dieng T, Dieng Y, Diallo S, Diagne AK: **Health personnel and population practices in the diagnosis of malaria and use of antimalarial drugs in Dakar] (in French).** *Med Trop (Mars)* 1995, **55:**47–50.
24. Othnigue N, Wyss K, Tanner M, Genton B: **Urban malaria in the Sahel: prevalence and seasonality of presumptive malaria and parasitaemia at primary care level in Chad.** *Trop Med Int Health* 2006, **11:**204–210.
25. Luxemburger C, Nosten F, Kyle DE, Kiricharoen L, Chongsuphajaisiddhi T, White NJ: **Clinical features cannot predict a diagnosis of malaria or differentiate the infecting species in children living in an area of low transmission.** *Trans R Soc Trop Med Hyg* 1998, **92:**45–49.
26. Franckel A: **Contexte villageois et recours aux soins dans la région de Fatick au Sénégal.** *Population* 2008, **63:**531–553.
27. Baxerres C, Le Hesran JY: **Recours aux soins en cas de fièvre chez l'enfant en pays Sereer au Sénégal: entre contrainte économique et perception des maladies.** *Sciences Sociales et Santé* 2004, **22:**5–23.
28. McCombie SC: **Treatment seeking for malaria: a review of recent research.** *Soc Sci Med* 1996, **43:**933–945.
29. Nuwaha F: **People's perception of malaria in Mbarara, Uganda.** *Trop Med Int Health* 2002, **7:**462–470.
30. Iriemenam NC, Dosunmu AO, Oyibo WA, Fagbenro-Beyioku AF: **Knowledge, attitude, perception of malaria and evaluation of malaria parasitaemia among pregnant women attending antenatal care clinic in metropolitan Lagos, Nigeria.** *J Vector Borne Dis* 2011, **48:**12–17.
31. Drame PM, Machault V, Diallo A, Cornelie S, Poinsignon A, Lalou R, Sembene M, Dos Santos S, Rogier C, Pages F, Le Hesran JY, Remoué F: **IgG responses to the gSG6-P1 salivary peptide for evaluating human exposure to Anopheles bites in urban areas of Dakar region.** *Senegal. Malar J* 2012, **11:**72.
32. Gadiaga L, Machault V, Pages F, Gaye A, Jarjaval F, Godefroy L, Cisse B, Lacaux JP, Sokhna C, Trape JF, Rogier C: **Conditions of malaria transmission in Dakar from 2007 to 2010.** *Malar J* 2011, **10:**312.

doi:10.1186/1475-2875-11-340
Cite this article as: Diallo *et al.*: Perceived malaria in the population of an urban setting: a skipped reality in Dakar, Senegal. *Malaria Journal* 2012 **11**:340.