Research Article | **Open Access**

Epidemiology of dysentery in South Khorasan province, Iran (2016-2020)

Hekmatollah Khoubfekr [ID] [1], **Majid Shayesteh** [ID] [2], **Ismail Sharafi** [2], **Vahid Rahmanian** [ID] [3] *

[1] Iranshahr Health Services, Iranshahr University of Medical Sciences, Iranshahr, Iran

[2] Birjand University of Medical Sciences, Birjand, Iran

[3] Ph.D. in Epidemiology, Research Center for Social Determinants of Health, Jahrom University of Medical Sciences, Jahrom, Iran

* **Corresponding author:** Vahid Rahmanian. Research Center for Social Determinants of Health, Jahrom University of Medical Sciences, Jahrom, Iran **Email:** Vahid.rahmani1392@gmail.com

Abstract

Background: Dysentery is an inflammatory bowel disease (IBD) caused by microorganisms invading the intestinal mucosa.

Objectives: This study aimed to determine the epidemiological profile of dysentery and identify associated risk factors in South Khorasan Province, Iran.

Methods: This cross-sectional study was conducted on 1181 patients with dysentery during 2016–2020 in South Khorasan Province, Iran. Data were collected through the disease surveillance system.

Results: The highest prevalence of dysentery was observed in counties such as Sarbisheh, Zirkooh, Darmiyan, and Nehbandan. Men accounted for the majority of cases (n = 639, 54.1%), while children under the age of 6 accounted for 30.6% of all cases. Shigella species were responsible for 48.2% of all cases of dysentery.

Conclusion: Shigella and E. coli were the most common causative agents of dysentery in South Khorasan Province, Iran. Additionally, counties located near the borders had the highest prevalence of diarrheal diseases.

Keywords: Dysentery, Shigella, *Escherichia coli*, Bloody Diarrhea, Iran.

Introduction

Diarrheal illnesses are among the most challenging public health issues,[1] and they are also the leading cause of disability and the second leading cause of death in children worldwide.[2,3] According to the World Health Organization's (WHO) annual report, approximately 600 million people suffer from water and food-borne diseases, resulting in 435,000 cases and 33 million years of life lost due to disabilities and premature death.[4] Diarrheal diseases are the second-leading cause of mortality in children under the age of five globally, with an estimated 525,000 deaths occurring annually in this age group.[5]

Dysentry, a serious condition, is distinguished by the presence of blood, pus, and mucus in the stool, indicating colon inflammation, and is invariably accompanied by intestinal ischemia and nutritional loss.[6] This type of gastroenteritis is generally persistent and has more complications than watery diarrhea.[7]

The bacterial pathogens of the genus Shigella are the most common and most important isolates from patients with diarrhea, accounting for approximately 5–15% of all cases of diarrhea worldwide.[8] Non-infectious causes of the condition include inflammatory bowel disorders (IBDs) such as Crohn's disease, ulcerative colitis, and celiac disease, which can induce similar symptoms.[9,10]

Other non-infectious causes of this serious illness in children include allergic responses to cow's milk, polyps and masses, Meckel's diverticulum, anal fissures, rectal prolapse, hemorrhoids, and digestive system injuries.[11-13] The wide spectrum of pathogens involved in dysentery, along with the variety of non-infectious causes, highlights the importance of adopting correct and immediate

therapeutic approaches to help the affected patients and understand the causes and frequency of each of the factors and pathogens involved.[14]

Objectives

This study aimed to determine the epidemiological profile of the disease and its related factors in South Khorasan province, Iran.

Methods

This cross-sectional study employed data on 1181 cases of dysentery during 2016–2020, utilizing the South Khorasan water and food-borne disease surveillance system. The Water and Food-borne Diseases National Surveillance System at South Khorasan University of Medical Sciences contributed the data. In this study, diarrhea was defined as experiencing three or more movements of loose stools per day for the past five days. The process by which the healthcare system manages diarrhea involves the following steps:

Following completion of individual examination forms and epidemiological information, patients provide a stool sample in laboratories with full knowledge and personal consent; alternatively, stool samples can be collected in healthcare centers if individuals lack access to a laboratory.

Stool samples are processed and tested in laboratories located within the healthcare centers of the counties within a maximum time frame of six hours. According to a standardized protocol, trained technicians culture all stool samples in environments containing the bacteria Shigella, Salmonella, Vibrio cholera, and Campylobacter.

The presence of red blood cells in the stool (as evaluated by a red blood cell count), white blood cell counts, and the kind of defined illness or unidentified origin (excluding Shigella, Salmonella, Vibrio cholera, and Campylobacter) are all recorded. These findings are then transmitted to healthcare centers for inclusion in the relevant database.

The required data for this study were retrieved from the portal of the System for Water and Food-borne Diseases associated with the Communicable Diseases Management Center of the Ministry of Health and Medical Education

Statistical analysis

The continuous variables were expressed as the mean±SD, and the categorical variables were presented as a percentage and frequency. Chi-squared and Fisher-exact tests was used foe comparisons. All statistical analyses were performed with SPSS (version 16.0, SPSS Inc, Chicago, IL, USA). A "P-value" less than 0.05 was considered significant. The Arc GIS 10.3 software was applied to map the distribution of cases of dysentery.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki, and institutional review board (IRB) approval was obtained. Using raw data from the national water and food-borne disease surveillance system, we took steps to protect the confidentiality of the personal information of individuals.

Results

During the four-year period of the study, a total of 1181 cases of dysentery were reported, with most being male patients (n=639, 54.1%). In terms of nationality, 1177 cases (99.7%) were Indian, while only 4 cases (0.3%) were Afghan nationals. The majority of patients (n=702, 59.4%) were villagers. The highest prevalence rate of the disease occurred in the age group under 6 years (n=382, 32.3%). Housewives had the highest frequency among occupations, with 310 cases (26.2%). A total of 870 patients (73.7%) had received outpatient treatment and recovered, while 311 individuals (26.3%) had undergone treatments after hospitalization, including three cases that led to death (one outpatient and two hospitalized patients). Blood in the stool was confirmed in 1036 cases (7.87%) based on laboratory test results. Stool culture was performed for 360 cases (30.5%), of which 139 cases (38.6%) were positive according to laboratory test results. The majority of cultured bacteria observed in 67 cases were of the genus Shigella (48.2%), and the lowest percentage was found in Salmonella (n=5; 6.3%). The highest prevalence rate of the disease was additionally recorded in the warmer months of the year, with a downward trend after the end of these months and the onset of the cold season [Figure 1]. The prevalence rates of dysentery during 2016–2020 were 43, 39, 36, and 33 cases per 100,000 population, showing an ascending trend. According to geographic distribution, the

highest prevalence was reported in Sarbisheh County (181.3 cases per 100,000 population), and the lowest rate occurred in Birjand County (7.9 cases per 100,000 population). Additionally, the prevalence rate of dysentery in counties bordering Afghanistan was higher [Figure 2].

Discussion

The current study uncovered that the genera Shigella and E. coli are significant contributors to dysentery in patients. Recent investigations in Iran have also confirmed that Shigella is the primary culprit behind diarrheal illnesses in Iran.[16,17] Additional surveys, such as those conducted by Abu-Elyazeed et al.,[18] in Egypt and Soltan Dallal et al.,[8] identified Shigella as the pathogen most usually linked to dysentery, which is consistent with the findings of our study. Research in neighboring countries like Pakistan and Kuwait has revealed a prevalence rate for the Shigella genus ranging from 14% to 27%.[19,20] Another study in Afghanistan found that norovirus and Vibrio cholera were responsible for 47% and 14% of cases of diarrhea, while enterotoxigenic E. coli (ETEC) was identified as the leading cause of the disease in 29% of participants.[21]

Table-1. Frequency of demographic data in patients with dysentery

Variable	Groups	Number	Percentage	Significance level
Gender	Male	639	54.1	0.005
	Female	542	45.9	
Nationality	Iranian	1177	99.7	0.0001
	Afghan	4	0.3	
Place of residence	Urban area	479	40.6	0.0001
	Rural area	702	59.4	
Age groups	Under 6 years old	382	32.3	0.0001
	7-29 years old	328	27.8	
	30-59 years old	319	27.1	
	60 years and above	152	12.9	
Occupation	Child	382	32.3	0.0001
	Housewife	310	26.2	
	Schoolchildren/University Student	175	14.9	
	Stock raiser/Farmer	154	13.0	
	Other	143	12.1	
	Army	15	1.3	
	Food preparation center	2	0.2	
Clinical status	Outpatient	870	73.7	0.0001
	Inpatient	311	26.3	

Table-2. Frequency of laboratory data in patients with dysentery

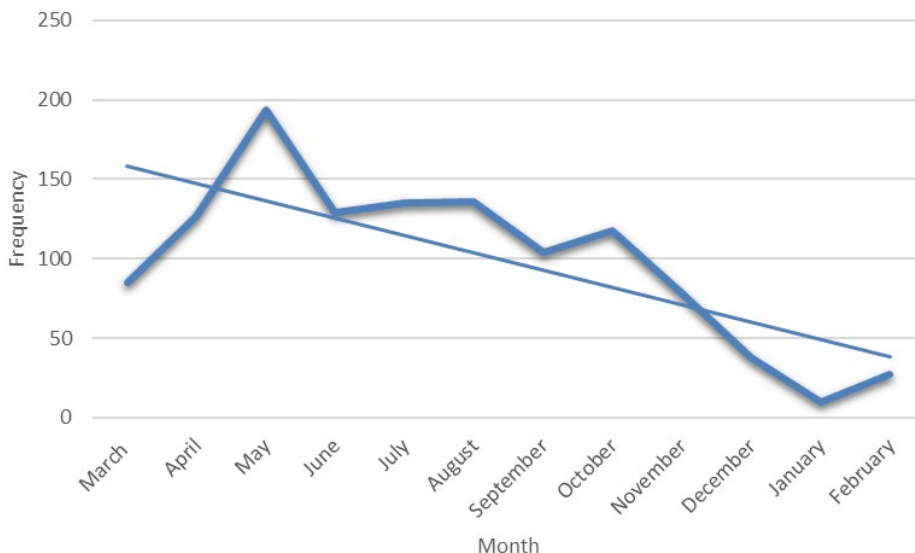| Variable		Number	Percentage	P value
Presence of blood in stool	Negative	145	12.3	0.0001
	Positive	1036	87.7	
Stool culture	Done	821	69.5	0.0001
	Done	360	30.5	
Culture results	Negative	221	61.4	0.0001
	Positive	139	38.6	
Type of microbe observed	the genus Shigella	67	48.2	0.0001
	Salmonella	5	3.6	
	E. coli	43	30.9	
	Other	14	10.1	
	Unspecified	10	7.2	

Figure-1. Monthly cumulative distribution of the number of patients with dysentery between 2016 and 2020
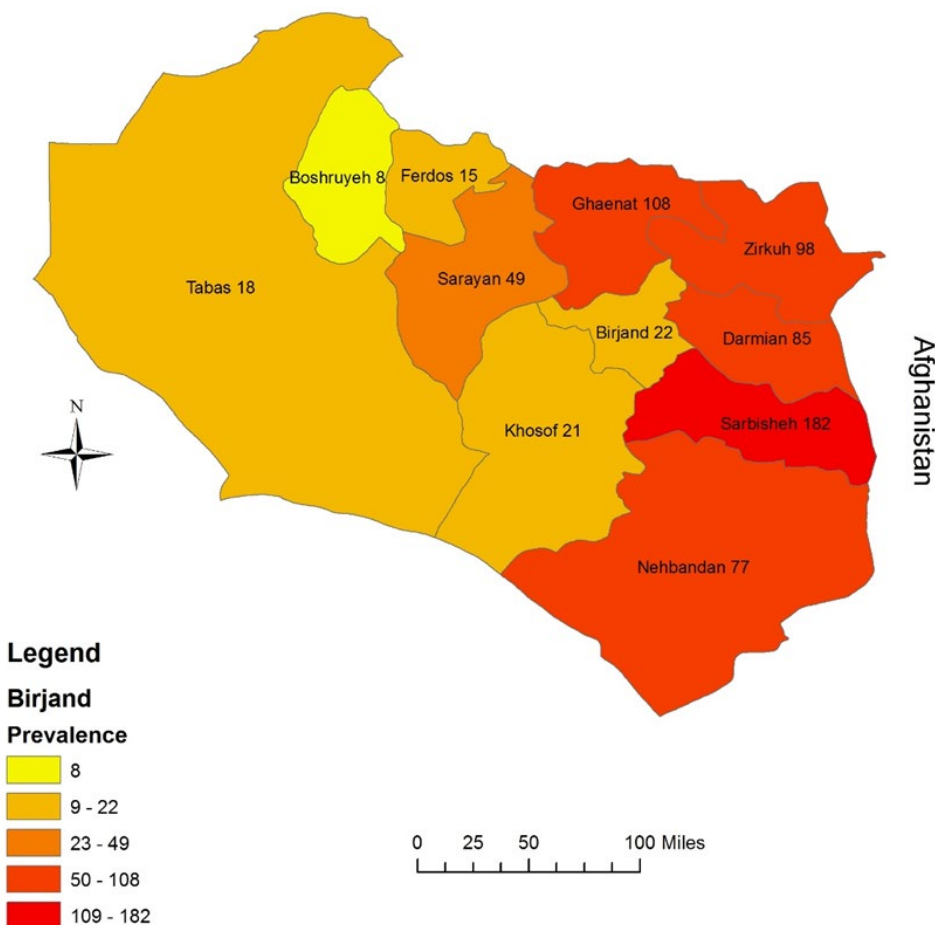

Figure-2. Average four-year prevalence of cases of dysentery per 100000 population in counties of South Khorasan province during the study periods

With more than five years since the discovery of the genus Shigella, Shigella infections continue to pose a significant threat, particularly in developing countries where water and food safety standards are subpar. The human body is the sole natural host for this pathogen. Studies conducted using a controlled serotyping method have shed light on the role of E. coli as a diarrheagenic microorganism (diarrhea-causing agent).[16,22,23]

The findings of this study revealed that the highest prevalence rates of this acute condition were observed in counties (i.e., Sarbisheh, Zirkooh, Darmiyan, and Nehbandan) along the Afghanistan border, whereas the lowest rates were recorded in the capital city of South Khorasan Province, Birjand. Shared borders with Afghanistan and the existence of bustling marketplaces, particularly in the city of Mahirood in Sarbisheh County with the highest prevalence rate of the illness, can significantly increase the sensitivity of the healthcare system and healthcare providers towards screening patients and adopting more proactive healthcare measures in border towns. Conversely, limited access to clean drinking water through indoor plumbing in impoverished and sparsely populated rural regions within Sarbisheh County, which typically relies on water tanker delivery, should also be addressed. As the locals obtain their potable water from these tankers, personal hygiene and handwashing practices may suffer, thereby contributing to a higher incidence of diarrheal disorders.[15] Previous studies have indeed documented a correlation between the type of ingested water and the likelihood of developing diarrhea.[24,25]

Other findings from the current study revealed that the highest prevalence rate of the disease during the reviewed years had been associated with children under 6 years of age, men, and rural residents, which was statistically significant (p<0.05). The results of studies by Soltan Dallal et al.,[8] and Abu-Elyazeed et al.,[18] which showed the highest prevalence of the disease in males and children, were consistent with the findings of this study. However, Ziyaei et al.,[17] reported that the largest group of patients in Nehbandan County were between 13 and 40 years old (47.1%), and the dominant gender was male (58.6%).

It is important to note that the most vulnerable individuals to gastrointestinal diseases caused by water and food are the elderly, pregnant women, and children.[26] Generally, children who live in rural slums far from the city often lack access to adequate healthcare and social welfare services due to their families' smaller size.

Other findings from the current study revealed that cases of dysentery were most common in June and generally during the early stages of the hot season. According to a survey conducted in Egypt, the majority of cases occurred during the warmest months of the year. 18 Similarly, in a study by Talan et al.,[27] in the United States, peak prevalence rates for dysentery were seen in the summer and early fall. A Chinese study also found similar associations between June and September as the months with the highest prevalence rates of dysentery.[28] Furthermore, a study by Ziyaei et al.[17] in Nehbandan County in South Khorasan Province, Iran, demonstrated that most cases of the disease occurred during the same hot season as the present study.

One of the strengths of this study is showing the geographic distribution of cases of dysentery and identifying high-risk areas for health interventions and safe drinking water supply in South Khorasan Province. A limitation of this study is that we used data from an existing surveillance system. While such data was not specifically collected for research purposes, and cases of dysentery may not have fully occurred within these systems, the prevalence may have been underestimated. Additionally, variations in the sensitivity of the healthcare system to diarrheal diseases over the years may have influenced the results obtained.

Conclusions

The genus Shigella and E. coli were found to be the most significant causes of dysentery in South Khorasan Province, Iran. Additionally, neighboring counties had the highest prevalence rates of diarrheal diseases. Therefore, healthcare systems should implement continuous education programs to increase awareness of the disease among high-risk groups and locations and take specific measures aimed at disease prevention. Furthermore, it is essential for Birjand University of Medical Sciences to allocate time and resources to recruit more healthcare professionals and promote inter-sectorial collaboration between disease control and prevention agencies, such as the Water and Wastewater Organization and local municipalities, to provide clean drinking water through indoor plumbing in disadvantaged rural areas situated near borders.

experts of the Vice-Chancellor's Office for Health at Birjand University of Medical Sciences for their cooperation in data collection in this study.

Competing interests

The authors declared no conflict of interest.

Abbreviations

IBD: Inflammatory Bowel Disease;

WHO: World Health Organization;

E. coli: Escherichia coli.

Authors' contributions

H.Kh., and V.R., conceived and developed the idea for the article; H. Kh. and VR, prepared numerous drafts; M.Sh. and H.Kh, contributed to the statistical analysis; I.Sh., M.Sh., and V.R., revised the manuscript. All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding

This study was conducted using existing data from the primary health care system and did not impose additional costs. There is no external fund to conduct this study.

Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained. The present study did not interfere with the process of diagnosis and treatment of patients.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

References

1. Van den Bossche A, Ceyssens P-J, Denayer S, Hammami N, van den Beld M, Dallman TJ, et al. Outbreak of Central American born Shigella sonnei in two youth camps in Belgium in the summer of 2019. Eur J Clin Microbiol Infect Dis. 2021; 40(7):1573-7. doi:10.1007/s10096-021-04164-y PMid:33569724 PMCid:PMC8205880

2. Jafari-Sales A, Shariat A. Antibiotic resistance pattern in Shigella species isolated from children with acute diarrhea in Tabriz city, Iran. J Health Sci Med. 2021;4(2):219-22. doi:10.32322/jhsm.859497

3. Rahman AE, Moinuddin M, Molla M, Worku A, Hurt L, Kirkwood B, et al. Childhood diarrhoeal deaths in seven low-and middle-income countries. Bull WHO. 2014;92:664-71.doi:10.2471/BLT.13.134809 PMid:25378757 PMCid:PMC4208570

4. Havelaar A, Grace D, Wu F. Foodborne diseases from dairy products in developing countries: Hazards and health implications. 2019.

5. Bauza V, Sclar G, Majorin F, Clasen T. Interventions to improve sanitation for preventing diarrhea. Cochrane Database Syst Rev. 2019;2019(5). doi:10.1002/14651858.CD013328 PMCid:PMC6497425

6. Juckett G, Trivedi R. Evaluation of chronic diarrhea. Am Fam Physician. 2011;84(10):1119-26.

7. Bawankule R, Shetye S, Singh A, Singh A, Kumar K. Epidemiological investigation and management of bloody diarrhea among children in India. PloS one. 2019;14(9): e0222208. doi:10.1371/journal.pone.0222208 PMid:31518363 PMCid:PMC6743764

8. Soltan Dallal MM, Rahimi-Forushani A, Aminharati F, Ohadian-Moghadam S, Nikmanesh B, Rastegare-Lari A. Investigation the Shigella serotypes invasive cells isolated from patients with diarrhea in HEp-2 cell culture. J Shahrekord Univ Med Sci. 2014;15(6).

9. Al Amin AI. Identification of Agents associated with Infectious and Non-infectious Infantile Diarrhea. Afr J Med Sci. 2016;1(2).

10. Parsaei P, Bahmani M, Naghdi N, Asadi-Samani M, Rafieian-Kopaei M, Sepehri-Boroujeni M. Shigellosis phytotherapy: A review of the most important native medicinal plants in Iran effective on Shigella. Pharm Lett. 2016;8(2):249-55.

11. Thapa B, Ventkateswarlu K, Malik A, Panigrahi D. Shigellosis in children from north India: a clinicopathological study. J Trop Pediatr. 1995;41(5):303-7. doi:10.1093/tropej/41.5.303 PMid:8531265

12. Kahbazi M, Dorreh F, Najmi AR, Arjomandzadegan M. Aetiology of dysentery in infants in infection ward of Amir Kabir Hospital, Arak, in 2010-2011. J Ayub Med Coll Abbottabad. 2011;23(3):91-3.

13. Istrati G, Meitert T, Ciufecu C, Sulea I. A study on cross-immunity in Shigellae following local immunization with living non-infectious agents. Zentralbl Bakteriol Orig. 1970;215(1):73-6.

14. Wang XY, Tao F, Xiao D, Lee H, Deen J, Gong J, et al. Trend and disease burden of bacillary dysentery in China (1991-2000). Bull WHO. 2006;84(7):561-8. doi:10.2471/BLT.05.023853 PMid:16878230 PMCid:PMC2627389

15. Brooks JT, Shapiro RL, Kumar L, Wells JG, Phillips-Howard PA, Shi Y-P, et al. Epidemiology of sporadic bloody diarrhea in rural Western Kenya. Am J Trop Med Hyg. 2003;68(6):671-7. doi:10.4269/ajtmh.2003.68.671 PMid:12892051

16. Dallal MMS, Ranjbar R, Pourshafie MR. The study of antimicrobial resistance among Shigella flexneri strains isolated in Tehran, Iran. J Pediatr Infect Dis. 2011;6(02):125-9. doi:10.3233/JPI-2011-0307

17. Ziyaei M, Azarkar G, Saadatjou S, Namaei M. Study of shigella genera and their drug resistance in dysenteric patients referring to Nehbandan health-care centers and health houses. J Birjand Univ Med Sci. 2007;14(02).

18. Abu-Elyazeed RR, Wierzba TF, Frenck RW, Putnam SD, Rao MR, Savarino SJ, et al. Epidemiology of Shigella-associated diarrhea in rural Egyptian children. Am J Trop Med Hyg. 2004; 71(3):367-72. doi:10.4269/ajtmh.2004.71.367 PMid:15381821

19. Carlos CC, Saniel MC. Etiology and epidemiology of diarrhea. Phillips J Microbio Infect Dis. 1990;19:51-3.

20. Sonawala M, Saraswathi K, Deodhar L. Serogroup prevalence of Shigellae in Bombay. J Postgrad Med. 1995;41(4):104.

21. Riddle MS, Tribble DR, Jobanputra NK, Jones JJ, Putnam SD, Frenck RW, et al. Knowledge, attitudes, and practices regarding epidemiology and management of travelers' diarrhea: a survey of front-line providers in Iraq and Afghanistan. Mil Med. 2005; 170 (6):492-5. doi:10.7205/MILMED.170.6.492 PMid:16001598

22. Katouli M, Jaafari A, Farhoudi-Moghaddam A, Ketabi G. Aetiological studies of diarrhoeal diseases in infants and young children in Iran. J Trop Med Hyg. 1990;93(1):22-7.

23. Katouli M, Jaafari A, Ketabi G. The role of diarrhoeagenic Escherichia coli in acute diarrhoeal diseases in Bandar-Abbas, Iran. J Med Microbiol. 1988; 27 (1):71-4. doi:10.1099/00222615-27-1-71 PMid:3050109

24. Nanan D, White F, Azam I, Afsar H, Hozhabri S. Evaluation of water, sanitation, and hygiene education intervention on diarrhea in northern Pakistan. Bull WHO. 2003;81:160-5.

25. Victora CG, Barros A, Fuchs S, De Francisco A, Morris J, Hall A, et al. Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis. Lancet. 2000;355(9202):451-5. doi:10.1016/S0140-6736(00)82011-5

26. McCabe-Sellers BJ, Beattie SE. Food safety: emerging trends in foodborne illness surveillance and prevention. J Am Dietetic Assoc. 2004;104(11):1708-17. doi:10.1016/j.jada.2004.08.028 PMid:15499359

27. Talan DA, Moran GJ, Newdow M, Ong S, Mower WR, Nakase JY, et al. Etiology of bloody diarrhea among patients presenting to United States emergency departments: prevalence of Escherichia coli O157: H7 and other enteropathogens. Clin Infect Dis. 2001;32(4):573-80. doi:10.1086/318718 PMid:11181120

28. Chang Z, Zhang J, Ran L, Sun J, Liu F, Luo L, et al. The changing epidemiology of bacillary dysentery and characteristics of antimicrobial resistance of Shigella isolated in China from 2004-2014. BMC Infect Dis. 2016;16(1):1-10. doi:10.1186/s12879-016-1977-1 PMid:27863468 PMCid:PMC5116132