International Journal of Research in Medical Sciences
Soorya V et al. Int J Res Med Sci. 2021 Aug;9(8):2381-2388
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20213085

Original Research Article

Trends in water borne diseases in Kerala: an analysis of directorate of health services portal data

Soorya V.[1], Jishnu Raj[2]*, Anitha Kumari K. R.[3]

[1]Modern Medicine, Trivandrum, Kerala, India
[2]Indian Navy, Ministry of Defence, Government of India, India
[3]Population Research Centre, University of Kerala, Karyavattom, Trivandrum, Kerala, India

Received: 05 June 2021
Revised: 05 July 2021
Accepted: 06 July 2021

***Correspondence:**
Jishnu Raj,
E-mail: jishnuraj27@gmail.com

ABSTRACT

Background: Kerala faces high mortality-morbidity rates from water borne diseases. For the timely management of communicable diseases, understanding trends, pattern and seasonality of disease was important. The aim was to find out the trend, pattern and seasonal variation of water borne diseases in Kerala.
Methods: Retrospective record based descriptive study was done to find out the trend and pattern of water borne diseases and to find out its seasonal variation in Kerala. Data from the DHS (directorate of health services) portal during 2011 to 2019 were collected and analyzed.
Results: More than 97 percent of water borne diseases are due to diarrheal diseases but no death reported. A rising trend in diarrheal disease is observed. Typhoid, hepatitis A and cholera showed decreasing trend. Leptospirosis shared only 0.2 to 0.4 percent, but death rate was high. Malapuram tends to report most number of cases but percentage share was highest from Kozhikode in 2011. Palakkad reported highest number and Kottayam lowest among central districts. Among southern districts, Thiruvananthapuram reported highest number of cases and Pathanamthitta lowest. Malappuram showed declining trend among northern districts while least number of cases were reported from Wayand district. Seasonal variability was observed in 2011-2013 and 2018.
Conclusions: Seasonal variation in occurrence of water borne diseases in rainy season is statistically significant when compared to winter season. Data on water borne disease other than diarrheal diseases is a matter of concern.

Keywords: Water borne disease, Diarrheal diseases Kerala, Seasonality, Trend and pattern

INTRODUCTION

According to WHO, diarrheal diseases contribute to as many as 4 million cases and 1.8 million deaths annually.[1] Water borne illnesses are the second cause of death among children under the age of 5 years.[2] Approximately 5000 people die every day from waterborne diarrheal illnesses.[3] Epidemiologic transition from infectious diseases to non-communicable diseases is a reality in Kerala where health indicators are assumed to be the best among Indian states and compared with developed countries. But it is reported to have the highest rates of morbidity among the Indian states. Research on various water borne diseases like diarrhea, acute jaundice, hepatitis A, leptospirosis in the state is evident from many studies.[4-11] Another concern is seasonality of disease incidence which can turn into epidemics if proper management does not exist. Seasonality of water quality and diarrheal disease counts in urban and rural settings in South India was studied.[12] Hyderabad based hospital study during 2011-2013 confirmed seasonality of diarrheal diseases.[13] A hospital based study in Kerala

noted higher number of ADD cases during summer.[14] Hence it was important to study the trends and pattern in diseases and its seasonality for early diagnosis and timely management.

Objectives

The objectives of the study were to analyse the trend and pattern in water borne diseases in Kerala and its districts and to study the seasonality of water borne diseases.

METHODS

This retrospective descriptive multi-year analytical study used data from DHS Kerala portal which provided communicable disease data. Month wise and district wise water borne disease data during 2011 to 2019 years were analysed from the communicable disease data. Surveillance data from all tertiary level hospitals, district hospitals, sub divisional hospitals, community health centers, primary health centers, urban primary health centers and private hospitals in the 14 districts of the state were reported in the office of the DHS in Thiruvananthapuram on weekly basis and from which it compiled and uploaded monthly in the portal as communicable diseases. Water borne diseases from communicable diseases (which include vector borne diseases and airborne diseases) data were separated and used for this study. Since it was a publically available data no ethical issue was involved. Month wise and district wise water borne disease data were analysed using percent distribution and average per year to find out the trend and seasonal variations. Districts were classified as south (Thiruvananthapuram, Kollam, Pathamthitta, Alappuzha and Idukki), central (Kottayam, Ernakulam, Thrissur and Palakkad) and north (Malappuram, Kozhikode, Wayanad, Kannur and Kasaragode) to find out the comparisons in the distribution of diseases.

Seasons were classified as summer (March-May), rainy (June-October) and winter (November-February). Mean differences in frequency between two sample proportions (between seasons) were tested using ANOVA test. $P<0.05$ was fixed as a significant level. If there is significant variability in mean values within groups, then multiple comparisons through Tukey post hoc test was conducted for the seasons.

RESULTS

Table 1 reveals that among communicable diseases water borne diseases holds more than 97 percent and hence water borne diseases are studied in the paper.

Trend analysis shows that a huge hike in number of water borne diseases in 2012 and there is steady increase during 2013 to 2016, a small reduction in 2017 and a steady increase after that (Figure 1).

Leptospirosis shares only 0.2 to 0.4 percent of the water borne diseases in Kerala. But death rate is high for this disease. During these years highest death rate of 7.42 is recorded in 2011 and lowest in 2016 (2.05). Trend shows that there is hike in 2016 and after it dropped in 2017, it again increased in 2018 and decreased drastically in 2019. Hepatitis A shares 1.7 percent in 2011 and in 2012 and reduced to 1.5 in 2013 and decreased thereafter and mortality is also less (ranges from 0.13 to 0.74). Trend of hepatitis A is steadily decreasing upto 2017 after that small increase is observed. Diarrhoea (ADD) is the most reported water borne diseases in Kerala. Its share is above 97 percent in all years. But no death is reported in all these years. Trend shows that the disease is steadily increasing as shown in Table 2. Percentage change during 2019 over 2011 shows that hepatitis A was decreased by 65 percent and cholera was reduced by 50 percent and 99 percent reduction in typhoid cases are reported in 2019 (Table 2). ADD was increased by more than cent percent and hence the increase of water borne diseases is due to ADD.

After 2012, cholera is decreasing continuously and it is not reported in the year 2015. Percent share of cholera is nearly zero and that of typhoid is varying from 0.1 to 0.9. Typhoid is decreasing after 2013 and a sharp decline observes after 2016 (Figure 2).

Thiruvananthapuram reports 7.8 percent and Kollam reports 4.4 percent of the cases of WBD on an average per year during 2011-2019 (Table 3). Pathanamthitta is the district reported lowest percent of WBD cases followed by Kottayam and Idukki as depicted in Figure 3. Ernakulam contributes on an average 7 percent of the WBD in the state. Thrissur holds more than 10 percent of the cases except in 2019 (9.2 percent). In all years Palakkad contributes more than 10 percent except in 2019. District is high among the central districts with regard to WBD. Kottayam provides the lowest contribution but when percentage change is considering it is highest among central part of Kerala. A large number of WBD is contributing by Malappuram in all years and is more than 20 percent in 2013 and 2014. Kozhikode contributes 7.3 percent in 2011 to 12.5 percent in 2019 WBD. Among the districts Malappuram contributes the highest and Wayanad is the lowest among northern districts (Table 3) (Figure 5). Only 2.7 percent (each in 2013 and 2015) to 4.1 percent (2019) of the WBD is contributed by Wayanad. Kannur contributes on an average 9 percent of WBD cases during these years. Percent change of water borne disease over 2011 in 2019 is highest in Kozhikode (246) followed by the districts Kasargode and Thiruvananthapuram.

Trend of districts shows that Alappuzha and Kollam shows a declining trend and Pathanamthitta which was lowest reported in earlier years now began to increase in reporting number of cases (Figure 3). Thiruvananthapuram has a jump in water borne diseases from 2015 and remain high during recent years. Among the central

districts even though Palakkad shares high percent of cases but it has a decline trend during recent years whereas Kottayam which is reporting the lowest cases shows an increasing trend. Ernakulam was reported almost same number of cases before 2016 and is began to increase from 2017. Trend of Thrissur is same as that of Palakkad both began to decrease in recent years. Malappuram which is reported high upto 2013 and decreased its number of cases upto the year 2016 and then slowly increased upto 2018 and now it decreased. Kozhikode shows an increasing trend from 2011 upto 2016 slowly decreased thereafter but in 2019 the number of cases increased. Trend line of Kannur is like a big U shaped. Wayanad and Kasaragod shows almost same trend (but low number of cases in Wayanad) with slowly increasing trend line (Figure 5).

Table 1: Trend in communicable diseases in Kerala, 2011-2019.

Diseases	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average
Vector borne	3517 (1.2)	6237 (0.9)	9940 (2.3)	5008 (1.1)	6993 (1.5)	9334 (1.8)	23587 (4.8)	5504 (1)	6612 (1.1)	8526 (1.7)
Water borne	269014 (95.2)	724424 (99.1)	421749 (97.6)	447966 (98.9)	471952 (98.5)	498712 (98.1)	466086 (95.1)	545139 (98.8)	546894 (93.7)	487993 (97.3)
Air borne	10194 (3.6)	115 (0)	256 (0.1)	43 (0)	176 (0)	215 (0)	408 (0.1)	1063 (0.2)	30468 (5.2)	4771 (1)
Total	282725 (100)	730776 (100)	431945 (100)	453017 (100)	479121 (100)	508261 (100)	490081 (100)	551706 (100)	583974 (100)	501289 (100)

Figures in brackets show percent.

Table 2: Trend and mortality in major water borne diseases during 2011-2019.

Water borne diseases	2011	2012	2013	2014	2015	2016	2017	2018	2019	% change over 2011
Leptospirosis number (%)	944 (0.4)	736 (0.2)	814 (0.2)	1075 (0.2)	1098 (0.2)	1710 (0.3)	1408 (0.3)	2079 (0.4)	1211 (0.2)	28.3
Death (death rate)	70 (7.4)	18 (2.5)	34 (4.2)	43 (4. 0)	43 (3.9)	35 (2.1)	80 (5.7)	99 (4.8)	57 (4.7)	
Hepatitis A number (%)	4583 (1.7)	6305 (1.7)	6166 (1.5)	2831 (0.6)	1980 (0.4)	1351 (0.3)	988 (0.2)	1369 (0.3)	1620 (0.3)	-64.6
Death (death rate)	10 (0.2)	8 (0.1)	8 (0.1)	6 (0.2)	10 (0.5)	10 (0.7)	24 (2.4)	5 (0.4)	57 (0.4)	
Cholera number (%)	18(0)	30 (0)	20 (0)	13 (0)	1(0)	10 (0)	8(0)	9(0)	9 (0)	-50.0
Death (death rate)	1 (5.6)	2 (6.7)	0	0	0	0	1 (12.5)	0	0	
Typhoid number (%)	2291 (0.9)	2849 (0.8)	2930 (0.7)	1956 (0.4)	1772 (0.4)	1668 (0.3)	314 (0.1)	109 (0)	27 (0)	-98.8
Death (death rate)	2 (0.09)	1(0.04)	0	0	0	2 (1.2)	1 (3.2)	0	0	
ADD number (%)	261178 (97.1)	357252 (97.3)	411819 (97.6)	442104 (98.7)	467102 (99.0)	493973 (99.0)	463398 (99.4)	540814 (99.3)	544027 (99.5)	108.3
Death (death rate)	4(0)	8(0)	2(0)	5(0)	0(0)	14(0)	8(0)	12 (0)	6(0)	
Total number	269014	367172	421749	447979	471953	498712	466116	544380	546894	103.3
Total deaths	87	37	44	54	53	61	114	116	70	

Table 3: Trend and pattern in water borne diseases in districts from 2011-2019.

Districts	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average	%change 2011-2019
Thiruvananthapuram	18986 (7.1)	21474 (5.8)	26921 (6.4)	26301 (5.9)	36530 (7.7)	46695 (9.4)	44934 (9.6)	50195 (9.2)	47530 (8.7)	35507 (7.6)	150.3
Kollam	11652 (4.3)	12491 (3.4)	19232 (4.6)	23835 (5.3)	23348 (4.9)	25099 (5.0)	19439 (4.2)	23211 (4.3)	21072 (3.9)	19931 (4.4)	80.84
Pathanamthitta	5893 (2.2)	6101 (1.7)	6555 (1.6)	6451 (1.4)	8501 (1.8)	8946 (1.8)	9521 (2.0)	14452 (2.7)	16030 (2.9)	9161 (2.0)	172
Idukki	9891 (3.7)	10165 (2.8)	11039 (2.6)	12148 (2.7)	12835 (2.7)	13259 (2.7)	13853 (3.0)	13566 (2.5)	12975 (2.4)	12192 (2.8)	31.18
Kottayam	7253 (2.7)	8495 (2.3)	11339 (2.7)	10327 (2.3)	9269 (2.0)	10011 (2.0)	10384 (2.2)	14369 (2.6)	17966 (3.3)	11045 (2.5)	147.7
Alappuzha	15456 (5.7)	21676 (5.9)	22128 (5.2)	22581 (5.0)	21523 (4.6)	23238 (4.7)	18632 (4.0)	20002 (3.7)	20403 (3.7)	20626 (4.7)	32.01
Ernakulam	19712 (7.3)	24797 (6.8)	28516 (6.8)	29995 (6.7)	31232 (6.6)	31231 (6.3)	33133 (7.1)	38444 (7.1)	44365 (8.1)	31269 (7.0)	125.1
Thrissur	30324 (11.3)	39973 (10.9)	47570 (11.3)	48326 (10.8)	52036 (11.0)	53186 (10.7)	48613 (10.4)	56665 (10.4)	50390 (9.2)	47454 (10.7)	66.17
Palakkad	36450 (13.5)	46117 (12.6)	50051 (11.9)	54915 (12.3)	57429 (12.2)	52701 (10.6)	47557 (10.2)	55591 (10.2)	49133 (9.0)	49994 (11.4)	34.8
Malappuram	41302 (15.4)	71237 (19.4)	87923 (20.8)	91081 (20.3)	89480 (19.0)	87503 (17.5)	84255 (18.1)	104556 (19.2)	86356 (15.8)	82633 (18.4)	109.1
Kozhikode	19699 (7.3)	37064 (10.1)	37270 (8.8)	44648 (10.0)	52010 (11.0)	59046 (11.8)	50625 (10.9)	52845 (9.7)	68174 (12.5)	46820 (10.2)	246.1
Wayanad	9504 (3.5)	10513 (2.9)	11540 (2.7)	13863 (3.1)	12945 (2.7)	14448 (2.9)	16542 (3.5)	19900 (3.7)	22286 (4.1)	14616 (3.2)	134.5
Kannur	30110 (11.2)	34753 (9.5)	37012 (8.8)	36542 (8.2)	36780 (7.8)	42074 (8.4)	39158 (8.4)	48569 (8.9)	55515 (10.2)	40057 (9.0)	84.37
Kasaragod	12782 (4.8)	22316 (6.1)	24652 (5.8)	26961 (6.0)	28035 (5.9)	31275 (6.3)	29441 (6.3)	32015 (5.9)	34699 (6.3)	26908 (5.9)	171.5
Total	269014	367172	421748	447974	471953	498712	466087	544380	546894	448215	103.3

Table 4: Seasonal variation in water borne diseases.

Year		N	Mean	F	P	Groups	Difference	P
2011	Winter	4	21639.25	14.598	0.001	Winter Vs Summer	8996.58	0.046
	Summer	3	12642.67			Winter Vs Rainy	7266.55	0.065
	Rainy	5	28905.80			Summer Vs Rainy	16263.13	0.001
2012	Winter	4	50342.0	3.058	0.097	Winter Vs Summer	4877.00	0.884
	Summer	3	55219.0			Winter Vs Rainy	21137.80	0.099
	Rainy	5	71479.80			Summer Vs Rainy	16260.80	0.271
2013	Winter	4	26802.75	5.664	0.026	Winter Vs Summer	3228.25	0.930
	Summer	3	30031.0			Winter Vs Rainy	24086.25	0.031
	Rainy	5	50889.0			Summer Vs Rainy	20858.0	0.083
2014	Winter	4	34000.25	1.989	0.193	Winter Vs Summer	309.25	0.998
	Summer	3	33691.0			Winter Vs Rainy	8178.15	0.253
	Rainy	5	42178.40			Summer Vs Rainy	8487.4	0.282
2015	Winter	4	35859.5	0.842	0.462	Winter Vs Summer	1774.5	0.962
	Summer	3	37634.0			Winter Vs Rainy	7262.90	0.462
	Rainy	5	43122.4			Summer Vs Rainy	5488.4	0.677
2016	Winter	4	31869.5	2.378	0.148	Winter Vs Summer	265.5	1.000
	Summer	3	31604.0			Winter Vs Rainy	23415.1	0.196
	Rainy	5	55284.60			Summer Vs Rainy	23680.6	0.237

Continued.

Year		N	Mean	F	P	Groups	Difference	P
2017	Winter	4	32173.75	1.980	0.194	Winter Vs Summer	3206.25	0.925
	Summer	3	35380.0			Winter Vs Rainy	14076.45	0.197
	Rainy	5	46250.2			Summer Vs Rainy	10870.2	0.410
2018	Winter	4	36726.75	3.998	0.057	Winter Vs Summer	3888.92	0.875
	Summer	3	40615.67			Winter Vs Rainy	18398.45	0.060
	Rainy	5	55125.20			Summer Vs Rainy	14509.53	0.184
2019	Winter	4	39288.0	2.397	0.146	Winter Vs Summer	1973.0	0.966
	Summer	3	41261.0			Winter Vs Rainy	13903.0	0.163
	Rainy	5	53191.8			Summer Vs Rainy	11930.8	0.297

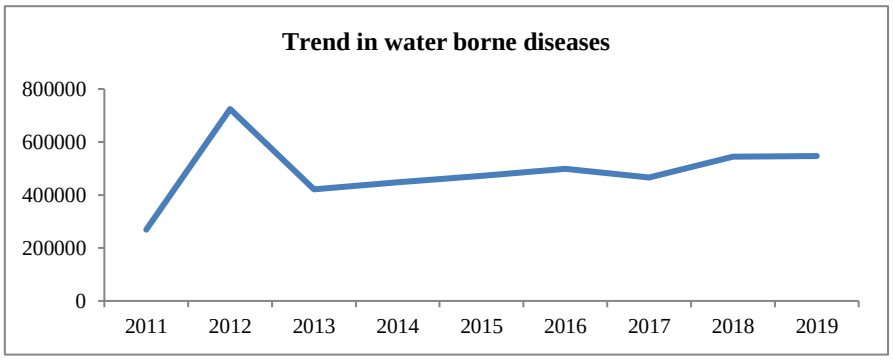

Figure 1: Trend in water borne diseases.

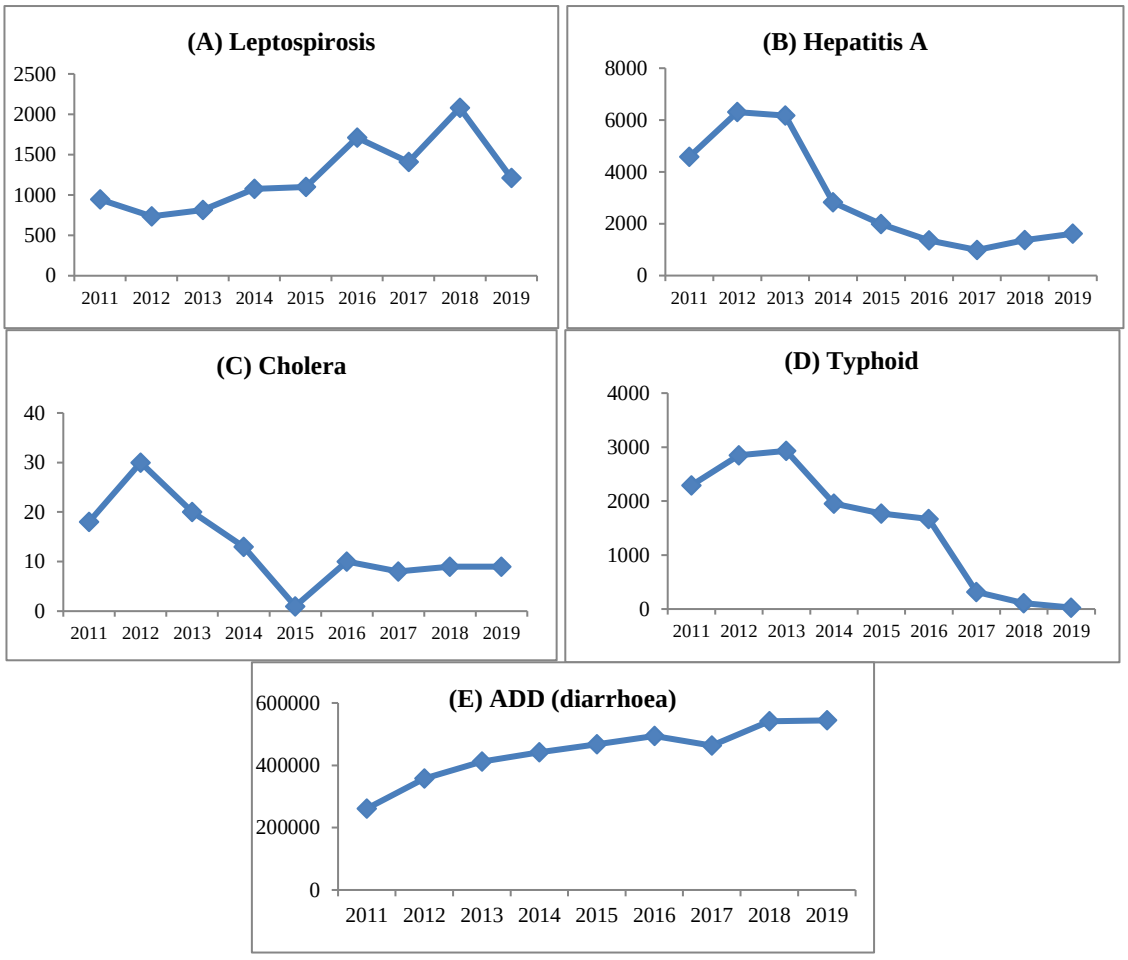

Figure 2: Trend in major water borne diseases; (A) leptospirosis; (B) hepatitis A; (C) cholera; (D) thyphoid; (E) ADD (diarrhoea).

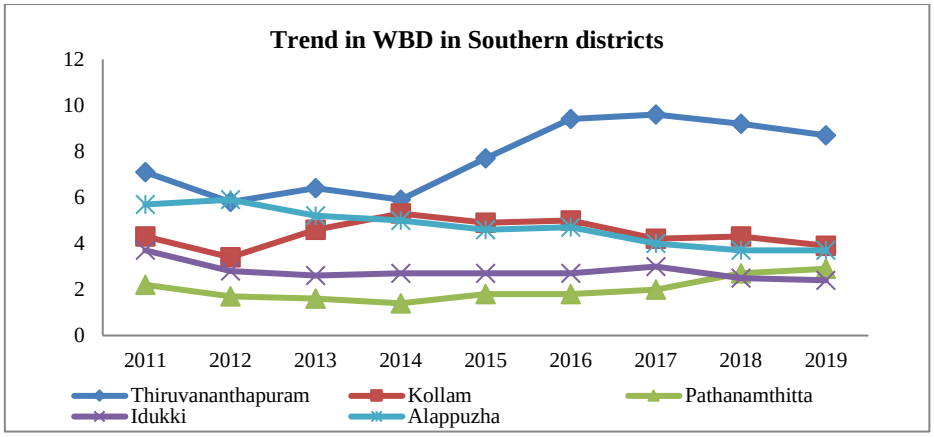

Figure 3: Trend in WBD in southern districts.

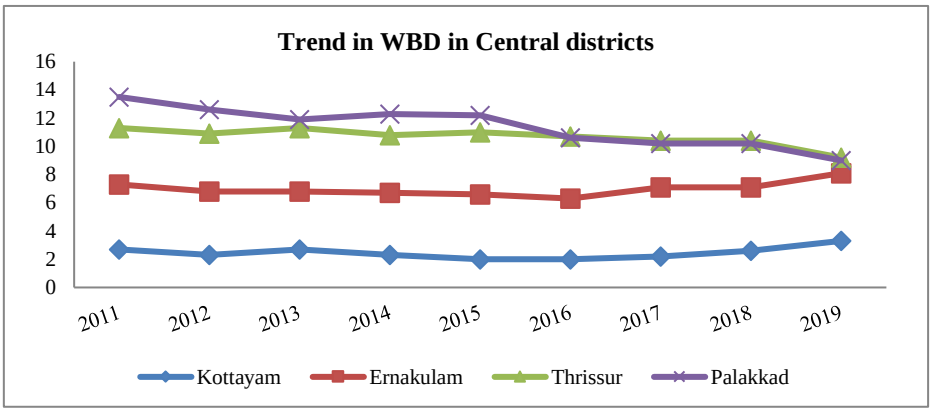

Figure 4: Trend in WBD in central districts.

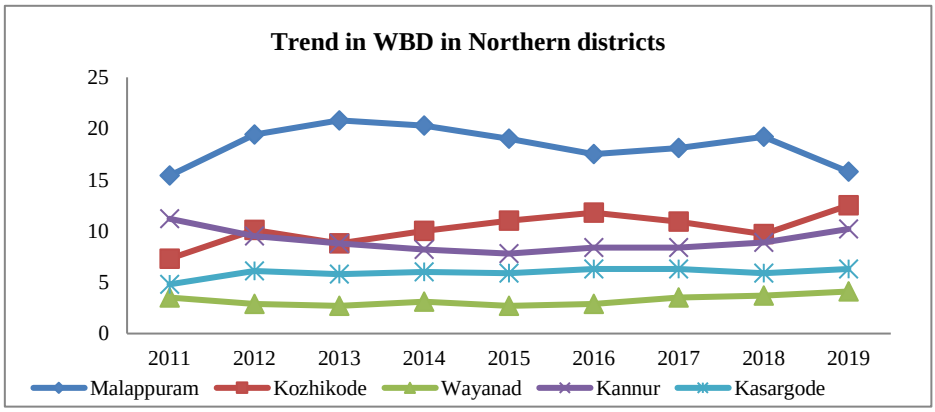

Figure 5: Trend in WBD in northern districts.

Seasonal variation in water borne diseases

Seasonal variation in infectious disease transmission plays an important role in determining when epidemics happen.[15]

Seasonal variation in WBD is evident in years 2011, 2012, 2013 and in 2018 (Table 4). Mean number of diseases in three seasons has variability (F=14.6 and p=0.001) in 2011. Hence, we go for the multiple comparisons through Tukey post hoc test. Significant variability in winter versus summer (p=0.05), winter versus rainy (p=0.06) and summer versus rainy (p=0.001). The difference in the occurrence of WBD in rainy season with respect to winter is statistically significant at 10% level in 2012. In 2013, rainy season with respect to winter and summer has an influence in the

concurrence of WBD. In 2018 number of cases is significantly varied according to the rainy seasons compared to winter.

DISCUSSION

Although the state had been successful in controlling a number of communicable diseases earlier, the emergence of water borne diseases in recent years has led to considerable increase in morbidity and mortality. Information about trends and pattern in disease is necessary for planning the infrastructure and human resources to combat with the health needs.

During the reference period, more than 98 percent of the communicable diseases were due to water bone diseases. Data from government of Kerala suggested that the water borne diseases were now emerging in the state. More than 97 percent of the water borne disease were due to diarrhea but no death was reported in the reference period. Increasing trend of diarrhea was observed. Typhoid, hepatitis A and cholera showed a decreasing trend. Leptospirosis shared only 0.2 to 0.4 percent of the water borne diseases in Kerala. But death rate was high for the disease as highest as 7.4. Water borne diseases (WBD) was mostly reported by Malappuram but percent share over 2011 was highest in Kozhikode. Among central districts reported cases of WBD were highest in Palakkad (but showed a declining trend after 2016) and lowest in Kottayam (but showed an increasing trend in recent years), whereas among southern districts Thiruvananthapuram reported the highest number of cases and Pathanamthitta the lowest (but now it showed an increasing trend). Malappuram which was reporting highest number of cases and now showed a declining trend among northern districts and Wayanad was the least reported WBD district. Seasonal variability in water borne disease was also observed in 2011-2013 and in 2018. The difference in the occurrence of WBD in rainy season with respect to winter was statistically significant.

Analysis of the DHS portal data showed that 97 percent of the waterborne diseases were due to diarrheal diseases and it was very high from other studies. Prevalence of water borne diseases among communicable disease was reported by 14.6% in a tertiary level hospital and was based on inpatient data.[14] Our study used DHS portal data which included outpatient data of primary level to tertiary level. In India, a case fatality rate of 5.0 per 1000 cases were reported.[16] Our study pointed out 0.2 to 0.4 percent share of leptospirosis and 0.2 to 1.7 percent these diseases among waterborne diseases. Admissions due to water borne diseases in the hospital increased during rainy season with respect to summer and winter was also proved in Kerala.[14] Occurrence of acute diarrheal diseases is more in monsoon season is proved in India and in states.[16,17] This was consistent with our study that mean number of cases increased during rainy seasons significantly. It may be due to the contamination of open wells. Spatial analysis study of open wells in urban Trivandrum reported that dug wells were a major source of drinking water and 73% of the wells contaminated with coliform organisms. The reasons for the coliform contamination are the close proximity of septic tanks with the wells and inadequate chlorination and cleansing activities by the households. Climate could influence water borne disease was confirmed by WHO.[19] In Kozhikode 74 percent of leptospirosis cases are reported in monsoon season and higher rate of contamination in Delhi in the same season.[11,20] Fatality rate of 7.4 of leptospirosis in this study was higher compared to 3.5% in Mangalore (Holla et al 2005) and consistent with 7.7 in Orissa (Jena et al 2004).[21,22]

Despite appointing arogya sena and health volunteers at the grass root level to report communicable diseases at the earliest, emerging and remerging infectious diseases were public health threaten even now in Kerala. Public health risks can be detected through good quality of data. DHS data suffered under reporting of many diseases. In some years, data of some diseases were missing and we could not be able to find out whether the disease was not recorded or actually the disease was absent. This was one limitation of the study. Under reporting or partially reporting was the major issue when approaching these types of data. WHO reported that diarrheal diseases remain vastly under-reported even in nations with highly developed surveillance systems mainly related to multiple factors including lack of diagnosis, lack of specimen collection, lack of reporting, and lack of treatment sought.[19] Hence data management through expertness was necessary in order to tackle the issues timely in the state. Seasonal variations or higher number of cases in rainy season indicated the importance of planning in health activities. Even though people were educated and kept personal hygiene, waterborne disease were increasing was a matter of concern.

Limitations

As some diseases are missing in some years, we could not be able to find out whether the disease was not recorded or actually the disease was absent. There was no regular recorded data in the portal. It was the limitation of the study.

CONCLUSION

Morbidity due to water borne diseases is mainly limited to ADD which can be reduced through effective grass root level coordination. Identification of seasonality dependent water borne diseases helps to improve pre monsoon activities, human and other resources in peripheral health institution for better service and to adopt effect control strategies. Continued and regular data availability is the major hindrance in preventing the communicable diseases. Only available public health data in the state is the data in the DHS portal. Our study highlights the importance of surveillance data monitoring

in the study to better understand disease pattern and trend and seasonality.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Soorya V, Raj J, Kumari KRA. Trends in water borne diseases in Kerala: an analysis of directorate of health services portal data. Int J Res Med Sci 2021;9:2381-8.