Chronological change in the incidence risk levels of mosquito-borne and rodent-borne infections

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Soichi Takeishi MD, Tatsuo Inoue MD, Koichi Miyamura MD, PhD
Infection Control Committee, Inuyama Chuo General Hospital

Background

- Mosquito-borne infections, such as malaria, dengue fever, chikungunya fever, and Zika virus infection, have spread widely in tropical area [1-6].
- Climate change affects vectors of quarantinable infectious diseases; therefore, detail investigation is needed.
- We examined the change over time in the incidence risk levels of mosquito-borne and rodent-borne infections.

1. WHO: World malaria report 2023
2. WHO: Chikungunya
3. European Centre for Disease Prevention and Control: Chikungunya virus disease Communicable disease threats report, 21-27 January 2024, week 4:
4. WHO: WHO Fact sheet: Dengue and severe dengue
5. WHO: Countries and territories with current or previous Zika virus transmission
6. Santos LLM, et al. Rev Panam Salud Publica 2023; 47: e34.

Research design & Methods

- We used the data of "Summary of risk assessment of vector-borne disease at Japanese Quarantine ports and airports" described in the "Annual Report of Vector-borne Diseases Pathogens and Vector Surveillance" from 2019 to 2022 made by the Ministry of Health, Labour and Welfare.
- We compared the chronological changes from 2019 to 2022 in "the number of ports and airports in risk category A (very low due to 'vector absence')" [A] and "that in risk category B (low due to 'indigenous vector presence but no pathogens')" [B] of quarantinable infectious diseases evaluated by basic inspection, for dengue fever, Japanese encephalitis, West Nile fever and malaria, which are mosquito-borne infections, and plague, hemorrhagic fever with renal syndrome, Lassa fever, and South American hemorrhagic fever, which are rodent-borne infections, using a Cochran-Armitage test.

Results

Mosquito-borne infections

	Dengue fever		Japanese encephalitis		West Nile fever		Malaria	
	A	B	A	B	A	B	A	B
2019	69	53	101	20	48	74	120	2
2020	31	83	22	91	14	100	102	12
2021	29	89	21	96	7	111	108	10
2022	26	95	18	102	6	115	107	14
	p<0.001		p<0.001		p<0.001		p=0.01	

Rodent-borne infections

	Plague		Hemorrhagic fever with renal syndrome		Lassa fever		South American hemorrhagic fever	
	A	B	A	B	A	B	A	B
2019	40	82	80	42	122	0	122	0
2020	39	69	69	39	108	0	108	0
2021	46	64	75	35	110	0	110	0
2022	42	65	74	33	107	0	107	0
Cochran-Armitage test	p=0.21		p=0.46		p=NA		p=NA	

NA: because there were no ports or airports in B from 2019 to 2022.

B significantly increased over time compared to A.

Chronological changes in A were not significantly different from those in B.

Discussion

1. Because 25℃～30℃ is suitable for breeding of mosquitoes, chronological global warming may increase vector mosquitoes.
2. Because mosquitoes lay eggs at waterside, the egg-laying site increases due to the increase in sea level caused by global warming

↓

resulting in chronologically increased incidence risk levels of mosquito-borne infections.

Because 25℃～30℃ is suitable for breeding of fleas, ticks, and rodents, chronological global warming may increase them.

offset

A decrease in habitats due to the increase in sea level due to global warming

↓

A decrease in vector rodents

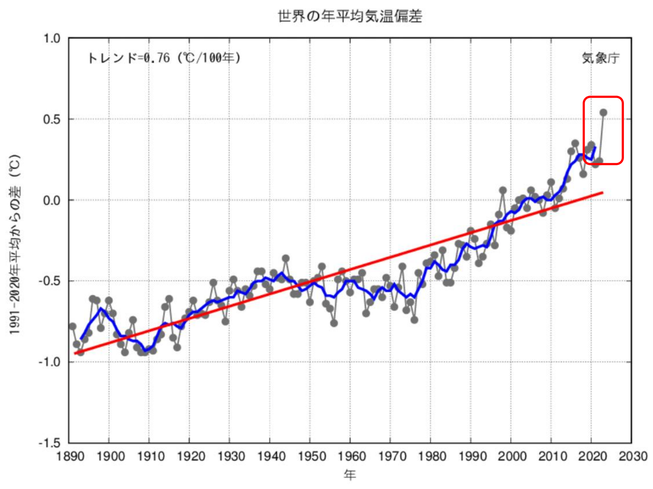
↓

A decrease in indigenous vector fleas and ticks because they lose parasitic places.

↓

no differences in the chronological changes in risk levels of rodent-borne infections

Global warming



Japan Meteorological Agency: World average annual temperature

- Compared to 2020 when WHO declared Public Health Emergency of International Concern (PHEIC), the world average annual temperature decreased in 2021 and 2022.
- The world average annual temperature increased in 2023 when the PHEIC finished, compared to 2020.

Why did the world average annual temperature decrease in PHEIC?

- The decrease in CO2 emission due to restriction of economic activity for infection control

- It has also been reported that the influence of the decrease in CO2 emission due to the COVID-19 pandemic on global warming is limited.

Jones CD, et al. Geophys Res Lett 2021; 48: e2020GL091883.

- The number of eggs laid increases exponentially theoretically due to the increase in sea level caused by global warming.
- The influence of global warming over decades before the COVID-19 pandemic on the increased egg-laying site due to the increase in sea level is enormous.
- If the egg-laying site decreases due to the decrease in global temperature for 2 years, this influence is limited compared to that influence over decades .

Laying 100×50^n eggs at least, per n months

- We think the fact that egg-laying sites increases due to an increase in sea level caused by global warming was involved in this reason.

Mosquito
Laying 100 eggs once
↓
50 male and 50 female are born.
↓
The 50 male and 50 female are copulated
1 month after laying eggs.
100 per 1 copulating, namely,
5000 eggs are laid by 50 copulating.
↓
2500 male and 2500 female are born.
↓
The 2500 male and 2500 female are copulated
1 month after laying eggs.
100 per 1 copulating, namely,
250000 eggs are laid by 2500 copulating.

Contact information

Soichi Takeishi, MD
Department of Internal medicine, Inuyama Chuo General Hospital
6, Futagozuka, Goromaru, Inuyama-city, Aichi, 484-8511, Japan.
Phone: +81-568-62-8111
E-mail:souichi19811225@yahoo.co.jp

Conclusion

The incidence risk levels of mosquito-borne infections may have increased over time.