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# TRENDS IN EPIDEMIOLOGICAL ASPECTS OF HUMAN Q FEVER IN KOREA FOR THE LAST DECADE SINCE EMERGENCE FROM 2006 TO 2015

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## ABSTRACT

**Background and Methods:** This study focuses on a quantitative analysis of the epidemiological aspects of human Q fever in Korea for the last decade since its emergence from 2006 to 2015. The raw data analyzed in this study was obtained from the website of "Q fever" managed by the Korea Center for Disease Control and Prevention (KCDC), 2006-2015. **Results:** There were a total of 133 cases with a cumulative incidence rate (CIR) of 0.27 per million populations. Significantly more men were infected by Q fever than women (79.7% versus 20.3%) ($p<0.01$), and a higher incidence of Q fever were observed in those age more than 40 years old (72.9%), ($p<0.01$). Moreover, the seasonal pattern of outbreaks revealed that most outbreaks occurred in the early spring throughout the ending of summer, and that significant more outbreaks occurred in the western parts (69.2%) than eastern areas (30.8%) in the Korean peninsula ($p<0.01$). Furthermore, the number of cases of Q fever was significantly higher in rural areas (67.7%) than in urban (32.3%), ($p<0.01$). **Conclusion:** Q fever in Korea is a new emerging zoonosis, a serious concerned to the public health. Therefore, the development a health education system for Q fever prevention and improvement of the living environment will aid in reducing from its spread from animal reservoirs.

**KEYWORDS:** Q fever, epidemic aspects, risk factor, Korea.

## INTRODUCTION

Q fever was first recognized as a human disease in Australia in 1935. The "Q" stands for "query" and was applied at a time when the causative agent was unknown. Human Q fever is known to be the result information with the obligate, intracellular, bacterium Coxiella burnetii.[1-7] Cattle, sheep, and goat are commonly infected and may transmit infection to humans when they give birth. C. burnetii can survive for long periods of time in the environment, and may be spread by wind and dust. The disease is global in distribution, with cases reported sporadically or occasionally as outbreaks. However, because Q fever may resemble other diseases, be mild, or even cause no symptoms in some people.[1-4]

In the case of Korea, the *C. burnetii* strain was first detected from the isolation of cultivation from raw milk of dairy cows in 1993.[4,5] Notwithstanding, the first reported case of Q fever in humans was in 2006.[5,6] Therefore, Q fever was legally designated as a communicable disease prevention act (category IV) by the Korea Center for Disease Control and Prevention (KCDC) in 2006.[5] Because Q fever is rarely a notifiable disease, the incidence of human Q fever cannot be assessed in most countries. Current epidemiological studies indicate, however, that Q fever should be considered a public health problems in many countries, including, France, the United Kingdom, Italy, Spain, Germany, Israel, Greece and Canada, as well as in many countries where Q fever is prevalent but unrecognized because of poor surveillance of the disease.[6] However, recently, Q fever has been reported in almost every country, except New Zealand.[6,7] In Korea, there is a little information concerning the epidemiological aspects of *C. burnetii* infection in either animals or humans. A few cases of Q fever in humans have been reported.[5,8,9]

*Coxiella burnetii*, the causative agent of Q fever, is of considerable concern to all us and the veterinary profession is deeply involved in and is playing a most important part for public health services studying it.

It is our intention to conduct a retrospective study of Q fever for epidemiological aspects related risk factors in Korea for the last decade since its emergence from 2006 to 2015 under the seven headings: cumulative incidence rate (CIR), epidemic aspects including cases related to gender, age-specific risks distribution, and related risk factors such as the seasonality, geography and habitat of those who have Q fever.

## MATERIALS AND METHODS

In this present descriptive study, we investigated the epidemiological aspects and related risk factors of Q fever in Korea for a total of 133 cases of Q fever from 2006 to 2015. We utilized the raw data from the national notifiable disease surveillance system (website) of the Korea Center for Disease Control and Prevention (KCDC), 2006-2015[10], the Ministry of Health and Welfare, Republic of Korea.

In this study, the cumulative incidence rate (CIR) of Q fever cases per million populations and male to female morbidity ratio (MFMR) were estimated by the criteria World Health Organization (WHO) established, and the upper and lower limits of the 95% confidence interval (CI) were calculated. Statistically significant differences between the epidemiological aspects and risk factors were determined using the Chi-square test or the paired *t*-test used, and the data analyses were carried out using the statistical systems of the software, Microsoft Excel 2007; and the results were considered to be statistically significant were set at $p<0.05$ and $P<0.01$.

## RESULTS

As shown in Table 1, the epidemiological aspects of Q fever cases in Korea between 2006 through 2015 were analyzed by association with CIR, cases of gender, MFMR, and age-specific risks of the individual. There were a total of 133 Q fever patients with a CIR of 0.27 (95% CI: 0.25-0.29) per million populations from 2006 to 2015. Differences between male and female individuals in response to infectious diseases are an overlooked public health aspect. In the cases of Q fever in Korea, a significantly higher number of males was infected a rate of 79.7% of the total of 133 cases, than females of 20.3% ($p<0.01$) and that of MFMR was 3.93, respectively.

The distribution of Q fever cases by age-specific was as follows: for the age groups of under 19, 20-39, 40-59, and over 60 years old the percentages were 2.3%, 24.8%, 49.6% and 23.3%, respectively ($p<0.01$), and a the highest incidence of Q fever was observed in those aged more than over 40 years old group (72.9%), which clearly shows a significantly higher incidence of Q fever in the elderly ($p<0.01$), and as shown in Figure 1.

Table 2 shows the epidemiological relative risk factors of Q fever cases that occurred in Korea between 2006 and 2015; these factors were analyzed by association with the seasonality, geography, and habitat of each individual. The estimation of the seasonal pattern of incidence rate in percentage of Q fever patients, in the order of spring, summer, autumn and winter were 31.3%, 25.0%, 18.9% and 25.0%, respectively ($p<0.05$).

A summary of incidence cases of Q fever that in relation to geography reveals that significantly more outbreaks occurred in the western part (68.4%) than the eastern part (30.8%) and in the Jeju island in the Korean peninsula ($p<0.01$). Moreover, the number of cases of Q fever was significantly higher in rural areas (67.7%) than in urban areas (32.3%), respectively ($p<0.01$).

**Table 1: Epidemiological aspects of Q fever patients in Korea, 2006-2015.**

| | No. of Cases (%) | 95% CI |
|---|---|---|
| Total No. of Patients | 133 | |
| CIR/1,000,000 | 0.27 | 0.25-0.29 |
| Gender of patients | | |
| Male | 106 (79.7) | 76.2-83.2 |
| Female | 27 (20.3) | 16.8-23.8 |
| p-value | <0.01 | |
| MFMR | 3.93 | |
| Age-specific | | |
| <19 | 3 (2.3) | - |
| 20-39 | 33 (24.8) | 17.5-32.1 |
| 40-59 | 66 (49.6) | 41.4-57.8 |
| >60 | 31 (23.3) | 16.1-30.5 |
| p-value | <0.01 | |

**Remarks: CIR; cumulative incidence rate per 1,000,000, MFMR; male to female morbidity ratio, CI; confidence interval of 95% of rate. p-value; Chi-square analysis indicated a significant difference from the total value.**

**Table 2. Risk factors for Q fever by seasonality, geography and habitat in Korea, 2006-2015.**

| Item | No. of Cases (%) | 95% CI |
|---|---|---|
| Seasonality | | |
| Spring | 37 (28.0) | 20.4-35.6 |
| Summer | 40 (30.1) | 22.3-37.9 |
| Autumn | 23 (17.3) | 10.9-23.7 |
| Winter | 33 (24.8) | 17.5-32.1 |
| p-value | <0.05 | |
| Geography | | |
| Eastern | 41 (30.8) | 23.1-38.7 |
| Western | 91 (68.4) | 61.4-77.1 |
| Jeju (island) | 1 (0.8) | - |
| p-value | <0.01 | |
| Habitat | | |
| Urban | 43 (32.3) | 22.8-46.0 |
| Rural | 90 (67.7) | 54.0-77.2 |
| Total | 133 | |
| p-value | <0.01 | |

**Footnotes are in Table 1.**

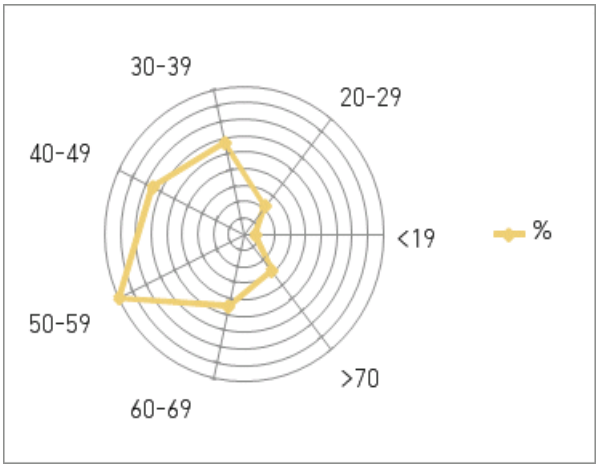


**Fig 1: Distribution pattern of Q-fever cases by age-specific groups in Korea for the last decade from 2006 to 2015.**

## DISCUSSION

In humans, *C. burnetii* infection may be asymptomatic, acute, or chronic. Acute Q fever may be manifest as pneumonia, hepatitis, or both. Chronic Q fever is rare, with endocarditis being the most common complication.[1,6-8] A case reported in Korea stated that the overall seroprevalence of *C. burnetii* in dairy cattle was 25.6% of the positive serum samples. By contrast, only 1.5% of healthy people in a rural area were seropositive.[8] However, it is not officially reported. In Korea, the number of Q fever cases were rapidly increased after the first official report in 2006; a total of 133 cases were reported between 2006 and 2015. There were a total of 133 Q fever cases with a CIR of 0.27 per million populations in Korea since its emergence from 2006 to 2015. During the period, outbreaks of Q fever increased; the number of patients in Korea tended to increased from 6 cases in 2006 to 19 in 2008, and 29 cases in 2015, when it was at its peak. Humans usually get infected from inhalation of these organisms from air that contains airborne barnyard dust contaminated by dried placental, birth fluids, and excreta of infected animals. Other modes of transmission to humans, including tick bites, ingestion of unpasteurized milk or dairy products, and human to human transmission, are rare.[1-5]

The frequency of reported cases of Q fever increases with age and is highest among males. These remarkable differences in gender distribution are believed to be due to differences between males and females in the items utilized in their jobs such as in livestock handling and works in the ranches and in the rural.[1-5,7,10-12] Moreover, in the case of Korea, there is a tendency for most young people to move to cities for work, whereas, the elderly people work a farming and livestock workers work on their own land. It was long believed that Q fever was most frequently reported in areas with locally practiced ranching, and that ranching may demonstrate increased incidence.[1,2,4,7]

Although cases of Q fever can occur during any month of the year, most cases report onset of illness during the early spring through the ending of summer in Korea. These increases coincide with an increase of farming activity for the ranches, and with the birthing season for a number of domestic animal species.[1-3,5,6] A summary of incidence cases of Q fever that in relation to geography reveals that significantly more outbreaks occurred in the western part (68.4%) than in the eastern part (30.8%) and Jeju island (0.8%) of the Korean peninsula ($p<0.01$). It was long believed that Q fever was most frequently reported in areas where ranching is locally practiced, and that ranching may demonstrate increased incidence.[1,2,4,7] Moreover, the distribution of Q fever cases was significantly higher in rural areas (67.7%) than in urban areas (32.3%) ($p<0.01$).

Q fever is global in distribution with cases reported sporadically or occasionally outbreaks. However, because Q fever may resemble other diseases, be mild, or even cause no symptoms in some people, cases of human Q fever are likely under-recognized in the elsewhere. A reported case in the United States that around 3% of the healthy population and 10-20% of persons in high-risk occupations (veterinarians, farmers, etc.) have antibodies to *C. burnetii*, suggesting exposure.[1,3] On other hand, there was a reported in Korea in which blood samples collected from 1,634 ruminants were analyzed with CHEKIT Q fever ELISA kit. Thirteen of 1,000 (1.3%) cattle, 10 of 604 (1.7%) wapiti, and negative of 30 sika deer had antibodies against *C. burnetii*. Moreover, there are risk factors of Q fever infection in Korea, because some Koreans habitually consume raw meat and drink deer blood.[13] Therefore, Q fever is mainly concerned with the livestock ranches, and infection by unprotected contact was its major rout of transmission.

Finally, the most effective way of controlling Q fever is to reduce human exposure to infected livestock and their excrements. Moreover, safety measures such as commendation calls for a comprehensive preventive strategy against Q fever infection, including health education and promotion, and vaccination in the most endemic areas are required for public safety.

In conclusion, Q fever in Korea is a new emerging zoonosis, a serious concerned to the public health. This study provides a quantitative analysis of the epidemiological aspects and risk factors of Q fever in Korea to shed insight on how to more effectively plain future strategies. It is hoped that this information will be a useful reference in the further studies of Q fever for the public health service.

### Conflict of interest

The authors declare no conflict of interest relevant to this article.

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