Original Article

Is cholera disease associated with poverty?

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Abstract

Background: Cholera remains a global threat and is one of the key indicators of social development. While the disease no longer poses a menace to countries with minimum standards of hygiene, it remains a serious challenge to countries where access to safe drinking water and adequate sanitation cannot be guaranteed. The objective of this work was to analyse the results obtained when contrasting the reports of the World Health Organization (WHO) about cholera disease with those of the World Bank List of economies (countries).

Methodology: Data were obtained from reports of two international organizations, the report on cholera disease incidence of the World Health Organization and the World Bank's classification of countries attending to their income.

Results: We determined that low-income countries are more affected by cholera disease than countries with middle or high income. This difference was reflected in the percent of countries, the total number of reported cases, the number of cases per 100,000 habitants, as well as in the reported mortality. These results support the phrase "cholera disease is a disease of poverty."

Conclusions: We consider that economic development is an important factor in the morbidity and mortality of cholera, together with environment, climate, culture, medical management, political intention, and the intrinsic factors of the system.

Key words: cholera, developing countries, poverty, income

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Introduction

Cholera is an acute diarrhoeal infection caused by ingestion of the bacterium *Vibrio cholerae*. Transmission occurs through direct faecal-oral contamination or via ingestion of contaminated water and food. In its most severe form, this disease is characterized by a sudden onset of acute watery diarrhoea that can lead to death by severe dehydration and kidney failure. The shortage of safe water and sufficient sanitation and generally poor environmental status are the main causes of spread of the disease. Typical at-risk areas include peri-urban slums, where basic infrastructure is not available, as well as camps for internally displaced people or refugees, where minimum requirements of clean water and sanitation are not met [1]. It was reported that in Latin America the gross national product per capita (above US $2,000) and literacy rates above 90% were negatively correlated with cholera cumulative incidence rates [2]. Specifically in Brazil, it was shown that the proportion of households without tap water was the variable that contributed the most to the increasing fluctuation of cholera incidence rates. Two other factors also revealed a positive association with cholera incidence rates: the proportion of households without sewage and the proportion of householders with an income less than or equal to the minimum wage [3].

The ocean and climate patterns are useful predictors of cholera epidemics because the dynamics of endemic cholera are being related to climate and/or changes in the aquatic ecosystem [4]

The incidence and mortality of cholera in countries where the disease is epidemic is very different. In a comparative study between Indonesia, India and Mozambique, Deen *et al.* [5] reported that the lowest overall rate was in Jakarta with 0.5 cases per 1,000 inhabitants per year. The incidence was three times higher in Kolkata (1.6/1,000/year) and eight times higher in Beira (4.0/1,000/year). In all sites, children were the most affected population. Improvement of water supply and sanitation is the best strategy against cholera and other diarrhoeal diseases, but it may not be achievable in these impoverished areas in the near future. In those cases, short- to medium-term strategies such as vaccination against cholera may be more useful [6]. At the present, only one cholera vaccine, Dukoral, is internationally licensed and available [7], and mOROVAC (http://www.vabiotechvn.com) is used only in Vietnam [8]. Some vaccine projects are in development, such as the attenuated vaccines Peru

15, CVD 110, 111 and 112 strains [9] and 638 strain [10]) and the inactivated whole cells and subunit vaccines [11-13].

While the disease no longer poses a menace to countries with minimum standards of hygiene, it remains a challenge to countries where access to safe drinking water and adequate sanitation cannot be guaranteed. Almost every developing country faces cholera outbreaks or the threat of a cholera epidemic. (http://www.who.int/topics/cholera/about/en/index.html)

Cholera outbreaks cause alarm, disrupt the social and economic structure, and impede development in the affected communities. Unjustified panic-induced reactions by other countries include the imposition of travel and food import restrictions from countries where a cholera outbreak is occurring. For example, the cholera outbreak in Peru in 1991 cost to the country US $770 million due to food trade embargoes and adverse effects on tourism (http://www.who.int/topics/cholera/impact/en/index.html).

The objective of this study was to determine the relationship between the incidence of cholera disease and the national income per capita.

Materials and Methods

Data were obtained from the WHO 2008 report on cholera disease incidence [14]. Incidence rates were determined excluding the imported cases. Economic data were obtained from the World Bank's classification of countries attending to their income, where countries are classed according to the 2007 gross national income (GNI) per capita, calculated using the World Bank Atlas method (World Bank list of economies, July 2008, http://go.worldbank.org/K2CKM78CC0). In the present study, groups of countries were defined as follows: low income (L), $935 or less; lower middle income (LM), $936 - $3,705; upper middle income (HM), $3,706 - $11,455; and high income (H), more than $11,455. To each of the four groups we associated the percentage of countries that reported cholera cases, the percentage of indigenous cholera cases, the rate (cases/100,000 habitants) and the mortality by indigenous cholera cases.

Both data bases employed here have some critical points. For example, it is accepted by the medical community that the national reports on cholera disease are underestimations of the actual scores [15]. On the other hand, the GNI per capita is not a good estimator of the life level of the people in one country because of the differences of economic groups within the same country. However, there are two important aspects that support the use of these data bases for our study: a) they were obtained independently and simultaneously and b) they were calculated with the same methods for all groups and countries.

Results and Discussion

Figure 1 shows that the percent of members reporting cases of cholera disease was the largest in the group of countries with low GNI per capita. In contrast, this proportion was ~34-fold lower in countries with middle-high and high income per capita. In addition, the majority of the reported cases belonged to the group of low GNI per capita, while countries with middle-high or high GNI per capita practically did not present cholera cases (Figure 2).

The number of cases per 100,000 habitants of all countries of each group is shown in Figure 3. Observe a large difference between countries with low GNI per capita and countries with middle (LM and HM) or high GNI per capita.

A similar structure was obtained when the analysis was done with cholera mortality, which was significantly larger in countries with low GNI per capita (Figure 4).

Thus, we determined that low GNI per capita countries are more affected by cholera disease than countries with middle or high GNI per capita. This observation was reflected in the percent of countries, in the number reported cases, in the number of cases per 100,000 habitants, as well as in mortality. These results underscore the statement "cholera disease is a disease of poverty."

However, some countries escape from this general rule. For example, Haiti, a country with low income, does not report cases of cholera. On the other hand, Seychelles with middle high GNI *per capita*, reports 204.6 cases per 100,000 habitants. These anomalies may be explained by a regional effect. Haiti is surrounded by countries with middle-high or high GNI per capita countries, whereas Seychelles is located in the most affected region with cholera, close to countries with low GNI per capita. Another remarkable exception is the United Stated of America where, in spite of a high GNI per capita, incidents of cholera were reported although with a very low rate (0.001 cases/ 100.000 habitants). Meanwhile, China and Cóte d'Ivoire, countries with

Figure 1. Percentage of countries reporting indigenous cholera cases in each group (income per habitant).

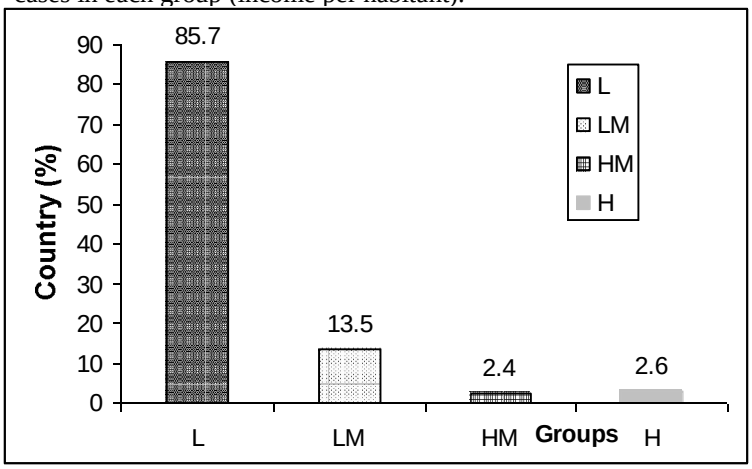


Figure 2. Percentage of indigenous cholera cases in the different groups of countries (income per habitant).

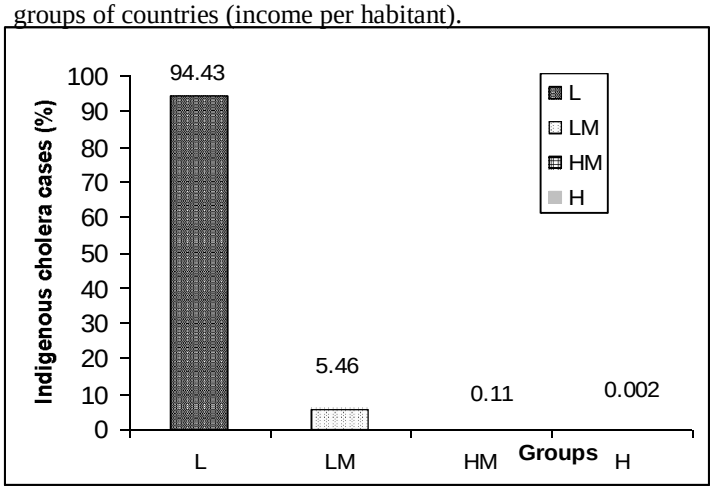


Figure 3. Rate (cases / 100,000 habitants) of indigenous cholera in different groups of countries (income per habitant).

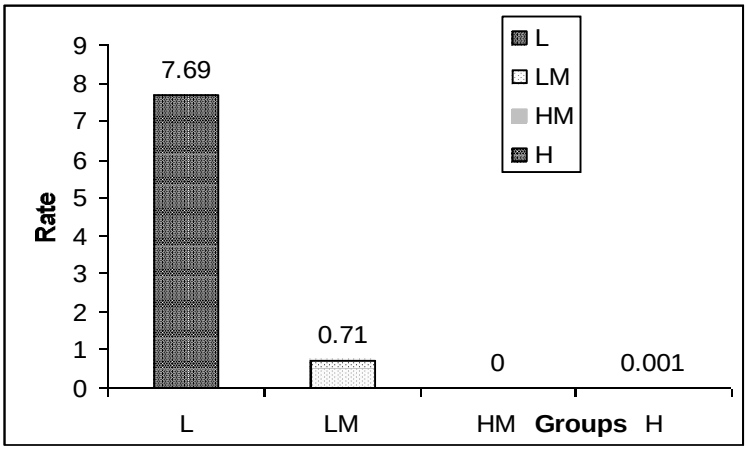
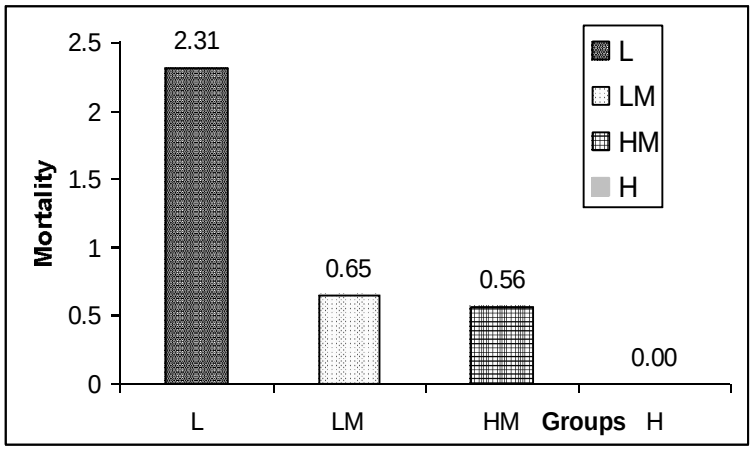


Figure 4. Mortality by indigenous cholera cases in the different groups of countries (income per habitant).



low GNI per capita reported a low number of cases per 100,000 habitants, 0.013 and 0.042 respectively.

We have shown here a relationship between morbidity and mortality of cholera and the national GNI per capita: the group of countries with less socioeconomic development is the group with more and almost exclusive morbidity and mortality of cholera. This is in agreement with previously reported relationships between cholera disease and access to safe water and sanitation [1,3]. This coincidence underscores the role of vaccination against cholera in short- to medium-terms [3,15]. Thus, any vaccination strategy should be based on risk mapping and should take into account the feasibility and the presence and geographical distribution of high-risk groups (particular age groups and vulnerable populations). Vaccines should be inexpensive and easy to administer and should be provided to inhabitants of high-risk areas, such that a very inexpensive vaccine becomes cost-effective only when incidence exceeds 1/1,000. For example, a vaccine priced at US$ 0.40 will cost less than US$ 400 per death averted, which compares favourably with case management, especially as hospital and treatment costs will decrease [6].

Finally, we consider that the regional economic development is an important factor in the morbidity and mortality of cholera, adding to the well-known contributions of the environment, climate, culture, medical management, political intention and the intrinsic factors of the *Vibrio cholerae* - human subsystem.

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