

The Global Burden of Chikungunya: Estimating DALYs and Cost Burden

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Background

Chikungunya is becoming an increasing global health issue as it spreads across the world

- Chikungunya is a mosquito-borne viral disease caused by chikungunya virus (CHIKV). This alphavirus is mainly transmitted by species of the *Aedes* mosquito¹⁻³
- CHIKV is in the acute phase characterized by acute febrile polyarthralgia and inflammatory arthritis^{1,2}
- The chronic phase, characterized by joint pain, can be severe, debilitating, and long-lasting, severely impacting the quality of life for affected individuals^{4,5}
- Chikungunya was first isolated in 1952 during an outbreak in Tanzania¹⁻³
- Currently, chikungunya has been identified in over 110 countries, with outbreaks reported across almost all continents⁶
- Epidemics are characterized by large, explosive, unpredictable outbreaks with high attack rates between years of apparent disappearance³
- Recent evidence suggests an alarming increase in the geographic range of the *Aedes* mosquitoes, highlighting the importance of understanding CHIKV⁷⁻⁹

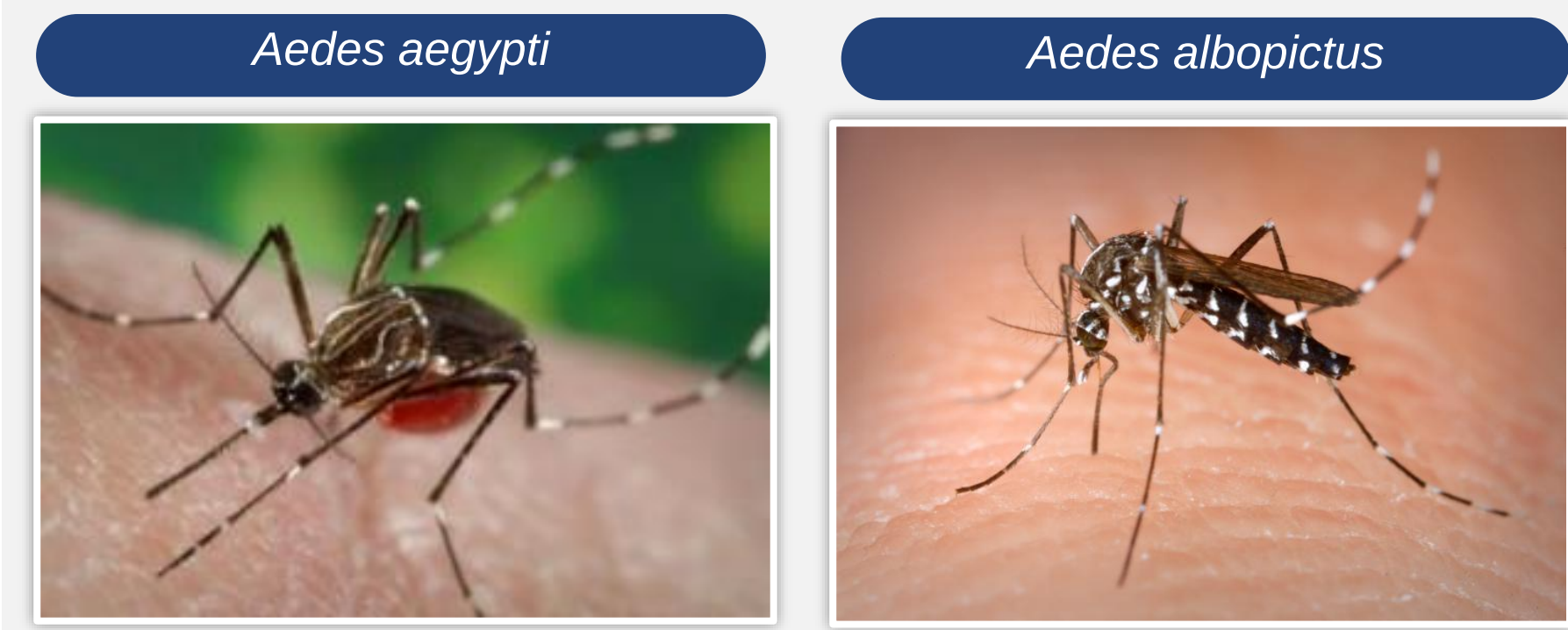


Figure 1. The primary vectors of CHIKV are *Aedes aegypti* (left) and *Aedes albopictus* (right) mosquitoes.

Objective & Methods

This study addresses the crucial need for a comprehensive assessment of the global burden of chikungunya, providing insights into its epidemiology, health, and cost burden

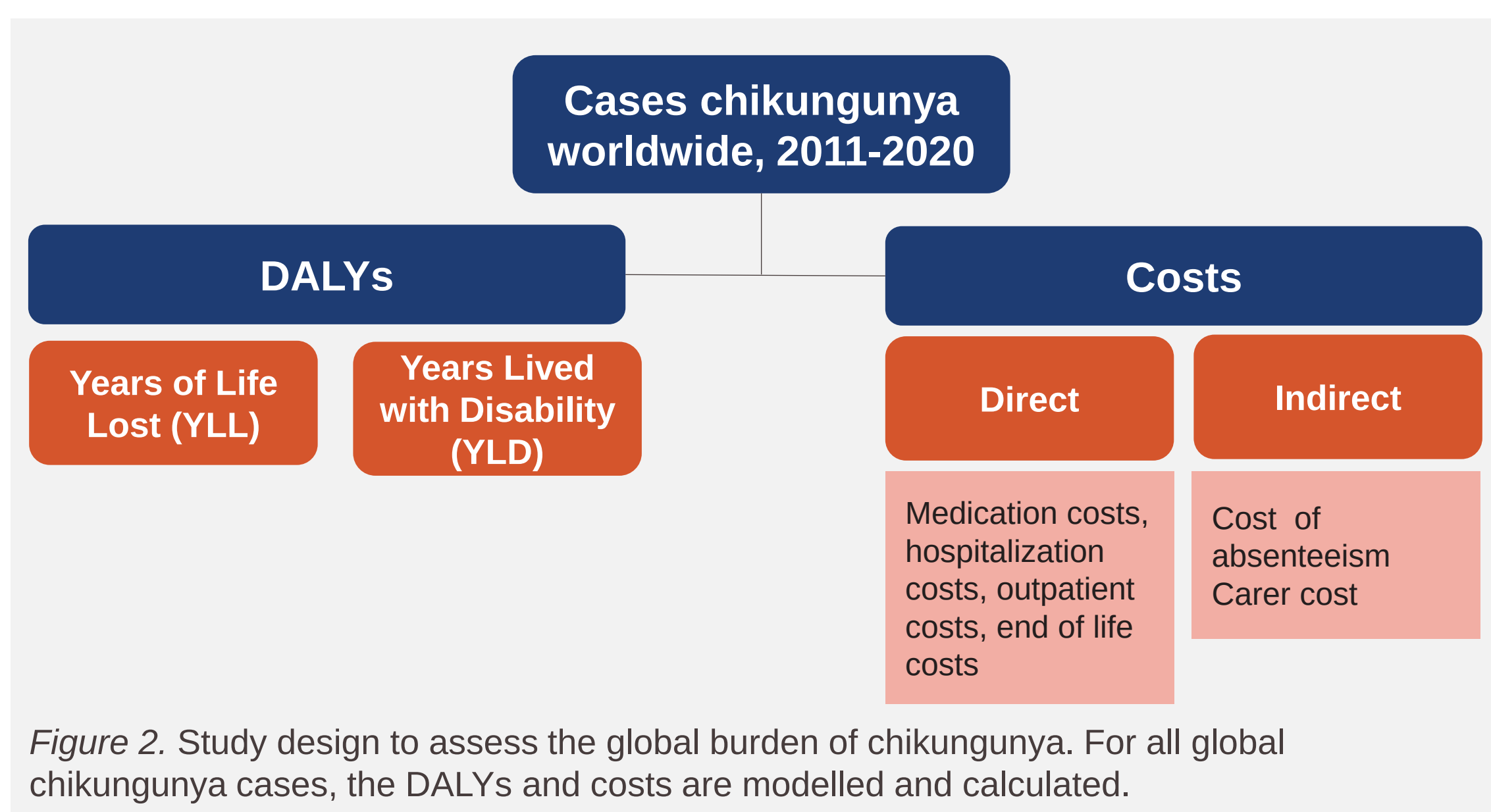


Figure 2. Study design to assess the global burden of chikungunya. For all global chikungunya cases, the DALYs and costs are modelled and calculated.

- A data-driven simulation model was developed, guided by the Global Burden of Disease (GBD) initiative¹⁰
- Cases in the 110 countries and territories with chikungunya cases between 2011 and 2020 were considered, and multiplied with an underreporting factor
- Disability-adjusted life years (DALYs) and costs were calculated based on global case numbers
- The global economic burden was studied from a direct and societal perspective

Results

8.1 million chikungunya cases were reported worldwide between 2011-2020

- Of these 8.1 million cases, reported in 110 countries, 3.4 million developed long term chronic sequelae
- Most cases were reported in Latin America and the Caribbean: over 7 million.
- The countries with the highest case-numbers were Brazil (2.6 million), the Dominican Republic (1.2 million), and Colombia (681,000).
- The year with the highest disease burden was 2014, with 2.8 million cases, due to outbreaks in the Caribbean area.

More than 850,000 DALYs were lost due to CHIKV between 2011-2020

- This corresponds to an average yearly loss of 85,000 DALYs
- Due to limited surveillance and additional underreporting, cases might be underestimated before 2014. Considering data from 2014 onwards, the DALY burden equates to a yearly loss of 120,274 DALYs

- Most DALY burden comes from chronic disease, with 643,000 DALYs (76%) lost due to chronic disease.
- Years lived with disability (YLD) takes up 77% part of the total DALY burden.
- The Latin American and Caribbean region was responsible for the highest DALY burden (734,000 DALYs, 86% of total), in line with the highest case numbers reported there.
- Brazil carried 32% of the DALY burden worldwide (266,000 DALYs)

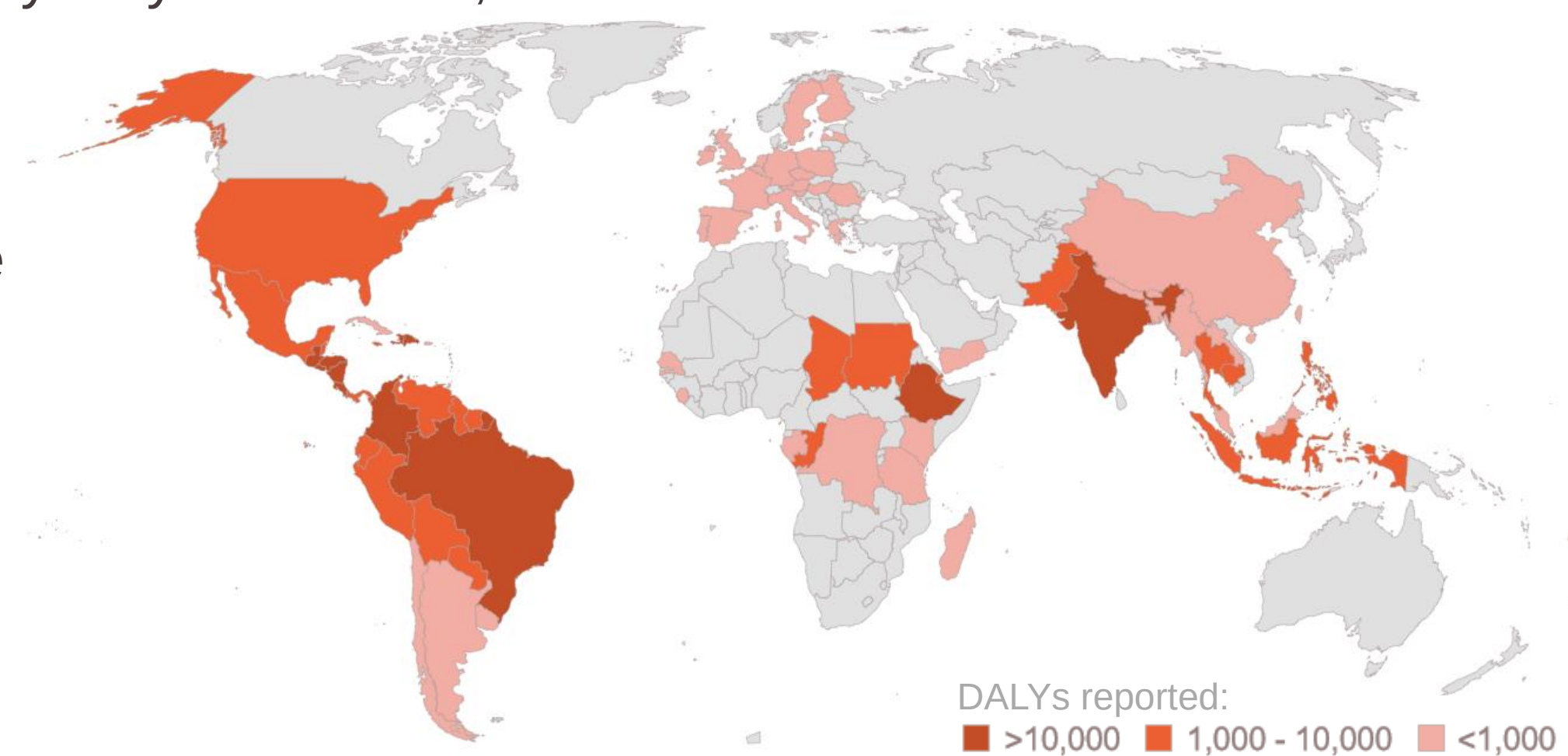


Figure 3. Total health burden due to chikungunya worldwide between 2011-2020, expressed in DALYs. Countries with DALYs lost in this period are colored. Grey areas are countries with no cases reported in this period.

The total global cost of chikungunya between 2011-2020 is US\$ 46.7 billion

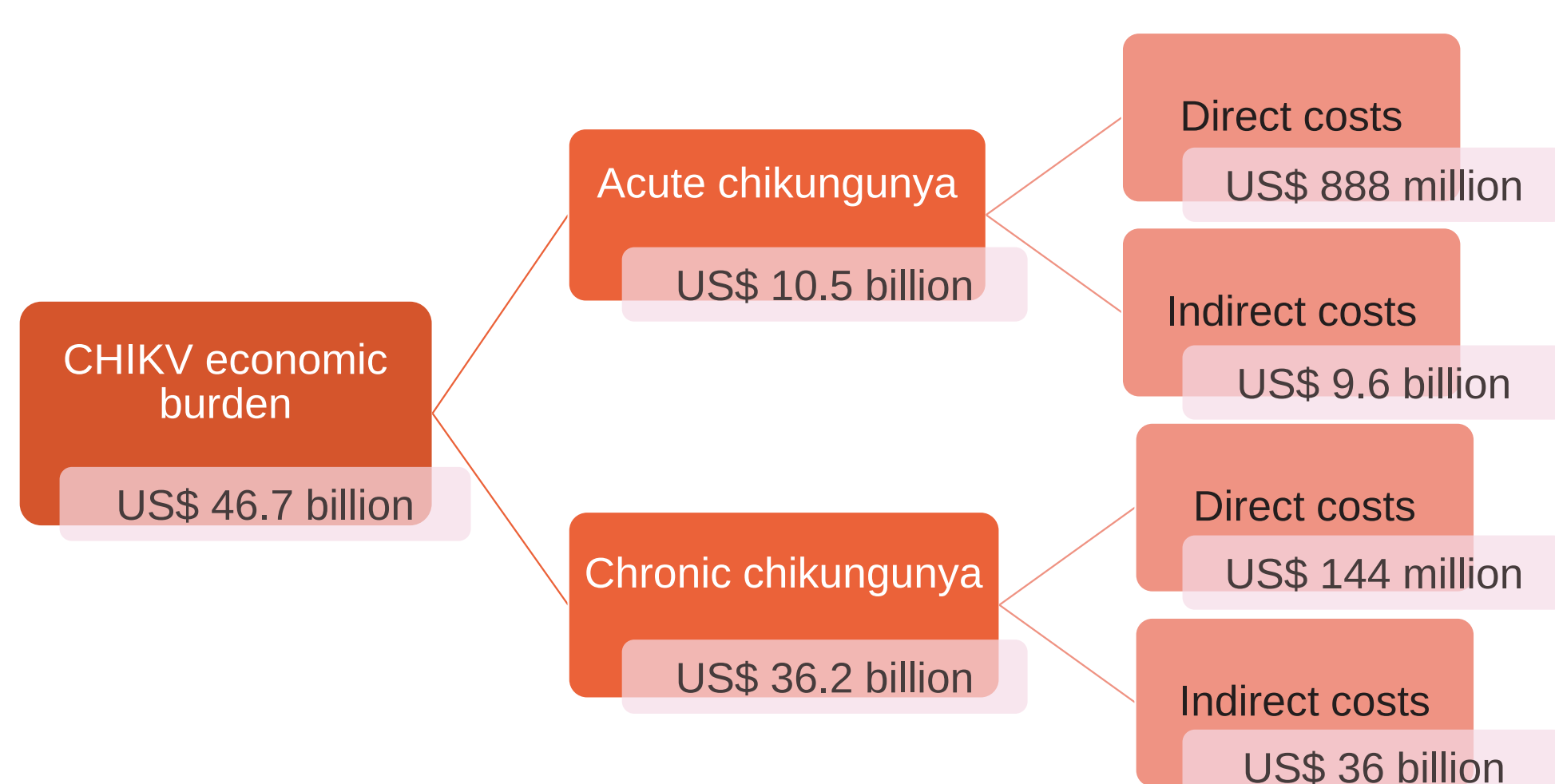


Figure 4. Economic burden due to chikungunya worldwide, between 2011-2020. Costs are separated for acute and chronic disease, and direct and indirect costs. Most cost are related to chronic disease. Furthermore, indirect costs are the main cost drivers.

- Most of the economic burden is attributable to chronic chikungunya disease and indirect costs, see figure 4.
- Direct medical costs are likely underestimated, as we took a conservative approach due to limited available literature and lack of reporting
- The main driver of the chronic costs is the cost of absenteeism, accounting for 82% of chronic costs
- Mortality was responsible for 0.001% of total costs worldwide
- The Latin American and Caribbean region, specifically Brazil, had the highest cost burden.

Conclusion

In summary, understanding the global burden of chikungunya is critical for designing effective prevention and control strategies.

Nevertheless, estimates of the aggregate health impact of CHIKV in the literature remain limited and are currently not included in the GBD reports.

Considering the increasing risk of large-scale outbreaks and the disabling consequences of CHIKV, it is crucial to address this knowledge gap and quantify the impact of CHIKV.

By synthesizing data from multiple sources and employing advanced modelling techniques, we provided a comprehensive overview of the chikungunya burden worldwide.



Chikungunya is a serious threat to global public health and causes significant disease burden worldwide



Outbreaks are explosive and unpredictable and often overwhelm local healthcare systems



Due to the unpredictable nature of CHIKV spread and lack of treatment options, there is an immediate need for effective preventive measures such as vaccines



Especially the chronic burden of chikungunya is substantial, with the DALY burden mainly determined by the years lived with disability



The economic burden related to chikungunya is significant, billions of dollars could be saved globally.



Increasing the awareness and knowledge of CHIKV could improve the effective usage of prevention strategies for CHIKV transmission and infection

Disclosures

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References

- Thiberville SD, Moya N, Dupuis-Maguiraga L, Nougaiere A, Gould EA, Roques P, de Lamballerie X. Chikungunya fever: epidemiology, clinical syndrome, pathogenesis and therapy. *Antiviral Res.* 2013 Sep;99(3):345-70.
- Vairo F, Haider N, Kock R, Ntoumi F, Ippolito G, Zumla A. Chikungunya: Epidemiology, Pathogenesis, Clinical Features, Management, and Prevention. *Infect Dis Clin North Am.* 2019 Dec;33(4):1003-1025.
- Paul BJ, Sadanand S. Chikungunya Infection: A Re-emerging Epidemic. *Rheumatol Ther.* 2018 Dec;5(2):317-326.
- Puntasecca CJ, King CH, LaBeaud AD. Measuring the global burden of chikungunya and Zika viruses: A systematic review. *PLoS Negl Trop Dis.* 2021;15(3):e0009055.
- Paixão ES, Rodrigues LC, Costa MDCN, et al. Chikungunya chronic disease: a systematic review and meta-analysis. *Trans R Soc Trop Med Hyg.* 2018;112(7):301-316.
- WHO Chikungunya factsheet. Retrieved from: <http://who.int/news-room/fact-sheet/detail/chikungunya> Accessed: October 2023.
- Leta S, Beyene TJ, De Clercq EM, Amenu K, Kraemer MUG, Revie CW. Global risk mapping for major diseases transmitted by *Aedes aegypti* and *Aedes albopictus*. *Int J Infect Dis.* 2018 Feb;67:25-35.
- Kraemer MUG, Reiner RC Jr, Brady OJ, Messina JP, Gilbert M, et al. Past and future spread of the arbovirus vectors *Aedes aegypti* and *Aedes albopictus*. *Nat Microbiol.* 2019 May;4(5):854-863.
- Kolimenakis A, Heinz S, Wilson ML, et al. The role of urbanisation in the spread of *Aedes* mosquitoes and the diseases they transmit-A systematic review. *PLoS Negl Trop Dis.* 2021;15(9):e0009631.
- World Health Organization. WHO methods and data sources for global burden of disease estimates 2000-2019. December 2020. Retrieved from <https://www.who.int/data/global-health-estimates> Accessed: April 2023.

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