

Evolution of the incidence of Typhoid Fever and Hepatitis A from 2008 to 2013 in Meknes (Morocco) and its association with climatic factors

Yousra Ameziane El. Hassani¹, Ibrahim El. Ghazi^{*2}, Fatiha Laziri¹

¹Laboratory of Environment, Ecology and Health, Department of Biology, Faculty of Sciences, Moulay Ismail University, Zitoune Meknes, Morocco

²Health & Environment, Competence Cluster, Faculty of Sciences, Moulay Ismail University of Meknes, Meknes, Morocco

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Abstract

Typhoid and Viral Hepatitis are waterborne diseases that affect hundreds of millions of people each year, as one-third of the global population remains without access to improved sanitation. Their transmission is through contaminated water. They, therefore, constitute a public health problem in several countries, notably Morocco. The aims of the study are to analyze the epidemiological situation of Typhoid and Hepatitis A and their distribution in Meknes from 2008 to 2013 and to determine the climatological factors associated with their incidences. The data used come from the epidemiological surveillance collected in the Prefectural Cell of Epidemiology registers. We processed the Data using Excel. Mapping was performed by Quantum GIS software. A total of 589 cases of typhoid fever and 379 cases of hepatitis A were recorded between 2008 and 2013; the majority of the cases were located in Bab Belkari health center. Number of cases was higher among males with no significant difference from females ($p > 0.05$). The age group 5-14 had the highest number of cases with of 254 (43.12%) for typhoid and 226 (59.63%) viral hepatitis. Seasonal variation had a significant effect on the on the distribution of typhoid cases over the years ($p < 0.05$), the highest occurrence of typhoid was during summer season. Seasonal variation didn't have any significant effect on the on the distribution of hepatitis cases ($p > 0.05$), the fall and the spring season had the highest number of cases.

*Corresponding Author: Ibrahim El. Ghazi ✉ elghazi.ibrahim@gmail.com

Introduction

Waterborne diseases affect hundreds of millions of people each year and are a major cause of morbidity and mortality worldwide. According to World Health Organization they account for 80% of diseases worldwide [3]. Waterborne diseases are caused by ingestion or contact with a source of water contaminated with human or animal fecal matter containing pathogenic microorganisms. Water quality is affected by changes in environmental conditions, including variables related to weather or climate conditions with the rising average temperatures, heat waves, drought, sea-level rise [1] [2].

The Mediterranean region has been heavily affected by drought [2]. Drought increases the degradation of the microbial quality of water and hygiene conditions and promotes the reuse of surface water and increases the risk of exposure to pathogens [1], which could lead to multiple waterborne diseases outbreaks, and affect public health.

Two major diseases are typhoid and viral hepatitis. Each year worldwide, there are 11 approximately 128.000 to 161.000 typhoid-related deaths and about 7.000 viral hepatitis deaths [3]. People with a weak immune system are more likely to develop more serious complications. In Morocco, the Fez Meknes region reports almost the majority of typhoid cases or 61% of national cases, Meknes Prefecture alone reports about 38% of typhoid cases at the national level 19% of viral hepatitis cases [4]. They are therefore a public health issue in the region. To determine the burden of these two waterborne diseases in the city of Meknes, this retrospective study was conducted to analyze the epidemiological status of typhoid fever and hepatitis A and their spatiotemporal evolution from 2008 to 2013 and to determine the climatological factors associated with their incidence.

Materials and methods

Description of the study sites

Meknes city is part of the Fez-Meknes region located in northwest Morocco, 140km from the

capital Rabat. Meknes is located at 516m altitudes. The climate is the semi-continental Mediterranean with cool, rainy winters and hot, dry summers. The average annual temperature ranges from 11°C to 24°C. Precipitation averages are 576mm yearly [5].

Data Entry

The retrospective study was carried out on the basis of data collected from the prefectural epidemiology cell of the prefecture of Meknes (Morocco) from 2008 to 2013. The data provided include reports of confirmed cases of typhoid and viral hepatitis, registered in 30 health centers of Meknes. The annual incidence for the period between 2008 and 2013 was calculated as follows:

$$\text{Incidence} = \frac{\text{No. of new cases in a specified period}}{\text{Size of population at risk}}$$

For each health center, the cumulative incidence was determined. Typhoid and viral hepatitis incidence maps between 2008 and 2013 were generated using Quantum GIS software.

The analyses of the relationships between the spatiotemporal evolution of typhoid and viral hepatitis were determined using Pearson correlation. Difference of number of cases between the two sexes was identified using Chi square test. One-way ANOVA were performed to analyze the differences and the effect of seasonal variation on number of cases. Pearson correlation analysis was used to determine the correlations between hepatitis A and typhoid and the meteorological factors using the annual mean temperature and cumulative rainfall.

Results and discussion

Over the period of 2008 to 2013, 589 cases of typhoid were confirmed. The average incidence of typhoid is 13.95 per 100.000 inhabitants (Fig. 1). The highest incidence was 23.38, recorded in 2010 and the lowest incidence was 10.01 in 2009. For viral hepatitis, 379 cases were confirmed. The average incidence was estimated at 10.51 per 100.000 inhabitants. The highest incidence was 13.87 in 2012, while the lowest

was 7.9 in 2009 (fig. 1). The annual evolution of the incidence typhoid and viral hepatitis did not show any significant correlation -0,024.

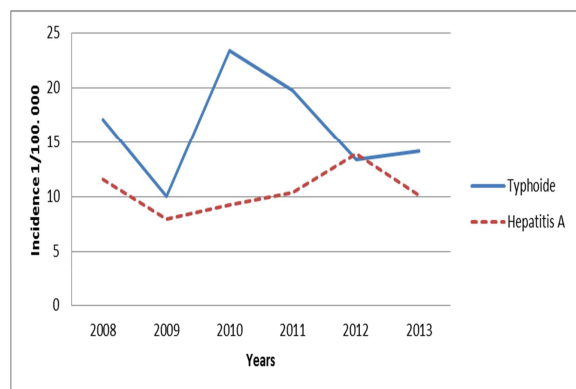


Fig. 1. evolution of the incidence (1/100.000) of typhoid and hepatitis A in Meknes over the period (2008-2013).

Distribution of Typhoid and Hepatitis A incidence cases

The analyses of the incidence distribution of typhoid and viral hepatitis from 2008 to 2013 in Meknes (Fig. 3 & 4) shows that Bab Belkari health center reported the most cases, the cumulative incidence was 1.86 for typhoid and 1.12 for viral hepatitis, followed by Bab Rha health center with a cumulative incidence of 0.37 for typhoid and 0.38 for viral hepatitis. The distribution of typhoid and viral hepatitis incidences reported in different health centers showed a high positive significant correlation 0.95.

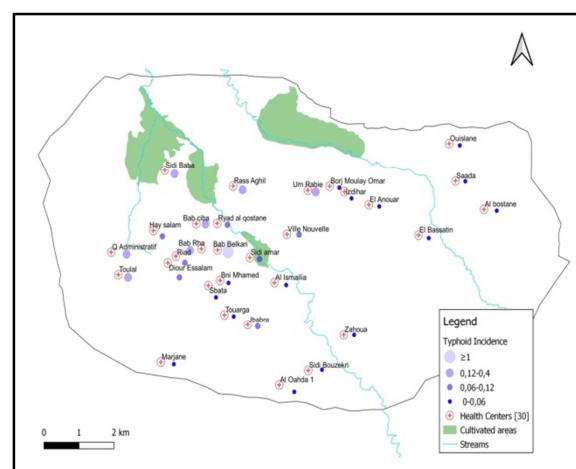


Fig. 2. Cumulative typhoid incidence per reporting health centers in Meknes (2008-2013).

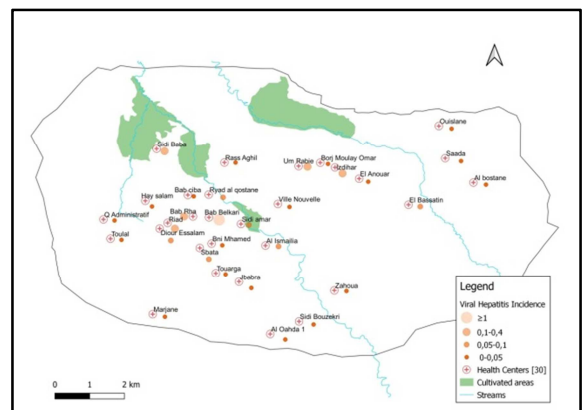


Fig. 3. Cumulative hepatitis A incidence per reporting health centers in Meknes (2008-2013).

Epidemiological characteristic of Typhoid and viral hepatitis

Sex

Of the 589 typhoid cases (Fig. 4), 290 were female (49.31%) and 298 were male (50.69%) with no significant difference ($X^2=9.08$; $p > 0.05$). As for viral hepatitis out of the 379 cases (Fig. 5), 180 were female (47.5%) and 190 were male (52.5%). The difference in the number of cases between women and men is not significant ($X^2=2.95$; $p > 0.05$).

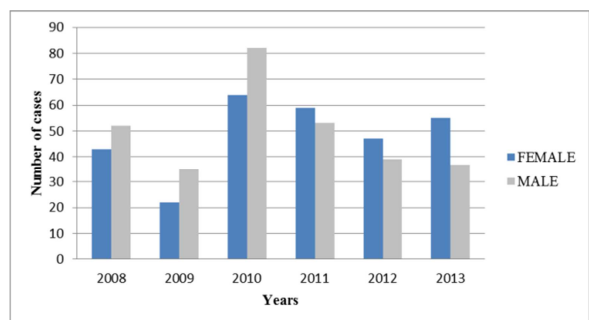


Fig. 4. Evolution of the annual number of Typhoid cases for both sex (2008 to 2013).

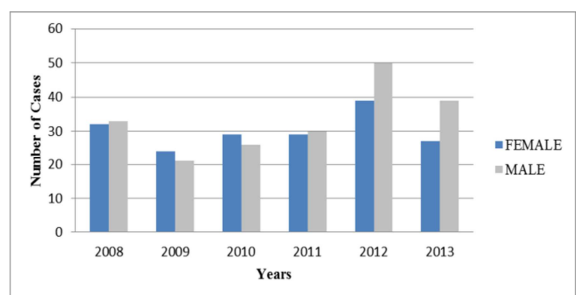


Fig. 5. Evolution of the annual number of Viral Hepatitis cases for both genders (2008 to 2013).

Age

The highest number of typhoid cases was among the 05-14 years age group with 254 (43.12%) followed by the 15-29 years age group with 164 cases (27.84%) and the 30-59 group with 130 positive cases (22.07%). The 0-4 and +60 years age groups had the lowest number of cases of 18 (3.05%) and 23 (3.09%) respectively (Fig. 6). As for viral hepatitis, the age group 05-14 years recorded the highest number 226 (59.63%) followed by the 15-29 years age group with 68 cases (17.94%). Group 0-4 and 30-59 years had a respective number of cases of 40 (10.56%) and 37 (9.76%). The age + 60 groups had the lowest number of cases with only 8 (2.11%) (Fig. 6).

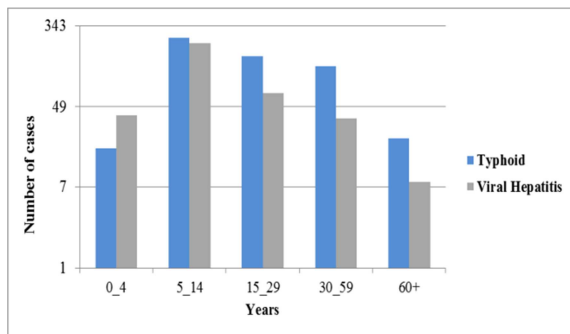


Fig. 6. evolution of number of cases of typhoid and viral hepatitis by age group over the period 2008-2013.

Seasonal variations

The results show a variation in the number of typhoid cases during the different seasons (Fig. 7). The summer season (June-August), had the most typhoid cases, 296 (50.25%) followed by autumn (September-November) with a number of cases of 144 (24.45%). While in spring (March-May) the number of cases recorded is 108 (18.34%). The winter season (December-February) had the lowest number of cases being 41 (6.96%). Seasonal variation had a significant effect on the on the distribution of typhoid cases over the years ($p < 0.05$).

As for viral hepatitis the fall season (September-November) and the spring season (March-May) had the most cases of viral hepatitis, 112

(29.55%) and 111 (29.28%) respectively (Fig. 8). The winter (December - February) and summer (June-August), seasons recorded the lowest and the same number of cases of either 78 cases of hepatitis A or (20.58%) each. Seasonal variation don't any significant effect on the on the distribution of hepatitis cases over the years ($p > 0,05$).

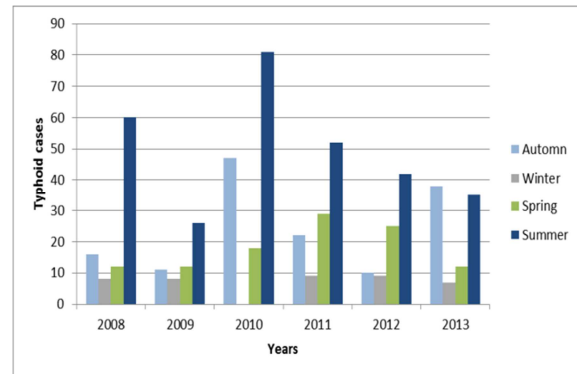


Fig. 7. seasonal evolution of typhoid cases over the period (2008-2013).

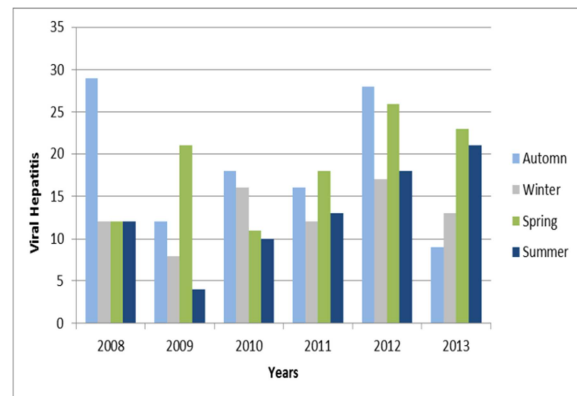


Fig. 8. Seasonal evolution of viral hepatitis cases over the period 2008-2013.

The analyses of the association between weather factors and monthly trends (fig. 9) in typhoid cases over the study period revealed that there is indeed a significant high positive correlation between the number of typhoid cases and the mean temperature (0.97) and a significant negative correlation with cumulative rainfall (-0.78). While the correlation between monthly evolution of viral hepatitis cases and mean temperature (0.005) and cumulative rainfall (0.1) were non-significant.

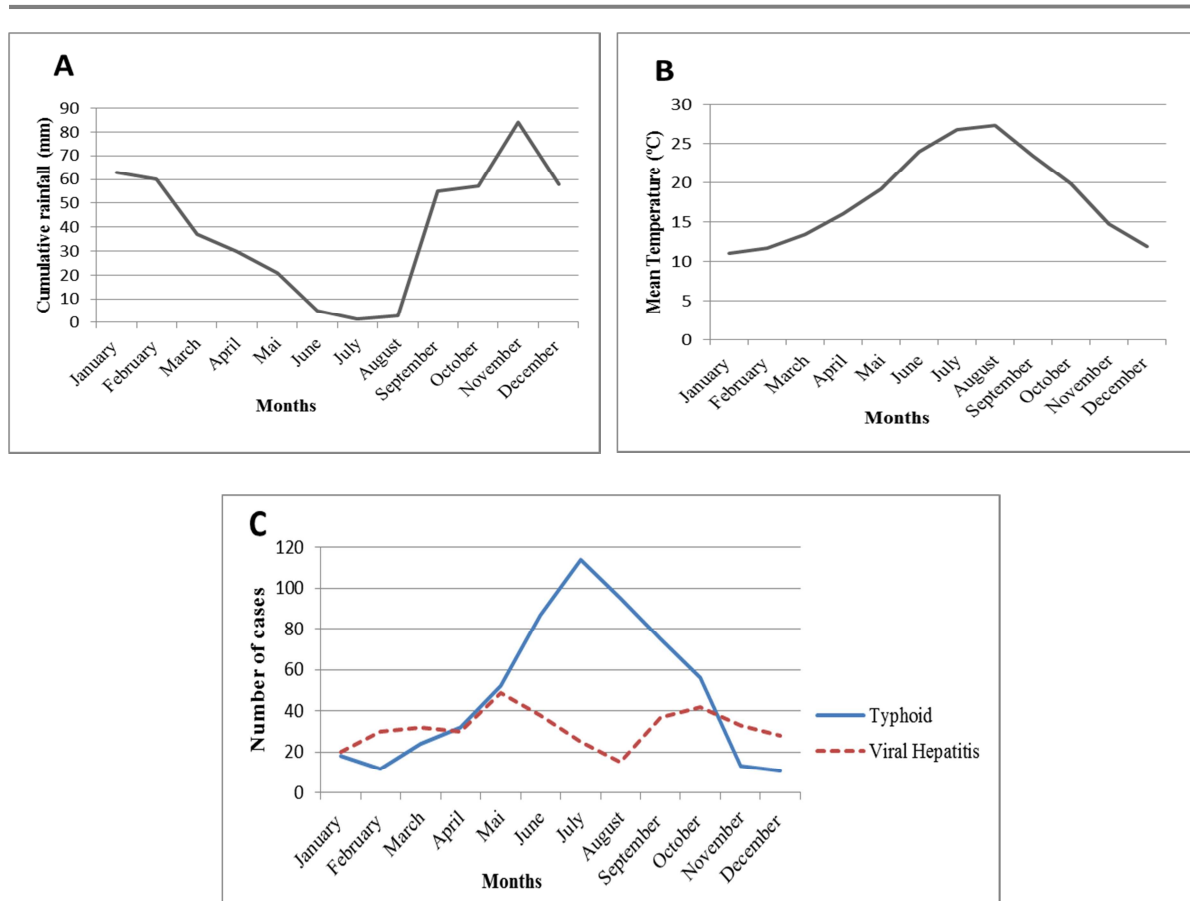


Fig. 9. A: monthly mean temperature dynamic between 2008 and 2013; B: monthly cumulative rainfall dynamic between 2008 and 2013; C: monthly evolution of typhoid and hepatitis cases during the period 2008 and 2013.

These variations could be explained by factors related to sources and modes of transmission, including inadequate access to sanitation and the use of contaminated water. The potential for typhoid transmission increases with drought [6], which explains the high number of cases in summer and the low number of cases in winter. The increase in water demand and wastewater discharges leading to a depletion of conventional water resources. With the scarcity of water resources, there is more tendency to use polluted water [7] [8]. Meknes region is well known for the use of untreated wastewater to overcome the frequent drought for irrigation of vegetables sold in local markets [9]. This could be a transmission pathway for typhoid and viral hepatitis diseases.

Conclusion

This work provided information on the spatiotemporal variability and epidemiology of

typhoid and viral hepatitis in Meknes (Morocco). Analyses of the distribution of typhoid and viral hepatitis were highly correlated. The epidemiological characteristic showed that the male population and the 5-14 year age group are the most affected by these two diseases. Seasonal analyses have shown that the risk of typhoid is high in the summer, while viral hepatitis is had the most cases in autumn and spring. The winter season recorded the lowest number of cases for both diseases.

Efforts to control those diseases are still insufficient, hence the need to improve awareness and information campaigns for the population at risk and to encourage and monitor scientific studies in this field. This could lead to a better understanding of the local mechanisms that drive their transmissions, which could facilitate surveillance and control efforts.

Conflict of interest

All authors declare that there is no competing or conflict of interest.

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