Medical Xpress

Tracking malaria and mosquitoes with the help of pregnant women and city dwellers

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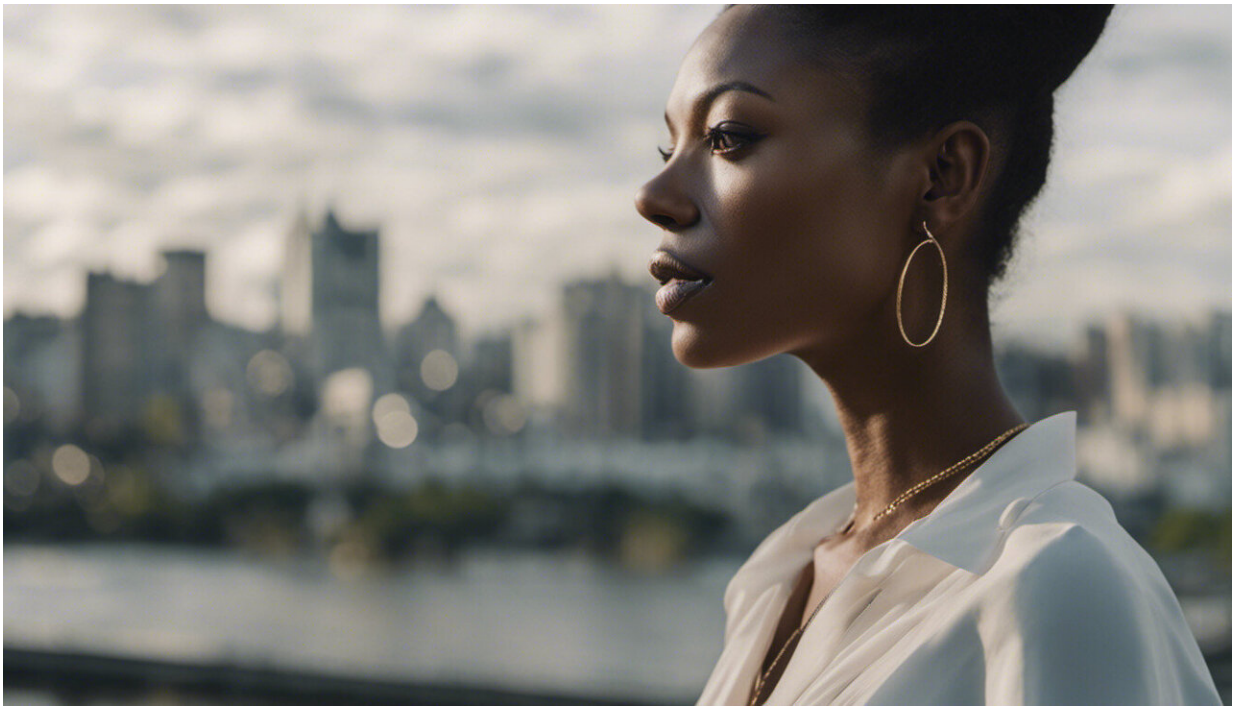

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Expectant mothers and app-equipped city residents have roles to play in the fight against mosquito-borne diseases that kill hundreds of thousands of people annually.

Arnau Pujol Vallribera is a Spanish data whiz who used to study

galaxies. Now he tracks diseases spread by mosquitoes.

"In cosmology, we use algorithms to better understand the laws of physics and how the universe evolves," said Pujol Vallribera of the Spain-based Barcelona Institute for Global Health, or ISGlobal. "Now I use the same algorithms to take action against malaria."

Small insect, big impact

The World Health Organization (WHO) estimates that malaria killed 619,000 people in 2021. Almost all of them were in Africa.

Include other mosquito-borne illnesses, like dengue or yellow fever, and more than 700,000 deaths a year are tied to these tiny insects.

Researchers like Pujol Vallribera hope that new techniques ranging from complex statistics to "citizen science" can improve understanding of the spread of diseases caused by the bite of an infected mosquito.

"We need to know the prevalence and transmission dynamics of malaria in a community to target public health measures," he said.

That's where a project, PregMal, and Pujol Vallribera come in. The idea behind the project is that malaria in pregnant women may serve as the ideal indicator for the prevalence of the disease in a community.

At the moment, calculating the spread of the disease is mainly done in health facilities like hospitals. This so-called passive approach tests patients who have symptoms such as fever. Based on those results, researchers try to estimate how common malaria is in an area.

But this method has limitations. Not everyone with symptoms will go to a hospital to be tested and some people might have malaria but no signs

of it. As a result, researchers get a biased view of how many people are infected in an area—either too high or too low—and policy responses can fall short.

Then there is what's called active surveillance. Here, health authorities go to an area and select a representative group of people to test. This paints a more accurate picture of malaria being spread, but it's expensive and hard to organize.

Pregnant stats

Pregnant women, however, might combine the best of both worlds.

About 80% of pregnant women in Sub-Saharan Africa attend a clinic at least once, reducing the problem of only a biased group getting tested, according to Pujol Vallribera. And because women become pregnant throughout the year, medical authorities get reliable malaria numbers over the whole period.

Finally, in malaria-prone regions testing pregnant women makes sense because the effects of the disease are often stronger in cases of pregnancy, with a major impact on the unborn child's health.

With that data, experts like Pujol Vallribera can better estimate the prevalence of malaria and how it's spreading.

"I used an algorithm adapted from the field of cosmology," he said. "It takes into account the population distribution and identifies clusters of infections, just as it would identify clusters of galaxies."

On top of assessing the prevalence of malaria in a community, the researchers also look at the genomic profile of the disease. They analyze the DNA of the parasite that causes malaria, allowing them to see small

variations and mutations in it.

In this way, they can trace where the disease came from. Malaria might, for example, have been eliminated in a certain area, but an infected person coming from another region and getting bitten by local mosquitos can spread the disease all over again.

The main focus of PregMal, which began in April 2021 and runs until late this year, is on Africa. For the past couple of years, team members have been testing their approach in Mozambique.

Out of Africa

Yet mosquito-borne diseases like malaria aren't just a thing of the tropics. Climate change and globalization mean that, even in Europe, the mosquitoes that spread these diseases are becoming more common. Researchers are particularly worried about the tiger mosquito.

"Tiger mosquitoes are one of the main sources of diseases like dengue, yellow fever and Zika," said John Palmer, associate professor at Pompeu Fabra University in Barcelona. "The tiger mosquito is now regularly found in Spain."

Palmer is coordinating a project called H-MIP, short for Human-Mosquito Interaction Project, which tracks these insects and studies how they interact with humans.

The researchers do this primarily in Barcelona, where sightings of the tiger mosquito have increased in recent years. There are now established tiger mosquito populations across the Mediterranean, with sightings extending as far north as the Netherlands.

Spot the stripe

What's new about this five-year project, which runs through March 2025, is that researchers are using regular people to spot the offending mosquitoes.

"It's citizen science," said Palmer. "Traditional surveillance methods use traps. But here we learn when people are bitten and how mosquitoes interact with humans."

Volunteers share mosquito sightings and bites, using an app to track where everything happens. This approach works well in a study on the tiger mosquito because it is easily recognizable by the white stripe along its back, according to Palmer.

H-MIP researchers also use more traditional scientific methods. They interview volunteers and test the DNA of the blood found in trapped mosquitoes.

With this information, they hope to understand better how the mosquitoes behave and how prevalent they are.

Better controls

The eradication of malaria is a priority, with the WHO seeking to reduce cases and mortality by 90% this decade.

New technologies and vaccines are expected to help. Last year, the European Innovation Council awarded a €5 million Horizon Prize on '"Early Warning for Epidemics" to a project that developed a surveillance tool to combat the threat of mosquito-borne diseases.

Harnessing the power of citizen scientists will also be key to detecting invasive species and tracking how mosquito-borne disease spread.

People's behavioral habits that researchers can identify help shed new light on disease transmission and inform prevention strategies.

Such habits include the types of clothes that people wear, the number of others they interact with and whether they live in urban areas and spend many hours a day in air-conditioned rooms or reside in the country surrounded by plants and wildlife.

"Understanding human-mosquito interaction is going to allow us to make much better decisions on mosquito control and public health," said Palmer. "We can, much more precisely, target control measures."

More information:

- PregMal
- H-MIP
- EU research on malaria

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