

Does Public Research Investment on Emerging Infectious Diseases Correspond to Disease Burden in China? A cross-sectional study from 2004 to 2019

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BACKGROUND

- As a developing country with high levels of land-use change and wildlife biodiversity, China is a global hotspot for the emergence and outbreak of emerging infectious diseases (EIDs)¹.
- The National Natural Science Foundation of China (NSFC) is responsible for directing the national natural science fund to support basic research and technology advancement, comprising the majority of EIDs projects funded in the country².
- However, it is unclear to what extent the government investment addresses infections caused by EIDs and whether it was distributed proportionally to the disease burden profile.
- Our study examined the magnitude of NSFC funding for EIDs with high threats in China and compared with their disease burden measured in the number of newly notified incidence cases and deaths between 2004 and 2019.

METHODS

- Disease scope:** The EIDs included in the study were mainly based on the pathogens that have been prioritized or discussed for prioritization in the World Health Organization R&D Blueprint³. We supplemented others that peer-reviewed literature has recognized as posing significant public health risks to China. A total of 63 diseases were identified, covering viral, bacterial, parasitic and other pathogens (Supplementary File).
- Data collection and analysis:** A search of NSFC projects and funding was performed on the NSFC Management Service Portal to identify granted projects whose primary purpose was to advance knowledge and new technologies to detect, prevent, control or treat identified EIDs. The funding was converted into US dollars using the exchange rate for the year award from the International Monetary Fund. We tracked the number of newly notified incidence and death cases of EIDs from the annual national reports on the epidemic situation of notifiable infectious diseases in China, the 2019 Global Burden of Disease Study, official government notice and other sources. The time span was from 2004 (when the annual report started) to 2019 (when the NSFC funding was updated). The relationship between public funding and disease burden was analyzed in a simple linear regression model reported using Pearson correlation coefficient by RStudio (version 4.1.3).

FINDINGS

- Disease burden of EIDs:** Of the 63 EIDs identified, 24 diseases had both NSFC funding and disease burden data, thus included in the analysis. Overall, these diseases resulted in 1,360,835 incidence cases and 2,185 deaths averaged by year. Hand, foot and mouth disease (HFMD) and rabies accounted for the highest incidence and death burdens, with 1,289,254 cases/year (94.7%) and 1,624 deaths/year (76.2%), respectively (*Figure 1*). Eight funded diseases have not caused any morbidity or mortality in China so far, including Ebola and Marburg virus disease, Zika, onchocerciasis, yellow fever, African trypanosomiasis, Middle East respiratory syndrome coronavirus (MERS-CoV), and Rift Valley fever (RVF).
- Public investment on EIDs:** Over the 15 years, China has invested in 195 NSFC projects on EID research, totaling 2.11 million USD. The annual average funding ranges from 0.06 million USD in 2006 to 0.82 million USD in 2015. The highest funding year was largely represented by the research projects on Ebola virus disease (886,592 USD/project), which is more than eight times of the median grant size (108,170 USD/project). Ebola virus disease and Zika received the largest amounts of NSFC investment in both total and average project funds (*Figure 2*). HFMD and rabies, as the most prevalent and fatal EIDs, only accounted for 6.92% and 6.28% of the total funding, respectively.

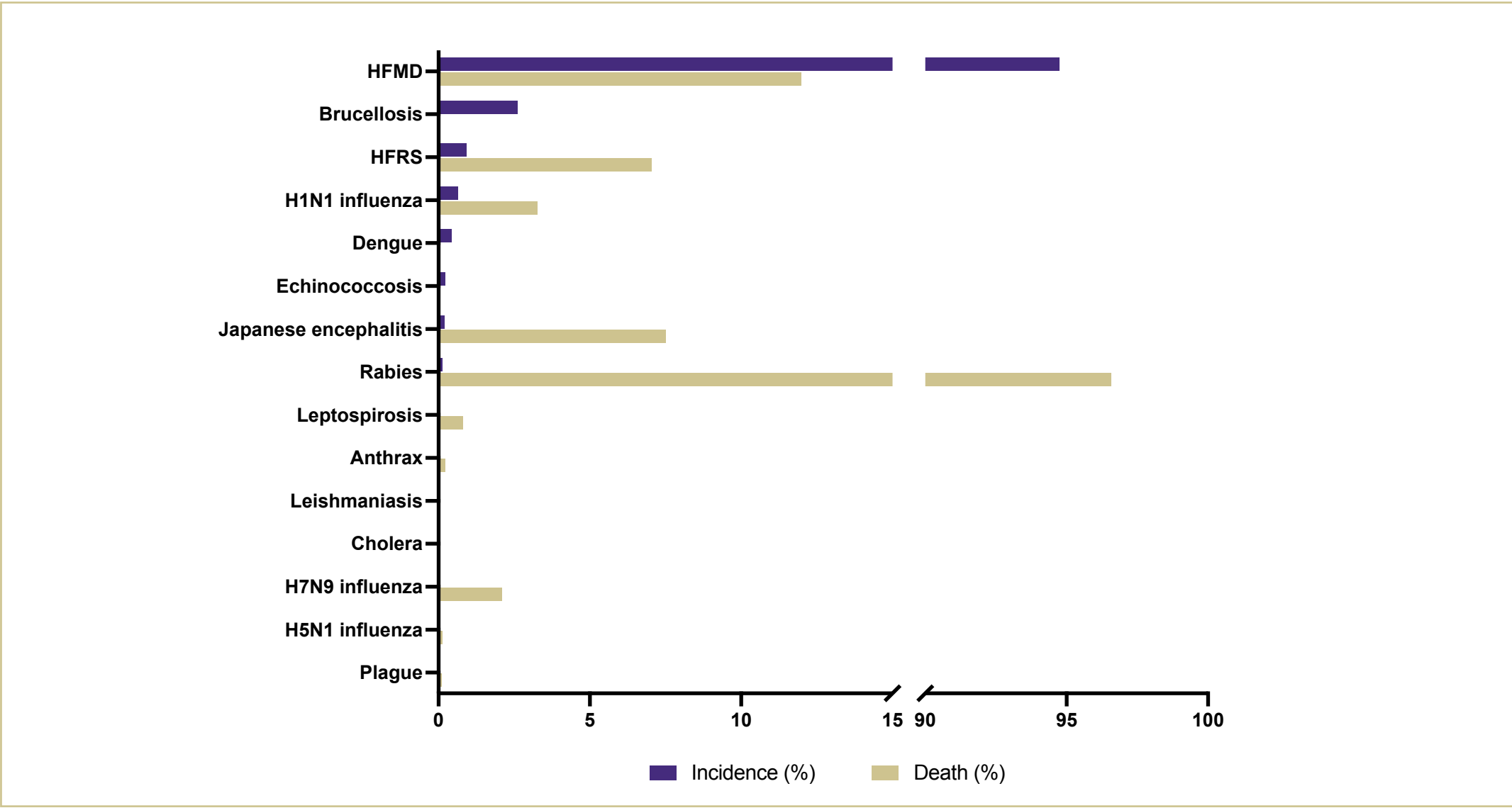


Figure 1. Proportional distribution of EID incidences and deaths between 2004 and 2019

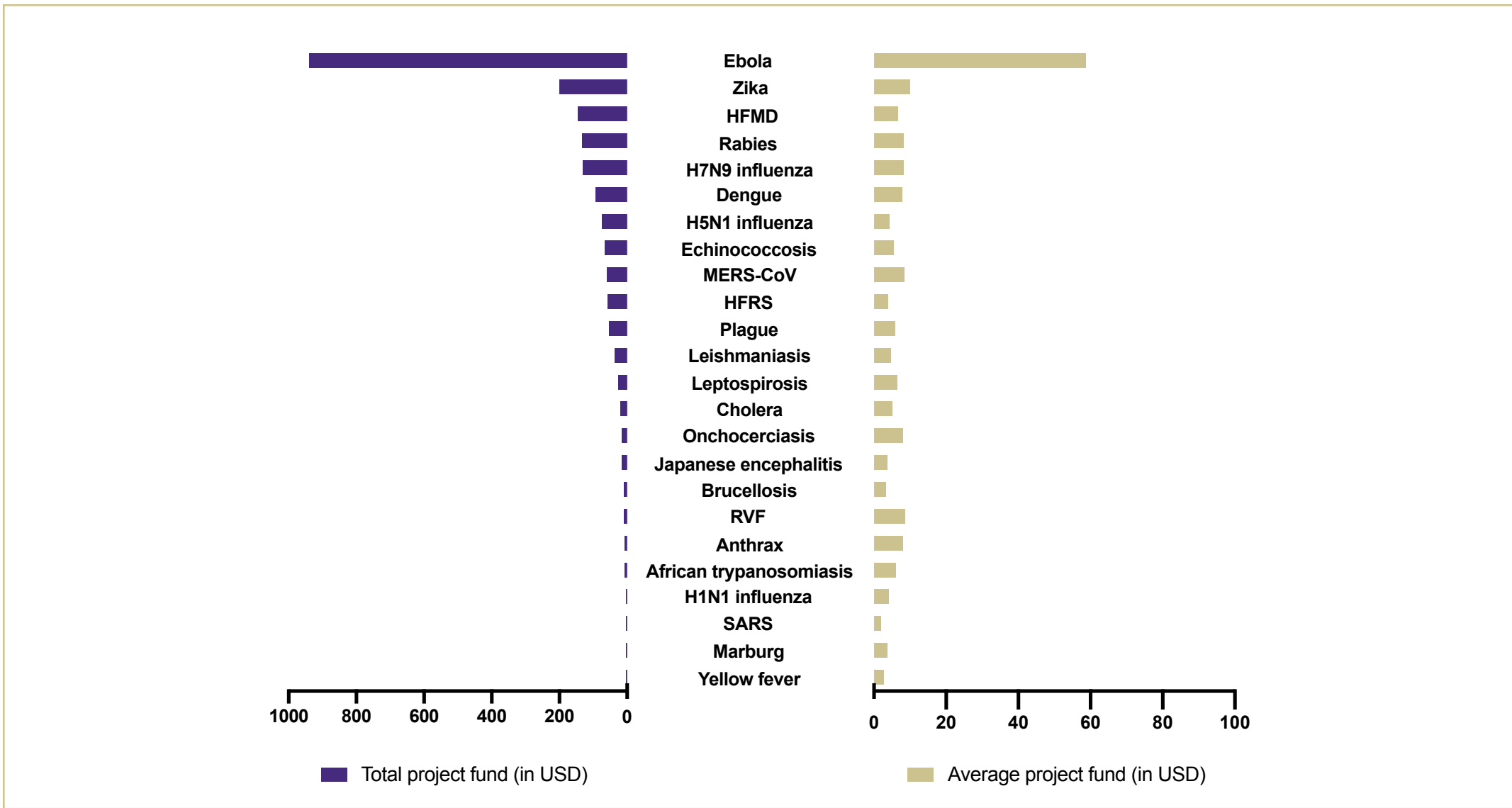


Figure 2. Total and average project fund by each EID between 2004 and 2019

- Association between disease burden and public investment:** Our analysis indicates the poor correlations between NSFC funding and EID burden in terms of incidence cases ($p = 0.46$; $r = 0.18$; 95%CI: -0.31-0.60) (*Figure 3A*) and deaths ($p = 0.17$; $r = 0.36$; 95%CI: -0.17-0.73) (*Figure 3B*). Japanese encephalitis, brucellosis and H1N1 influenza were relatively underinvested compared with their incidence and death cases.

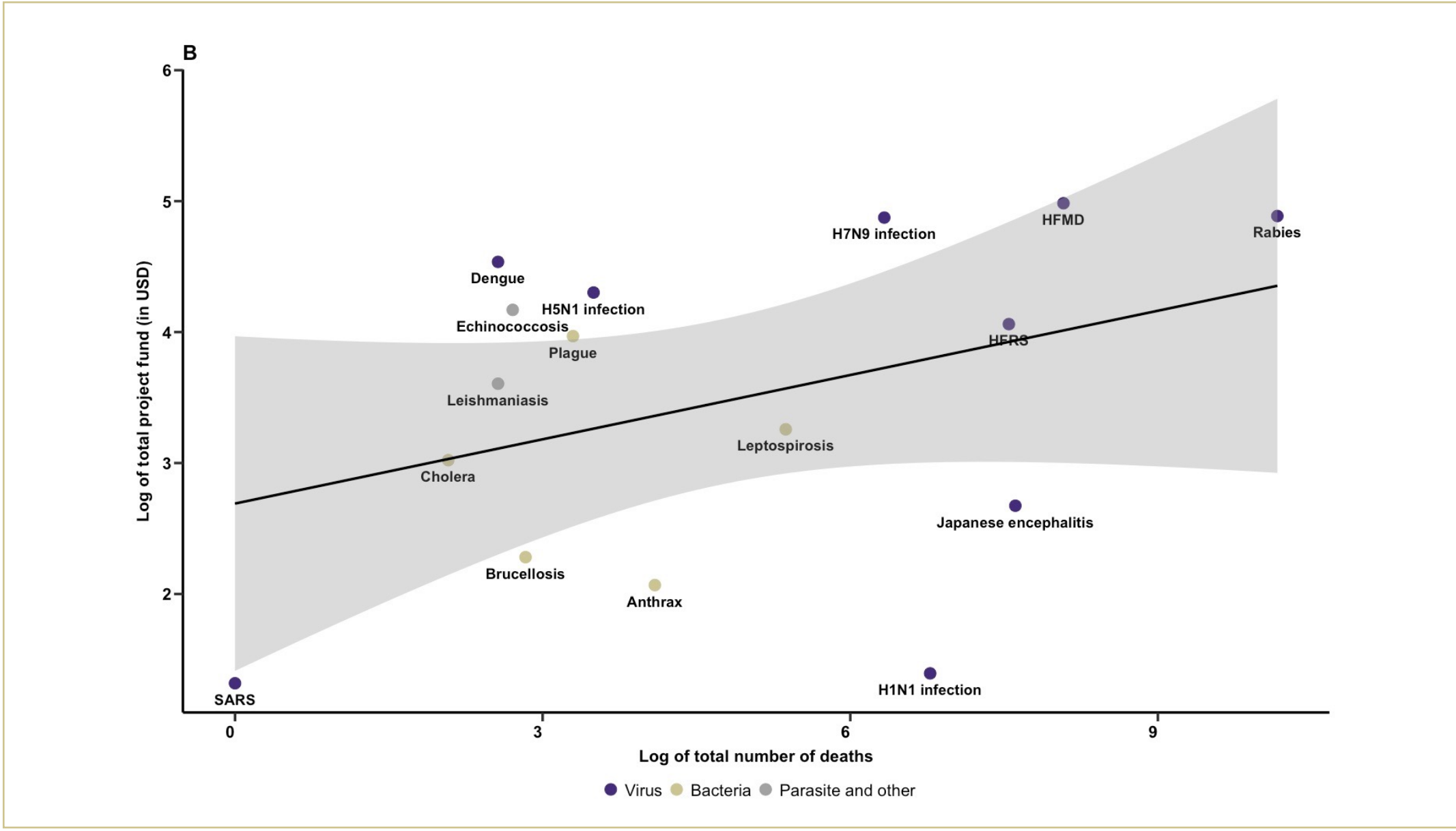
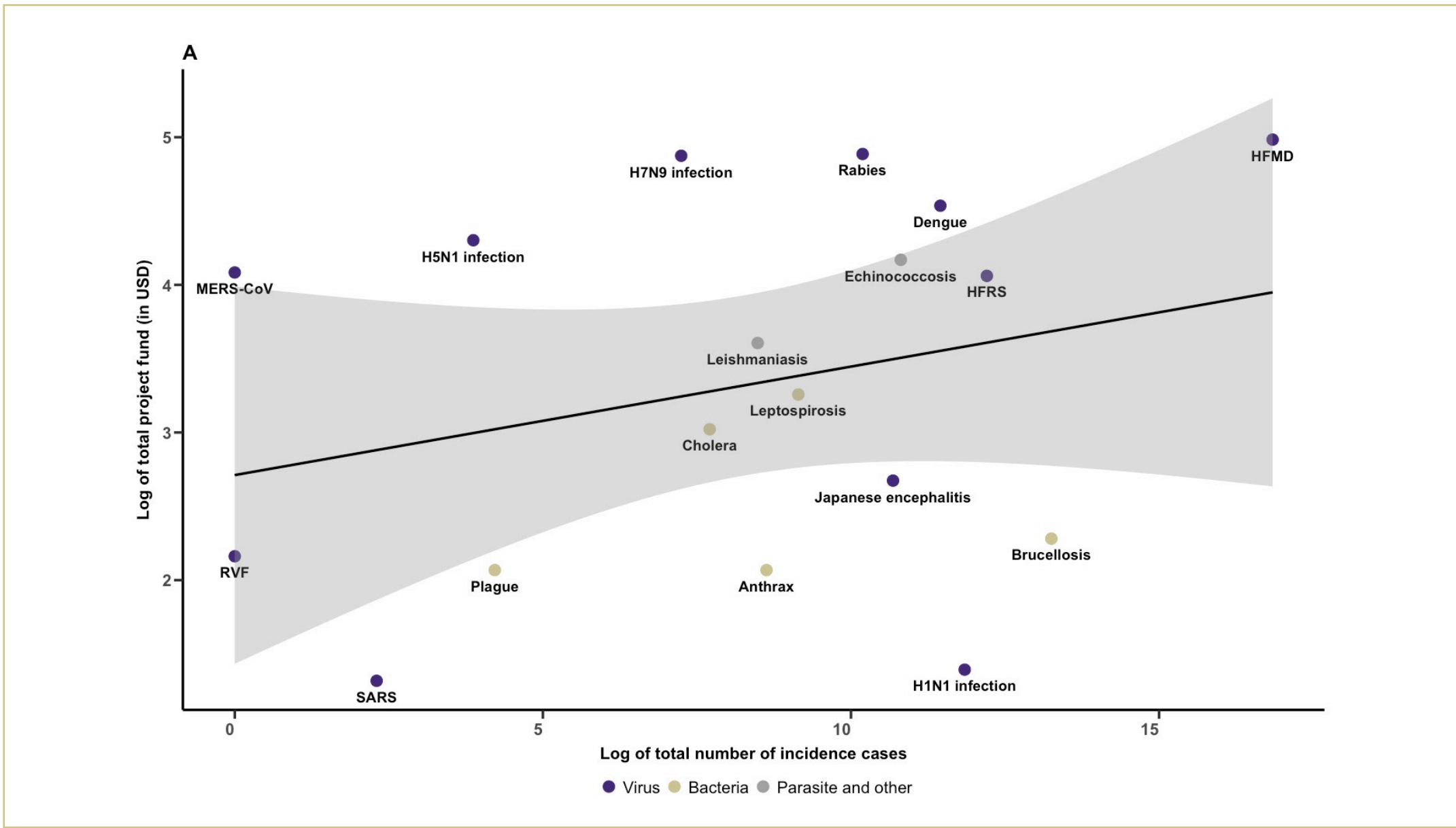


Figure 3. Association between the total number of NSFC fundings with incidences (A) and deaths (B) across 16 EIDs between 2004 and 2019

CONCLUSIONS & RECOMMENDATIONS

- A potential public funder on global EIDs:** Although China is always missing from the global landscape of research funding on EIDs, our study suggests it may become a strong public funder on global priority pathogens in terms share of funding, ongoing support and diversified disease portfolio.
- Mismatch between disease burden and public funding:** Our analysis revealed a challenging scenario between domestic disease burden and government funding for EIDs in China. The underlying reasons could be partly explained by public health responses to emergencies and humanitarian crises, global advocacy and partnerships, and political decision-making drivers.
- Given that the EIDs have the potential to disrupt global health, economic development and social stability over a short period of time, **a better understanding of priority settings of national health and research needs is required to facilitate strategic funding plans toward better pandemic preparedness and response.**
- Our study contributes to evidence-informed research investment **by highlighting the need for strengthening awareness and responsiveness of funding allocation mechanisms to the changes in burden of disease, particularly in developing countries, where resources are limited and the burden is heavy.**

Reference:
1. Allen T, Murray KA, Zambrana-Torrel C, et al. Global hotspots and correlates of emerging zoonotic diseases. *Nat Commun.* 2017;8(1):1124.
2. Zhonghe Zhou, Weijie Zhao, Funding system reform for excellence in science: an interview with Jinghai Li, President of NSFC. *Natl Sci Rev.* 2019;6(1):177-181.
3. Mehand MS, Al-Shorbaji F, Millett P, Murgue B. The WHO R&D Blueprint: 2018 review of emerging infectious diseases requiring urgent research and development efforts. *Antiviral Res.* 2018;159:63-67.