Spatial change in the risks of *Plasmodium vivax* and *Plasmodium falciparum* malaria in China, 2005-2014.

Samuel Hundessa[a], Gail Williams[a], Wenyi Zhang[b], Shanshan Li[a], Linping Chen[a], Yuming Guo[a*]

[a] Division of Epidemiology and Biostatistics, School of Public Health, University of Queensland, Brisbane, Australia.

[b] Institute of Disease Control and Prevention, Academy of Military Medical Science, Beijing, People's Republic of China.

*Corresponding author: Dr Yuming Guo, room 227, School of Public Health, University of Queensland, Herston Rd, Herston, Queensland, 4006, Australia.

Abstract

Objective: Despite the declining trend of malaria incidence over the last decade, *Plasmodium falciparum* malaria has increased in China both in terms of the number of case and geographical coverage. Thus, to improve the control intervention, we examined the change in the risk of both *Plasmodium vivax* and *Plasmodium falciparum* malaria across China during 2005-2014.

Methods: We applied logistic regression model to understand change in the risk of *Plasmodium vivax* and *Plasmodium falciparum malaria* in each county across the study period, and linear regression model to examine annual change in longitude and latitude of affected areas.

Results: The risk of *Plasmodium falciparum* malaria significantly increased with latitude and longitude, indicating that the incidence rate of *Plasmodium falciparum* malaria increased in the northern and eastern, or decreased in south and western China. Similarly, latitude and longitude of counties with *Plasmodium falciparum* significantly associated with year, showing annual increase in *P. falciparum* affected counties within the north and east. For *Plasmodium vivax*,

the risk increased with latitude and longitude, but the longitude significantly decreased, and no significant change in latitude.

Conclusion: The risk of both *Plasmodium falciparum* and *Plasmodium vivax* malaria increased in the northern and eastern China, and was more noticeable for *P. falciparum*. An underlying cause of the increased malaria risk needs further investigation.

Keywords: *Plasmodium vivax, Plasmodium falciparum,* risk, latitude, longitude