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High Prevalence of Campylobacter in Broiler Flocks is a Crucial Factor for Frequency of Food Poisoning in Humans

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The identification and reduction of risks that affect food safety is essential in preventing foodborne illnesses (1). Campylobacteriosis is one of the most frequently reported diseases and causes of food poisoning worldwide (2, 3). In Japan, Campylobacter is the second most frequent cause of food poisoning after norovirus (4, 5). The primary contamination site in the broiler production chain is in the farms (2, 6, 7). The frequency of bacterial food poisoning from common causes, such as Salmonella and Vibrio parahaemolyticus, peaks once a year in Japan, with the highest frequencies in summer and lowest in winter. In contrast, Campylobacter cases in Japan have a unique ‘trapezoid-like’ pattern, which is persistently high from April to October/November and then gradually decreases (5). The cause of this pattern and the causal relationship between the prevalence of Campylobacter contamination in broiler chickens and food poisoning remain unclear. Furthermore, seasonal changes in the prevalence of Campylobacter contamination in broiler chicken samples have not been fully described. This study aimed to determine the potential association and correlation between the prevalence of Campylobacter contamination in broiler chicken farms and the frequency of Campylobacter food poisoning in humans. Moreover, we assessed the relationship between seasonal changes in the prevalence of Campylobacter contamination in broiler farms and the frequency of food poisoning and compared the results to the corresponding patterns for Salmonella.

Three live broiler chickens from each broiler flock population were randomly chosen. A total of 66 cecal and 132 cloacal samples from 36–49-day-old broilers (n = 198) were collected from 66 broiler flocks from 11 broiler houses in 9 farms in Kyushu, Japan, between August 2013 and February 2016 using a previously described method (8, 9). Samples were collected from 4 to 12 flocks every month throughout the three-year period, except between March and May, which is a prevention against the highly pathogenic avian influenza (HPAI) virus. We tested all 198 broiler samples of Campylobacter and Salmonella cells through both direct plating and selective enrichment followed by plating, which is in accordance with our conventional protocol (9). The relationships between the prevalence of Campylobacter and Salmonella contamination in broiler samples at different temperatures and the incidence of food poisoning were compared through correlation coefficient analysis with R ver. 3.1.3 (R Foundation for Statistical Computing, Vienna, Austria), and a P value (P) of < 0.05 is considered statistically significant. Meteorological and food poisoning surveillance data between April 2013 and March 2016 were retrieved from the websites of Japan Meteorological Agency and the Ministry of Health, Labour and Welfare of Japan, respectively (4, 10).

Out of 66 broiler flocks, 28 were positive for Campylobacter, of which all 3 individual broiler chickens examined were positive in 26 flocks, 2 of 3 were positive in one flock, and one of 3 was positive in another flock. This finding was expected because once the pathogen infects the first birds in naturally contaminated broiler flocks, fecal shedding of 6.0 log Campylobacter cells per gram of feces along with coprophagy leads to a rapid transmission of infection throughout the flock (7).

The prevalence of Campylobacter colonization in Norwegian and Irish broiler flocks in the subarctic zone is highly correlated with average temperatures between −4 and +20°C (Norwegian: −4 and +18°C; Irish: 7.2 and +20°C), whereas the associations with temperatures above 20°C are unclear (2, 6). Therefore, we first confirmed that the prevalence of Campylobacter contamination fluctuated in broiler farms in the temperate zone throughout the three-year period. Campylobacter prevalence had gradually increased and then decreased in March (12.2°C) and November (15.1°C), respectively, with a subtle peak in June (22.4°C) and between June and February (Fig. 1). Therefore, the prevalence remained high between April and October (Fig. 1). The correlation coefficients between temperature rates and the incidence and prevalence of food poisoning caused by Campylobacter and Salmonella were 0.949 (P < 0.0001) and 0.825 (P < 0.001) and −0.849 (P < 0.01) and 0.919 (P < 0.0001).

Campylobacter food poisoning frequency peaks once a year in summer with moderate temperatures in Finland and Ireland (2, 6), whereas the frequency in Germany...
had an ambiguous plateau in summer with both mean and maximum temperatures above about 18°C (3). In the present observation between June and February, the frequency of Campylobacter food poisoning in Japan showed a similar pattern to the bacteria’s prevalence pattern. Therefore, despite the fluctuations in average temperatures between April and October (range: 16.5–27.9°C), the monthly frequency of Campylobacter food poisoning remained consistent throughout this period (Fig. 1), with a subtle peak in June before gradually decreasing. This is consistent with previous reports on the frequency of Campylobacter food poisoning in humans (5). The corresponding subtle peaks in the frequency of Campylobacter prevalence and food poisoning in June may be associated with the East Asian rainy season, which affects most areas in Japan except for the northern regions. Heavy rainfall constitutes one of the factors for colonization in broiler flocks (2). Despite the limitation of sampling by HPAI safeguard period, further analysis, including a thorough year comparison, is required to clarify this hypothesis.

In contrast, Salmonella prevalence in broiler farms was consistent at 60% regardless of season, with food poisoning frequency peaking in July (summer) (Fig. 1). This finding was expected given that Salmonella is a facultative anaerobe, and its growth is accelerated at high temperatures. On the other hand, Campylobacter is a microaerophilic bacterium, whose growth is unaffected by temperature. The cause of the high Campylobacter prevalence in broiler farms in the warm months with temperatures above 10°C between June and November is unclear. However, the improved ventilation in poultry houses in the warm months due to the high temperatures and moisture (2, 7) may enhance invasion by vectors, such as rodents and insects, that potentially increases the spread of Campylobacter contamination in broiler farms. Furthermore, the lack of persistent circulation-mediated Campylobacter contamination compared to that of Salmonella in Japanese broiler houses, as shown in our previous report, may partly explain the fluctuating or constantly high prevalence of contamination caused by these bacteria in Japanese broiler farms throughout the year (6).

In conclusion, both Campylobacter prevalence in Japanese broiler farms and Campylobacter food poisoning frequency in humans show a similar pattern with a subtle peak in June, indicating a high correlation between prevalence and infection rate. Therefore, the high prevalence of Campylobacter contamination in broiler flocks may be associated with the frequency of the cases caused by these zoonotic foodborne bacteria.

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Conflict of interest None to declare.

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