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Epidemiological Aspects of Pathogenic Microbial Foodborne Disease Outbreaks in Korea and Japan, 1999-2004

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Abstract: Pathogenic microbial foodborne disease outbreaks (PMFBDOs) have increased in many countries, the boom in food service establishment is not matched by effective food safety and control. In this study, we investigated the current state and the epidemic aspects of FBDOs in Korea and Japan. In Korea, the average prevalence rate of foodborne disease (FBD) was 15.0 per 100,000 population and cases per outbreak of FBD was 57.0. During the same period in Japan, the prevalence rate showed an average of 24.9, and the cases per outbreak were 16. When both prevalence rate and cases per outbreak were compared, the prevalence rate in Japan was much higher than that in Korea ($p<0.01$). However, average cases per outbreak of FBD in Japan were much lower than those in Korea ($p<0.01$). In Korea, outbreaks of FBDs were more common in spring ($p<0.01$), while in Japan, more frequent in summer and winter ($p<0.01$). Outbreaks of FBD occurred largely through restaurant and school foods (32.0% and 27.5%) in Korea. In Japan, the proportion of the outbreak cases in the restaurant and home were 23.7% and 12.1%, and cases of unknown causes of FBDs were 48.2%, respectively. Bacteria were the major causes of infection in both countries. The prevalence of PMFBDOs by *Salmonella spp. Vibrio parahemolyticus* and *Staphylococcus aureus* were much higher in Korea, while those by *Camphylobacter spp.* and *SRSV* were more common in Japan. The causes by virus were more frequent in Japan (13.7%) than in Korea (7.7%). The prevalence of FBDs in Korea and Japan showed characteristic differences, especially in the PMFBDOs due to such factors as geography, climate, culture, diet and food management.

Keywords: foodborne disease, Korea, Japan, prevalence, risk factors

Introduction

Foodborne Disease (FBD) are defined as diseases, usually either infectious or toxic in nature, caused by agents that enter the body through the ingestion of food. Every person is at risk of FBD.[1] Some FBD are well recognized, but are considered emerging because they have recently become more common.[2] FBDs are a widespread and growing public health problem, both in development and developing countries.[1] The global importance of food safety is not fully appreciated by many public health authorities despite the constant increase in the prevalence of FBDs.[3,4] Significant changes in the life-styles of developing countries have taken place during the past decade, especially in food preparing facility and industry as well as safety. The surveillance for FBD has been stressed because of centralization of food production and increased international trade and tourism.[2,5] The responsibility for food safety has moved from individuals to industries and government, thereby these changes have created potentials for epidemiological outbreaks of FBD.

Korea and Japan are situated very close to each other geographically, and as well as they share similarities in several aspects such as foods, climate, life style and social system, etc.

Our intention was to study current trends of foodborne disease outbreaks (FBDOs), including pathogenic microbial foodborne disease outbreaks (PMFBDOs) in Korea and Japan for the six-years period from 1999 to 2004 by considering prevalence and risk factors of FBD in conjunction with the main pathogenic substances.

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Material and Methods

Data Collection/Aims

Detailed in data collection were previously report.[5] Based on the surveillance data of FBDOs, most of the confirmed cases in Korea obtained from "Outbreak Food Poisoning (Web), 1999-2004" by Korea Food and Drug Administration (KFDA),[6] and "Status of Food Poisoning Outbreaks", 1999-2004 by KFDA.[7] Japanese data were obtained from "Topics; Food Safety Information: Annual Report of Food Poisoning Outbreaks (Web), 1999-2004" by Ministry of Health, Labour and Welfare, Japan (MHLWJ),[8] and "Statistics of Food Poisoning Japan" published by Inspection and Safety Division, Department of Food Sanitation, MHLWJ from 1999 to 2004.[9]

To better quantify the impact of FBDOs on health in Korea and Japan, we complied and analyzed information from multiple surveillance system and other source for six years period from 1999 to 2004 by considering prevalence and relation to risk factors including prevalence rate of FBDs, cases per outbreak, seasonal outbreaks, outbreaks of venues, causative agents (pathogenic microorganisms) and others.

Data Analysis

Statistical methods of data analysis used included one-way analysis of variance (ANOVA) for the prevalence rate per 100,000 of FBDs, and cases per outbreak between Korea and Japan during period from 1999 to 2004. Another data analysis was performed using Microsoft Excel with a Chi-square test (X^2-test) to compare the frequency distribution in the rate of FBDs with the FBDOs of seasonal, venues of facilities and pathogenic substances. In addition, calculated with 95% confidence intervals of the rate of case frequency. Result were considered to significant at $p<0.05$ and $p<0.01$.

Results

Prevalence of Foodborne Disease Outbreaks and Relative Risk Factors

Table 1 shows the prevalence and relative risk factors of FBDs between Korea and Japan from 1999 to 2004. In Korea, the average prevalence rate of FBDs was 15.0 per 100,000 population with a variation from 6.26 to 21.6, and cases per outbreak (Cases/Outbreaks) of FBD was 57.0. During the same period in Japan, the prevalence rate showed an average of 24.9 with a variation from 20.3 to 34.2, and the cases per outbreak was 16. When both prevalence rate and cases per outbreak were compared, the prevalence rate in Japan was much higher than in Korea (ANOVA; $p<0.01$). However, average cases per outbreaks of FBD in Japan was much lower than that in Korea (ANOVA; $p<0.01$).

The seasonal distribution of FBDs outbreaks throughout a year showed that the prevalence in spring were in Korea than that in Japan (X^2-test; $p<0.01$), and the incidence in summer and winter were more in Japan than Korea (X^2-test; $p<0.01$) (Table 1).

Table 1. Comparative observation of the relative risk of foodborne disease outbreaks between Korea and Japan, 1999-2004

Index	KOREA	JAPAN
Prevalence rate	15.0	24.9**
No. of Cases	42,716	189,542
No. of Outbreaks	749	11,973
Cases/Outbreak	57**	16
Seasonal outbreaks		
Spring	256 (34.2)**	2,061 (17.2)
Summer	263 (35.1)	4,648 (38.8)*
Autumn	196 (26.2)	3,185 (26.6)
Winter	34 (4.5)	2,079 (17.4)**
Sum	749	11,973
Identified of Causes		
Microbe;		
Bacteria	412 (55.0)	9.247 (77.2)**
Virus	34 (4.5)	1,461 (12.2)**
Sum	446 (59.5)	10,708 (89.4)
Others Causes	303 (40.5)**	1,265 (10.6)
Total	749	11,973

Remarks; Prevalence rate per 100,000 population (compared by one-way ANOVA) Chi-squared analysis indicated a significant difference from the total value, *p<0.05, **p<0.01.
95% CI; Confidence interval of 95% of the rate.

In order to find what the major causes of FBD in Korea and Japan, we compared the data from 1999 to 2004. In Korea, 55.0% (412 cases) of total 749 outbreaks of FBD was due to bacteria, 4.5% (34 cases) was owing to virus, and 40.5% (303 cases) was caused by other pathogenic substances (chemicals etc.) including unknown cases. In Japan, 77.2% (10,708 cases) of total 11,973 outbreaks of FBD was due to bacteria, 12.2% (1,461 cases) was owing to virus, and 10.6% (1,265 cases) was caused by others including unknown cases. Taken together, the prevalence of FBD caused by the bacteria and virus was higher in Japan than in Korea (X^2-teast; $p<0.01$), while the prevalence caused by other agents was lower in Japan than Korea (X^2-test; $p<0.01$).

The Venues of FBDOs

Table 2 shows the venues of facilities where the outbreaks of FBDs from 1999 to 2004. In Korea, approximately a third a FBD outbreaks cases (32.0%) occurred at restaurants. The rest of the outbreak of FBD at schools (27.5%), homes (8.6%), work-place (7.6%), hotels (0.9%), others including food stores (21.2%) and unknown places (2.1%). In Japan, the Major places of venues were restaurants (23.7%), homes (12.1%), hotels (5.3%) work-places (2.9%), schools (1.3%), others including food stores (6.5%) and unknown facilities (48.2%). FBDs outbreaks were frequently occurred via restaurant and school foods in Korea, while via unknown venues, restaurants and homes in Japan (X^2-test; $p<0.01$).

Microorganisms Responsible for PMFBDOs

As shown in Table 3, bacteria were the most common implication pathogenic microorganisms causing FBDs in Korea. The number of bacterial FBDs were 412 of 446 cases of total PMFBDOs (92.5%), which had etiologic related to *Salmonella* species (spp.) (33.9%), *Vibrio parahemolyticus* (27.1%), *Staphylococcus aureus* (13.9%), *Escherichia coli* (7.5%), *Bacillus cereus* (1.3%), *Campylobacter* spp. (1.3%), *Enterohemorrhagic E. coli* (1.1%), and other bacterial spp. (6.3%). The FBDOs by virus were only 31 (7.7%): *Norovirus* (5.4%), *Small round structure virus* (*SRVS*) (1.1%), *Calicivirus* (0.7%), and *Astrovirus* (0.5%), respectively.

In Japan, 9,247 cases (86.8%) of 10,708 cases of total PMFBDOs were due to bacteria: *Campylobacter* spp. (27,0%), *Salmonella* spp. (25.6%), *Vibrio parahaemolyticus* (18.1%), *E. coli* (7.3%), *Staphylococcus aureus* (4.0%), *Bacillus cereus* (0.7%), *Yersinia entelocolitica* (0.2%) and other species (1.0%). PMFBDOs caused by virus were 1,461 (13.7%): *SRSV* (13.6%) and others (0.1%), respectively. The PMFBDOs attributed to *Salmonella* spp., *Staphylococcus aureus* and *Vibrio parahaemolyticus* were more frequent in Korea than in Japan (X^2-test; $p<0.01$), even though *Campylobacter* spp. and *Salmonella* spp. were the main causes in Japan as well. The PMFBDOs attributed to *Campylobacter* spp. and *SRSV* were more common in Japan (X^2-test; $p<0.01$).

Table 2. Comparative observation of foodborne disease outbreaks in venues between Korea and Japan from 1999 to 2004

	KOREA		JAPAN	
Venues	No. of Outbreaks (%)	95% CI#	No. of Outbreaks (%)	95% CI#
Home	64 (8.6)	6.6-10.6	1,448 (12.1)**	13.9-15.1
Restaurant	240 (32.0)**	28.7-35.4	2,836 (23.7)	22.9-24.5
Hotel/inn	7 (0.9)	-	628 (5.3)**	4.9-5.7
School	206 (27.5)**	28.9-29.1	158 (1.3)	1.1-1.5
Work place	57 (7.6)**	5.7-9.5	348 (2.9)	2.6-3.2
Other's	159 (21.2)**	18.4-24.1	781 (6.5)	6.1-7.0
Unknown	16 (2.1)	2.0-3.2	5,77 (448.2)**	47.3-49.1
Total	749		11,973	

Remarks; Chi-squared analysis indicated a significant difference from the total value, *$p<0.05$, **$p<0.01$.
95% CI: confidence interval of 95% of the Rate.

Table 3. Comparative observation of the cause of microbial foodborne disease outbreaks between Korea and Japan from 1999 to 2004

	KOREA		JAPAN	
Microbial agent	No. of Outbreaks (%)	95% CI#	No. of Outbreaks (%)	95% CI#
BACTERIA				
Bacillus cereus	6 (1.35)	-	74 (0.69)	-
Campylobacter spp.	6 (1.35)	-	2,886 (26.95)**	26.1-27.8
Clost. botulinum		-	3 (0.03)	-
Clost. perfringenusm	5 (1.12)	-		-
Clost. welchii		-	175 (1.63)	-
E. coli	28 (6.28)	4.0-8.5	785 (7.33)	6.8-7.8
Enterohemorrhagic E. coli	5 (1.12)		91 (0.85)	-
Salmonella spp.	151 (33.86)**	31.2-37.7	2,744 (25.63)	24.8-26.5
Staphy. aureus	62 (13.90)**	10.7-17.1	432 (4.03)	3.7-4.4
Vibrio parahe.	121 (27.13)**	23.0-31.3	1,938 (18.10)	17.4-18.8
Yersinia entero.			16 (0.15)	-
Others	28 (6.28)	4.0-8.5	103 (0.96)	-
Sum	412 (92.38	89.8-94.8	9,247 (86.36)	85.7-87.0
VIRUS				
Norovirus	24 (5.38)	3.3-7.5		
SRSV	5 (1.12)		1,453 (13.57)**	12.9-14.2
Calicivirus	3 (0.67)			
Astrovirus	2 (0.45)			
Others	8 (0.08)			
Sum	34 (7.62)	5.2-10.1	1,461 (13.64)**	13.0-14.4
Total	446 (100%)		10.708 (100%)	

Remarks; Chi-squared analysis indicated a significant difference from the total value, *p<0.05, **p<0.01.
95% CI: confidence interval of 95% of the rate.

Discussion

The FBDs are usually focused on by the general public who are expecting to explain rapidly both the causes of disease and its growth.[10] Greater numbers of people go out and eat meals prepared in foods facilities. In many countries, the boom in food service establishments is not matched by effective food safety and control. Insanitary preparation of food provides ample opportunities for contamination, growth, or survival of foodborne pathogens.[2,11]

This study presents the results of the comparative observation on the FBDs between Korea and Japan. As shown Table 1, the prevalence rate of FBD was higher in Japan, while the cases per FBDs were more in Korea. One may explain the great differences of prevalence of FBD between two countries are based on the difference in their food handling and its cultural background, even tough these two countries are geographically located in close proximity. For example, compared to the Japanese, Koreans like their food spicier or saltier as well as fermented food such as a kimch, suggesting that perhaps the spicy or salty and fermented foods may damage pathogenic bacteria.[5,12]

It is well known that most communicable disease are affected by season or climatic conditions.[13] Therefore, observation of the seasonal pattern of FBDs prevalence in both Korea and Japan. The distribution of FBDs throughout a year show a high incidence between the months of May, late in

the spring, and June, early in the summer, but the prevalence declined from November to February, which are winter months in Korea (Table 1). On the other hand, peaks of FBDs existed between July and September in Japan. These data strongly indicate that the FBDs incidence in these two countries are influenced by their peculiar climate conditions, frequencies of national holidays, a school term (term-end holidays) and vacation, as well as the seasonal patterns of microbial infection.[5,14]

The major venues of facilities where foods were improperly handled were homes and public consumptions such as restaurants, hotels, schools workplace and others including food stores and street food vendors (Table 2). In Korea, outbreaks of FBDs were frequently occurred via restaurants (32.0%) and school foods (27.5%), respectively, while via unknown venues (48.2%), restaurants (23.7%) and homes (12.1%) in Japan. FBD outbreaks in restaurant were much higher in Korea than in Japan, whereas FBD outbreaks at homes were more frequent in Japan than in Korea. Recently in Korea, greater number of people go out and eat meals prepared in foods facilities, which are restaurants for their party, such as wedding or birth-day, and picnics, canteens, fast food outlets, and by street food vendors.

The global incidence of FBD is difficult to estimate, but it has been reported that in 2000 alone 2.1 million people died from diarrhea diseases.[3] A great proportion of these cases was attributed to contamination of foods and drinking water.[3,15] In order to understand the characteristics of Korean and Japanese FBDs, it is necessary to identify the state of food-related pathogenesis[16]. As shown in Table 3, bacteria were the major causes of infection in both countries. The PMFBDOs by *Salmonella* spp, *Vibrio parahemolyticus* and *Stapphylococcus aureus* were more frequent in Korea, while those by *Campylobacter* spp. and *SRVS* were more common in Japan. Michino and Otsuki[17] also reported that major hazards in 269 PMFBDOs in Japan were caused by *Campylobacter jejini*, *Salmonella* spp., *E. coli* and *Staphylococcus aureus*. In contrast, in the western hemisphere and in Europe, *Salmonella serotype enteritis* (SE) was the predominant strain, which was supposed to be largely related to the consumption of poultry eggs.[2]

In oder to prevent PMFBDOs, it is necessary to avoid the contamination of foodstuff and to adopt proper measures of decontamination. It is also essential that the public health sector collaborate with the agriculture and fisheries sectors.[5,18] Actually, our lives are becoming increasingly dependent on safety of food supplies. The efforts including public health vigilance, careful investigation of new problems, responsible attention of food safety from to table, and partnership to bring about new FBD control measurement will be tools for achieving improved future.[14,19-22] Moreover, it requires refinements with appropriate distributions and mechanical relationships before it can be applied to a specific pathogen-food-consumer situation.[5] Therefore, further studies are needed to investigate the association of the epidemiological aspects between Korea and Japan.

Finally, outbreaks of FBDs in Korea and Japan for the purpose of achieving this goal, microbiological criteria should be update for many varieties of foods. Also, the prevention and reduction of biological and chemical contamination of foods should be regularly achieved by the public health food sanitation authorities.

In conclusion, The prevalence of FBDs in Korea and Japan showed characteristic differences. Especially, the PMFBDOs in Korea and Japan. These results reflect cultural, food habit, handling and foodstuff, climate and geographical differences between two countries.

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