

Epidemiology of *Shigella*-Associated Diarrhea in Gorgan, North of Iran

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ABSTRACT

Objective: *Shigella* is an important etiological agent for diarrhea and especially dysentery. Shigellosis is an intestinal infection that is a major public health problem in many developing countries. The aim of this study was to evaluate the prevalence of *Shigella* and its various species in diarrheal samples in Gorgan located in the north of Iran. **Materials and Methods:** Between January-December 2005, the epidemiology of *Shigella*-associated diarrhea was studied among 634 patients in Gorgan. The diarrheal samples accompanied with a questionnaire, which contained the demographic and main symptoms of the patients, were transported to the laboratory and inoculated in different culture media. Colonies suspected to be of *Shigella* were detected using differential biochemical tests and subsequently, the serotype of *Shigella* was defined using antisera. **Results:** *Shigella* was isolated from 56/634 diarrheal samples (8.8%) of which *S. sonnei* was the predominant species (55%). Occurrence of *Shigella* was highest in the 2-5 years' age group (70.9%) and highest in summer (73.2%) with the most frequent clinical manifestation being abdominal pain (67.8%). The prevalence of *Shigella* in males and females was 8 and 9.8% respectively, but this difference was not statistically significant. **Conclusion:** It has been shown that *Shigella sonnei* is the most common *Shigella* serogroup among 2-5 year-old children in Gorgan. It is therefore suggested that hygienic training be given to childcare attendants and the children themselves.

Key Words: *Shigella*, Diarrhea, serotype, epidemiology, Iran

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Diarrhea is a generally unpleasant condition in which the sufferer has frequent watery, loose bowels. It is a major cause of childhood morbidity and mortality, especially in developing countries,^[1] accounting for 5-8 million deaths annually.^[2] *Shigella* is an important etiological agent for diarrhea, in particular, dysentery. The illness is also known as 'bacillary dysentery' and it is more severe than other forms of gastroenteritis. Shigellosis is a global human health problem.^[3] A recent review of literature concluded that of the estimated 165 million cases of *Shigella* diarrhea that occur annually in the world, 99% occur in the developing world and the remaining 1% occurs in industrialized countries. In developing countries, 69% of these episodes occur in children under five years of age. Moreover, of the 1.1 million deaths attributed to *Shigella* infections in developing countries, 60% occur in the under-five age group in children.^[4]

Prevention of *Shigella* infections has proven to be difficult, mainly due to the low inoculum needed to produce disease with infectious doses as low as 10-100 viable bacterial cells and inadequate empirical therapy options secondary to antimicrobial resistance.^[5]

Shigellosis remains an important problem in developing countries. The purpose of this study was to evaluate the prevalence of *Shigella* and its various species in diarrheal samples in Gorgan located in the north of Iran.

MATERIALS AND METHODS

Sample population: Between January-December 2005, diarrheal samples were collected from individual patients aged ≤ 16 years, referring to the private or governmental laboratories. These samples were cultured for *Shigella* species. A diarrheal sample was defined as the occurrence of ≥ 3 unformed stools (or ≥ 1 , if bloody) in a 24 hour period. We filled a questionnaire for each subject, which contained their demographic characteristics, time and frequency of diarrhea and signs of illness.

Laboratory tests: Standard microbiology laboratory techniques were used to isolate and identify *Shigella*. While an aliquot from a diarrheal sample was cultured directly on *Salmonella-Shigella* plates (SS1), XLD media and MacConkey Agar, another aliquot was inoculated in

Salmonella-Shigella plates (SS₂) after 6-8 hours' enrichment in Selenite F (SF) broth. *Shigella* serogroups were determined using Iranian commercially available standard antisera (Tehran, Iran).

Statistical analyses: Data from all cases were entered into SPSS 11.5. Binary data analysis was performed using Chi-Square test.

RESULTS

Diarrheal samples of 634 patients were studied during 2005. Of these, 348 (54.8%) were male and all patients were ≤ 16 years of age. We isolated *Salmonella* species from five (0.79%) samples and *Shigella* species from 56 (8.8%) samples. Twenty-eight (4.4) of these 56 patients infected with *Shigella* were male, but the difference between the two groups was not statistically meaningful ($P > 0.05$) [Table 1].

We found that the majority of bacillary dysentery cases occurred during the summer time-41 cases (73.2%), followed by ten (17.9%), four (7.1%) and only one case in autumn, winter and spring respectively [Table 1].

The age distribution data revealed that *Shigella* sp. was isolated from 40 (70.9%) cases in the 2-5 year-old, 13 (23.6%) in the 6-12 year-old and three (5.5%) in ≤ one year-old age groups. Moreover, this difference was statistically significant ($P < 0.001$), suggesting that the peak age of shigellosis was 2-5 years in children [Figure 1]. The most common symptoms in our patients with *Shigellosis* were abdominal pain, tenesmus (69.6%) and fever (56.6%). However, these rates are not statistically different from those seen in the non-*Shigellosis* population [Table 2].

Out of 56 *Shigella* strains isolated during the surveillance period, *S. sonnei* (31 cases, 55%), *S. flexneri* (12 cases, 22%), *S. dysenteriae* (ten cases, 18%) and *S. boydii* (three cases, 5%) were detected [Figure 2].

DISCUSSION

Our study showed that the prevalence of *Shigella* in diarrhea

cases among children in Gorgan was 8.8%. However, other studies conducted in Iran reported prevalence rates of 3-21.7%.^[6-9] The reasons for this variation include behavioral and cultural differences and time of sampling. Prevalence of *Shigella* infection was 16% in Kenya^[10] and 7.7% in Calcutta (India),^[11] which is similar to the rate reported in our study.

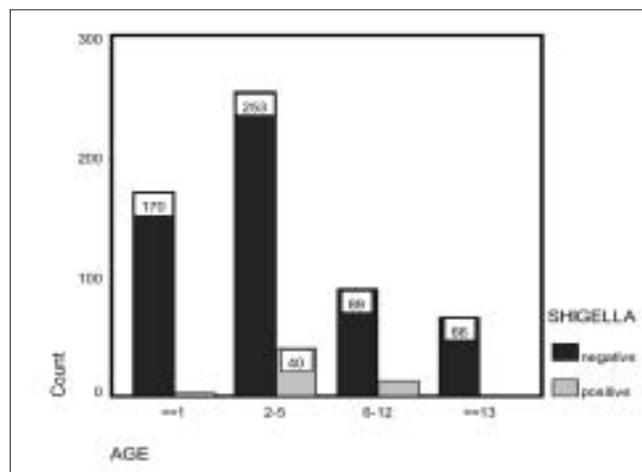


Figure 1: Age distribution of Shigellosis cases among the diarrhea patients

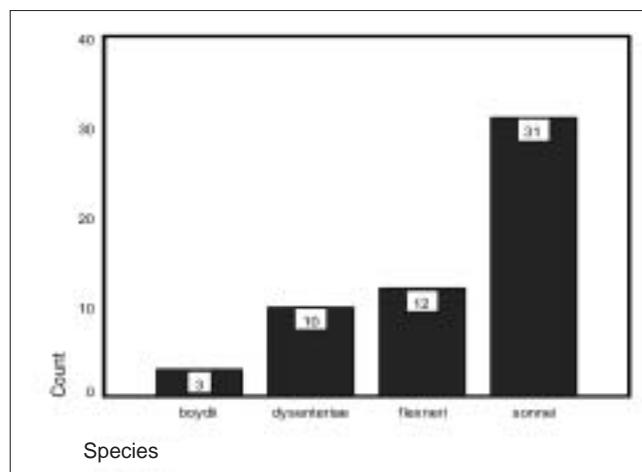


Figure 2: Distribution of *Shigella* species isolated from diarrheal samples in North of Iran

Table 1: Gender-wise and seasonal distribution of Shigellosis among diarrheal samples

		Shigellosis (%)	Non-Shigellosis (%)	Total	P value
Sex	Male	28 (4.4)	320 (50.5)	348 (54.9)	0.26
	Female	28 (4.4)	258 (40.7)	286 (45.1)	
	Total	56 (8.8)	578 (91.2)	634 (100)	
Season	Spring	1 (1.8)	83 (14.4)	84 (13.3)	< 0.001
	Summer	41 (73.2)	252 (43.6)	293 (46.2)	
	Fall	10 (17.9)	115 (19.9)	125 (19.7)	
	Winter	4 (7.1)	128 (22.1)	132 (20.8)	
	total	56 (100)	578 (100)	634 (100)	

Table 2: The most common symptoms in patients with and without Shigellosis diarrhea

Symptoms	Shigellosis (%)	Non-Shigellosis (%)	Total number of cases with symptoms
Abdominal pain, tenesmus	38 (67.8)	403 (69.7)	441 (69.6)
Fever	32 (57.1)	327 (56.6)	359 (56.6)
Nausea	22 (39.3)	175 (30.3)	197 (31.1)
Vomiting	11 (19.6)	82 (14.2)	93 (14.7)
Vertigo	4 (7.1)	27 (4.7)	31 (4.9)
Total cases (100% of each category)	56	578	634

We found that Shigellosis occurred mostly in children with a peak age of 2-6 years (70.9%). The risk of *Shigella*-associated diarrhea in children less than a year old is low (5.5%), this difference probably being due to their behavior and contact with different infected material.^[4,5,12-14] Although it has been reported that the majority of *Shigella* isolates from developing countries are *S. flexneri*^[4] (median 60%) which is also the case in some parts of Iran,^[7,9] we found that *S. sonnei* was the most common serogroup in our region. Similarly, other studies in Tehran showed that 58.9% of *Shigella* strains were *S. sonnei*.^[12,15] Thus, it can be predicted that development of a polyvalent vaccine that covers strains of *S. sonnei* and *S. flexneri* would provide protection against 77% of *Shigella* infections occurring in Gorgan in the north of Iran.

S. sonnei is mostly associated with crowding and poor sanitation in institutions such as schools, day-care and nursing centers and also among members of tour groups.^[16] During a community-wide outbreak of *S. sonnei*, children younger than 6 years of age who attended day-care were found to be 2.4 times more likely to experience shigellosis than children who did not.^[17] Due to this reason, more attention should be paid to the health of children less than 5 years of age in day-care centers. Educating child-care attendants and the children themselves regarding the importance of frequent hand washing is the key to prevent shigellosis. Also, because this infection is transmitted so easily from infected children to others, all symptomatic persons, employees and children with *Shigella* infection should be excluded from the daycare setting until diarrhea has ceased and stool cultures are negative for this bacteria.

Consistent with other studies,^[4,12,18] the peak of Shigellosis in our region occurred during summer time.

In contrast to the study on Egyptian children,^[5] our studies found that there are no statistical differences between diarrheal *Shigellosis* among males and females, indicating that the virulence of *Shigella* infections was not gender-related.^[16]

CONCLUSION

This study was conducted to determine the epidemiologic pattern of shigellosis in diarrheal samples in Gorgan. We may

conclude that *Shigella* can be considered as an important agent of diarrhea among Iranian children living in Gorgan. The most common *Shigella* serogroup identified was *S. sonnei* in which age and season were significant risk factors for *Shigella*-associated diarrhea.

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