Université Cheikh Anta Diop
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Laboratoire d'Ecologie Vectorielle et Parasitaire
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URBAN MALARIA VECTOR BIONOMICS AND HUMAN SLEEPING BEHAVIOR IN THREE CITIES IN SENEGAL

Fatou NDIAYE
phD Student/UCAD

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Parasites & Vectors

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Urban malaria vector bionomics and human sleeping behavior in three cities in Senegal

Abdoulaye Diop[1†], Fatou Ndiaye[2†], Katherine Sturm-Ramirez[3], Lassana Konate[2], Massila Senghor[2], El Hadji Diouf[2], Abdoulaye Kane Dia[2], Seynabou Diedhiou[2], Badara Samb[2], Doudou Sene[4], Sarah Zohdy[3], Ellen Dotson[3], Mame Birame Diouf[5], Valerie Koscelnik[5], Lilia Gerberg[6], Abdoulaye Bangoura[7], Ousmane Faye[2], Tiffany Clark[7], El Hadji Amadou Niang[2] and Joseph Chabi[7*]

INTRODUCTION 1/1

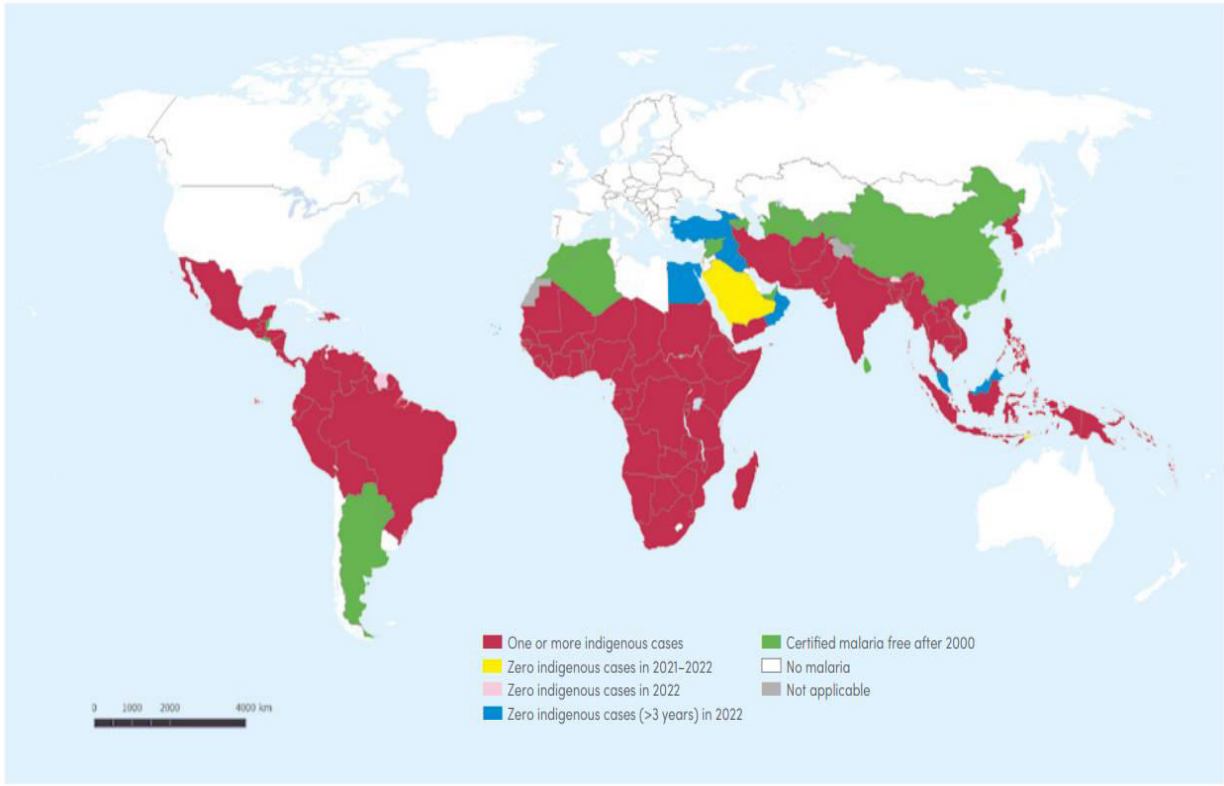
Malaria: febrile parasitic disease, caused by a protozoan of the genus *Plasmodium* , transmitted to humans by the infective bite of a female mosquito of the genus *Anopheles*.

- Worldwidely

In 2022, **249 million** cases and **608,000** deaths **(WHO, 2023)**

- The WHO Africa region continues to bear the largest share of the burden of rising case numbers worldwide (**95%** of cases and **96%** of deaths) **(WHO, 2022)**

Between 2000 and 2022, **82%** of cases and **94%** of deaths had been **avoided** in Africa and South East Asia **(WHO, 2023)**

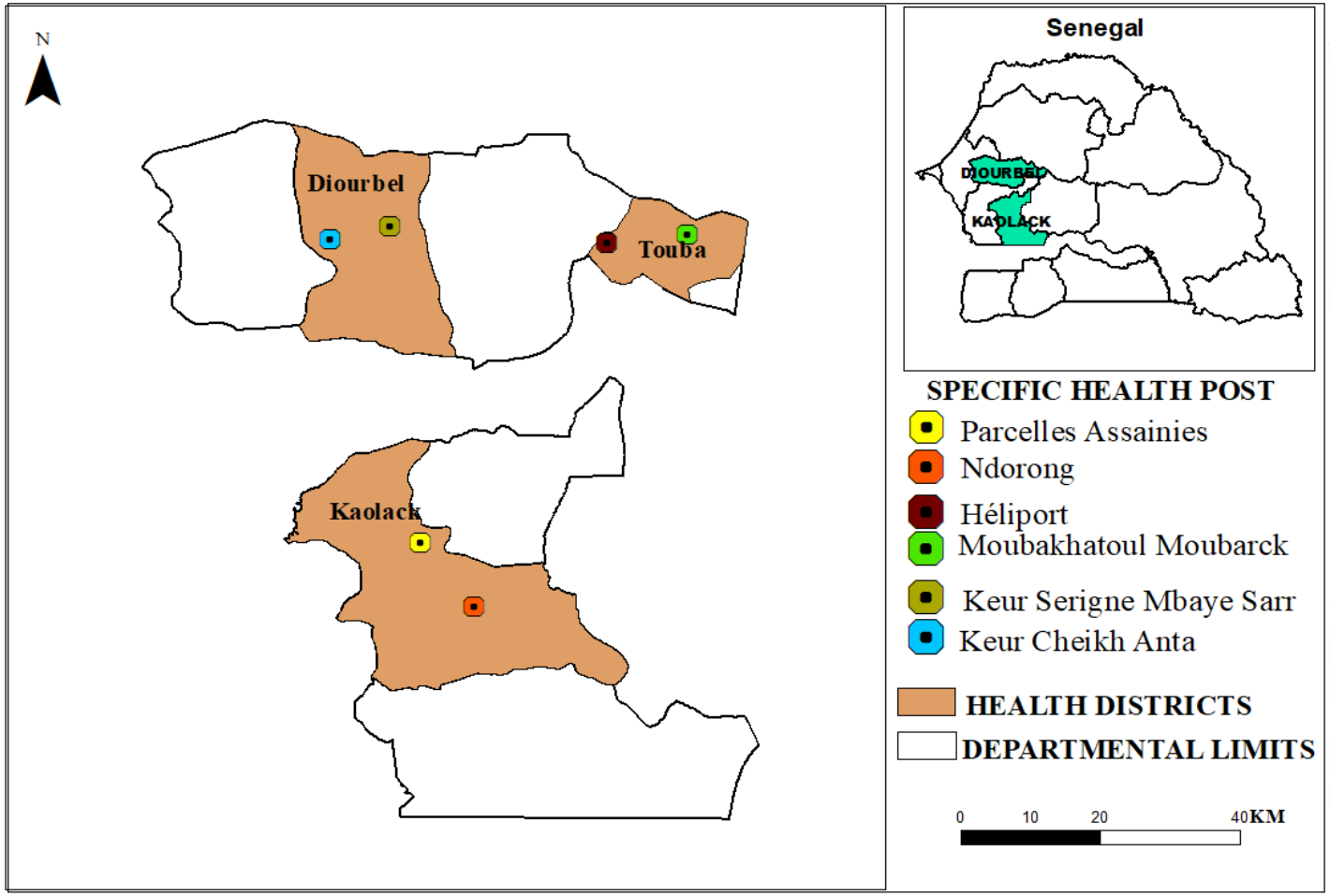


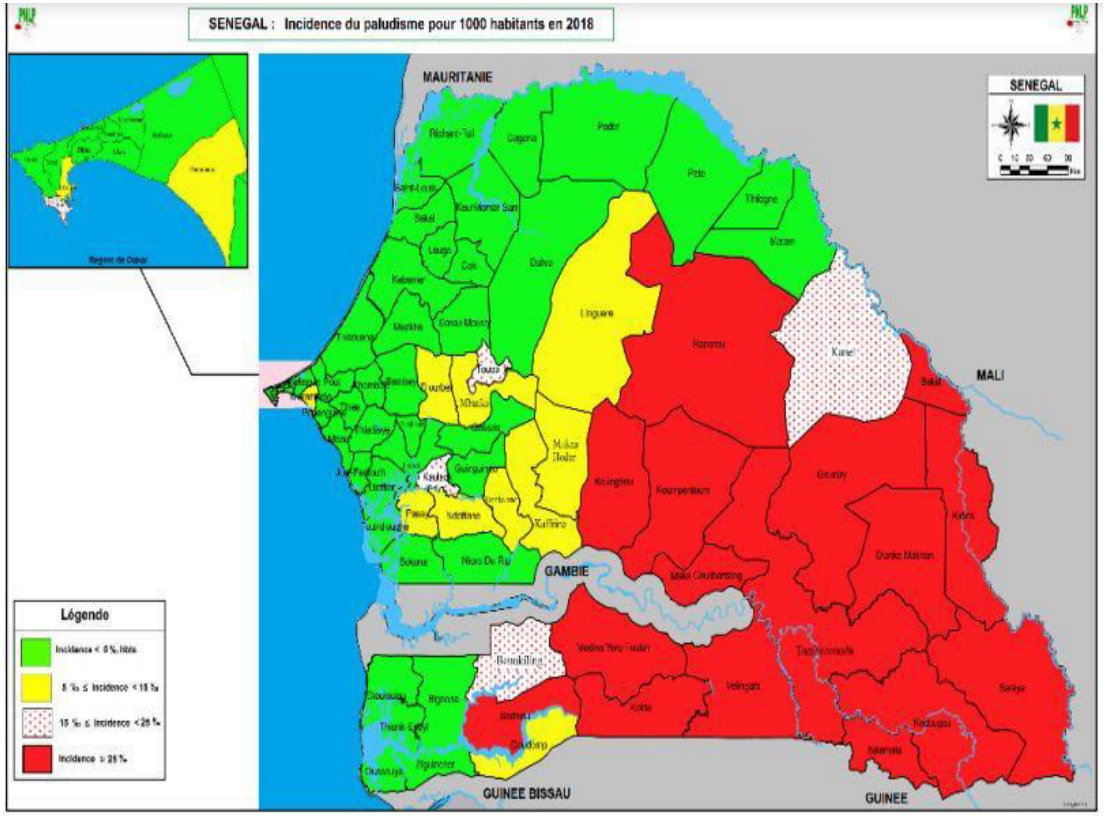
Malaria situation in the world **(WHO, 2023)**

CONTEXT OF STUDY 1/2 (May 2019-December 2019)

General presentation of the study area

Two priority areas with specific interventions





Incidence of malaria in Senegal in 2018 (NMCP, 2019)

The study was conducted in urban areas of the cities of Diourbel, Touba and Kaolack in west-central Senegal. This area includes the **most populated regions of Senegal** , after the capital Dakar.

OBJECTIVES OF THE STUDY 2/2

➢ Main objective

Suggest appropriate and targeted vector control strategies in urban areas with high malaria incidence in Diourbel, Touba and Kaolack

➢ Specific objectives

- ❑ Know the biting and resting behavior of malaria vectors in the area
- ❑ Evaluate transmission through entomological indicators
- ❑ Know human behavior in the urban environments of Diourbel, Touba and Kaolack

METHODOLOGY 1/1

➢ Human Landing Catches (HLC)

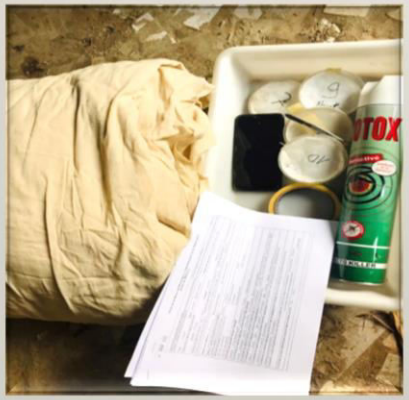
1. Setting up the catchers

2. Periodical inspection of bare legs

3. Mosquito collection on landing

➢ Pyrethrum Spray Catches (PSC)

1- Used materials



2- Preparation of the room

3- Spraying with pyrethroid

4- Taking out the sheets

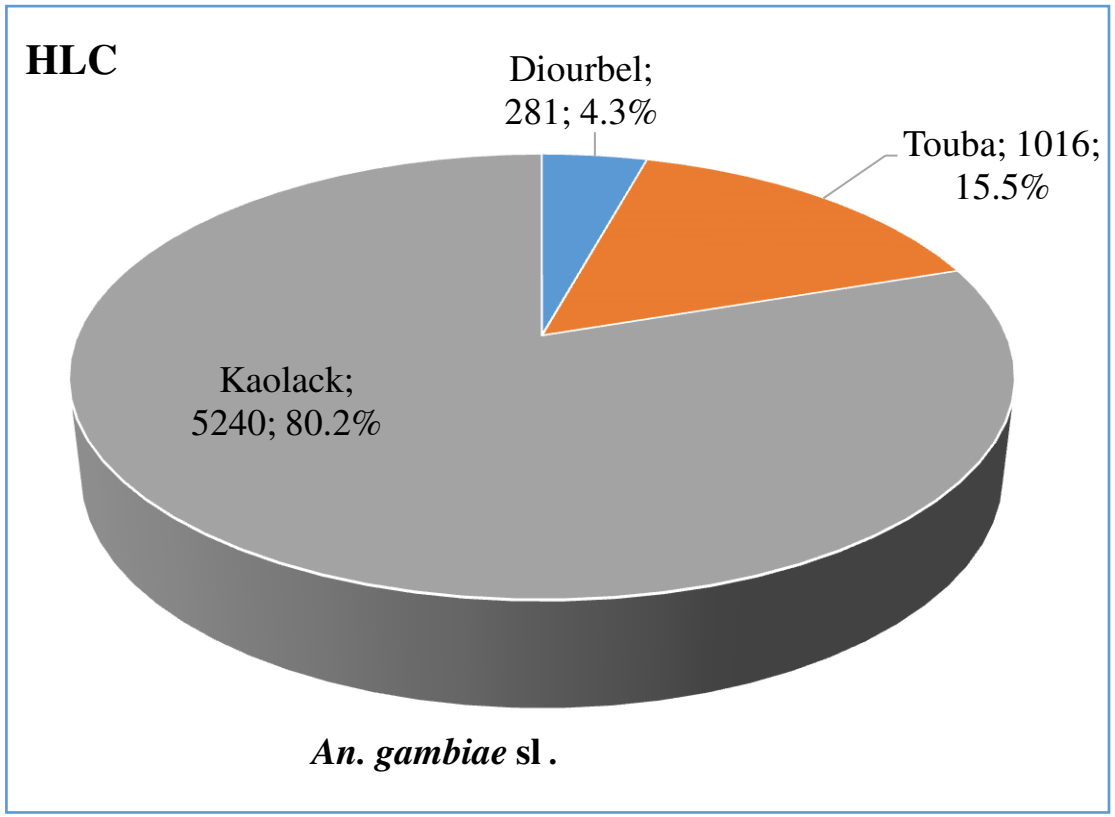
5- Collection of mosquitoes

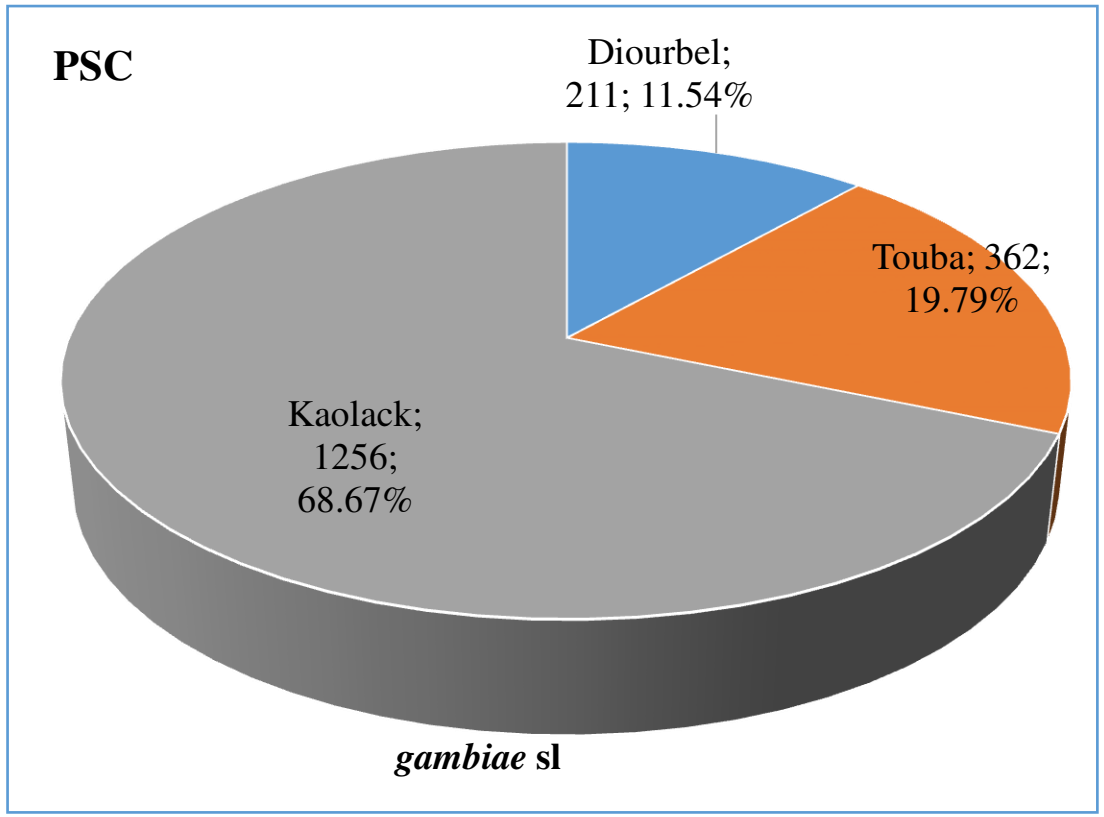
6- Morphological identification

Source (NIANG 2014)

RESULTS 1/ 5

Anopheles Specific Composition



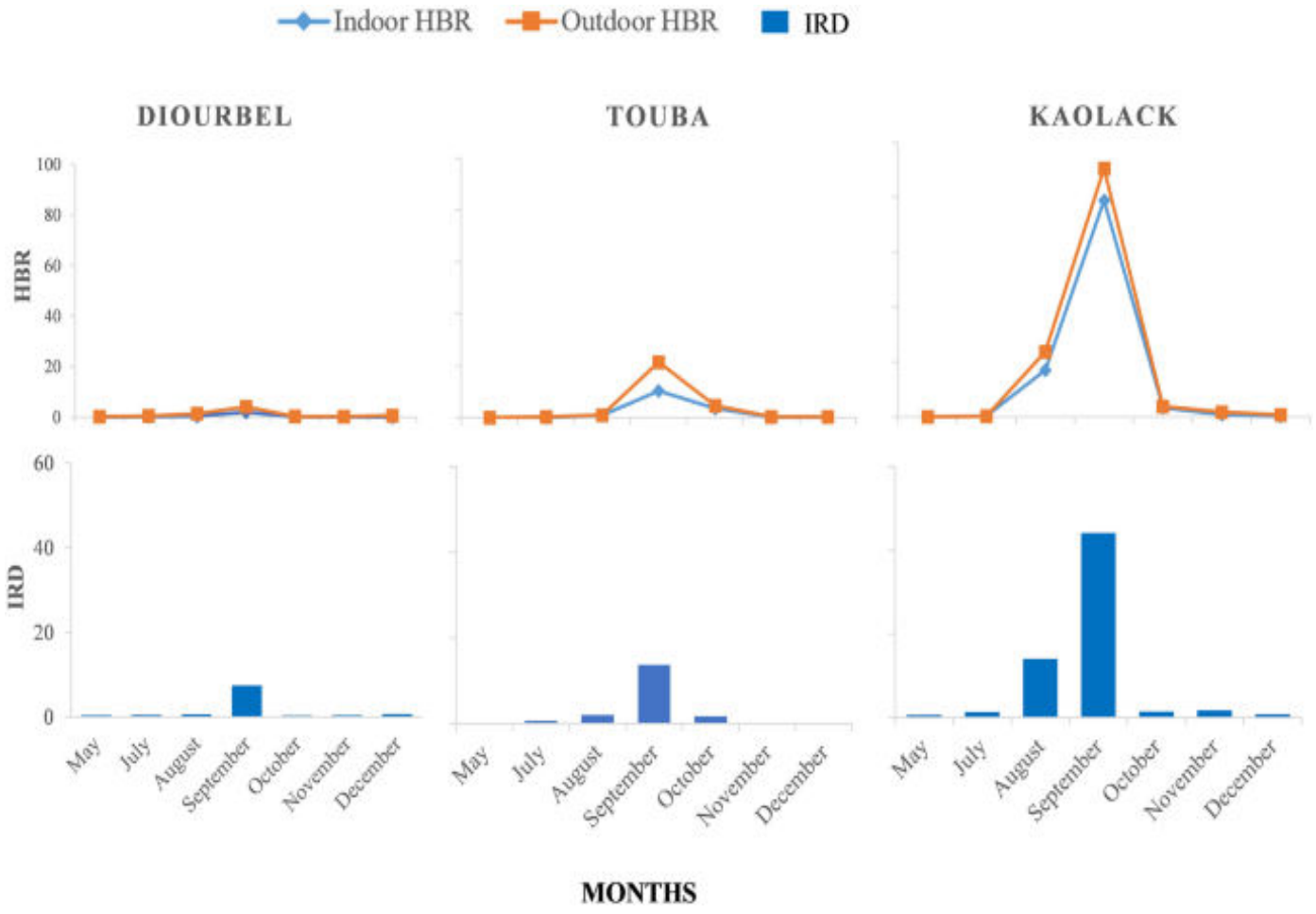


- Exclusive to *An. gambiae* sl in Diourbel,
- The only specimen **of *An. funestus* sl .** on (HLC) in **Touba** .
- Almost all specimens ***of An. Pharoensis*** on (HLC) in **Kaolack (50/53).**

RESULTS 2/5

Monthly variations in HBR and IRD densities of *females*

An . gambiae sl.



- **With 37 bites/person-night,** the average rate of bites on humans (HBR) is significantly higher in Kaolack than in Touba (7 b/p/n) and in Diourbel (1 b/ p/n).
- **Tendency to exophagy** is statistically significant than in **Touba** where the average rate of bites is almost **twice as high outdoors** as indoors **($p < 0.05$)** .
- Resting densities are lower in Diourbel (**1 female/room**) and higher in Kaolack (**9 females/room).**
- In all towns, IRDs increased gradually from August before peaking in September where a peak of **44 females/room** was noted **in Kaolack** . A drastic drop in IRD was noted from October, with **less than 2 females/room** obtained in all sites.

RESULTS 3/5

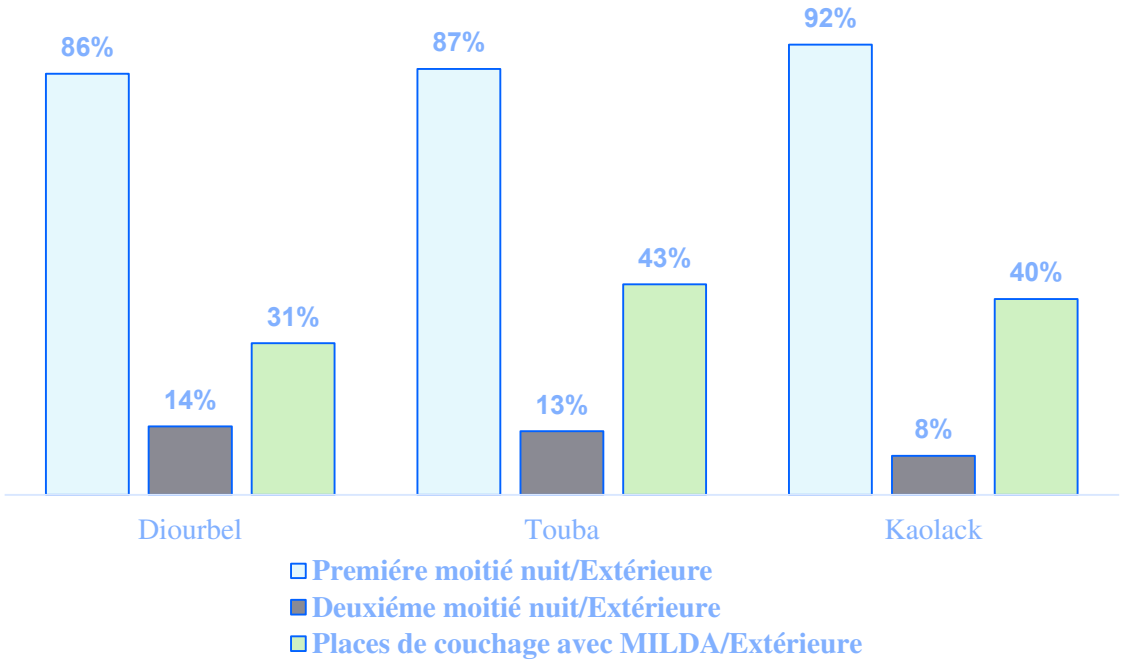
✓ **Infestation and Entomological Inoculation Rate of Vectors in Diourbel, Touba, and Kaolack**

City	HBR	IR	EIR (b/p/n)	**EIR Annual (b/p/year)**
Diourbel	1,301	0.0049	0.01	**3.65**
Touba	1,792	0.0096	0.02	**7.31**
Kaolack	10,058	0.0114	0.11	**40.21**

Entomological inoculation rates (EIR) of *An. gambiae sl* . as well as infection rates were relatively lower in Diourbel with 3.65 b/p/year and were higher in the town of Kaolack with 40.21 b/p/year

RESULTS 4/5

❖ Sleep Behaviors



Respondents' sleeping period outside the room

Cities	Respondents	**Heat (%)**	Limited sleeping places (%)	Limited rooms (%)	Others (%)
Diourbel	314	126 (56%)	6 (3%)	9 (4%)	85 (38%)
Touba	329	163 (81%)	2 (1%)	4 (2%)	32 (16%)
Kaolack	277	76 (58%)	3 (2%)	3 (2%)	50 (38%)
Total	920	**364 (65%)**	11 (2%)	16 (3%)	167 (30%)

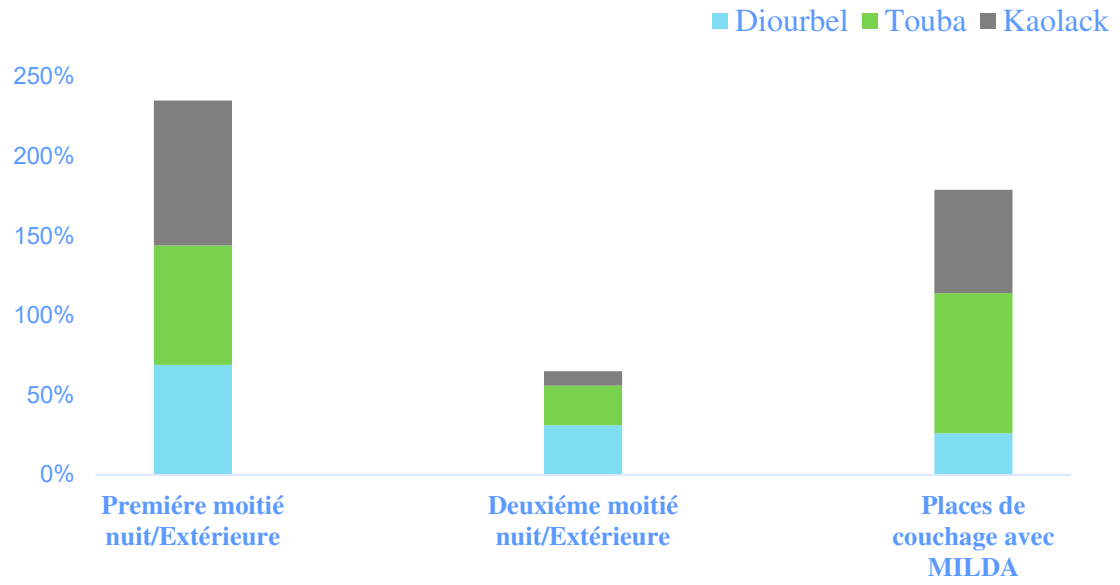
Reasons for sleeping outside bedrooms

RESULTS 5/5

❖ Special case of the Daaras

City	Daaras investigated	Structures identified	Identified rooms	People sleeping indoors	People/ room	People sleeping indoors
Diourbel	9	28	33	47	1.4	65
Touba	15	27	66	102	1.5	220
Kaolack	10	21	40	77	1.9	165
Total	34	76	139	226	1.6	450

Number and Characteristics of Daaras surveyed by City



Proportion of time spent outdoors and use of LLINs by residents of Daaras

DISCUSSION 1/3

- Entomological monitoring revealed the predominance **of *An. arabiensis*** in the three cities studied, where it displayed variable seasonal densities and biting behavior. **(Faye et al 2011, Diédhiou et al 2016**)

- Not surprisingly, the highest vector population densities were recorded during **the rainy season** in the three cities, **with Kaolack having the highest bite rate** over the collection period.

- Overall, that vectors bite indoors and outdoors **with a higher tendency outdoors in all urban areas studied** except in Kaolack during the dry season.

- **Low annual EIRs in all cities** should be due to this predominance of females with reduced longevity and infection rates, which may have a critical epidemiological importance on **the risk of transmission in the area.**

the proliferation and high productivity **of suitable breeding sites**

the high frequency and persistence **of artificial water storage systems,** productive with high larval densities mainly in Touba, **(Ndiaye et al 2023)**

DISCUSSION 2/3

The study of human behavior found that during the dry season, in most households surveyed, **members spend more time outdoors during the night due to the heat.**

Another risk factor linked to human behavior corresponds to **the proximity and gathering of a high density of young populations at risk in several Daaras of Touba, during nighttime learning of the Koran** , mainly from 6:00 p.m. to 9:00 p.m. and more, or early in the morning (5:00 a.m. to 7:00 a.m.) could promote several protection gaps and increase the risk of malaria transmission, thus becoming a critical challenge for conventional malaria vector control and **highlighting the need for complementary targeted interventions.**

Therefore, the assessment of concomitant human and vector behaviors has recently been the main approach, as shown in several recent studies (**Monroe et al. 2020; Soma et al. 2021**), in order to better understand and identify potential threats in the deployment of vector control tools such as indoor residual spraying of insecticides and distribution of impregnated mosquito nets, and for the implementation of appropriate and targeted protection measures/tools, to ensure effective impact on the transmission of malaria.

DISCUSSION 3/3

- Knowledge about the causes of malaria transmission and prevention measures was high in all three urban areas, which could be an important asset to **support potential community-based vector control strategies** **(Dear et al. 2018)** .

- Between **2018** to **2019** , the overall coverage and use of ITNs by households were relatively high in the area except in **Touba where only 20% of the ITNs distributed were used** **(NMCP 2018;2019)** .

- The use of ITNs by pregnant women and children under five years old was almost optimal in the three cities (defined as ≥80% use), **with the exception of pregnant women recorded in Kaolack** **(73% use)**.

- Touba recorded the greatest number of Daaras, although only some Daaras were studied. The particular focus on the Daaras showed that around **59% of the residents of the Daaras in the three cities slept outside** most of the time, including school-going children who made up the majority of the household populations. The coverage and use of ITNs in Daaras needs to be further studied and additional interventions identified **to address the gaps caused by outdoor sleeping and learning behaviors** .

- Among the three cities, Diourbel showed the highest use of ITNs with around 80% of the population sleeping under ITNs. This could contribute to the low transmission observed in Diourbel. Additionally, further education for adoption and use of ITNs during the transmission period could be undertaken among the population to reduce human-vector contact.

RECOMMENDATIONS

- ✓ Additional education for **the adoption and use of ITNs outdoors during the transmission period** could be undertaken within the population to reduce contact between humans and vectors.

- ✓ Results support the use of IRSs in Daaras **and** advocate the use of **ITNs** or **other personal protection measures to fill the gaps caused by outdoor sleeping and learning behaviors** .

- ✓ The implementation **of larval source management** , for example **in Touba and Diourbel** , in addition to the universal **coverage** of insecticide-impregnated mosquito nets (ITN),

- ✓ Raising awareness about household behavior, environmental cleanliness and the **management of water storage basins in Touba** could contribute to the reduction of larval habitats of anthropogenic origin.

- ✓ The level of knowledge of the populations on the causes of malaria transmission and prevention measures was high in the three urban areas; which could constitute an important asset to **support potential community-based vector control strategies.**

THANK YOU FOR YOUR ATTENTION