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ORIGINAL RESEARCH

Sentinel Surveillance-Based Epidemiological Analysis of Foodborne Diseases in Shengsi County, China, 2019–2024

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Background: Globally, foodborne diseases (FBDs) pose a significant public health burden, particularly in coastal regions where seafood consumption is high. Therefore, continuous surveillance is essential to detect shifts in pathogen profiles.

Purpose: We analyzed the epidemiological characteristics and temporal dynamics of pathogen profiles in patients with FBD in Shengsi County, Zhoushan City, Zhejiang Province, China.

Patients and Methods: A descriptive epidemiological analysis was conducted on FBD cases that occurred between 2019 and 2024 and were reported by sentinel surveillance hospitals in Shengsi County through the China Foodborne Disease Surveillance and Reporting System.

Results: A total of 2173 cases were analyzed, with an average of 362 cases occurring per year. Cases were primarily in adults aged ≥19 years (68.20%), with peak incidence occurring in the summer (38.93%). Marine animals and their products were the main suspected food category (34.74%), and the primary food consumption setting was the household (76.44%). *Vibrio parahaemolyticus* was the predominant pathogen observed throughout the study period, with annual positivity rates ranging from 5.93% to 13.48%. Notably, *Salmonella* cases surged to 9.32% in 2024, compared to 0–1.09% between 2019 and 2023. The proportion of febrile cases also increased in 2024 (34.10%), coinciding with the rise in *Salmonella* infections.

Conclusion: FBDs in Shengsi County exhibited distinct seasonal and household-related patterns. While *V. parahaemolyticus* remains endemic, the sharp increase of *Salmonella* cases in 2024 warrants heightened vigilance. Future efforts should focus on the safety of marine food products and household kitchen hygiene, alongside sustained surveillance to detect dynamic pathogen shifts.

Keywords: foodborne diseases, epidemiology, pathogen surveillance, *Vibrio parahaemolyticus*, *Salmonella*

Introduction

Foodborne diseases (FBDs) present a significant global public health challenge. The World Health Organization estimates that FBDs account for approximately 600 million illnesses and 420,000 deaths annually worldwide.[1,2] In China, the spatial distribution of FBDs is markedly uneven. Cases are disproportionately concentrated in the southern and coastal regions, a pattern that has expanded significantly over the past five years. Coastal provinces have reported substantially higher proportions of FBD events than inland areas due to high seafood consumption, intensive cold-chain logistics, and a vibrant catering industry.[3] Moreover, the disease burden in these regions is considerable. For example, surveillance in Zhejiang Province between 2015 and 2020 documented 962 outbreaks, which affected 8324 individuals and resulted in

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1028 hospitalizations and 20 deaths.[4] Similarly, in Taiwan Province between 2012 and 2015, an estimated 3,895,914 annual FBD cases led to 1,445,384 physician visits, 50 deaths, and a loss of 4974 disability-adjusted life years.[5]

The causative agents of FBDs are diverse; they encompass bacteria (eg, *Salmonella* spp., *Vibrio parahaemolyticus, Listeria monocytogenes*, and *Staphylococcus aureus*), viruses (eg, Norovirus and Hepatitis A), parasites, fungal toxins, chemical contaminants, and various environmental and behavioral factors.[6] In coastal China, *V. parahaemolyticus* is the most prominent foodborne pathogen. A national sentinel-surveillance-based study examining the years 2013 to 2022 identified it as the leading cause of sporadic FBDs, with cases concentrated in coastal provinces.[7] In addition to *V. parahaemolyticus, Salmonella* spp. is a common pathogen in coastal areas and nationwide. Nontyphoidal *Salmonella* spp. is a frequent cause of foodborne gastrointestinal infections in China, consistently ranking among the top three pathogens responsible for bacterial FBD outbreaks.[8]

Zhejiang Province has maintained a provincial-level FBD sentinel surveillance system since 2010. These hospitals follow standardized protocols for case definition, specimen collection, and data reporting. Data from this system have provided detailed evidence of the local FBD burden. From 2010 to 2022, *V. parahaemolyticus* was the dominant foodborne pathogen in Zhejiang, with outbreaks peaking in summer and exhibiting significant associations with air temperature and sea surface temperature.[9] *Salmonella* also exhibited a clear seasonal pattern, with infections peaking in the summer.[10]

This study focused on Shengsi County, an archipelago in Zhoushan City, Zhejiang Province, which serves as an ideal natural laboratory for studying FBDs. Shengsi is China's easternmost island county and a core part of the Zhoushan Fishing Ground. Marine fisheries are its traditional industry, and the local diet is heavily based on seafood, often consumed raw, lightly cooked, or fermented (eg, drunken crab and raw, marinated shellfish), leading to a high risk for *V. parahaemolyticus* infection. In addition, Shengsi is a popular tourist destination that experiences considerable seasonal population influxes, which strains local food safety oversight. Despite the endemicity of *V. parahaemolyticus* in coastal Zhejiang, it remains unclear whether the pathogen profile has changed in recent years. In particular, healthcare-seeking behavior for mild gastrointestinal symptoms may have decreased during the COVID-19 pandemic (2020–2022) due to lockdowns and a fear of visiting hospitals. Food exposure patterns may have also shifted from communal dining toward home-based or solitary eating, as tourism-related activities declined during the pandemic.[11]

Therefore, this study analyzed the 2019–2024 surveillance data from Shengsi County to describe the epidemiological characteristics of local FBDs, identify high-risk populations and exposure settings, and track changes in pathogen profiles. The findings should provide evidence-based support for local food safety risk communication, targeted health education, and the optimization of surveillance strategies.

Materials and Methods

Data Source

Data were extracted from the Foodborne Disease Case Surveillance System within the China Information System for Disease Control and Prevention after approval by the Shengsi County Center for Disease Control and Prevention (CDC). The dataset included all FBD events and case information reported between January 1, 2019 and December 31, 2024 for individuals whose registered residence was in Shengsi County. The collected information encompassed four dimensions: clinical manifestations, epidemiological investigation, food hygiene investigation, and laboratory testing. Specifically, data for each case included basic demographic information, recorded signs and symptoms, dietary exposure history, clinical laboratory results, and the clinical diagnosis. The surveillance system requires complete reporting of these key variables. A small number of incomplete cases were excluded from the final analysis. Shengsi County People's Hospital served as the primary sentinel surveillance site and was responsible for the active monitoring of suspected FBD cases, specimen collection, and subsequent shipment of samples to the local CDC for testing.

Case Definition

An FBD case was defined according to the Foodborne Disease Surveillance and Reporting Regulations issued by the National Health Commission.[12] This definition encompasses infectious and toxic diseases, including food poisoning, caused by pathogens entering the body via food. A reportable case was defined as an individual presenting primarily with

diarrhea (defined as ≥3 bowel movements per day with abnormal stool consistency) that was confirmed or suspected to be caused by food consumption. Cases presenting with vomiting without meeting the diarrhea definition were excluded from the analysis.

Laboratory Methods

Specimen Collection and Transport

Fecal specimens or rectal swabs were collected by attending physicians at Shengsi County People's Hospital from patients meeting the case definition. Collection occurred preferably before antibiotic administration. Specimens were transported to the laboratory of the Shengsi County CDC for analysis.

Bacterial Culture

Routine testing was performed for three major bacterial pathogens: *V. parahaemolyticus, Salmonella* spp., and *Shigella* spp., following the standard culture-based protocols of the National Manual for Foodborne Disease Surveillance. Serological confirmation was further performed by slide agglutination assay with type-specific and group-specific antisera to validate strain serotype and ensure accurate species identification.

Molecular Detection

All presumptive *V. parahaemolyticus* isolates were subjected to nucleic acid extraction using a commercial kit (TIANGEN Biotech, Beijing, China). Subsequently, real-time polymerase chain reaction (qPCR) was carried out with a commercial PCR detection kit (Beijing Baiao Leibo Technology Co., Ltd., Beijing, China) to detect key virulence genes encoding thermostable direct hemolysin and thermostable-direct-hemolysin-related hemolysin. A cycle threshold (Ct) value ≤35 was defined as a positive result.

Statistical Analysis

All statistical analyses were conducted using R software (version 4.2.2). Categorical data are presented as numbers and percentages (n, %). Group comparisons were performed using Pearson's chi-square test to examine differences in the distribution of baseline characteristics across different years. The significance level was set at $\alpha = 0.05$, and a two-sided P-value <0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 2173 FBD cases were reported in Shengsi County between 2019 and 2024, with an annual average of 362 cases. The annual case numbers remained relatively stable: 337 cases in 2019, 341 in 2020, 439 in 2021, 322 in 2022, 385 in 2023, and 349 in 2024. In total, 51.73% of the cases were in male patients and 48.27% were in female patients. Adults aged ≥19 years accounted for 68.20% of all cases, with 29.13% aged between 19 and 40 years and 39.07% were ≥41 years. The most frequently represented occupational categories were office workers (21.95%), children in childcare (19.33%), and homemakers/unemployed individuals (17.44%).

Summer was the peak season for disease outbreaks (38.93% of all incident cases occurred during the summer), followed by spring (22.32%), autumn (20.57%), and winter (18.18%). Marine animals and their products were the most frequently implicated food category (34.74%), followed by other or unknown foods (25.03%), and plant-based foods (19.10%) ($P < 0.001$). Households were the primary setting for food consumption (76.44%), and meals were most commonly shared in small groups of one to three persons (83.34%). Most cases (97.28%) did not require hospitalization. Co-diners also developed symptoms in 10.03% of cases, and 7.87% of cases had used antibiotics within 12 hours prior to seeking medical care.

Chi-square tests revealed significant differences in the distribution of most baseline characteristics across the six-year study period (age group, occupation, season, food category, consumption setting, number of people sharing a meal, co-diners with symptoms, and antibiotic use prior to seeking medical care; all $P < 0.01$), except for gender ($P = 0.28$). The annual distributions are shown in Table 1.

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Table 1 Baseline Characteristics of Foodborne Disease Cases by Year, 2019–2024

Variables	Total (n = 2173)	2019 (n = 337)	2020 (n = 341)	2021 (n = 439)	2022 (n = 322)	2023 (n = 385)	2024 (n = 349)	*P*
Gender, n (%)								0.28
Male	1124 (51.73)	177 (52.52)	170 (49.85)	239 (54.44)	160 (49.69)	185 (48.05)	193 (55.30)	
Female	1049 (48.27)	160 (47.48)	171 (50.15)	200 (45.56)	162 (50.31)	200 (51.95)	156 (44.70)	
Age Group, n (%)								<0.01
≤1 year	100 (4.60)	32 (9.50)	20 (5.87)	19 (4.33)	11 (3.42)	10 (2.60)	8 (2.29)	
1–3 years	209 (9.62)	51 (15.13)	27 (7.92)	53 (12.07)	35 (10.87)	26 (6.75)	17 (4.87)	
4–10 years	175 (8.05)	21 (6.23)	22 (6.45)	56 (12.76)	31 (9.63)	25 (6.49)	20 (5.73)	
11–18 years	207 (9.53)	20 (5.93)	38 (11.14)	46 (10.48)	34 (10.56)	33 (8.57)	36 (10.32)	
19–40 years	633 (29.13)	89 (26.41)	107 (31.38)	114 (25.97)	93 (28.88)	117 (30.39)	113 (32.38)	
≥41years	849 (39.07)	124 (36.80)	127 (37.24)	151 (34.40)	118 (36.65)	174 (45.19)	155 (44.41)	
Occupation, n (%)								<0.01
Homemaker/Unemployed	379 (17.44)	38 (11.28)	74 (21.70)	71 (16.17)	46 (14.29)	65 (16.88)	85 (24.36)	
Retiree	125 (5.75)	19 (5.64)	5 (1.47)	14 (3.19)	19 (5.90)	46 (11.95)	22 (6.30)	
Other/Unknown	407 (18.73)	75 (22.26)	61 (17.89)	82 (18.68)	66 (20.50)	66 (17.14)	57 (16.33)	
Children in Childcare/dwelling	420 (19.33)	100 (29.67)	62 (18.18)	102 (23.23)	61 (18.94)	52 (13.51)	43 (12.32)	
Student	306 (14.08)	26 (7.72)	52 (15.25)	86 (19.59)	54 (16.77)	50 (12.99)	38 (10.89)	
Fisherman	59 (2.72)	16 (4.75)	10 (2.93)	7 (1.59)	4 (1.24)	21 (5.45)	1 (0.29)	
Office Worker/Employee	477 (21.95)	63 (18.69)	77 (22.58)	77 (17.54)	72 (22.36)	85 (22.08)	103 (29.51)	
Season of Onset, n (%)								<0.01
Spring	485 (22.32)	15 (4.45)	88 (25.81)	221 (50.34)	11 (3.42)	58 (15.06)	92 (26.36)	
Winter	395 (18.18)	68 (20.18)	138 (40.47)	3 (0.68)	47 (14.60)	41 (10.65)	98 (28.08)	
Autumn	447 (20.57)	74 (21.96)	71 (20.82)	39 (8.88)	65 (20.19)	161 (41.82)	37 (10.60)	
Summer	846 (38.93)	180 (53.41)	44 (12.90)	176 (40.09)	199 (61.80)	125 (32.47)	122 (34.96)	
Hospitalization, n (%)								<0.01
Yes	59 (2.72)	18 (5.34)	4 (1.17)	4 (0.91)	1 (0.31)	12 (3.12)	20 (5.73)	
No	2114 (97.28)	319 (94.66)	337 (98.83)	435 (99.09)	321 (99.69)	373 (96.88)	329 (94.27)	
Food Category, n (%)								<0.001
Ready-to-Eat/Composite Foods	92 (4.23)	5 (1.48)	12 (3.52)	28 (6.38)	16 (4.97)	16 (4.16)	15 (4.30)	
Other/Unknown Food	544 (25.03)	10 (2.97)	47 (13.78)	137 (31.21)	79 (24.53)	169 (43.90)	102 (29.23)	
Meat, Eggs, and Dairy Products	296 (13.62)	57 (16.91)	39 (11.44)	76 (17.31)	48 (14.91)	33 (8.57)	43 (12.32)	
Aquatic Animals and Products	755 (34.74)	168 (49.85)	182 (53.37)	92 (20.96)	98 (30.43)	95 (24.68)	120 (34.38)	
Beverages and Snacks	71 (3.27)	4 (1.19)	14 (4.11)	20 (4.56)	13 (4.04)	11 (2.86)	9 (2.58)	
Plant-based Foods	415 (19.10)	93 (27.60)	47 (13.78)	86 (19.59)	68 (21.12)	61 (15.84)	60 (17.19)	
Food Consumption Setting, n (%)								<0.01
Food Service Industry	390 (17.95)	50 (14.84)	81 (23.75)	61 (13.90)	49 (15.22)	64 (16.62)	85 (24.36)	
Household	1661 (76.44)	251 (74.48)	247 (72.43)	355 (80.87)	254 (78.88)	309 (80.26)	245 (70.20)	
Retail Market	3 (0.14)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.86)	
Other	86 (3.96)	36 (10.68)	11 (3.23)	10 (2.28)	10 (3.11)	10 (2.60)	9 (2.58)	
School	29 (1.33)	0 (0.00)	2 (0.59)	13 (2.96)	9 (2.80)	2 (0.52)	3 (0.86)	
NA	4 (0.18)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (1.15)	

Number of People Sharing the Meal, n (%)								<0.001
1~3	1811 (83.34)	263 (78.04)	267 (78.30)	380 (86.56)	283 (87.89)	334 (86.75)	284 (81.38)	
4~6	160 (7.36)	43 (12.76)	20 (5.87)	23 (5.24)	20 (6.21)	24 (6.23)	30 (8.60)	
7~9	32 (1.47)	12 (3.56)	1 (0.29)	4 (0.91)	2 (0.62)	3 (0.78)	10 (2.87)	
≥10	170 (7.82)	19 (5.64)	53 (15.54)	32 (7.29)	17 (5.28)	24 (6.23)	25 (7.16)	
Co-diners with Symptoms, n (%)								<0.01
Yes	218 (10.03)	27 (8.01)	53 (15.54)	31 (7.06)	33 (10.25)	29 (7.53)	45 (12.89)	
No	1955 (89.97)	310 (91.99)	288 (84.46)	408 (92.94)	289 (89.75)	356 (92.47)	304 (87.11)	
Antibiotic Use Prior to Visit, n (%)								<0.01
Yes	171 (7.87)	18 (5.34)	15 (4.40)	37 (8.43)	36 (11.18)	43 (11.17)	22 (6.30)	
No	2002 (92.13)	319 (94.66)	326 (95.60)	402 (91.57)	286 (88.82)	342 (88.83)	327 (93.70)	

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Clinical Symptoms

Diarrhea was the most prevalent symptom, which was present in 98.94% of cases. Vomiting was reported in 31.98% of cases. Notably, the proportion of cases presenting with fever fluctuated significantly over the years, peaking at 34.10% in 2024. Other symptoms such as fatigue, headache, and decreased urine output were less frequent but also varied significantly by year, as shown in Figure 1.

Pathogen Detection Trends

A total of 634 cases were tested for *Salmonella* spp. and *V. parahaemolyticus*, and 604 for *Shigella* spp. From 2019 to 2024, *V. parahaemolyticus* consistently had the highest detection rate, with annual positivity rates ranging from 5.93% (2021) to 13.48% (2022). In contrast, *Salmonella* spp. positivity was minimal between 2019 and 2023, ranging from 0% to 1.09%. However, in 2024, the *Salmonella* spp. positivity rate surged to 9.32%, the highest recorded during the six-year period. No *Shigella* spp. were detected throughout the entire surveillance period. The annual positivity rate trends of the three pathogens are presented in Figure 2.

Discussion

This study analyzed 2173 FBD cases reported in Shengsi County between 2019 and 2024. Our results show a distinct seasonal pattern (with cases peaking in summer), a predominance of adult cases, and a primary exposure link to marine products consumed in household settings. *V. parahaemolyticus* remained the dominant pathogen throughout the study period, but *Salmonella* spp. positivity increased sharply in 2024.

The age distribution analysis showed that adults aged ≥19 years accounted for 68.20% of all cases. This likely reflects a higher exposure frequency, as this demographic is more engaged in social and economic activities, including dining out and

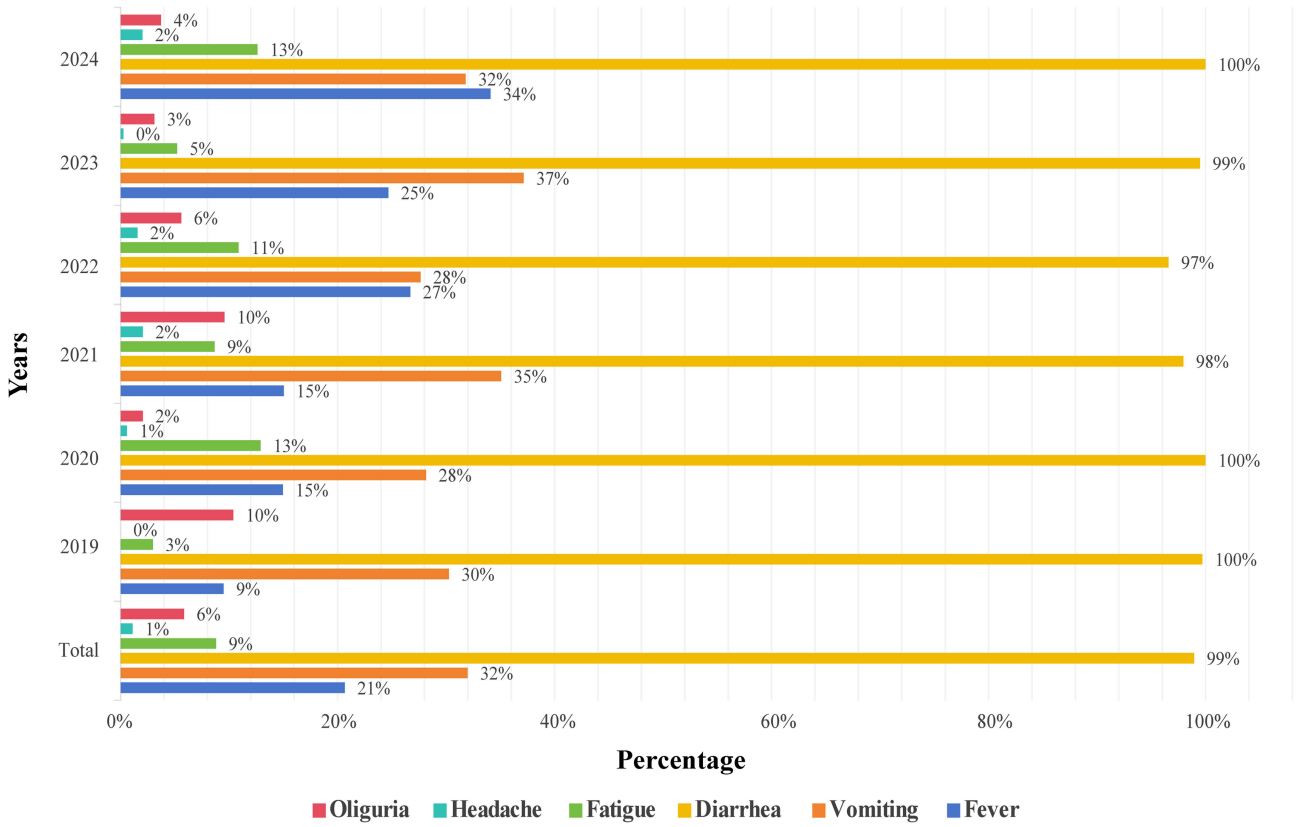

Figure 1 Annual distribution of clinical symptoms, 2019–2024. The bar chart shows the annual percentage of cases presenting with each symptom: diarrhea, vomiting, fever, fatigue, headache, and oliguria. Diarrhea was the most prevalent symptom across all years (98–100%), while the proportion of febrile cases peaked in 2024 (34%). Data labels indicate the exact percentage for each symptom by year.

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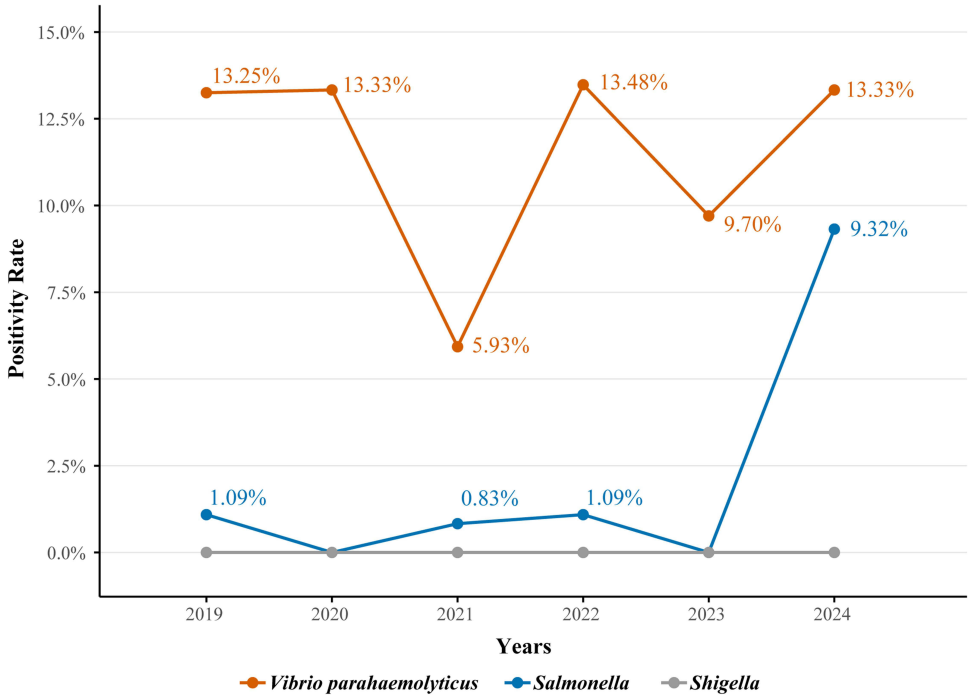

Figure 2 Annual positivity rates of major bacterial pathogens, 2019–2024. The line chart shows the annual positivity rates of three bacterial pathogens: *Vibrio parahaemolyticus, Salmonella* spp., and *Shigella* spp. *V. parahaemolyticus* consistently exhibited the highest detection rate (5.93–13.48%). *Salmonella* spp. positivity remained low (0–1.09%) from 2019 to 2023 but surged to 9.32% in 2024. No *Shigella* spp. were detected during the surveillance period.

home cooking. In terms of occupational distribution, office workers may have been exposed through the workplace or commercial dining, students via school meals, and homemakers or unemployed individuals primarily through household food handling. However, despite these differences, households remained the common exposure setting across all groups.[13,14]

Summer was the peak season for FBD incidence, which is consistent with other national and international studies.[10,15] Zhejiang Province has a subtropical monsoon climate, characterized by high temperature and humidity in the summer. During this period, coastal water temperatures enter the optimal range for bacterial proliferation, creating ideal conditions for the contamination of seafood, particularly filter-feeding or benthic species such as shellfish, shrimp, and crabs.[16] Moreover, in coastal regions such as Shengsi, local dietary habits shift during the summer toward increased consumption of raw or lightly cooked seafood, which further heightens exposure risk.[17] Summer is also the peak tourist season. National surveillance data have identified multiple FBD outbreaks associated with tourism, primarily caused by *V. parahaemolyticus* and *Salmonella* spp., with cases mainly occurring in tourist area catering services.[18]

Household outbreaks have consistently been a major component of FBD incidents in China,[19,20] where household meals are typically shared between one to three persons and are prepared by household members. The handling of marine products during home cooking may also increase the risk of foodborne illnesses. A study in Wenzhou (another coastal city in Zhejiang Province) reported that households accounted for 30.8% of foodborne outbreaks, with marine products being the primary source of contamination.[14] A national investigation of *V. parahaemolyticus* outbreaks in China further identified the main contamination links as incomplete cooking of marine food products and cross-contamination between raw and ready-to-eat meat and vegetable products.[17]

Among the three pathogens tested for in this study, *V. parahaemolyticus* consistently exhibited the highest detection rate. This confirms its status as the dominant, endemic pathogen in this coastal region, which is consistent with its role as the leading cause of bacterial FBD in coastal Zhejiang Province.[4,7,9] The most striking pathogen profile change was the sharp surge in the positivity rate of *Salmonella* infections in 2024 (rising from 0 to 1.09% in previous years to 9.32%). This marked shift within a short period suggests potential changes in local contamination sources or transmission routes. *Salmonella* is commonly associated with raw or undercooked eggs, poultry, and meat, as well as cross-contamination during food preparation, such as using the same cutting board for raw meat and ready-to-eat foods such as salads.[21] In

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Zhejiang Province, contaminated fruit and fruit products have been reported as the leading cause of *Salmonella* infections.[10] Unsafe food preparation practices and contaminated food items may be more common in household kitchens, potentially contributing to the rise in *Salmonella* cases observed in 2024. This study also included the COVID-19 pandemic period. We found that the positivity rate of *V. parahaemolyticus* in 2021 was the lowest observed throughout the six-year period. This pattern is consistent with findings from Jiangsu Province, where the detection rate of *V. parahaemolyticus* decreased significantly during the pandemic, likely due to restaurant closures and reduced tourism.[22] Changes in healthcare-seeking behavior and reduced testing during the pandemic may have also contributed to the decline in reported cases. After the pandemic, the resumption of tourism activities may have introduced new strains or increased exposure opportunities for *Salmonella spp*.[23]

Our analysis points to several practical considerations. First, the consistent summer peaks in FBD outbreaks support the allocation of enhanced surveillance resources during this season, combined with public messaging on the risks of consuming raw or undercooked seafood during warm months. Second, given that households accounted for over three-quarters of the exposure settings, future health education initiatives should target household food handlers with practical guidance on the proper storage of marine products, the importance of separating raw and cooked foods, and the need for thorough cooking. Given that households were a common exposure setting across all demographic groups, community-based interventions may be more effective than general messaging. Also, given the persistently high prevalence of *V. parahaemolyticus*, targeted interventions should cover the entire "catch to consumption" chain of marine products. Finally, the sharp increase in *Salmonella* spp. positivity in 2024 calls for targeted investigations into local food supply chains, particularly poultry, egg, meat, and fruit products, along with enhanced supervision and sampling of poultry and livestock products.

This study has several limitations. First, the design is descriptive. Therefore, no multivariable regressions or causal inferences were conducted. Hence, all interpretations should be considered speculative rather than conclusive. Second, the data were derived from hospital-based sentinel surveillance, which may not have captured mild cases that did not seek medical care. Furthermore, pathogen testing was systematic but not universal; thus, some cases may have been missed. Third, data on pregnancy status was not collected, which may be relevant given the potential susceptibility of pregnant women to certain foodborne pathogens. Finally, the COVID-19 pandemic may have influenced healthcare-seeking behavior and exposure patterns. Future research incorporating molecular subtyping techniques (eg, whole genome sequencing) is needed to trace infection sources and better understand the transmission dynamics of the emerging *Salmonella* spp. strains in Shengsi County.

Conclusion

Based on six-year sentinel surveillance data from Shengsi County, we found that local FBDs exhibited distinct epidemiological profiles characterized by a summer peak, a predominance of adult cases, and household exposure to marine food products as the primary setting for infections. Throughout the study period, *V. parahaemolyticus* maintained its role as the dominant, endemic pathogen. Notably, *Salmonella* spp. positivity increased sharply in 2024, with 11 positive cases out of 118 tested (9.32%), compared to only 3 positive cases in total during the 2019–2023 period (annual positivity rate 0–1.09%). Future efforts should focus on strengthening the safety of marine products and household kitchen hygiene, maintaining continuous pathogen surveillance, and optimizing the regulation of local food supply chains.

Abbreviations

FBD, Foodborne disease; CDC, Center for Disease Control and Prevention.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Approval Statement

This study was approved by the Ethics Committee of Shengsi County Center for Disease Control and Prevention (Approval No. SSCDC-IEC-2025-004) along with a waiver of informed consent. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki. All data were deidentified after collection and analyzed anonymously.

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Author Contributions

All authors made a significant contribution to the work reported here, whether in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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