

RESEARCH ARTICLE

A retrospective epidemiological study on the incidence of salmonellosis in the State of Qatar during 2004–2012

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ABSTRACT

Background: *Salmonella* is a food- and water-borne pathogen that can be easily spread in a population, leading to the outbreak of salmonellosis that is caused by ingestion of mixed salads contaminated by the pathogen. Most cases occur in the late spring months and can be seen as single cases, clusters, or episodes. **Objective:** The aim of this study was to describe the incidence and epidemiological characteristics of salmonellosis in the State of Qatar.

Methods: This was a retrospective, descriptive study carried out in laboratory-confirmed cases of salmonellosis during 2004–2012 from all *Salmonella* surveillance centers. Therapeutic records of patients who were clinically suspected of having *Salmonella* diseases were analyzed. Initially, cases with typhoid fever were investigated in the laboratory by means of Widal agglutination tests, while non-typhoidal *Salmonella* diseases were determined based on culture technique.

Results: The annual incident of salmonellosis cases were 12.3, 23.0, 30.3, 19.4, 15.3, 18.0, 22.7, 18.5, and 18.1 per 100,000 population in 2006–2011 and 2012, respectively. The number of salmonellosis cases was high among less than 2-year-old females and 3-year-old males. In addition, one-fourth of patients (27.7%) were Qatari when compared to other nationalities. A significant difference in age was found between Qatari (6.08 ± 12.28 years) and non-Qatari (15.04 ± 19.56 years) patients. Of the reported cases, 79.8% included the onset date of the first symptoms. Contact phone numbers were available for 94% of the cases but addresses were available for only 50.4% of cases. The time difference

between onset of symptoms and diagnosis was 5.4 ± 5.7 days. The most frequent serotype reported were type b (41.9%), type d (26.9%), and type c1 (12.2%).

Conclusion: The present surveillance data showed a high incidence of salmonellosis in Qatar that poses a serious public health problem. Special intervention and health awareness programs are required for early screening, detection, and treatment as well as for strengthening the surveillance system of salmonellosis, with special emphasis on the laboratory study of cases.

Keywords: *Salmonella* surveillance, Qatar, food- and water-borne pathogen, incidence rates

INTRODUCTION

Salmonella has emerged as an important global public health problem and an economic burden in several parts of the world.^{1–5} Non-typhoidal salmonellosis is a major cause of food poisoning worldwide,^{6–8} with an annual incidence of about 1 million cases being reported in the USA.¹ Moreover, in Europe, the incidence of the infection was estimated to be about 6.2 million cases in 2009, which is the second most frequently reported zoonotic infection.² The animal reservoir of this pathogen is broad, and transmission of the pathogen to humans occurs almost exclusively by ingestion of contaminated food. The clinical spectrum of the infection ranges from self-limiting diarrhea, which is the usual case, to systemic infections in immunocompromised individuals mainly due to cancer, advanced AIDS, steroid use, or malnutrition.⁷ Most patients recover after adequate hydration, without the need for antimicrobial treatment.

Another important element of concern is antimicrobial resistance, which is considered to be predominantly due to the use of antimicrobial agents in animal food, particularly ceftriaxone and ciprofloxacin, which are the first-line drugs in the management of patients with systemic or localized infections that require antimicrobial treatment. Infections with multidrug-resistant to *Salmonella* species are associated with increased morbidity and mortality.^{8–10} The main objective of this study was to describe the incidence and epidemiological characteristics of salmonellosis in the State of Qatar.

METHODS

This was a retrospective, descriptive study carried out in laboratory-confirmed cases of salmonellosis during 2004–2012 in the State of Qatar. The incidence of salmonellosis was estimated from the annual surveillance report of the Public Health Department (Ministry of Public Health, Qatar). Reporting of cases to the national surveillance system occurs in two modes: physician reporting using the official notification form and laboratory reporting by sending the laboratory results of confirmed cases (i.e., isolation of *Salmonella* from a clinical specimen¹¹).

From all laboratory-confirmed cases reported during 2004–2012, the following data were obtained: age, sex, and nationalities. From the physician-reported cases, the following complete essential data were collected: contact number, address or place of work, date of onset, and date of laboratory confirmation. For contact number, either mobile or landline number was considered; for address, either the place of residence or the place of work (e.g., company name) was recorded.

The data collected from the laboratory report were serotype of *Salmonella* and antimicrobial resistance. The majority of these reports were obtained from Hamad Medical Corporation facilities (the main provider of healthcare services in Qatar), and only a few laboratory reports were from private facilities.

This study was part of a public health investigation and response, so the research team determined it to be non-research. Therefore, this study was not subject to the guidelines of the institutional review board. The study was approved by the Manager of Health Protection and Communicable Diseases, Public Health Department at the Ministry of Public Health.

STATISTICAL ANALYSIS

Statistical analysis was performed using the software JMP 10 (SAS Institute, 2012).¹² Frequency and percentages were used to calculate the variables such as sex, serotype, and nationalities, while means and standard deviations were used to calculate variables such as age and time. Incidence rates (IR) of salmonellosis cases were calculated per 100,000 population per year.

RESULTS

The overall annual incidence of salmonellosis during 2000–2004 in the State of Qatar are shown in

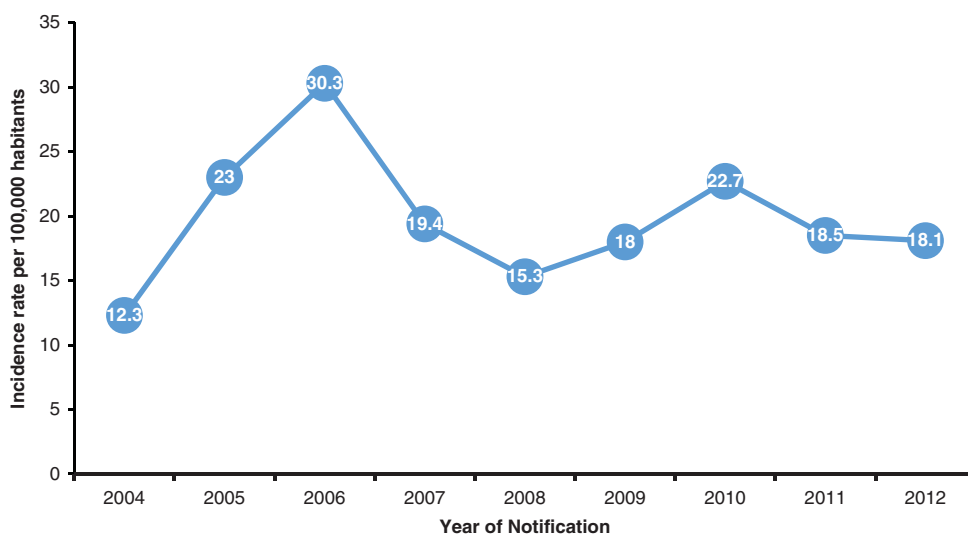


Figure 1. Incidence of laboratory confirmed Salmonellosis cases (per 100,000 population) during 2004-2012 in the State of Qatar.

Figure 1. The annual IR were found to be 12.3, 23.0, 30.3, 19.4, 15.3, 18.0, 22.7, 18.5, and 18.1 per 100,000 population in 2004 – 2011 and 2012, respectively. During the first part of 2004, a consistent upward trend was observed, and during 2007 – 2010, the incidence of the disease remained fairly constant, with a decreasing incidence being observed during 2011 – 2012. A total of 339 confirmed cases of salmonellosis were reported in 2012. Of these cases, 219 (64.7%) were laboratory-reported and 119 (35.2%) were

reported by the physician, and the majority of the patients ($n = 175$, 52.2%) were found to be male. Increased incidence in cases were reported between May and September, with the lowest value being recorded between January and April (Figure 2).

Figure 3 shows the percentile number of cases by sex, where half of the patients were children below the age of 2 years (female) and 3 years (male). In addition, more than one-fourth of the patients (27.7%) were Qatari when compared to non-Qatari

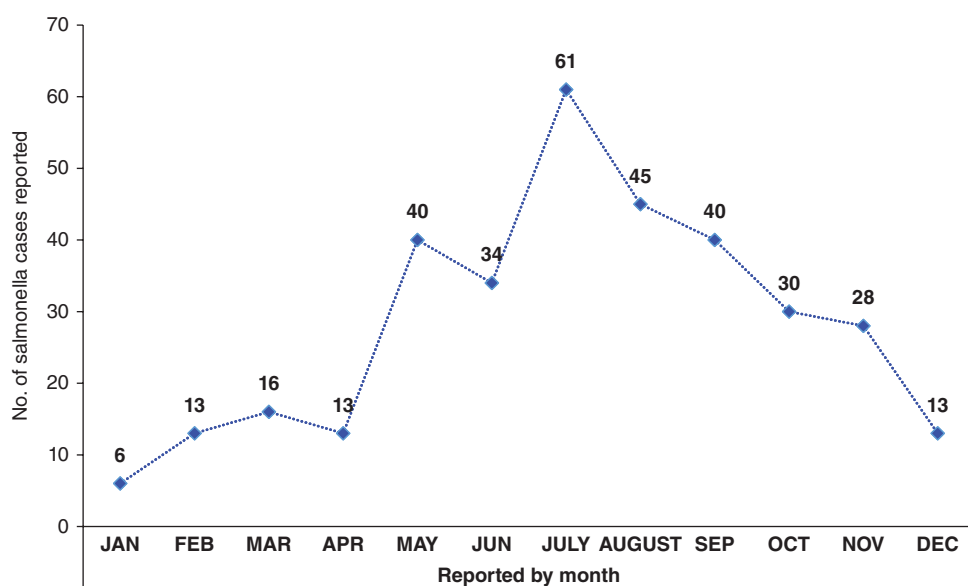


Figure 2. Laboratory-confirmed salmonellosis cases reported by months in the State of Qatar, 2012.

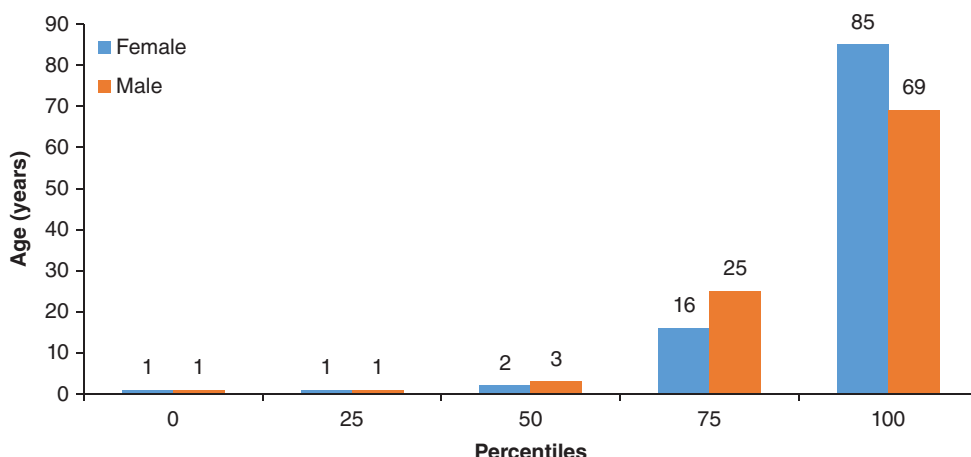


Figure 3. Percentile distribution of age (years) according to gender in laboratory confirmed salmonellosis cases in the State of Qatar, 2012.

patients such as Indians (10.6%), Egyptians (8.3%), Pakistanis (6.2%), and other nationalities (Figure 4).

A significant difference in age was found between Qatari (6.08 ± 12.28 years) and non-Qatari (15.04 ± 19.56 years) patients. Of all cases, 79.8% had the onset date of the first symptoms. Contact phone numbers were available for 94% of the cases, but addresses were available for only 50.4% of cases (Figure 5).

The time lag between the onset of symptoms and diagnosis was 5.4 ± 5.7 days. The most frequent serotype identified were type b (41.9%), type d (26.9%), and type c1 (12.2%) (Figure 6). Antimicrobial resistance was recorded in 104 patients (30.7%) with absolute resistance to cephalexin and gentamicin, followed by 85.7% for cefuroxime, 38.5% for piperacillin-tazobactam, and 36.4% for cefepime. Lower frequencies of resistance were observed for third-generation cephalosporins, ciprofloxacin, and meropenem (Figure 7).

DISCUSSION

The incidence of non-typhoidal salmonellosis decreased in the State of Qatar during 2004–2012. This can be attributed to the improvement in the food chain and sanitation in the country. Similar population IR have been reported in Canada (19.4 cases per 100,000 population),¹³ Poland (22.9 per 100,000 population),¹⁴ other European countries (20.7 cases per 100,000 population),² and the USA (16.42 per 100,000 population).¹ However, the effect of

underreporting is a frequent problem in surveillance systems worldwide,^{14,15} particularly in Qatar.

The increased incidence of salmonellosis observed between May and September is attributed to climatic factors, particularly temperature, being significant in the month of July and August. These factors, especially elevated temperatures and rainy periods, have been associated with the risk of increased incidence of enteric disease.^{16–18} The high frequency of salmonellosis observed in children, which has been strongly associated with immunological factors, is consistent with that reported in previous studies.^{3–6,19}

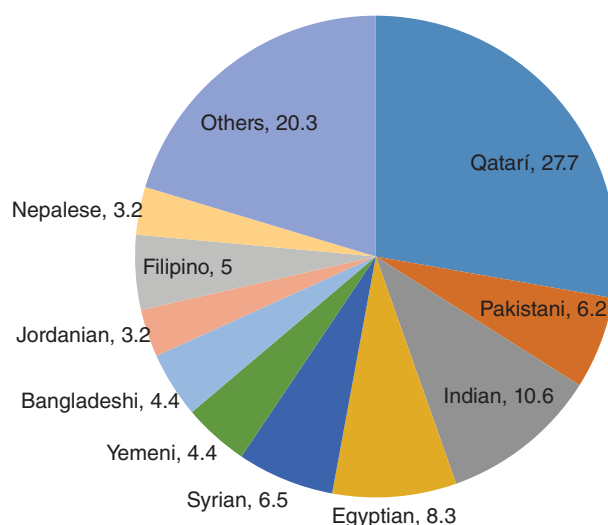


Figure 4. Case reported with salmonellosis according to nationalities (per 100 reported cases), Qatar, 2012.

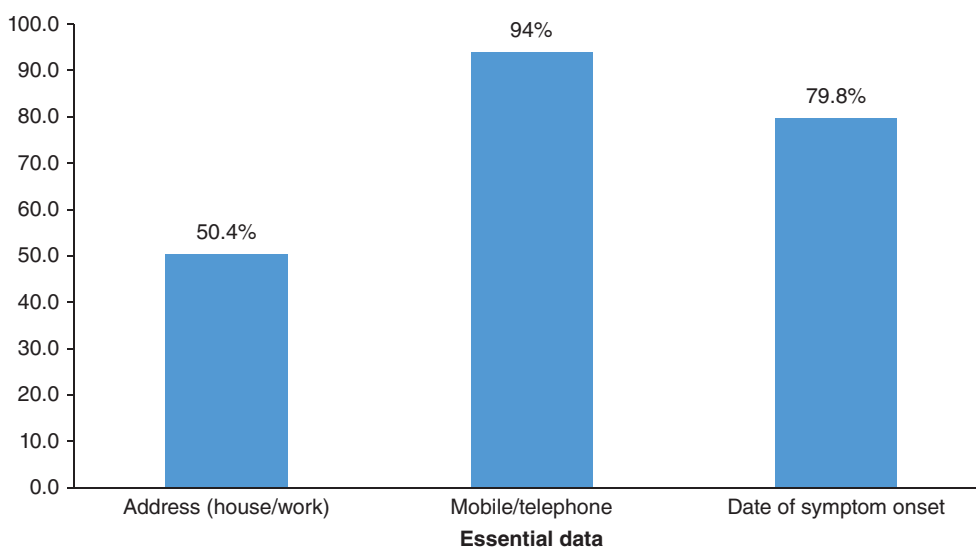


Figure 5. Completeness of data in laboratory confirmed salmonellosis (per 100 notified cases), Qatar, 2012.

According to 2012 US data, the incidence of salmonellosis in children below 5 years of age was 63.49 cases per 100,000 population, whereas the incidence for age groups ranging from 5 years to > 65 years was < 20.0 cases per 100,000 population.¹ The high frequency of cases observed in Qatari patients is associated with the age distribution of the reported cases and the characteristics of the population in the State of Qatar. The quality of data of

reported cases is essential for the timely identification of patients, epidemiological evaluation in order to investigate the source and mode of transmission of infections, and the timely implementation of control measures. The frequency of the patients reporting an address and place of work was significantly lower than that of contact number.

Based on the characteristics of the population residing in Qatar, we considered it necessary to have more

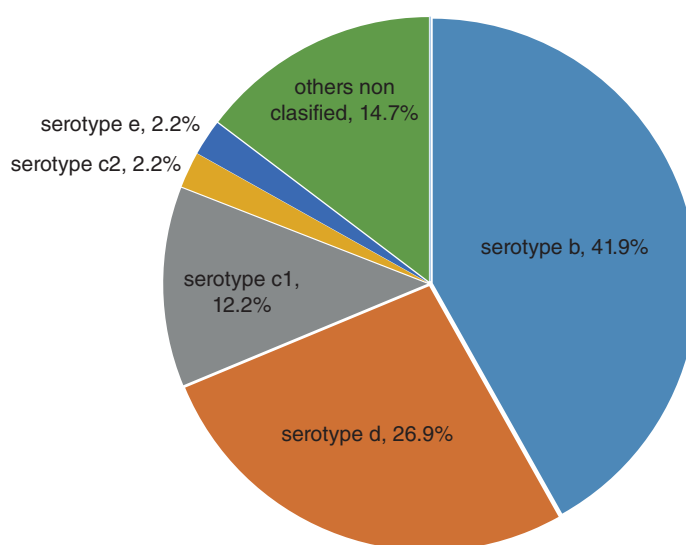


Figure 6. Serotype of salmonella in cases reported (per 100 isolates), Qatar, 2012.

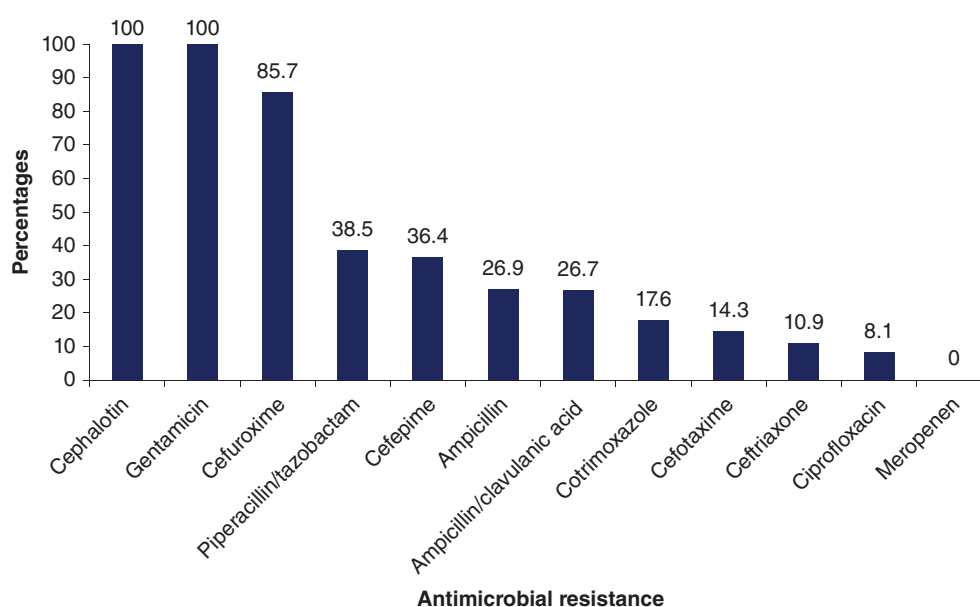


Figure 7. Antimicrobial resistance in *Salmonella* isolates (per 100 isolates), Qatar, 2012.

than one essential data (contact number, address, and place of work). This may be attributed to the lack of perceived value of this information and language barriers that exist when communicating with patients who do not speak English or Arabic (commonly spoken languages among medical staff), as previously reported in a study that evaluated measles surveillance in Qatar where a majority of reported cases (60%) were non-Arabic/non-English speakers.²⁰

The time between the onset of symptoms and diagnosis is generally considered as adequate for most diseases, not exceeding the incubation period of the disease.²¹ The predominance of serotype b is associated with the age group of cases, with the majority being children < 5 years of age, as previously reported.⁵ However, the rates of antimicrobial resistance identified in the isolates were found to be $\geq 40\%$ for only five antimicrobial agents, including piperacillin-tazobactam, a drug that is frequently used in Qatar.

Interestingly, a low-resistance pattern was observed in third-generation cephalosporin and ciprofloxacin.⁸⁻¹⁰ However, it should be noted that the small amount of cases with complete laboratory results is a limiting factor for the analysis of this result. Our findings highlight the need for strengthening the surveillance system of salmonellosis, with special emphasis on the laboratory study of cases. Further

studies are required to identify underreporting in specific populations by using active surveillance methods.

LIMITATION OF THE STUDY

The main limitation of this study is its retrospective nature that is associated with the use of surveillance and notification data. In addition, the IR reported are unable to provide definite temporal measurements and/or could be underestimated because of inadequate reporting by physicians. Therefore, the results of this study should be generalized with caution because of failure to describe the IR of salmonellosis in the State of Qatar.

CONCLUSION

The present surveillance data showed a high incidence of salmonellosis in the State of Qatar, which poses a serious public health problem. Special intervention and health awareness programs are required for early screening, detection and treatment as well as the need for strengthening the surveillance system of salmonellosis, with special emphasis on the laboratory study of cases.

COMPETING INTERESTS

The authors declare that they have no conflict of interest.

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