Osong Public Health Res Perspect 2013 4(2), 68–71
http://dx.doi.org/10.1016/j.phrp.2013.03.005
pISSN 2210-9099 eISSN 2233-6052

ORIGINAL ARTICLE

Availability of Clean Tap Water and Medical Services Prevents the Incidence of Typhoid Fever

Deog-Yong Lee [a,*], Esther Lee [a], HyeMin Park [a], SeongHan Kim [b]

[a]*Division of Enteric Diseases, Korea National Institute of Health, Osong, Korea.*
[b]*Division of TB and Respiratory Diseases, Korea National Institute of Health, Osong, Korea.*

Received: January 8, 2013
Revised: February 20, 2013
Accepted: February 27, 2013

KEYWORDS:
fatality rate,
incidence,
medical service,
typhoid fever,
water service

Abstract
Objective: In this study, the factors that induced a decrease in the incidence of typhoid fever were analyzed. Based on the study results, we propose a quantitative and concrete solution to reduce the incidence of typhoid fever.
Methods: We analyzed the incidence and fatality rate of typhoid fever in Korea. Tap water service rate and the number of pharmacies, which affect the incidence rate of typhoid fever, were used as environmental factors.
Results: To prevent typhoid fever in the community, it is necessary to provide clean tap water service to 35.5% of the population, with an individual requiring 173 L of clean water daily. Appropriate access to clean water (51% service coverage, 307 L) helped the population to maintain individual hygiene and food safety practices, which brought about a decrease in the incidence of typhoid fever, and subsequently a decrease in fatality rate, which was achieved twice. During the 8-year study period, the fatality rate decreased to 1% when the population has access to proper medical service.
Conclusion: The fatality rate was primarily affected by the availability of medical services as well as by the incidence of typhoid fever. However, an analysis of the study results showed that the incidence of typhoid fever was affected only by the availability of clean water through the tap water system.

1. Introduction

Typhoid is an enteric fever caused by the bacterium *Salmonella* Typhi and is a common waterborne disease. In 2006, the World Health Organization reported that the estimated incidence of typhoid fever was 10–33 million cases worldwide, with an annual fatality rate of 1.5–3.8% [1]. Typhoid fever outbreaks associated with dirty and contaminated water are continuously reported throughout the world, especially in developing countries [2–4]. Typhoid fever experts have emphasized that appropriate availability of medical services and clean

*Corresponding author.
E-mail: leedy0610@korea.kr

water and individual hygiene practices are required to prevent typhoid fever. However, to date, no one has suggested how much clean water or medical service is needed to decrease the incidence of typhoid fever in a community. Therefore, we analyzed the incidence of typhoid fever, the associated fatality rate, and the factors that induced decreases in the incidence of typhoid fever and deaths in Korea. Based on the results of our analysis, we propose a quantitative and concrete solution to reduce the incidence of typhoid fever.

2. Materials and Methods

2.1. Incidence and fatality rate of typhoid fever

The incidence and fatality rate of typhoid fever were determined using an online disease statistics system [5] and a communicable disease surveillance yearbook [6], which had a record of communicable diseases from 1961, when such a statistics system was first established in Korea. The incidence rate was calculated by dividing the incidence by the midyear population and multiplying by 100,000 persons. The fatality rate was calculated by dividing the number of deaths by the number of patients and multiplying by 10 to allow graphical comparison with other data.

2.2. Environmental factors

We screened factors to identify those that are related to the decreasing incidence and fatality rate of typhoid fever in Korea. Based on our analysis, public health policy, clean water supply, wastewater treatment, and the availability of medical services, especially antibiotics treatment, were identified as having an impact on the incidence and fatality rate of typhoid. Data on water services, such as tap water service coverage and amounts, were provided by the Korea Water and Wastewater Works Association [7]. However, it was difficult to find data related to public health policy, wastewater treatment, and antibiotic treatment because records of these data were established only after the 1980s, by which the incidence of typhoid fever had already decreased in Korea. As an alternative measure, the number of pharmacies was substituted for the amount of antibiotic treatment, the data of which were provided by the Korea Pharmaceutical Manufacturers [8] and the Korean Pharmaceutical Associations [9]. The saturation was calculated as a relative percentage of a given year: the number of pharmacies in a year divided by the number of pharmacies in 1991.

3. Results

3.1. Incidence and fatality rate of typhoid fever

Approximately 2000–4000 patients were diagnosed with typhoid fever annually since 1961; however, the rate sharply decreased to less than 1000 patients after 1973. After 1977, the incidence of diagnosis was 400 patients, which was similar to the current incidence, reported to be approximately 200 patients annually since 2002, according to an online disease statistics system. The incidence rate decreased to less than 10 persons/100,000 persons after 1971 and remained steady at one person/100,000 after 1977. The number of deaths caused by typhoid fever also decreased gradually; less than 100 people died in 1965, 10 people died in 1973, and only one person died in 1977. There have been no deaths due to typhoid fever in Korea since 1990 except for one case in 2001. The fatality rate decreased in four steps as follows: the first step was a sharp decrease in the rate until 1967, the second step was maintaining the fatality rate at 1% from 1968 to 1975, the third step was a second decrease from 1976 to 1977, and the fourth step was the last turbulent period from 1978 to 1989 (Table 1).

3.2. Water service and medical service

The water service coverage gradually increased from 1961. This was the year when water service statistics were first recorded in Korea. Currently, more than 92% of the population has access to water service; 30 million tons of clean water can be produced and 350 L of tap water can be used per person each day. The number of registered pharmacies has also increased, and currently there are 20,320 pharmacies in Korea. The per capita density of pharmacies was highest in 1991, with 2189 people per pharmacy. The percent saturation of the pharmacy density was calculated based on the per capita density in 1991.

3.3. Relationship between typhoid fever and environmental factors

The decrease in the fatality rate was accompanied by an increase in the percent pharmacy saturation in the early 1960s. The stationary step then began in 1968, and there was a 1% fatality rate for the next 8 years. The second decrease in the fatality rate was accompanied by an end in the decrease of the incidence rate. The decrease in the incidence rate was also accompanied by increases in the percent pharmacy saturation and the water service coverage from 1971 to 1973 (Figure 1). However, the water service coverage might be a more influential factor in the decline of the incidence of typhoid fever, although the correlation coefficients for water service coverage ($\rho = -0.84$) were similar to that for pharmacy saturation ($\rho = -0.85$) from 1969 to 1977 (calculated using MS Excel, Microsoft, Redmond, WA, USA).

4. Discussion

The mortality rate of typhoid fever varies between 10% and 32% without treatment but was typically