Prevalence of several infectious diseases in the District Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan

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Research Article

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Abstract

Aims: Infectious disease is a health disorder and is the leading cause of morbidity and mortality in humans globally. The present study determined the prevalence of several highly infectious diseases in the District Dera Ismail Khan.

Subject and Methods: The retrospective study include the indoor data from December 2019 through November 2021 (two years) were collected from the admin office of District Head Quarter Teaching Hospital, Dera Ismail Khan.

Results: Overall diarrhea/dysentery showed the highest (59.1%) while pulmonary tuberculosis demonstrated the lowest prevalence (1.8%) and May contributed the largest share (16%), while February lowest (3.9%). Diarrhea/dysentery has relative the highest prevalence for most of the months. Overall diarrhea/dysentery, enteric/typhoid, and pneumonia contribute to 91.4% share of the studied diseases. The overall prevalence of the diseases increased steadily from March through May. Diarrhea/dysentery and malaria resulted in the highest prevalence of 19.6% and 17.1%, respectively in May, while enteric/typhoid revealed the highest prevalence of 24.4% in August. Pneumonia (23.5%) in June, Pulmonary tuberculosis (26.2%) in November, Extra Pulmonary tuberculosis in March (65.4%).

Conclusion: Monthly and seasonal variations occurred in the prevalence of the diseases which is associated with an increase in vector population and an increase in temperature.

Introduction

An infection is the attack of body tissues by pathogenic organisms, their reproduction, and the response of the host tissues to the infectious agents and their toxin. The transmission of pathogens from person to person occurs through the spread of direct contact, water, or foodborne transmission, through inhalation in airborne droplets, body fluids, and vectors such as mosquitoes and ticks.

Diarrhea is worldwide, one of the most common illnesses among children (Cohn 1991; Khan et al. 2004). Diarrhea is symptomized by loose or watery stool with dehydration and loss of body minerals and is caused by bacteria *Salmonella*, *Shigella*, *Escherichia coli*, parasites, and toxins. Acute diarrhea is short-lived and only lasts for 1-3 days. It is a viral infection or spread by consuming unhygienic food and water contained pathogens. While, chronic diarrhea is more severe, long-lived, and continues for many weeks. It may be caused due to any existing disease or food intolerances. Diarrhea contributes 16% of all child mortality in Pakistan (Quadri et al. 2013). Dysentery is characterized by inflammation of the intestine and bloody diarrhea, led to dehydration, and is caused by bacteria *Shigella* and *Entamoeba histolytica*. Typhoid is a bacterial infection, caused by *Salmonella typhi* that can lead to high fever diarrhea, and vomiting. All these aforementioned diseases are water and food-borne.

Malaria is caused by five plasmodia: *Plasmodium falciparum*, *P. malariae*, *P. vivax*, *P. ovale*, and *P. knowlesi*, and symptoms of malaria include high fever and shivering. *P. vivax* and *P. falciparum* are main malaria parasites in Pakistan (Najera, 2001; Majid et al., 2016; Bashir et al. 2019). Nevertheless, mostly malaria in Pakistan is caused by *P. vivax* (Najera 2001; WHO, 2012; Ibrahim et al. 2014; Majid et al. 2016; Shah et al., 2016) and the country is endemic for both species of plasmodium (Asif, 2008; Yasinzai, 2008). Malaria is the second-highest disease, which affects about 4 million people annually in Pakistan (Ullah et al. 2020).

Both Pneumonia and pulmonary tuberculosis (PTB) are lower respiratory tract infections (LRTIs). Pneumonia is an inflammation of the lung, affecting alveoli, caused by *Streptococcus pneumoniae*, and is characterized by dry cough, chest pain, fever, and difficulty in breathing. Pneumonia is the single largest cause of mortality in children globally (Tribune 2020) and is the second-highest contributor to childhood morbidity and mortality in Pakistan (Hussain et al. 1997), accounting for 25% of overall mortality in children in the country (Tribune 2020). Pneumonia is the most killer disease of children aged <5 years in Pakistan (Anonymous 2008). More than 500,000 children of <5 years and 96,000 adults succumb to pneumonia every year in Pakistan (Tribune, 2020).

While, PTB is caused by *Mycobacterium tuberculosis*, and is one of the deadliest diseases of lung globally (Khan 2020). PTB is transmitted through inhaling air containing droplets released by sneezing and coughing of an infected individual (WHO 2010; Ricks et al. 2011; Khaliq et al. 2015). Respiratory infections account for 20–30% of the total mortality of children in Pakistan (Naz et al. 2018). Extrapulmonary tuberculosis (EPTB) is also caused by *Mycobacterium tuberculosis* and is tuberculosis (TB) within a location in the body except for lungs including most commonly are the lymph nodes, kidney, bladder, bones, joints, genital tract, intestine, brain meninges, skin, adrenals, and eyes (Khan et al. 1990). TB is one of the top 10 causes of death globally (WHO 2020; Li et al 2021). Pakistan ranked fifth among 30 high-TB burden countries (Khaliq et al. 2015, Khan 2017; WHO 2018; Tahseen et al. 2020) which covered 87% of the TB cases globally [Khan 2020; Qadeer et al. 2016; Khan 2017).

This is the first study that deals with the seasonal and monthly prevalence of several major infectious diseases in the District Dera Ismail Khan including diarrhea/dysentery, typhoid/enteric, malaria, pneumonia, PTB, and EPTB. Further studies are required to know about the sex and age-wise prevalence of the studied diseases to more effectively control the said diseases in the study area. The finding of the present research help in adopting timely strategies including mass awareness about the prevalence of the said diseases, improving hygienic conditions, and adopting preventive measures including vaccination of the people and spray to kill vectors of the diseases to reduce the rate of diseases in the study area.

Methods

Diagnosis of the infectious diseases

A variety of laboratory tests/techniques are used to diagnose infectious diseases including samples of blood, urine, stool, mucus, or other body fluids are examined mostly under a microscope or occasionally culturing the pathogens to find out the causes of the diseases.

Data collection, management, and statistical analysis

The combined indoor patient data from December 2019 through June 2021 of both District HeadQuarter Teaching Hospital Dera Ismail Khan (DHQ hospital, D.I.Khan) and the District Zanana Hospital Dera Ismail Khan was collected from the official computerized record in the computer office (Admin) of DHQ hospital, D.I.Khan. The data was sorted and the average monthly consolidated report of the diseases for December, and January through June of the study, periods were prepared.

The distribution of the frequencies of the diseases over the months was analyzed with the Pearson chi-square test (X-squared = 17131, df = 55, p-value < 2.2e-16) for the association between diseases and months, and found to be significant ($p < 0.0001$), followed by post hoc pairwise comparisons. Benjamini & Hochberg's (1995) method, at a level = 0.01, for adjusting the p -values for multiple comparisons was used. All months were pairwise statistically different from each other ($p < 0.0001$).

Results

Overall diarrhea/dysentery contributed to 59.1% of all six infectious diseases (Table 1), followed by enteric/typhoid (22.7%), and pneumonia (9.6%). The remaining diseases including malaria, pulmonary tuberculosis, and extra-pulmonary tuberculosis resulted in each $\leq 4.6\%$ of the overall studied infections in the study area: water and food-borne transmission (diarrhea/dysentery and enteric/typhoid) contributed 81.8% of overall transmission compared to the remaining three types of airborne transmission (pneumonia, pulmonary tuberculosis, and extra-pulmonary tuberculosis) and malaria (18.2%) in the study area. May contributed the largest share in the prevalence of the overall diseases (16%), followed by August (12.2%), September (10%), and April (9.2%), October (9.1%), December (8.6%), June (7.6%), March (7.1%), July (6%), November (5.2%), January (5%), and February (3.9%): a steady increase in the overall prevalence of the diseases occurred from March and reach a peak in May, followed decreased from June through July and again increased in August and then followed gradually decreased during September-November.

Table 1

Monthly prevalence of several infectious diseases (indoor patient's data) in Dera Ismail Khan from December 2019 through November 2021 (Two years)

Disease	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diarr/Dys	924	994	1888	3878	5577	1172	2441	2733	2565	2043	1587	2604	28406
Ente/Typ	955	109	30	83	1358	1217	156	2673	1609	1454	295	997	10936
Malaria	113	159	108	129	375	73	92	150	268	333	248	149	2197
Pneum	254	486	612	308	346	1079	134	200	249	434	141	356	4599
Pulm.Tub	64	49	67	38	43	39	20	92	82	96	226	47	863
Ext Pu Tub	98	97	714	0	6	65	53	6	26	22	2	3	1092
Total	2408	1894	3419	4436	7705	3645	2896	5854	4799	4382	2499	4156	
%													
All months were pairwise statistically different from each other ($p < 0.0001$).													

Monthly percentage prevalence of the diseases

Diarrhea/dysentery showed the highest prevalence of 19.6% (Table 1) in May, followed by April (13.7%), August (9.6%), December (9.2%), September (9%), July (8.6%), October (7.2%), March (6.6%), November (5.6%) and the remaining months ($\leq 4.1\%$). While, enteric and typhoid also revealed the highest prevalence of 24.4% in August, followed by September (14.7%), October (13.3%), May (12.4%), June (11.1%), December (9.1%), and January (8.7%). While the remaining months showed the prevalence of enteric and typhoid ($\leq 2.8\%$). Malaria accounted for the highest prevalence of 17.1% in May, followed by October (15.2%), September (12.2%), November (11.3%), February (7.2%), each August and December (6.8%), April (5.9%), January (5.1%), March (4.9%), July (4.2%), and June (3.3%). Pneumonia resulted in the highest prevalence in June (23.5%), followed by March (13.3%), February (10.6%), October (9.4%), December (7.7%), May (7.5%), April (6.7%), January (5.5%), September (5.4%), August (4.3%), November (3.1%), and July (2.9%). PTB contributed the highest share (26.2%) in November, followed by October (11.1%), August (10.7%), September (9.5%), March (7.8%), January (7.4%), February (5.7%), December (5.5%), May (5%), each April and June (approx. 4.5%), and July (2.3%). EPTB resulted in the highest prevalence in March (65.4%), followed by January and February (each approx. 8.9%), June (6%), and July (4.9%). While the remaining months (Table 1) showed EPTB prevalence ($\leq 2.4\%$).

Monthly relative percentage prevalence of the diseases

Diarrhea/dysentery demonstrated the relative highest prevalence in all months except January and June as replaced by Enteric/Typhoid showed the relative highest prevalence (Fig. 1). Diarrhea/dysentery showed the highest relative prevalence of 87.4% in April, followed by July (84.3%), May (72.4%), November (63.5%), December (62.7%). While January, February, March, June, August, September, and October demonstrated a 32.2% to 55.2% relative prevalence of Diarrhea/dysentery. Enteric and typhoid led to the highest relative prevalence of 45.7% in August, while January, June, September, and October showed a relative prevalence of enteric and typhoid ranged 32.2% to 39.7%. December indicated 24 % while May 17.6% prevalence of enteric and typhoid. The remaining months revealed a $\leq 11.8\%$ prevalence of enteric and typhoid. Malaria showed the highest relative prevalence in November (9.9%), followed by February (8.4%), October (7.6%), September (5.6%), May (4.9%), and June (4.7%). The remaining months demonstrated a $\leq 3.6\%$ relative prevalence of malaria. Pneumonia resulted in the highest prevalence in June (29.6%), followed by February (25.7%), March 17.9%, January (10.5%), October (9.9%), December (8.6%), April (6.9%). While the remaining month led to $\leq 5.6\%$ of the relative prevalence of pneumonia. PTB led to the highest relative prevalence in November (9%), followed by January (2.7%), February (2.6%), October (2.2%), and March (2%). The remaining months showed a $\leq 1.7\%$ relative prevalence of PTB. EPTB indicated the highest prevalence in March (20.9%),

followed by February (5.1%), and January (4.1%). While the remaining months demonstrated a $\leq 1.8\%$ relative prevalence of EPTB (Fig. 1).

Seasonal prevalence of the diseases

Diarrhea/dysentery has highly prevailed during late spring/early summer (Table 1). Enteric/Typhoid was highest in the late summer. Malaria was highest in early summer, followed by relatively higher in late summer through late autumn but was lowest in mid-summer. Pneumonia was highest in early summer, followed by in late winter as well as in spring. PTB was highest in late early winter, while EPTB was highest during spring.

Discussion

The current study demonstrated seasonal and monthly variation of several commonly occurred infectious diseases in district Dera Ismail Khan (Table 1, Figure 1). Among these are the most prevalent is diarrhea/dysentery (59.1%), followed by enteric/typhoid (22.7%) and pneumonia, 9.8% (Table 1). The diseases have the highest prevalence in May (16.6%), followed by August (12.2%), September (10%), April (9.2%), October (9.1%), and December (8.6%), while the lowest in February, 3.9% (Table 1).

A steady increase in the overall prevalence of the diseases (mainly contributed by diarrhea/dysentery) from February and reach to peak in May in the present study (Table 1) is because of rising temperature and the increasing population of flies/mosquitoes, as both play an important role in the transmission of such diseases. Diarrhea/dysentery contributed the largest to the overall prevalence of studied infectious diseases in D.I.Khan, emphasize the fact that flies play a major role in the transmission of the disease in the study area. This is because the 1) favorable conditions for breeding prevailed which promote an increased population of flies in the area, and 2) the unhygienic conditions including unhygienic feeding to the babies. All the diseases except for both types of tuberculosis showed early summer as the peak season of transmission in the study area. February revealed the lowest prevalence of the diseases mainly because of low temperature hence the low population of vectors. Previous research is not sufficiently available on the monthly/seasonal prevalence of diarrhea and typhoid in Pakistan. Nevertheless, the highest prevalence of diarrhea in late spring and early summer (April-May) and the highest peak of typhoid in May (Table 1) was supported by Khan et al (2021) who investigated gastroenteritis in children aged ≤ 15 years in Bannu and found April followed by May represented the highest prevalence of gastroenteritis.

Mirza et al (2012) investigated stool samples in combined military hospital D.I.Khan to determine different intestinal parasites responsible for gastrointestinal disorder/diarrhea in the general population of D.I.Khan, and found *Taenia saginata* was the most frequently observed parasite (15.76%). *Giardia lamblia* (both vegetative and cyst forms) accounted for a 3.09% prevalence. *Hymenolepis nana* contributed 1.34% prevalence, *Ancylostoma duodenale* (29%), *Entamoeba histolytica* (vegetative form only: 0.17%), and *Ascaris lumbricoides* was the least frequently observed (0.11%). Literature is not available on the seasonal/monthly prevalence of pneumonia and extrapulmonary tuberculosis in Pakistan.

Comprehensive studies of monthly/seasonal prevalence of malaria in D.I.Khan was conducted previously. Malaria was at its peak in May, followed by October, and lowest in June (Table 1), and was supported by Ahmad et al. (2015) who found the highest prevalence of malaria in October, while the lowest was recorded in June in Dir Lower. The transmission of malaria occurred throughout the year but more cases were reported from July through November after the rains (Macdonald 1957; Detinova, 1962). Malaria steadily increased during April-May, following a sudden decrease in June (Table 1) was supported by Bashir et al (2019) who conducted a study in DHQ hospital D.I.Khan and found percentage positivity of plasmodium was lowest in February, increased steadily up to May, and then again decreased in June in D.I.Khan. Similarly, Khan (2014) concluded that *P. vivax* was common during August-October with a peak in October, whereas *P. falciparum* infection was most common during October-December with a peak in October in the district Bannu. Ullah et al. (2020) found 366 (91.5%)

were *P. vivax*, 24 (6.0%) were *P. falciparum*, and 10 (2.5%) were co-infection of both species of plasmodium out of the 400 cases of malaria in Gomal Medical College, Dera Ismail Khan.

Limited literature is available on the EPTB. The EPTB now accounts for 20% of all notified TB cases (Tahseen et al 2020). The EPTB revealed the highest cases of 714 (65.4%) in March, followed by approx.. 9% in January and February. Munir et al. 2017 collected data of 71 admitted patients with gastrointestinal tuberculosis in the Gomal Medical College, D.I.Khan from January 2016 to January 2017, and found 43.7% were males and 56.3% were female with a male to female ratio of 1:1.2. Chandir et al. (2010) recorded a total of 194 patients treated for EPTB in Liaquat National Hospital (LNH), Karachi, Pakistan including 75% of patients were female. The patients with lymph nodes and spines contributed the highest (60%).

Khan et al (1990) investigated 360 biopsy specimens and found 107 (29.7%) were non-tumors, 20 (18.7%) were tubercular. The highest number of EPTB was tuberculosis of the skin (35%), followed by gastrointestinal tract (20%), bones and joints (20%), lymph nodes (15%), and testis (109%). Young adults and those of slum areas, crowded areas in the city, and of the lower socio-economic class were mostly affected. Tahseen et al (2020) concluded pleural EPTB (29.6%) as the most common form of EPTB, followed by lymphatic (22.7%) and abdominal TB (21.0%) in Pakistan in 2016. Pleural TB accounted highest 34.2% in adults and abdominal TB in children (38.4%). Atif et al (2020) investigated 651 EPTB patients registered during 2015-2017 in the chest disease unit of the Bahawal Victoria Hospital, Pakistan, and found the highest proportion of patients had pleural TB (n = 217, 33.3%).

Lin et al (2009) compared EPTB and PTB in southern Taiwan and found 766 TB patients comprised EPTB 102 (13.3%) and PTB 664 (86.7%) cases; 19.6% of EPTB patients also had PTB. Bone and joints EPTB (24.5% prevalence) was the highest EPTB.

Conclusions And Recommendations

Monthly and seasonal variations in the prevalence of diseases occurred in the study area (Table 1 and Fig. 1).

Diarrhea/dysentery contributed 19.6% in May, while enteric/typhoid and 24.4% in August (Table 1) in D.I.Khan. Malaria showed the highest 17.1% prevalence in May and the lowest in June (3.3%). Pneumonia resulted in the highest prevalence (23.5%) in June, and the lowest in July (2.9%). Pulmonary tuberculosis contributed the highest prevalence (26.2%) in November and lowest in July (2.3%). While extrapulmonary tuberculosis contributed the highest prevalence of 65.4% in March and the lowest 0% in April. Diarrhea/dysentery demonstrated the relative highest prevalence in all months except January and June (Fig. 1) and showed increased prevalence from spring through early summer. Enteric/Typhoid showed the relative highest prevalence in January and June (Fig. 1) and indicated the highest prevalence during early and late summer. Malaria showed high prevalence in early summer and during late summer through autumn. Pneumonia demonstrated the highest prevalence in early summer. While, pulmonary tuberculosis and extrapulmonary tuberculosis revealed the highest prevalence in late autumn and spring, respectively (Table 1).

The developing countries should adopt several preventive strategies for reducing the burden of infectious diseases including 1) mother feeding instead of bottle feeding, 2) proper flies and mosquito control, 3) use of mosquito net during sleeping, 4) proper disposal of patients stool and phlegm, 5) adopting a hygienic way of life such as hand washing and covered and boiled food and drinking, and 6) proper early vaccination.

Limitations

The present research work deals with the prevalence of several infectious diseases in the District Dera Ismail Khan. The study includes only the general prevalence of the diseases and doesn't include sex and age-wise distribution of the diseases and the etiology of the disease in the study area.

Declarations

Availability of data and material: Data is provided in the tables in the drafted manuscript.

Authors' contributions

I am the sole author of this manuscript and solely contributed to the study conception and design, data collection and management, and interpretation.

Competing interests

The author declares no competing interest

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This study is not funded by any source.

Ethics approval and consent to participate

Dr. Naseen Sabha, director of DHQ hospital, Dera Ismail Khan approved my research with reference No. 2606/MD-1 dated 17th June 2021. I willingly and voluntarily participated in the study.

Consent for publication

Not applicable.

Code availability: Not applicable

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Figures

Figure 1

Percentage monthly relative prevalence of several infectious diseases (indoor patient’s data) in Dera Ismail Khan from December 2019 through November 2021 (Two years): each month showed combined data for the said period.