Effetti dell’inquinamento e dei cambiamenti climatici sulla salute della popolazione in ottica di genere

Malattie trasmesse da vettori e cambiamenti climatici

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Tra questi animali, quale è il più pericoloso?

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Vector-borne diseases

World Health Organization

- Vector-borne diseases account for more than 17% of all infectious diseases, causing more than 700 000 deaths annually. They can be caused by either parasites, bacteria or viruses.
- Malaria is a parasitic infection transmitted by Anopheline mosquitoes. It causes an estimated 249 million cases globally, and results in more than 608 000 deaths every year. Most of the deaths occur in children under the age of 5 years.
- Dengue is the most prevalent viral infection transmitted by Aedes mosquitoes. More than 3.9 billion people in over 132 countries are at risk of contracting dengue, with an estimated 96 million symptomatic cases and an estimated 40 000 deaths every year.
- Other viral diseases transmitted by vectors include chikungunya fever, Zika virus fever, yellow fever, West Nile fever, Japanese encephalitis (all transmitted by mosquitoes), tick-borne encephalitis (transmitted by ticks) and Oropouche fever (transmitted by Culicoides flies)
- Many of vector-borne diseases are preventable through protective measures and community mobilization

https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases

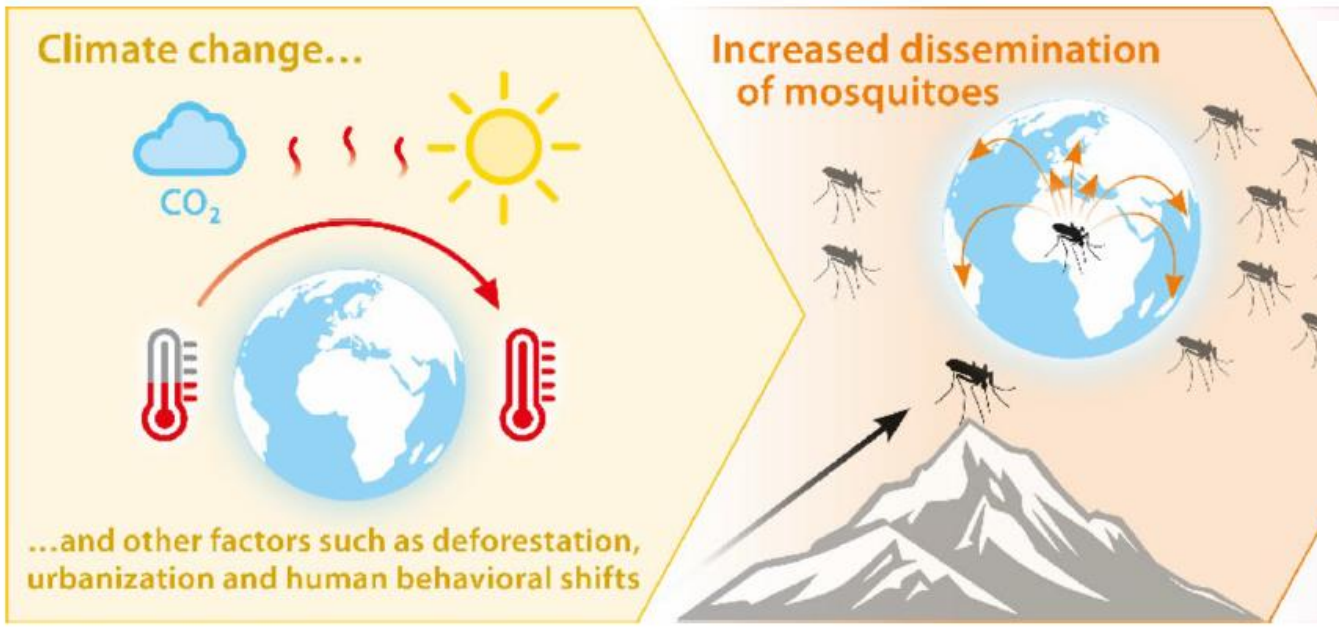
Climate change and human health : Vector-mediated infectious diseases

Neira et al, Environmental Research (2023)

	West Nile Fever	Malaria	Leishmaniasis	*Aedes*-borne arboviral infections
Causative agent	• West Nile Virus.	• Various species of *Plasmodium* parasites.	• Various species of *Leishmania* parasites.	• Dengue virus, Zika virus, chikungunya virus, among others.
Common vectors	• Various species of *Culex* mosquitoes.	• Various species of *Anopheles* mosquitoes.	• Various species of Psychodidae sandflies.	• Various species of *Aedes* mosquitoes.
Symptoms	• Ranging from mild and flu-like to encephalitis and death.	• Intermittent periods of high fever with a feeling of intense cold. • Nausea, headaches, and myalgia. • In severe cases, blood vessel blockage, organ failure and death.	• Varying from non-healing skin lesions (which can lead to disfigurement and disability) to internal organ enlargement, anemia and death.	• Large proportion of cases can be asymptomatic. • When present, symptoms vary from mild and flu-like to severe and potentially fatal, including haemorrhagic syndrome, polyarthralgia and neurological complications.
Relevant environmental influences	• High temperatures (particularly during the summer). • High precipitation in late winter/early spring, coupled with particularly dry summers. • Presence of migratory bird species.	• Rainfall, temperature, humidity, vegetation, hydrogeology and wind speed. • In areas where this disease has been eradicated, the presence of endemic competent vector species increases the risk of re-emergence.	• Precipitation, temperature, altitude, land use, water development projects and presence of potential reservoir species.	• Temperature, precipitation and host/reservoir availability. • Temperature is a major determinant of several important parameters, including habitat suitability for vectors, vector capacity and virus mutation rates.

Effects of Climate Change on Vector-Borne Diseases and Gender Implications

Climate Change and Vector-Borne Diseases



Gendered Impacts of Vector-Borne Disease under Climate change

Effect of temperature on the life history of mosquitoes

Pathogens of various mosquito-borne diseases

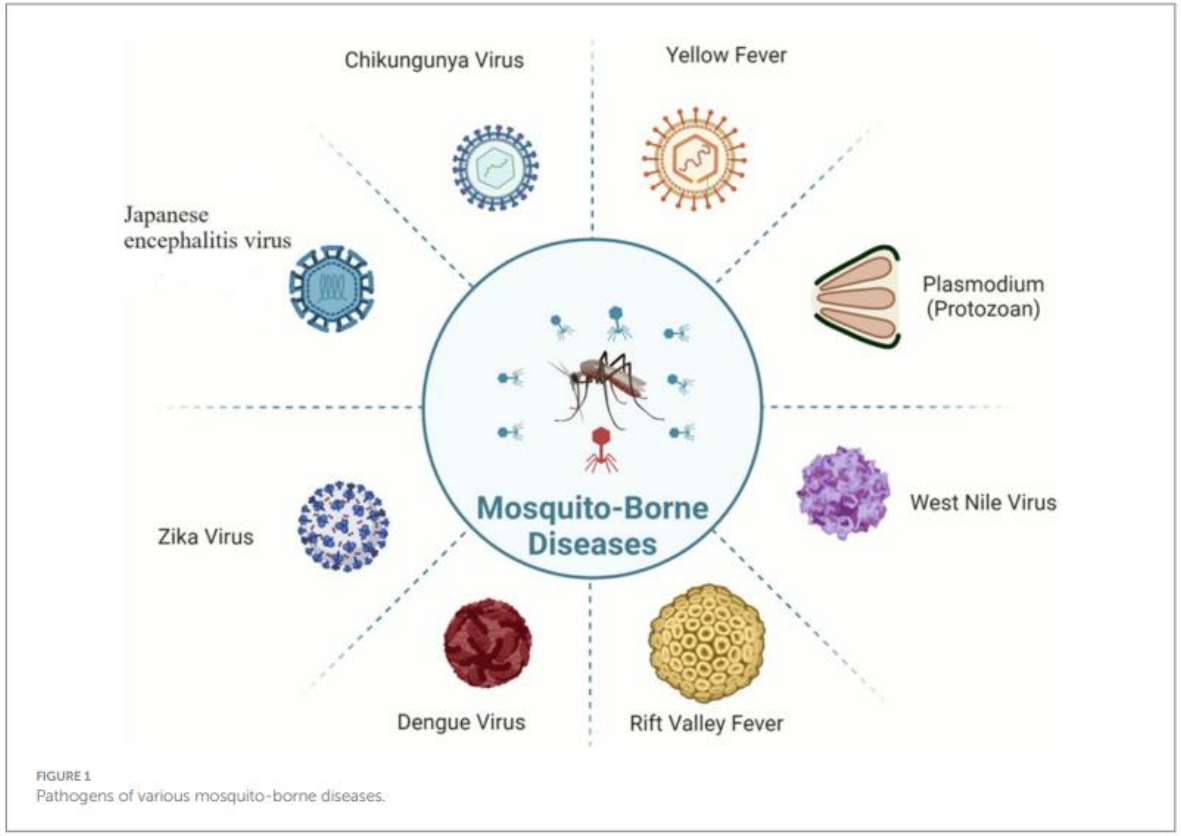
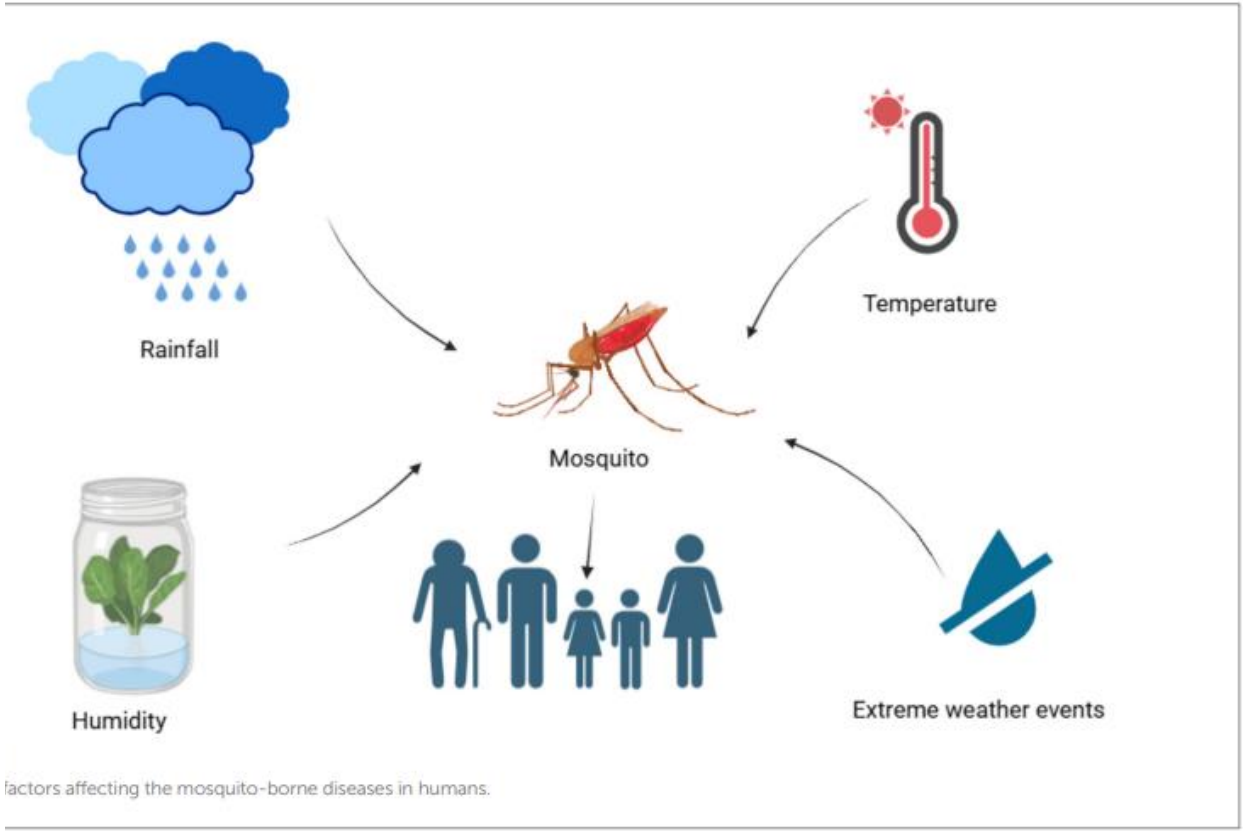


FIGURE 1
Pathogens of various mosquito-borne diseases.

Climatic factors affecting the mosquito-borne diseases in humans



factors affecting the mosquito-borne diseases in humans.

Zhang et al, Front Microb, 2024
10.3389/fmicb.2024.1488106

Effect of temperature on life history traits during immature development of Aedes aegypti and Culex quinquefasciatus (Diptera: Culicidae) from Córdoba city, Argentina

Aedes aegypty (Dengue Virus)

Culex quienquefasciatus (West Nile Virus)

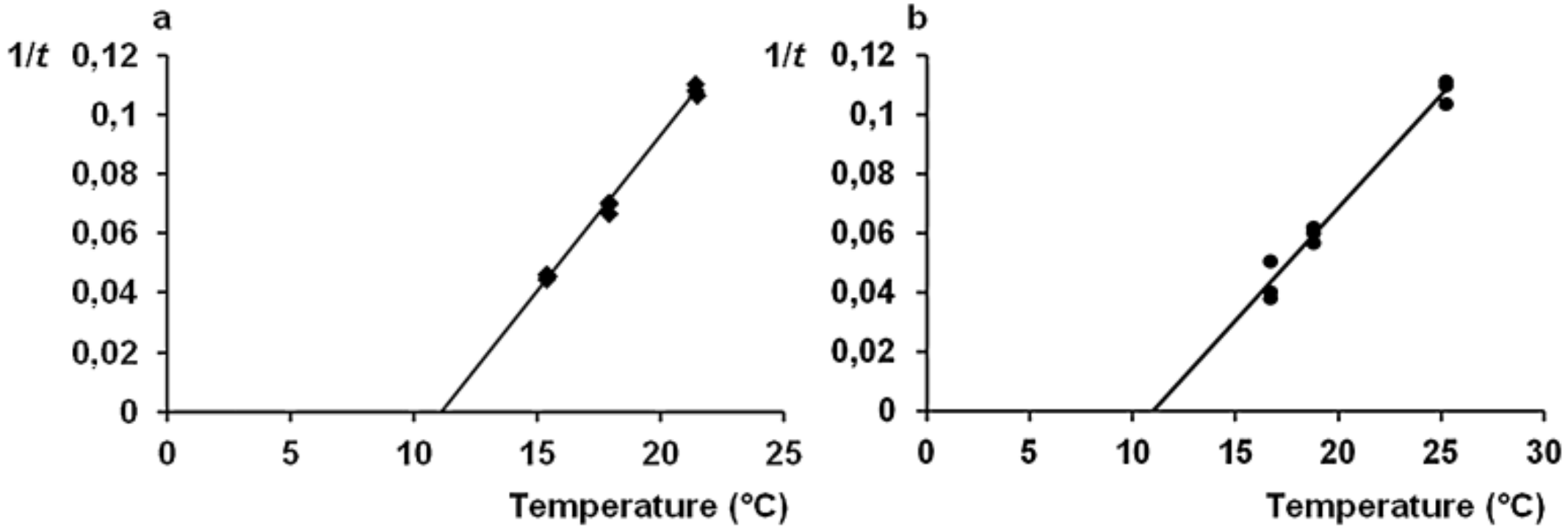
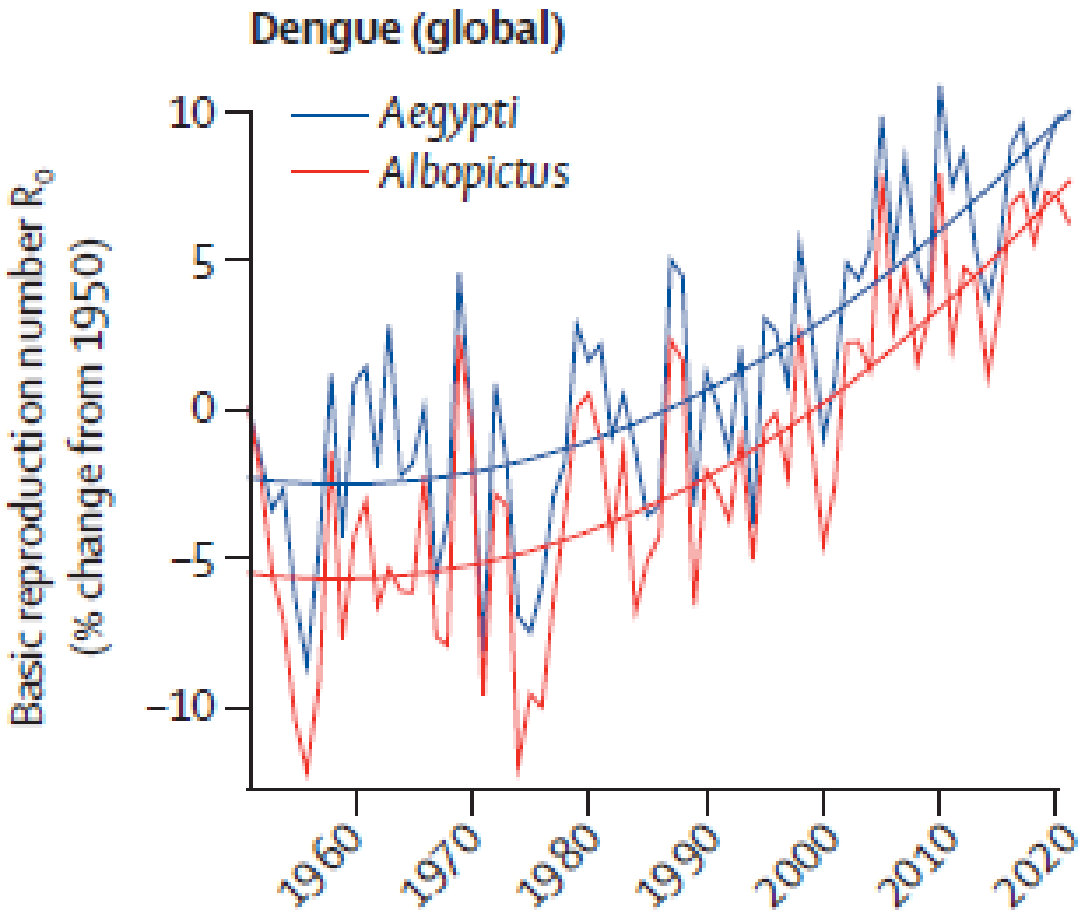


Fig. 1. Development rate (1/*t*) of *Aedes aegypti* (A), and *Culex quinquefasciatus* (B) reared under different temperature conditions.

Grech et al, Acta Tropica, 2015

The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels



R0: The basic reproduction number (R0) is a mathematical term that describes how contagious an infectious disease is. It is the average number of new infections caused by one infectious person in a completely susceptible population.

Arbovirus

Between 2012 and 2021, the basic reproduction number (R0) for:

- Dengue transmission increased by 11.5% via *Aedes aegypti* and 12.0% via *Aedes albopictus*.
- Chikungunya transmission by *Aedes albopictus* rose by 12.0%, while
- Zika transmission through *Aedes aegypti* increased by 12.4%,

compared with the rates observed during 1951–1960.

During the same period, **the length of the transmission season** increased for all arboviruses by approximately **6%**.

The **vector incubation period became shorter** in warmer season

Romanello et al, The Lancet 2022

Effects of Climate Change on Vector-Borne Diseases and Gender Implications

Gendered Impacts of Vector-Borne Disease under Climate change

Gender Differences in Water and Vector-borne Diseases in India

https://www.aiib.org/en/news-events/media-center/blog/2025/unequal-burden-how-climate-change-impact-women-health.html

Unequal Burden: How Climate Change is Disproportionately Impacting Women's Health

DOWNLOAD PICTURE

Gender and Climate Change

Women are the main producers of the world‘s staple crops:

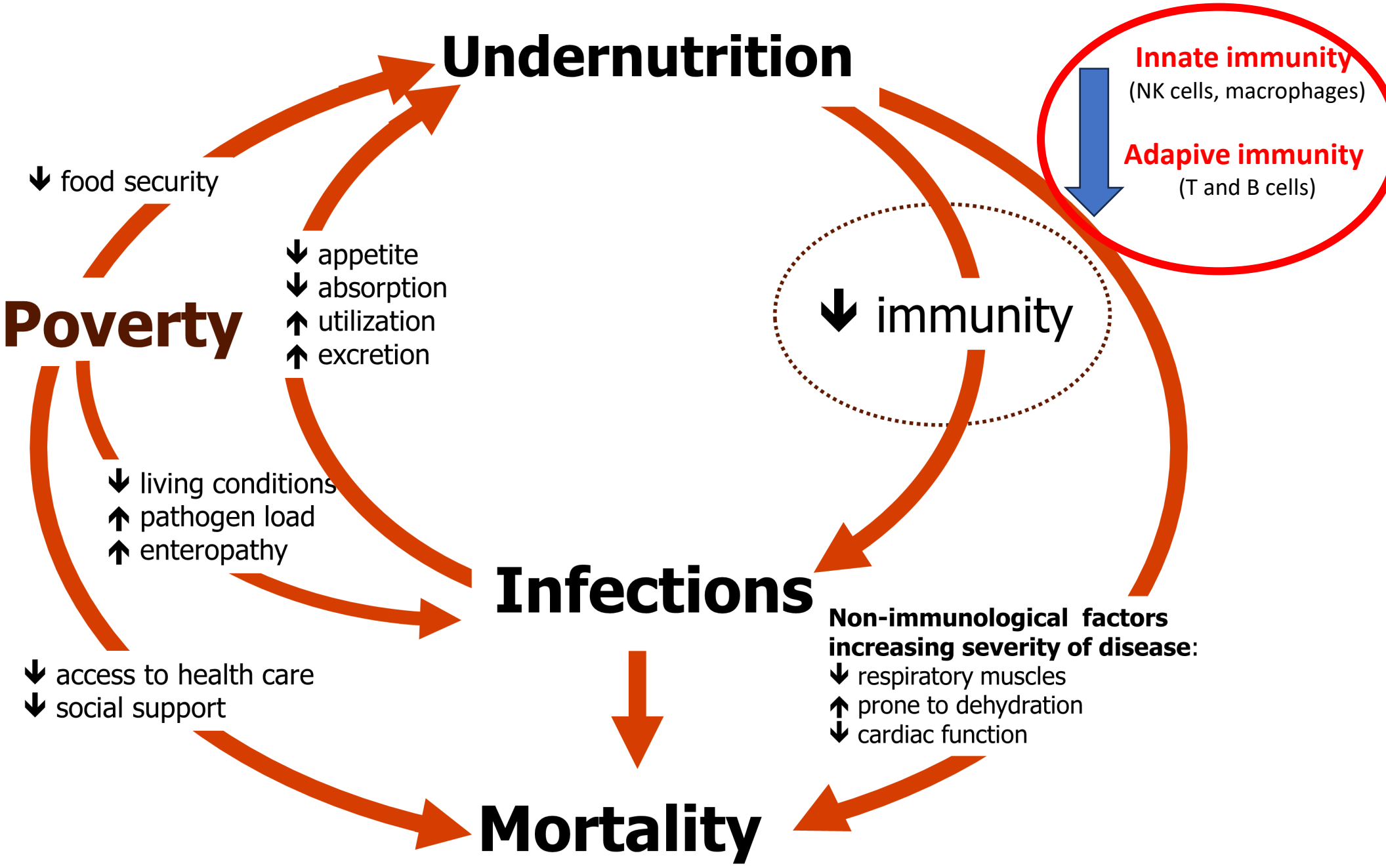
- providing up to 90% of the rural poor’s food intake
- producing 60–80% of the food in most developing countries.

Gender and Climate Change

- Climate variability played an important role in initiating malaria epidemics in the East African highlands (Zhou et al., 2004) and accounts for 70% of variation of cholera series in Bangladesh in 2002 (Rodo et al., 2002).
- This increase in outbreaks could have gender-differentiated impacts because women:
  - have less access to medical services than men (Nelson et al., 2002) and
  - women's workloads increase as they have to spend more time caring for the sick
  - malnutrition

IUCN
The World Conservation Union

Framework on the relationship between malnutrition, infections and poverty



Heilskov Rytter et al, PloS One 2014

Daly (Disability Adjusted Life Years)

DALY

I **DALY (Disability Adjusted Life Years)** sono un indicatore dell'impatto globale di uno o più fattori di rischio. Vengono espressi come gli anni cumulativi di vita persi a causa di morbosità, mortalità e disabilità.

= **YLD**
Anni vissuti con malattia o disabilità

\+ **YLL**
Anni di vita persi

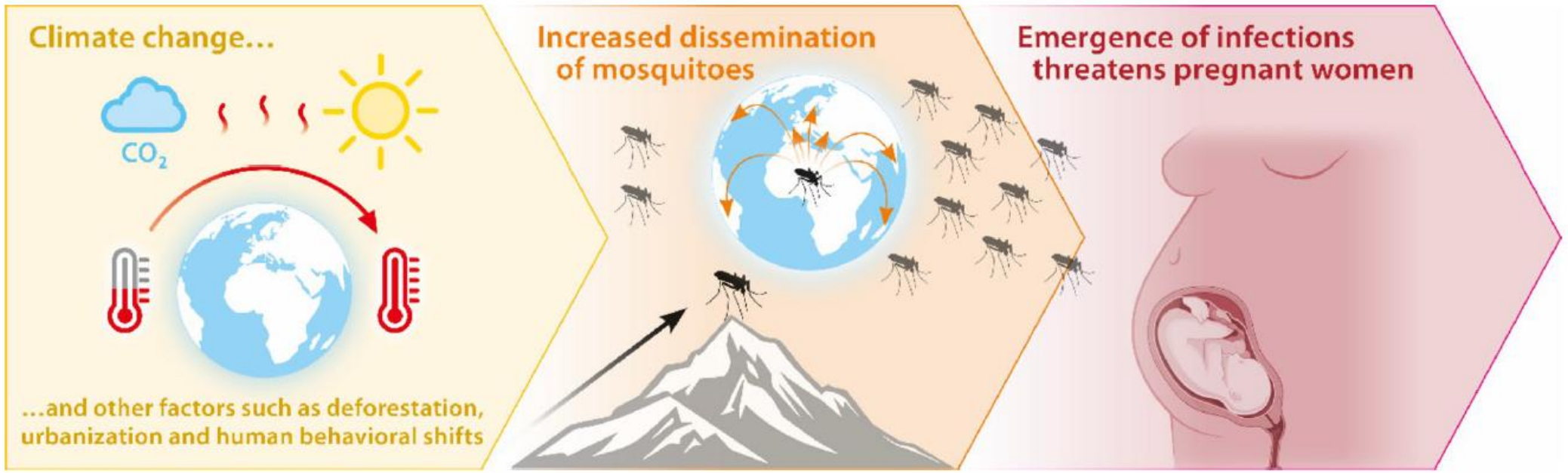
Impact of water- and vector-borne diseases (WVBDs) on women life

- Climate change intensifies the spread and impact of water- and vector-borne diseases (WVBDs) like **dengue, malaria, diarrhea, leptospirosis and Zika** virus by increasing the survival and dispersion of pathogens and vectors, and by disrupting health infrastructure.
- In India, health data indicates that women endure a larger prevalence of WVBDs than men. Indian women account for 18.8% of global Disability-Adjusted Life Years (DALY)—a measure of years of life lost due to premature death or diseases due to WVBD—compared to a standardized life expectancy.
- In comparison, Indian men account for only 16.5% of WVBD-related global DALY. The difference is even more pronounced among the working-age group (15-69 years).

https://www.aiib.org/en/news-events/media-center/blog/2025/unequal-burden-how-climate-change-impact-women-health.html

Mothers and mosquitoes: climate change contributes to the spread of vector-borne pathogens posing a substantial threat t pregnant women

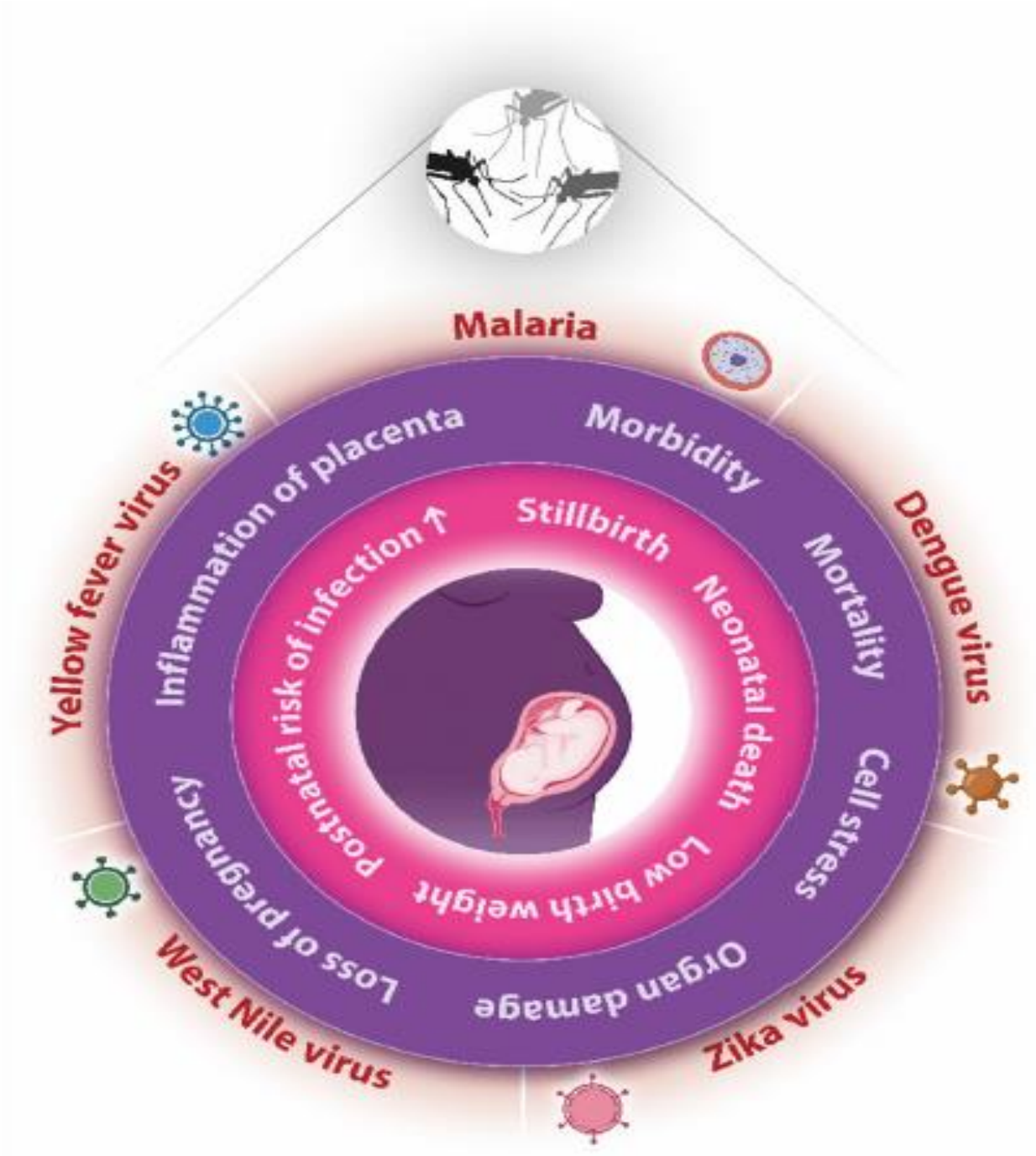
Wiemers et al, Seminars in Immunopathology, 2025



Pregnant women are susceptible to infections

- Pregnant women are especially susceptible to infections, a phenomenon that can be partly attributed to the physiological adaptations to pregnancy.
- These adaptations include:
  - an enhanced blood supply to mucosal tissues and the decreased lung volume resulting from the diaphragmatic elevation
  - immune system adaptations that foster a tolerogenic environment, which plays a significant role in the increased severity of infections during pregnancy:
- The immune tolerance mounted during pregnancy is the suppression of anti-fetal effector responses, allowing for the survival of the semi-allogenic fetus.
- This ineffective elimination of pathogens is considered to be one of the main factors contributing to the severity of infections observed in pregnant women.
- More specifically, the less efficient anti-viral response mechanisms during pregnancy result from:
  - an altered antigen presentation capacity of innate immune cells,
  - lower frequencies and efficiency of the pathogen-specific T cell response,
  - reduced migration of effector cells to the site of infection, such as the lung, and an increased mutation rate of pathogens due to lower environmental pressure in the host

Generalized overview of the potential effects of vector-borne diseases on maternal and fetal health



Wiemers et al, Seminars in Immunopathology, 2025

Mothers and mosquitoes: climate change contributes to the spread of vector-borne pathogens posing a substantial threat to pregnant women

Wiemers et al, Seminars in Immunopathology, 2025

Table 1 Mosquito-borne diseases with low prevalence may disseminate and become a potential threat to maternal and newborn health in other regions in the future

Pathogen	Disease caused	Cases in Europe
Oropouche virus	Oropouche fever	19 travel-related cases were registered in 2024 [27]
Rift Valley virus	Rift valley fever	There was one probable case in France 2021 [28]
O'nyong'nyong virus	O'nyong'nyong fever	Sporadic travel-related case reported [29]
Japanese encephalitis virus	Japanese encephalitis	Sporadic case reports [30]
Parasitic roundworms	Lymphatic filariasis	Sporadic migration-related cases [31]
Venezuelan equine encephalitis virus	Venezuelan equine encephalitis	No recent cases reported

Come possiamo migliorare…

Azione climatica attenta al genere:

- È fondamentale integrare le considerazioni di genere nelle politiche e negli interventi sui cambiamenti climatici, garantendo che le esigenze e le prospettive delle donne siano integrate nelle soluzioni.

Rafforzamento dei sistemi sanitari:

- È essenziale investire in infrastrutture sanitarie resilienti e migliorare l'accesso a servizi sanitari di qualità, in particolare per le donne incinte e altri gruppi vulnerabili.

Promozione della parità di genere:

- Affrontare le disuguaglianze di genere sottostanti attraverso l'istruzione, l'emancipazione economica e iniziative di giustizia sociale è fondamentale per costruire la resilienza della comunità ai cambiamenti climatici.
- Raccolta e utilizzo dei dati di genere:
- Raccogliere dati e analizzare dati disaggregati per sesso è fondamentale per comprendere gli impatti specifici dei cambiamenti climatici su donne e ragazze, orientare interventi efficaci e monitorare i progressi.

Impatto del genere sulle malattie trasmesse da vettori nel contesto del cambiamento climatico

Il genere gioca un ruolo importante nel modo in cui le popolazioni affrontano, gestiscono e si riprendono dai rischi per la salute. Donne, uomini e minoranze di genere non sono colpiti in egual misura.

Esposizione

- Divisione del lavoro: in molte regioni, le donne sono responsabili della raccolta dell'acqua, dell'agricoltura e dell'assistenza, il che aumenta il contatto con zanzare e zecche.
- Alloggio e mobilità: gli uomini possono trascorrere più tempo all'aperto per lavoro (ad esempio, silvicoltura, pesca, edilizia), aumentando il rischio di esposizione ai vettori.
- Rischi in gravidanza: malattie come il virus Zika colpiscono in modo sproporzionato le donne in gravidanza a causa di complicazioni fetali (microcefalia).

Vulnerabilità e conseguenze sulla salute

- Differenze biologiche: fattori immunologici e ormonali possono influenzare la suscettibilità e la progressione della malattia tra uomini e donne.
- Nutrizione e accesso all'assistenza sanitaria: le donne spesso si trovano ad affrontare disuguaglianze strutturali nell'accesso all'assistenza sanitaria, nel processo decisionale e nelle risorse, il che le rende più vulnerabili alle complicazioni.
- Intersezionalità: lo status socioeconomico, l'età e le norme culturali aggravano la vulnerabilità di genere.

Coping e adattamento

- Conoscenza e capacità di agire: le donne potrebbero avere un accesso limitato alle informazioni su clima e salute a causa di lacune nell'alfabetizzazione o dell'esclusione dai forum decisionali.
- Ricerca di assistenza sanitaria: le norme di genere a volte ritardano l'accesso delle donne alle cure, mentre gli uomini potrebbero sottoutilizzare l'assistenza a causa delle norme maschili sulle malattie "persistenti".
- Resilienza della comunità: le donne svolgono un ruolo chiave nel controllo dei vettori a livello familiare (ad esempio, rimuovendo l'acqua stagnante, utilizzando zanzariere), ma potrebbero non avere risorse o riconoscimento.

Professor Drew Weissman, Nobel Price Medicine 2023 at INMI
Rome, October 11, 2024