

Association Between Typhoid Fever and Climatological Factors in Meknes Province, Morocco, Based on Partial Least Squares Approach

Omar Mouhaddach¹, Imane Boularab¹, Adnane El Yaacoubi¹, Marie-Paule Kestemont², Samir El Jaafari¹

¹*Moulay Ismail University, Faculty of Science, Meknes, Morocco;* ²*Catholic University of Louvain, Louvain-la-Neuve, Belgium*

Background: In spite of all efforts deployed by health officers to control typhoid fever, Meknes stills the most severely affected province in Morocco. Various factors may explain this trend, including climatological and environmental ones. Therefore, this study was carried out in Meknes province and aims to understand the impact of climatological factors on the typhoid temporal variability, and to highlight the relationship between climatological and environmental factors in this case, over the period 2004-2013.

Methods: Due to non-normal distribution of our input data, Spearman correlation was used. In order to point out the relevant periods of the year where the infection by *Salmonella* Typhi was strongly correlated to climate conditions, namely air temperature and rainfall, a new statistical approach was used, Partial Least Squares.

Results: The results reveal a temporal periodicity of typhoid recorded cases, and the presence of significant positive correlation between the studied factors and the typhoid cases ($P < 0.01$). Partial Least Squares regression showed two relevant periods where the number of typhoid recorded cases increased, in coincidence with rise of air temperature and decrease of rainfall. The first period started from the end of March to the beginning of June, while the second one extended from the beginning of August to the end of October. In fact, the need for water for irrigation is higher during these two periods, which are characterized by water scarcity. The wastewater reuse in irrigation is a common practice during the hot season, which may explain this typhoid temporal variability.

Conclusions: This study identified some climatological and environmental determinants of typhoid fever in Meknes Province, which currently exhibits the highest incidence in Morocco. This knowledge can be used to design intervention measures to reduce and hopefully eradicate the disease in this area.