

SPATIAL PATTERNS OF DIARRHEA INCIDENCE IN DISTRICT BAHAWALPUR, PAKISTAN

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ABSTRACT

Diarrhea is a major food borne disease of Pakistan which can be directly linked with environment. This study deals with the geospatial analysis of diarrhea in District Bahawalpur of Southern Punjab Pakistan. The main purpose is to measure spatial patterns which might be helpful for better understanding the environment and diarrhea relation in local setting and leads to hypothesis generation for further investigation. Study design selected to conduct this research is of descriptive and exploratory nature. Epidemiological data of diarrhea was collected mainly through all 115 health centers from the study area for year 2012 and was used to map spatial patterns of diarrhea through geospatial techniques. Results show that the clusters of disease found mainly around urban units of tehsils. The study also suggests the set of remedies and policy changes addressing the local environmental problems and to reduce the incidence of diarrhea through collaboration of local government and community.

KEYWORDS: Diarrhea, Incidence rate, Spatial Analysis

1. INTRODUCTION

Diarrhea is defined as the passage of loose, liquid or watery stools. These liquid stools are usually passed more than three times a day (Park, 2009; WHO, 2009). Diarrhea is the disease of digestive system, hence anything we eat or drink if contains pathogens can cause diarrhea, reasons of which are mainly exposure to poor sanitation, poor water quality, inadequate excreta disposal, and poor hand washing practice (Esteves, 2012). According to WHO, diarrhea is the second largest cause of death in children and it kills nearly 7.5 hundred thousand around the globe. Moreover 1.7 million cases of diarrhea are reported every year around the world (Incekara, 2010). Almost every year, approximately 1.5 million children around the world lost their lives from this fatal disease, reason of which is rooted in poor environmental and hygiene practices (Khan et al.). According to Halvorson (2004) poor water quality, unhygienic behaviours, contaminated food, and inadequate sanitation practices are the main cause of childhood diarrhea in Pakistan. However Ahmed et al. (2016) are of the view that climate change, chaotic urbanization, industrialization, poor hygienic conditions, and inappropriate water management are

responsible for most of the water borne diseases in Pakistan. Developing countries are highly vulnerable to this disease because of the diarrheal favourable conditions.

Human health is facing serious problems due to deteriorating drinking water quality (Jabeen et al., 2015). Research shows that diarrhea risk reductions of 48, 17 and 36 percent associated respectively, with hand washing with soap, improved water quality and excreta disposal as the estimates of effect (Yasinzai & Kakarsulemankhel, 2009). Human excreta are a major source of diarrhea. Research proved that more than 80 percent diarrhea cases worldwide are the result of fecal-oral contamination (Banerjee, 2006). Therefore, safe removal of excreta disposal is very important for community health. Beside diarrhea, improper excreta disposal may cause many other infectious diseases which include typhoid, dysentery, cholera, viral hepatitis and other intestinal diseases. The organisms causing diarrhea can be transmitted from infected faeces to people through food and water, person-to-person contact, or direct contact. Hand washing is effective in reducing the morbidity from diarrhea and dysentery (Graham, 1989; Noreen & Khalid, 2012).

Thus, this epidemiologic evidence can provides a base for improving local environmental condition, ultimately promoting and improving the health and wellbeing of human populations in the District Bahawalpur. This study will not only help to understand the spatial pattern of diarrhea but also to understand the factors responsible for the occurrence and diffusion of this disease. Moreover, its findings contribute to preventing and controlling this disease by providing useful information not only for designing public health policy and planning, as well as to raise awareness among people about adverse health behaviours and mal practicing of hygienic behaviour.

1.1. Study Area

Area selected for this research is District Bahawalpur, which is situated in the southern Punjab. The total area of the district is 24,830 square kilometres. According to Survey of Pakistan, the absolute location of Bahawalpur district is 28.8333°N to 71.6667° E (Sheet No.39-0 of Survey of Pakistan) (Fig 1). Administratively, District Bahawalpur is divided into five Tehsils, those are Ahmadpur East, Hasilpur, Bahawalpur, Khairpur Tamewali and Yazman but District Municipal Corporation divide it into six units, splitting Bahawalpur Tehsil into Bahawalpur City and Bahawalpur Saddar (Table 1). These tehsils are further divided into almost 108 union councils. Therefore all these tehsils and union councils are considered for detailed spatial and temporal environmental epidemiological analysis. Nature of study design, i.e. descriptive in general and exploratory in specific, is the main cause to choose such an extensive area. Moreover, like

most of the other parts of Punjab, Bahawalpur is also facing environmental health problem, which is persistent because of research dearth. Hence, this research is a step toward the improvement of environmental health condition of this geographic unit.

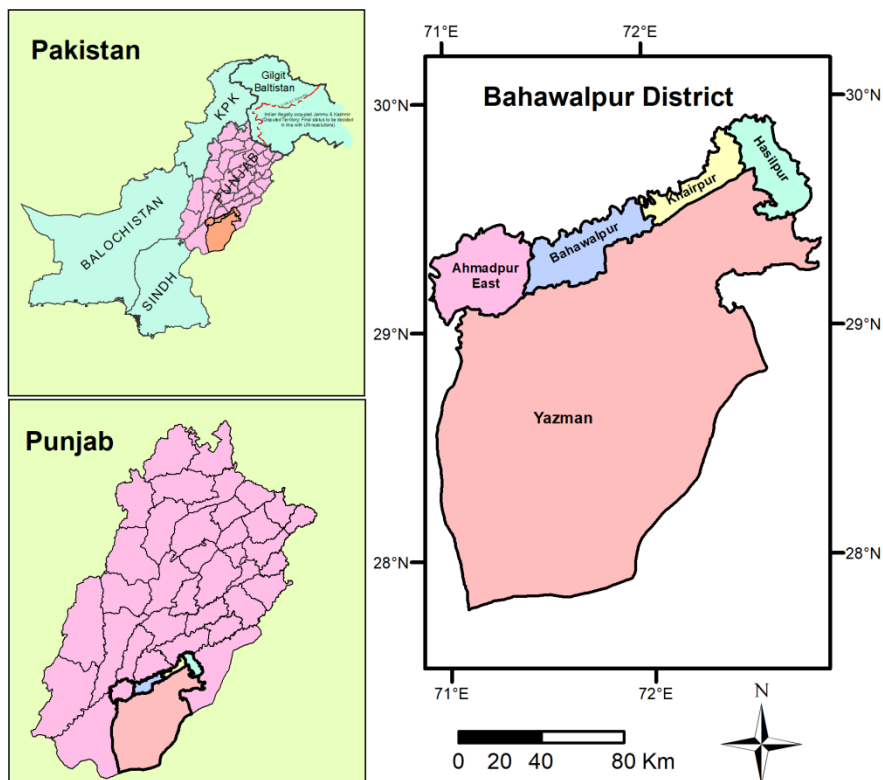


Fig. 1: Location of Study area (District Bahawalpur) in Pakistan

Table 1: Total Area and Population of Tehsils of District Bahawalpur

	Tehsil	Area (Sq.km)	Population
1	Bahawalpur	2372	7,98,509
2	Ahmad Pur East	1707	7,14,102
3	Yazman	18491	4,02,573
4	KhairpurTamewali	888	1,83,250
5	Hasilpur	1372	3,12,132
	Total	24830	2,433,091

Source: District Census Report of Bahawalpur 1998

The disease pattern of any region show the major health issues of the respective area. For Bahawalpur, the trend of diseases has been taken from the consolidated District Health Information System (DHIS) reports collected from Primary Health Care and Secondary Health Care facilities. According to the DHIS of Bahawalpur, among top twenty five diseases of

District, diarrhea stands second, showing the severity of this disease (Table 2).

Table 2: Health Problems of District Bahawalpur

1. Acute respiratory tract infections (ARI)	2. Diarrheal Diseases	3. Pulmonary Tuberculosis
4. Suspected Malaria	5. Anemia	6. Scabies
7. Hepatitis	8. Road side accident & injuries	9. Worm infestation
10. Diabetes Mellitus	11. High under 5 Mortality	12. High Maternal Mortality
13. Asthma	14. Skin Diseases	15. Arthritis
16. Hypertension	17. Enteric Fever	18. Dental Caries
19. U T I	20. Acid peptic Disease	21. Cataract
22. Dog Bites	23. Ischemic Heart diseases	24. Snack bite
25. Enteric Fever		

Source: District Health Information System Bahawalpur

2. MATERIAL AND METHODS

2.1. Study Design

The study design selected for the current research is of descriptive nature and specifically ecological study design. Ecological studies involved aggregate data regarding prevalence of risk factors compared with the rate of an outcome condition. It is quick and relatively inexpensive study allows estimations of effects not easily measurable for individuals and can be used to evaluate programs, policies or regulation implemented at ecological level (Morgenstern & Thomas, 1993); current research is of exploratory study, in which researcher compare the rate of diarrhea disease among different regions of District Bahawalpur during the same period. In neither case exposure to specific environmental factors measured. The simplest type of exploratory study of spatial patterns is a graphical comparison of relative rates across all regions i.e. mapping study.

2.2. Data Collection

Primary data for any study of disease is collected as reported cases irrespective of the field survey which is considered as bias data collection method because of unreliability of disease diagnostic characteristics.

Therefore, it was a great challenge for researcher to collect authenticated disease data of diarrhea from such a vast geographic area. District Health Office (DHO) Bahawalpur with their representative tehsil offices, were found to be the main data sources.

Hence, disease data was collected as reported cases from almost 155 different health centers throughout the district from all its tehsils, including one District Head Quarters¹(DHQ) Hospital and four Tehsil Headquarter Hospitals² (THQs), 10 Rural Health Centers³ (RHC), 73 Basic Health Unit⁴ (BHU), 48 Rural Dispensaries (RD), 10 Maternal Child Health Centers (MCH), 5 Government Rural Dispensaries (GRD) and 2 TB Centers was collected. Two more hospitals i.e. Tibia Hospital and Police Hospital are also included from Bahawalpur City and categorized as others sources (Table 3).

Table 3: Data Collection Centres

Tehsils	Disease Data Collection Centers								
	DHQ/THOS	THQ	RHC	BHU	MCH	RD	GRD	TBC	Others
Bahawalpur City	1	-	3	15	6	13	3	1	2
Ahmadpur East	-	1	3	24	2	16	-	-	-
Hasilpur	-	1	2	11	2	8	-	1	-
Yazman	-	1	2	15	-	10	2	-	-
KhairpurTamewali	-	1	-	8	-	1	-	-	-
Total	1	4	10	73	10	48	5	2	2

2.3. Data Analysis

The application of GIS, together with statistical techniques has been used for spatial analysis of diarrhea in study area. Morbidity has been defined as “any departure, subjective or objective from a state of physiological well-being”. Incidence rate of diarrhea has been calculated for the year 2012. Incidence rate are the relation of new cases of diseases during a specific period with the whole population which is at risk during that particular period in any geographical area. It can be calculated as under;

¹The District Head Quarters (DHQ) Hospital is located at District headquarters level and serves a population of 1 to 3 million, depending upon the category of the hospital.

²Tehsil Head Quarter (THQ) hospital is located at each THQ and serves a population of 0.5 to 1.0 million.

³The RHCs have 10-20 inpatients beds and each serves a catchment population of up to 100,000 people.

⁴The BHU is located at a Union Council and serves a catchment population of up to 25,000.

Incidence Rate

$$= \frac{\text{Number of new cases of specific disease during a given period of time}}{\text{Population at risk during that period}} \times 1000$$

For this research, spatial analysis and diseases clustering has been carried out with the help of ARC GIS 9.3 to identify that why disease concentration is higher at one place than the other. Chart maps and dot density maps have been used to show the incidence rate and reported cases of diarrhea in study area. This mapping may be helpful to identify the high risk areas. In this way, hypothesis generation will be possible that what could be the geographical and environmental determinants of these variations and how this study would be helpful for prevention of this disease and facilitate further research.

3. RESULTS AND DISCUSSION

3.1. Incidence Rate of Diarrhea

Incidence rate refers to more refined statistics to identify the intensity of disease in any geographical region over the specified period of time. Incidence rate of diarrhea is calculated (Table 4) irrespective of the age groups, as the total population under five year of age was not known for the year 2012. This refined measure of morbidity displays very useful fact that Bahawalpur City have incidence rate of 199 diarrhea cases per 1000 population during 2012 which is abnormally high as compared to remaining tehsils. Similarly, Ahmadpur East exhibits incidence rate of 129 cases per 1000 population, while rest to the tehsils fluctuates between 79 to 54 cases per 1000 population (Fig 2). District total incidence rate of diarrhea is 69 cases per thousand populations during 2012.

Table 4 Incidence Rate of Diarrhea in Bahawalpur District During 2012

	Total Population 2012 (DHS)	Total no. of Diarrhea cases	Incidence rate per 1000 population during 2012
Ahmadpur East	972235	125357	128.94
Bahawalpur City	589658	117364	199.04
Bahawalpur Sadder	452656	30332	67.01
Hasilpur	417895	33084	79.17
Khairpur Tamewali	258151	17074	66.14
Yazman	555515	30132	54.24
District Total	3246110	222512	68.55

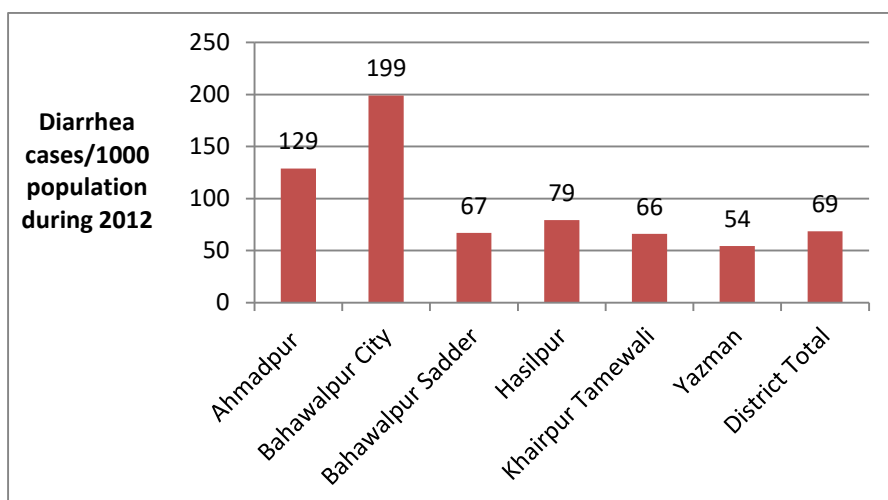


Fig. 2: Incidence Rate of Diarrhea in Bahawalpur District During 2012

3.2. Spatial Analysis of Diarrhea

For spatial analysis of diarrhea incidence at district level, total cases were considered irrespective of age groups, while spatial analysis at tehsil level was carried out on the bases of age groups (< 5 years and >5 years) to have in depth vision of diarrhea morbidity and for measuring the sensitiveness of this health issue. Hence spatial distribution of diarrhea incidence rate in district Bahawalpur declare some high intensity areas with incidence rate of more than 215 cases of diarrhea per 1000 population, such as Dhoorkot, Uch Sharif, Ahmadpur East I, Ahmadpur East IV, Khanga Sharif, Khanu Wali, Bahawalpur 3, Bahawalpur 2, Khairpur Tamewali, Channan Pir and Hasilpur Old II. Low intensity areas are few in numbers and all the remaining areas have moderate intensity and their values fluctuates between 44-214 cases per 1000 population during 2012 (Fig 3).

Moreover, over view of tehsil maps show that the diarrhea is more prevalent among children than rest of the population and hotspot areas can be identified mostly around the urban units (Fig 3).

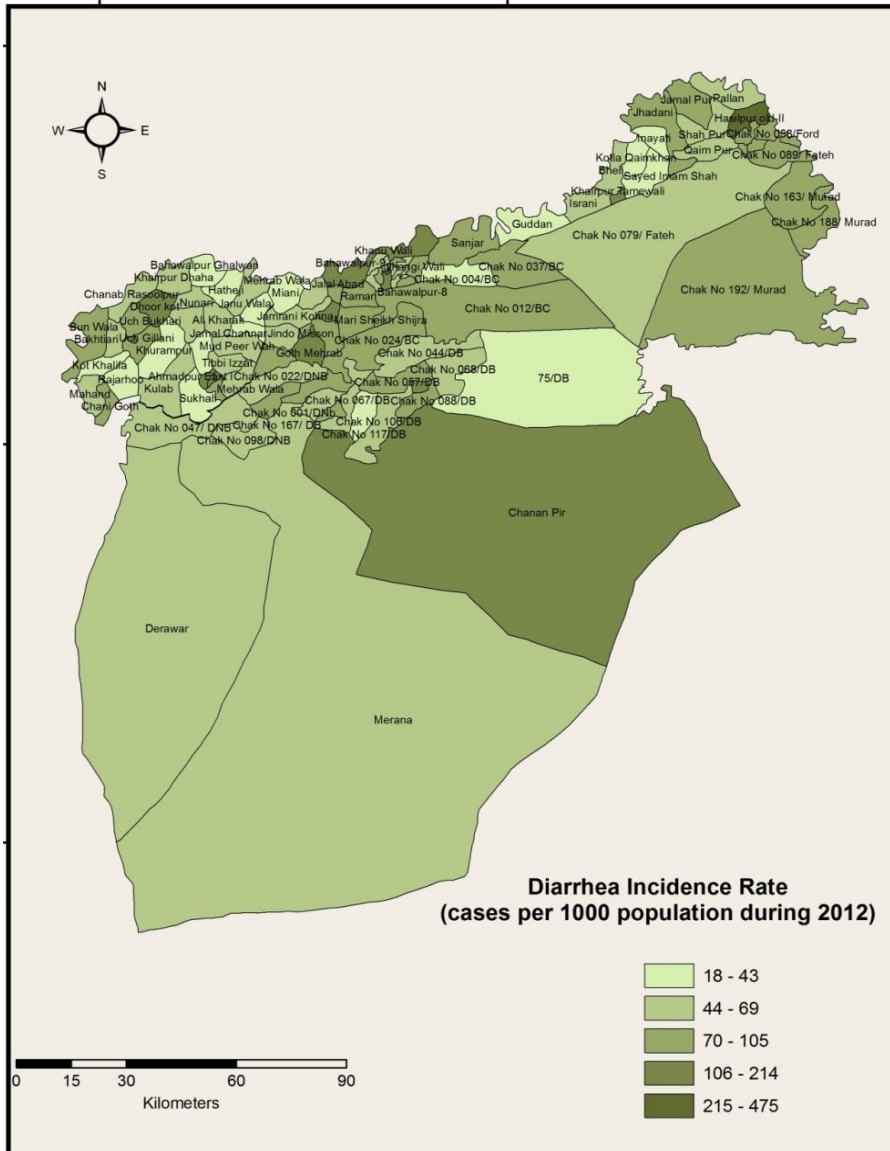


Fig. 3: Choropleth distribution Showing Diarrhea Incidence in District Bahawalpur During 2012

Spatial analysis on tehsil level is carried out on two criterions, firstly, based on diarrhea intensity and second on the difference of diarrhea incidence among children (<5 years) and rest of the population (Fig 4).

In case of tehsil Ahmadpur East, in the union councils of Uch Sharif, Channi Goth, Ahmadpur East I, II and III diarrhea intensity is high as well as percentage of diarrhea cases among children is as high as almost 75 percent of total.

Spatial Patterns of Diarrhea Incidence in District Bahawalpur, Pakistan

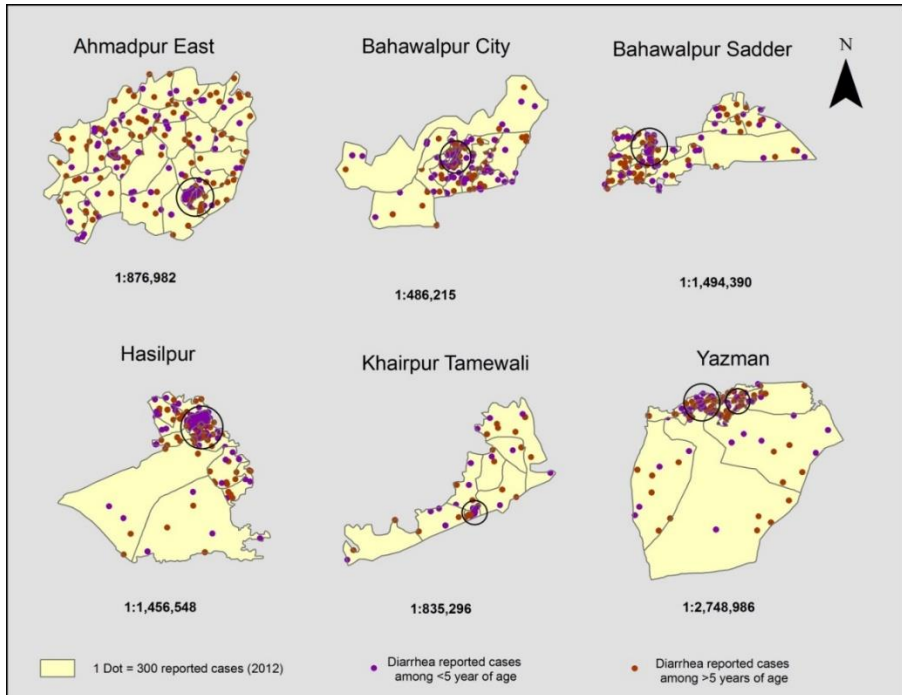


Fig. 4: Spatial Pattern of Diarrhea Morbidity in Different Tehsils of District Bahawalpur

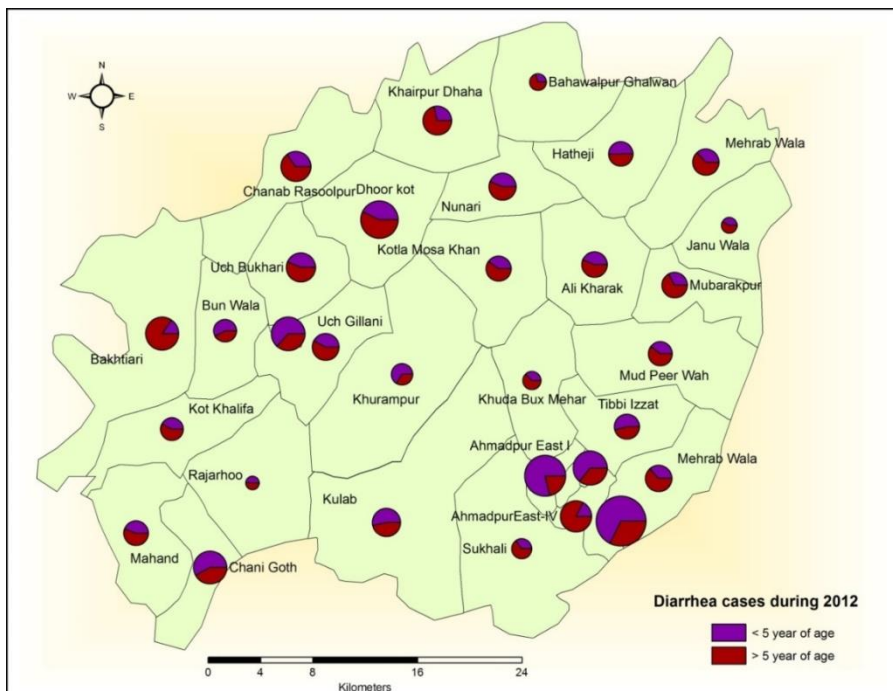


Fig. 5: Diarrhea Morbidity in Tehsil Ahmadpur East During 2012

Similarly, other union councils with high concentration of diarrhea are Ahmadpur East IV, Bakhtiari, Dhoorkot, Chanab Rasoolpur, Khairpur Daha and Mehrab Wala but these areas show 75 percent cases of diarrhea among population other than children. Union councils with moderate intensity of diarrhea are Bunwala, Kot Khalifa, Uch Gillani, Nunari, Alikharak, Mubarakpur, Hatheji, Mehrabwala, Tibbi Ezzat, and Mahand whereas Rajarhoo, Bahawalpur Ghalwan, Januwala and Sukhali are areas showing low concentration of Diarrhea cases along with the variation in the intensity of diarrhea among children and rest of population (Fig 5).

In Bahawalpur City, Khanuwali, Bahawalpur 2, Bahawalpur 3 and Bahawalpur 18 are the units with high concentration of diarrhea morbidity, whereas the remaining areas have moderate one. In addition, diarrhea among children is dominant in almost all union councils (Fig 6).

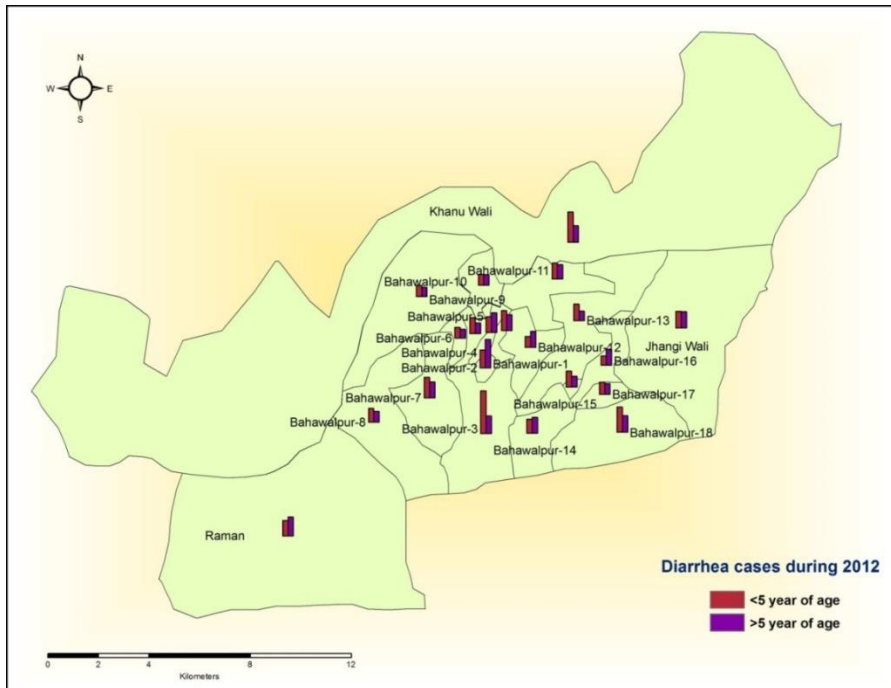


Fig. 6: Diarrhea Morbidity in Tehsil Bahawalpur City During 2012

In Bahawalpur Saddar, Chak 024/BC, Chak 037 BC, Mari Sheikh Shajra, Samasatta, Jamrani Kohna and Jindo Misson show high occurrence of diarrhea especially in children. Though the union councils of Sanjar Kanga Sharif, Goth Mehrab, Wahi Hussain and Jamal Channar show high number of diarrhea cases but its intensity among children is low as compare to rest of age groups. Miani, Jalalabad, and Chak 004/BC show less number of diarrhea cases than rest of union councils (Fig 7).

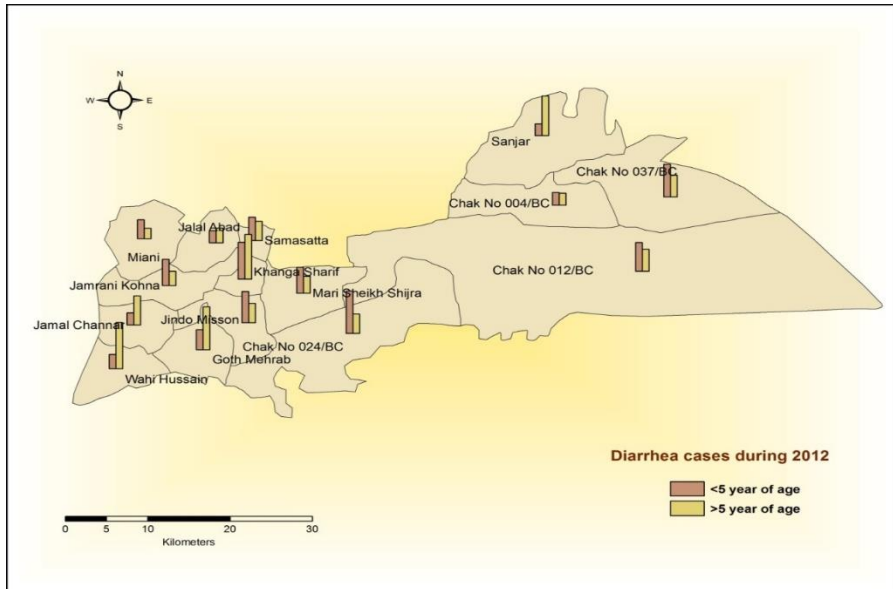


Fig. 7: Diarrhea Morbidity in Tehsil Bahawalpur Sadder During 2012

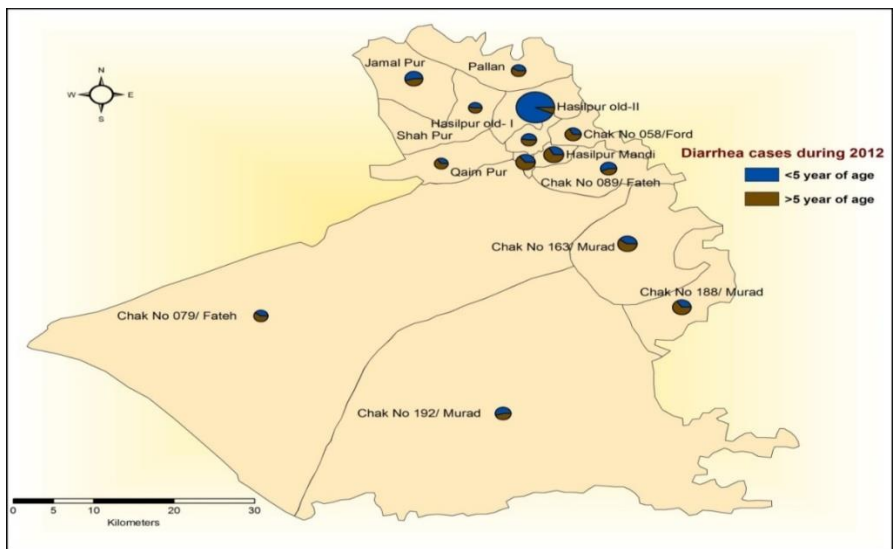


Fig. 8: Diarrhea Morbidity in Tehsil Hasilpur During 2012

Hasilpur old II is the only union council of tehsil Hasilpur with highest diarrhea cases dominated especially among children while all the remaining union councils have comparatively less number of diarrhea cases (Fig 8). Similarly, Khairpur Tamewali and Jhadani are the union councils with high number of diarrhea cases, Bheli and Israni with moderate number of cases while Kotla Qaimkhan, Sayed Imam Shah, Guddan and Inayati show least number of diarrhea cases in tehsil Khairpur

Tamewali. Diarrhea among children is dominated in Bheli, Israni and Khairpur Tamewali (Fig 9).

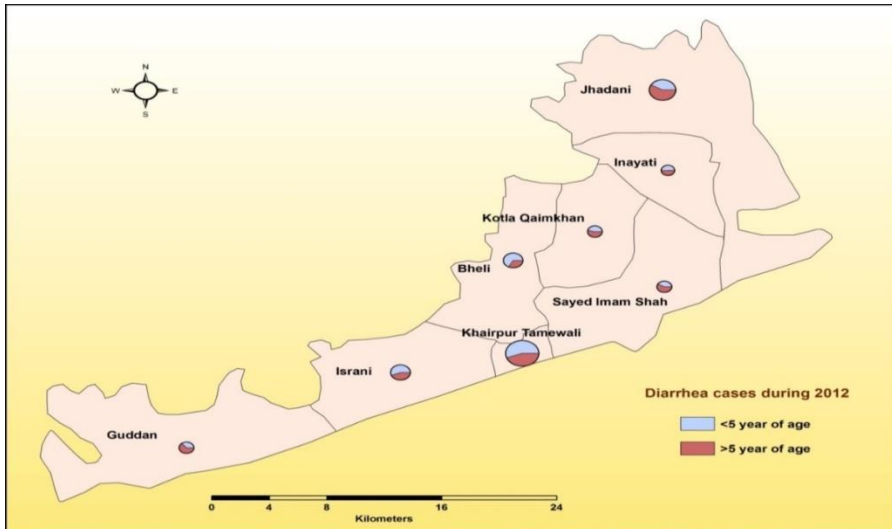


Fig. 9: Diarrhea Morbidity in Tehsil Khairpur Tamewali During 2012

High concentration of diarrhea cases can be seen in union councils of Yazman, Chak 057/DB, Channan Pir and Derawar in tehsil Yazman. Chak 067/DB, Chak 017/DNB, Chak 036/DNB, Chak 017/DNB, and Chak 044/DB show moderate number of diarrhea cases while rest of the union councils show low numbers. Diarrhea morbidity is highest among children in Yazman and Chanan Pir (Fig 10).

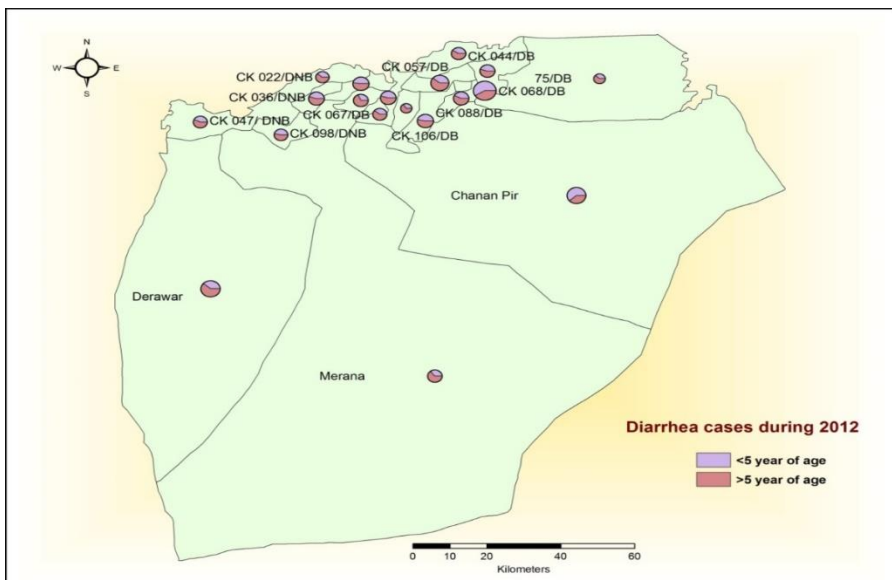


Fig. 10: Diarrhea Morbidity in Tehsil Yazman During 2012

4. CONCLUSION AND SUGGESTIONS

In the study, exploratory spatial analysis of diarrhea was conducted at district level of Bahawalpur for the year 2012. Spatial mapping of diarrhea was done with the help of ARC GIS 9.3, which leads the evaluation of disease pattern and highlighted geographical areas with significant high incidence of diarrhea in district Bahawalpur. The study showed that the spatial distribution of diarrhea pointed the clustering of disease around the urban centres of all the tehsils. One of the basic objectives of this study is to design a complete set of strategies to control this disease in the areas of the region where they are more prevalent. Diarrhea is thought to be the disease of poor and ignorant, hence domestic and community level interventions can be most effective than rest of levels. As human and animal faeces are the basic carriers of viruses, bacteria and protozoa causing diarrhea, hence they should be delimited to enter human body through water and food. Domestic sanitation is very important which includes clean and functioning latrine, hand washing with soap after defecation and before meal, and insecticide spray for flies. According to a recent study the risk of diarrhea is higher if the drinking water source is far away and lowers in population using water from septic tanks and tube wells (Ali et al., 2022). Moreover, treating, handling and storing drinking water safely and food hygiene practice are very important. Improved weaning and breast feeding are two most significant interventions to prevent diarrhea among infants. Similarly, health education especially to mother, cleanliness of immediate environment through community engagement, diarrhea awareness campaigns especially for poor and ignorant at community level can be effective. Structural development is required from local government which includes safe water supply, proper drainage and disposal of waste water and solid waste and regular monitoring of local environment especially in the high risk areas. In addition, provision of primary health care services, oral rehydration facility, maternal health and immunization are required from healthcare department to minimize diarrheal incidence in region. Though many interventions mentioned above are already operational in study area, but adopting all these interventions partially or completely will assure the eradication of these diseases in district Bahawalpur.

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