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ORIGINAL PAPER

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Epidemiologic Investigation of Dysentery in North of Iran: Use of Geographic Information System (GIS)

Aliasghar Nadi¹, Ghassem Abedi², Khatoon Isazadeh³, Farideh Rostami⁴, Hasan Siamian⁵, Mahbobeh Hosseini⁶, Mehran Asadi-Aliabadi⁷

¹Health Sciences Research Center, Mazandaran University of Medical Sciences, Sari, Iran

²Department of Public Health, Health Sciences Research Center, Mazandaran University of Medical Sciences, Sari, Iran

³Faculty of Health, Student Research Committee, Mazandaran University of Medical Sciences, Sari, Iran

⁴Health Sciences Research Center, Mazandaran University of Medical Sciences, Sari, Iran

⁵Department of Medical Records and Health Information Technology, Faculty of Allied Medical Sciences, Health Sciences Research Center, Mazandaran University of Medical Sciences, Sari, Iran

⁶GIS Research Center, Mazandaran University of Medical Sciences, Sari, Iran

⁷Deputy of Health, Mazandaran University of Medical Sciences, Sari, Iran

Corresponding author: Mehran Asadi-Aliabadi, MSc in Epidemiology, Deputy of health, Mazandaran University of Medical Sciences, Sari, Iran. ORCID ID: <http://www.orcid.org/0000-0003-0292-9166>. Tel; + 989119266603. E-mail: Siamian46@gmail.com

ABSTRACT

Introduction: Dysentery is an intestinal inflammation which is created by the microorganisms attacking intestine mucus. Knowing the prevalence of this disease in different societies paves the way for programming and providing treatment and preventive measures. The main purpose of this study is to investigate the epidemiologic pattern and geographical distribution of dysentery based on GIS. **Method:** This was a cross-sectional and analytical study. The dysentery cases were gathered from the section of contagious diseases in health chancellery of Mazandaran University of medical sciences through a checklist during the years 2008 to 2013. In order to analyze the data, we made use of chi-square test. Then, the GIS software was used to recognize the geographical distribution of the disease. **Findings:** There was reported about 653 cases affected by dysentery and the disease proportion was equal for both men and women. Most of the persons with dysentery was city dwellers. The highest rate of incidents was reported to be in Fereidunkenar in 2011, and the disease was mostly found among farmers, students, and college students. **Conclusion:** Since dysentery is a disease transmitted from water and food, and in this study, it was found out that the disease sources included using polluted water, vegetables, and lack of appropriate personal hygiene. Therefore, it is essential to take into consideration the health issues. Moreover, the suitable conditions of the geographical area which has the highest rate of incident have paved the way for dysentery occurrence. In addition, using geographic information system (GIS) as a visual instrument can help the stakeholders and officials to elaborate on the death trend and recognize the areas for optimal use of the available resources.

Keywords: GIS, dysentery, Iran, North.

1. INTRODUCTION

Dysentery is an intestinal inflammation which is created by the microorganisms attacking intestine mucus. This disease is able to be widely spread and become epidemic (1). From among the factors creating dysentery in the world, we can mention Shigella, an aggressive type of Escherichia coli (E coli), and to some extent the bacteria such as Cam-

pylobacter, yersinia, salmonella and of parasites such as Entamoeba histolytica (2).

In spite of developments in health status in the world, there are about 123000 deaths in children below five years old with the death proportion of 8.5%, about 40,000 deaths among children above five, and yearly, there are about 88.4 million school-age cases exposed to this disease. In addition,

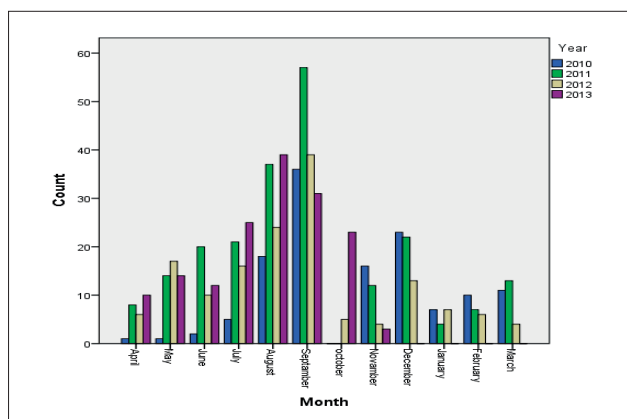


Figure 1. Observed cases of dysentery in separation between 2010-2013

it is reported that about 2 million persons in the world die of dysentery and about 900,000 cases are hospitalized yearly. World Health Organization estimated the death burden and the burden of dysentery based on DALYs to be 750,000 and 7 million respectively in 2014 (3).

According to the longitudinal studies conducted in developed countries in 2012, there are about 1.7 billion cases of dysentery incidence yearly in the world. Among the Asian and Latin American children, dysentery has been the cause of more than 50% of all deaths, especially when famine was prevalent in these areas. The program for dysentery in Iran includes implementing the country's guidelines for care system about transmitted diseases and asking the state or private health care centers to report the outbreak of diarrhea diseases such as shigella diarrhea (4). Knowing the prevalence of disease in various societies is very important and paves the way for programming and providing the required treatments and preventive measures.

In order to determine the frequency of this disease in an area, we need to use GIS software. GIS is an electronic system for obtaining geographical information. By the use of this system, all the obtained information is put in different layers and after control and segregation of the data, all the descriptive and location data will be entered into the system. Therefore, GIS helps us to have easy and quick access to all information. It provides us maps, charts, and tables including all details which help us to have different ideas for various conditions. In addition, GIS can provide information about the potentialities and opportunities of an area as well as the weak points and problems existing in a special area (5). GIS is an information system which focuses on processing the location information and glean the required information about the phenomena which are related to the location of a specific area.

The aim of this study was Epidemiological investigation of dysentery in North of Iran by use of Geographic Information System.

2. METHOD

This was a cross-sectional and analytical Study. The study population included all persons affected by dysentery during 2010 to 2013 and they were living in urban and rural area being supported by Mazandaran University of medical sciences. After removing the repetitious cases, we had 345

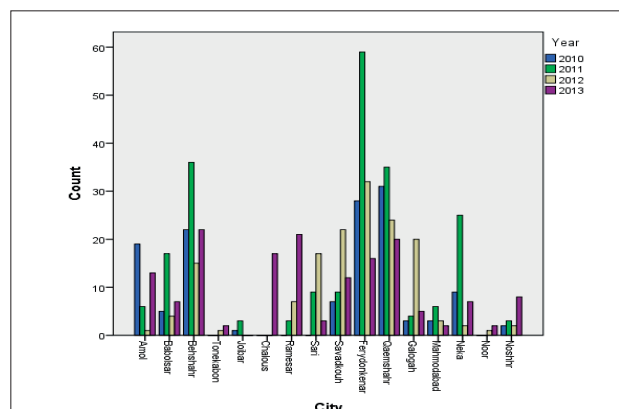


Figure 2. Frequency of cases in different districts of province between 2010-2013.

cases in the years 2010 and 2011, 308 cases in the years 2012 and the first six months of 2013, and totally 653 persons were studied. The required information was gathered through recording and reporting the contagious diseases from all pathology centers in state and private sections of the province.

In this study, all of the dysentery cases which were observed in various health care centers of 18 city of the province were reported. Furthermore, in order to provide the GIS map for the gathered data and information, information layers were made ready and appropriate to be entered into the GIS setting. After preparing the existing layers and rectifying the necessary items, a location database and all the required layers were provided. In this location database, the information layers were transferred, classified, and combined by the use of GIS analysis functions. Then, the statistical analyses and GIS location analysis were used to analyze the data and reach a conclusion.

3. FINDINGS

During the years 2010 to 2013, 653 dysentery cases were reported in Mazandaran province. The frequency of dysentery was 329 cases for men and 324 cases for women, and the proportion of these two groups was not statistically significant. The highest rate of dysentery affection was among the age groups from 1 to 6 years old with 116 cases, and the age group above 60 years old with 101 cases. However, the age groups from 36 to 42 and 54 to 60 years old had the lowest rate of affection to dysentery with 20 cases. According to the results of chi-square test, there was a statistically significant difference among the observed proportion of different age groups. The highest rate of dysentery incidence was related to the year 2011 with 215 cases and there was a statistically significant difference between the observed proportions of persons with dysentery in various years. The monthly distribution of dysentery cases revealed that September and August with 163 and 118 disease cases respectively are the first and the second months with the highest rate of dysentery incidence. However, January and February months had the lowest rate of incidence with 18 and 23 cases respectively (Figure 1).

Regarding the location distribution of the disease, the current study reported that Fereidunkenar with 135 cases and Qaemshahr with 110 cases of dysentery had the highest frequency, and Tonekabon and Noor towns with three

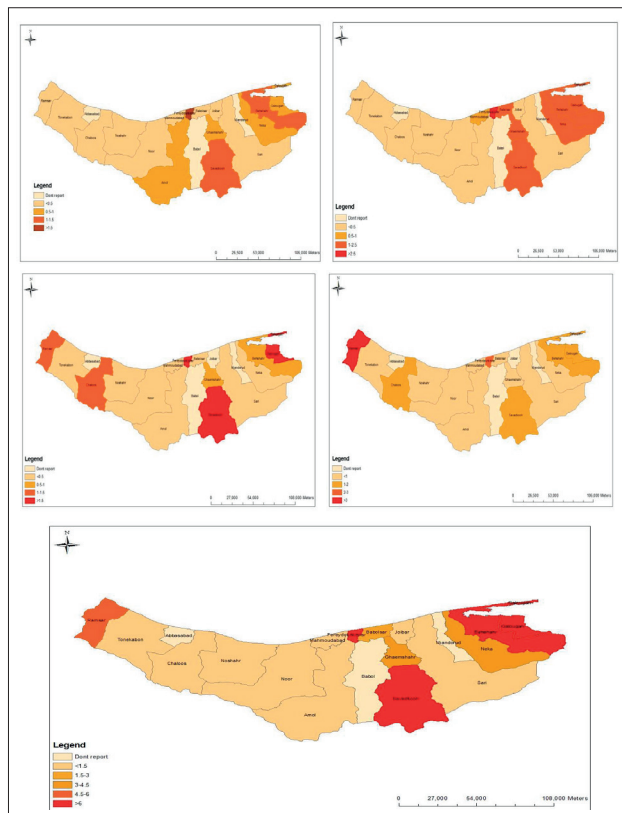


Figure 3. Distribution map of dysentery in Mazandaran province during 2010-2013

cases in each had the lowest rate of dysentery affection (Figure 2). Among them, 36 cases were farmers, 191 cases were housewives, 103 cases were students and colleges students, and 179 cases had other jobs. In testing the presence of blood in stool, 77.3% of the patients had blood in stool, and 22.7% of them did not observe blood in it (Figure 3).

The frequency of dysentery in rural was 281 cases and in urban dwellers, it was 372 cases and due to the significant amount obtained from chi-square test, there was a statistically significant difference between rural and urban dwellers with regard to their affection to dysentery disease. After investigating the water sources used by the persons, it was revealed that among the rural, 166 cases were using well water, 14 cases were using the fountain water, 87 cases were using pipeline water, and 14 cases were using other methods of drinking water. Therefore, according to the results of chi-square test, it is concluded that there is a statistically significant relationship between persons affected by dysentery in urban and rural and the drinking water they use.

Moreover, for carrying away the sewage, 190 rural dwellers were using wells, and 91 of them were using rivers. While, among the urban dwellers, 69 persons were using well and 303 persons were using the sewage system to remove their wastes. In addition, 137 villagers were using insanitary toilets and 144 persons were using sanitary ones. Therefore, based on the chi-square test results, it was reported that there was a statistically significant relationship between methods of using toilets in persons with dysentery and their residential area.

In order to find sources of affection to dysentery, it was

concluded that among the rural dwellers, 107 cases were using polluted water, 76 cases were using vegetables or fruits, 98 cases were not following the personal hygiene conditions. According to the tables of chi-square test, it is reported that there is a statistically significant relationship between the disease sources and the patients' residential area (Table 1).

In general, among 653 cases affected by dysentery, 194 persons were using well water, 14 cases were using The Fountain water, 418 cases were using pipeline water, and 27 cases were using other methods of drinking water. In addition, 259 persons were using wells to carry away their wastes, 91 persons were using rivers, and 303 people were using sewage system. Moreover, 165 persons used insanitary toilets, and 488 cases were using sanitary ones. Finally, due to the results of chi-square test, it was revealed that there was a statistically significant relationship between the reasons of affection to dysentery and various age groups.

4. DISCUSSION

In this study, demographic and epidemiologic features of dysentery were taken into account in 18 cities of Mazandaran province during 2008 to 2013. Comparing the trend of dysentery incidence in different years revealed that the highest rate of dysentery cases was in 2011 and the lowest rate was in 2010. Regarding the location distribution of the disease in this province, it was reported that Fereidunkenar had the highest rate of incidence during the study. Of course, this high rate may be due to the exact registration

Resources		Residence		Chi square	Exact Sig.
		Rural	Urban		
Source Of Drinking Water	Wells	166	28	246.74	0.0001
	The Fountain	14	0		
	Piping	87	331		
	Other Methods	14	13		
Sewage System	Sewage Disposal Wells	190	69	446.51	0.0001
	River	91	0		
	Sewage System	0	303		
Sanitary Situation Of Toilet	Sanitary	144	344	144.09	0.0001
	Insanitary	137	28		
A Source Of Infection	polluted water	107	143	6.79	0.033
	Vegetables Or Fruits	76	130		
	Lack Of Personal Hygiene	98	99		
Total		281	372		

Table 1. The characteristics of risk factors among patients with dysentery

and complete reports of the cases in this area; however, the lowest rate of dysentery incidence belonged to Tonkabon and Noor towns.

Studies conducted in Europe, Australia, the USA, and Peru reported that there is a relationship between diarrhea diseases and weather conditions including temperature, rainfall and humidity. In These studies, it is indicated that humidity and rainfall rate directly influence the quick incidence and transmission of the disease (6-11). Some published studies considered weather conditions, population, and other environmental issues as they affecting factors in this

disease. In their study, Ying et al. investigated the effects of weather changes in North and South of China on dysentery incidence and reported that there was a statistically significant relationship between whether humidity and pressure and the incidence of dysentery (12).

Fereidunkenar is coastal city with high humidity and is considered as an area with 900 mm rainfall during the year even in summer. It should be mentioned that during the hot seasons of the year and in tropical areas with high rainfall rate, dysentery disease incidence is more prevalent (13). Therefore, of these conditions require organized health programs and some preventive methods to control the disease incidence in Fereidunkenar and other areas of the province. In Khoshdel's study, the main contagious diseases in Iran were mapped in 2008. In general, 3644 cases with dysentery are reported in Iran (14); Among the provinces, south khorasan and Bushehr had highest incidence, 36.21 and 21.91 (per 100000) respectively (15).

In this study, among the patients affected by dysentery, 49.6% were women and 50.4% were men and there was no statistically significant difference between these two groups. This finding matches the results of the study conducted by Hosseini (16). The disease incidence was different in various months of the year; that is, the highest rate of incidence was in August and September and the lowest rate was in January and February months. In Khorshidi's study, the highest rate of incidents was in August and the lowest rate was in March (17). Moreover, in Ghaemie's study, the highest rate was summer (18). Majority of the studies indicated that the rate of dysentery incidence was higher in hot seasons than the cold seasons of the year. In addition, there are several documents indicating that there is a strong relationship between atmospheric changes and the incidence of infection diseases such as dysentery and those transmitted by insects such as malaria. These conditions are known as EL.NINO in medical and health centers by the stakeholders (19).

Job and socio-economic status play important roles in decreasing the disease transmission. Human behaviors can affect the number and pollution levels of a disease. In the present study, the highest rate of dysentery was among farmers, students, and college student. Generally, most of dysentery cases are transmitted from individual to individual. School-age children affected by dysentery do not usually follow the hygienic issues and they can easily transmit the infection touching other students or the foods they share with each other. Therefore, in children and other people with low education, the disease incidence is probably higher than that in other groups. The current study's findings also confirm such an issue. In addition, in Hassanzadeh's study conducted in Shiraz Namazi hospital, the highest infection prevalence belonged to children aged 11 to 15 (20). In Another study carried out by Ali, the patient's age average was 18 months and the proportion of female to male cases was 1.7 to 1 (21). Moreover, in Ghaemi's study, most of the patients aged between 2 to 6 years old (18).

The GIS maps show a relative frequency in Eastern areas of the province. Some studies indicated that high temperature leads to high incidence of the disease. In Ying's study, it was revealed that if weather temperature increases, dysentery incidence would increase from 12 to 16% (12). It is

believing that since Mazandaran province is located near to Torkaman Sahra from the eastern areas, temperature in east is higher than that in Western parts of the province and therefore we will observe more dysentery incidences in this area.

In most of the studies conducted on this issue, it was reported that the dysentery's creating factor has been *Shigella dysenteriae* (18-22). In the present study, due to the incomplete culture of patients' stools, the results of creating factors of dysentery were not completely available. Therefore, in order to provide health programs and the exec control of the disease, it is recommended to take more exact and complete tests in patients affected by dysentery various health care centers.

Some public health problems and diseases are directly associated with geographic context of places, therefore, geographic information system (GIS) could be of great benefit in management of such issues and planning to control the spread of diseases (23). Dysentery is considered as an important health issue for the society and due to the environmental conditions of this area which paves the way for dysentery incidence, it is necessary to implement preventive measures more seriously. Furthermore, another aim of the present study was to find out the geographical distribution of dysentery which can be used as a guideline for stakeholders in order to implement preventive interventions on the one hand, and provides some ideas for finding the reasons of such a disease, on the other hand.

Although, due to the appropriate interventions such as health education, the incidence rate of disease is decreasing in some eastern parts of Mazandaran province, the relative progression of disease in the western area of Mazandaran province requires a comprehensive supervision and control throughout the province. Moreover, since a lot of people travel to these areas during the warm seasons of the year, when dysentery's high incidence is observed, the health education programs and preventive measures should be implemented more seriously.

- Author's contribution: Aliasghar Nadi, Ghassem Abedi, Khattoon Isazadeh, Farideh Rostami, Hasan Siamian, Mahbobeh Hosseini, Mehran Asadi-Aliabadi made substantial contribution to conception, design, drafting the article and critical revision for important intellectual content. Hasan Siamian made substantial contribution to design and drafting based on the Journal Instruction. Hasan Siamian made Endnote and final edition. All the authors approved the final version to be published.
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