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Research Article

Prevalence of Diarrhoea and Acute Respiratory Infection among Under Five Children: A Spatial-Temporal Changes of Maharashtra Districts

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Received: June 28, 2021; **Published:** September 30, 2021

Abstract

Background: Acute Respiratory infections (ARI) and diarrhoea are leading causes of under-five mortality in the world. India contributes 14% of the total deaths among children aged of five due to diarrhoea and more than 15% of deaths are associated with ARI. The study attempts to show the spatial prevalence and spatial-temporal changes of diarrhoea and ARI among under five children across the districts of Maharashtra with using NFHS-4 and NFHS-5.

Methodology: The present study is based on National Family Heath Survey (NFHS) data, that was NFHS-4 (2015-16) and NFHS-5 (2019-20) of Maharashtra districts of India. The study used spatial analysis software of ArcGIS 10.8.

Results: The prevalence of diarrhoea and ARI is 8.9% and 3.2% in Maharashtra in the year 2019-20. The diseases prevalence was increased by 0.4% (diarrhoea) and 0.8% (ARI) in 2020 as compared in 2015. Out of 35 districts, 18 districts (i.e. Kolhapur, Latur, Sangli, and Jalgaon etc.), and 10 districts (i.e. Raigarh, Ratnagiri, Thane, and Sindhudurg etc.) are showing the decrease (negative changes) of diarrhoea and ARI prevalence among children. On the other hand, 17 districts (i.e. Washim, Nashik and Jalna etc.) and 25 districts (i.e. Chandrapur, Buldhana, Akola, Osmanabad and Washim etc.) are showing the increase in prevalence (positive changes) in 2015 to 2020.

Conclusion: Study findings highlighted that eighty percent districts of Maharashtra are in negative growth of diarrhoea disease, which needs to be recognised by the state government. The policy makers and any interventions related to these health issues should consider of study identified districts of the state in order to improve possible measures for diarrhoea disease and ARI in control. The state programmes could ensure for better outcomes by including women from mentioned areas and ensure eradicate diseases related women and child.

Keywords: *Spatial Prevalence; Diarrhoea; Acute Respiratory Infections (ARI); Childhood Mortality; Spatial-Temporal Changes*

Introduction

Acute Respiratory infections and diarrhoea are leading causes of Childhood mortality in the world [1-3]. One out of three children die due to these occurrences of the diseases in the south East Asia [4]. Globally 1.7 billion children get affected by diarrhoea and it consists second leading cause of under-five child mortality [5,6]. Every year more than 525,000 children die due to occurrence of diarrhoea in the world [6]. At the same time periods, more than 6.5 lakh under five children die due to lower acute Respiratory Infection [1], which

contributes 20% of childhood deaths in the world [1,7]. According to World Health Organization (2016) diarrhoea is defined as passage of unusually loose or watery stools at least three times within 24 hours as reported by child caregivers [8]. Respiratory disease is defined as the presence of fever with difficulty in breathing and/or cough [9]. The recent data shows that in the developing counties, on an average under 5 children suffer from diarrhoea three times in a year whereas for ARI its four to five times in a year [10,11].

A study shows that 10% of household income was spent on treatment of acute childhood morbidities in rural India [12]. Study shows an improved socio-economic and health care status helps to improve the child morbidity status. Further, Immediate breastfeeding within the first hour, followed by early exclusive breastfeeding, improve the health and survival status of new-borns from diarrhoea and other infectious diseases [13,14]. Similarly, exclusive breastfeeding alone has the potential capacity to prevent nearly 13% of under-five deaths in developing countries [15]. There is a negative correlation between breastfeeding and childhood diarrhoea [14]. The prevalence of diarrhoea and ARI is found to be lowest among children whose mothers have higher education [16]. The prevalence of both the diseases is high among 6 - 11 months of age [17].

The latest report of United Nations International Children's Emergency Fund (UNICEF) revealed that malnourishment (45%), Pneumonia (15%), diarrhoea (8%), malaria (5%) and others (9%) are major responsible causes for the death of under 5 children in the world [5]. IMR varies widely across the world, ranging from 51 per 1000 live births in Africa to 8 per 1000 in Europe [18]. National Family Health Survey (NFHS) 4 in India reported an Infant mortality rate (IMR) of 41 per 1000 live births in 2015-2016 which was 68 per 1000 live births in 2000 [19,20]. The momentum achieved during Millennium Development Goal has been shifted to Sustainable Development Goal, to bring down mortality further. Still, there were 802,000 infant deaths occurred in the world in 2017 [4]. India contributes to 18% of global pool of infant deaths [21]. India alone contributes 14% of the total deaths among children under-five years of age due to diarrhoea [22,23] and 13% to 16% of all children deaths (pneumonia) are associated with ARI [24,25].

The National Family Health Survey (NFHS) shows a decrease in the prevalence of Acute Respiratory Infection (ARIs) among children in India from 2006 to 2016 but the prevalence of diarrhoea has been increased at the same time. Child health is a public health concern in India and the country has already set its goal to achieve SDGs target to reduce under five child mortalities by 25 per 1000 live births in 2030 (SDGs) which is 50 per 1000 live births as per National Family Health survey [26,27]. The comparison between NFHS-4 (2015-16); NFHS-3 (2005-06) shows that under-five mortality rate (U-5MR) has been reduced from 74 to 50 and infant mortality rate (IMR) has been decreased from 57 to 41 per 1000 livebirths between 2006 and 2016 [26,28,29].

As per National Family Health Survey-5 (2019-20), in Maharashtra the prevalence of diarrhoea has been increased from 8.5% in 2015-16 (NFHS-4) to 8.9% in 2019-20 (NFHS- 5). On the other hand, the prevalence of ARI also has increased from 2.4% to 3.2% between the same time periods in Maharashtra. So, the increasing trends of these morbidities is a major public health concern as these two diseases are the leading causes of childhood mortality and mortality. The present study has been conducted to show the prevalence of diarrhoea and ARI among under five children between the two points of time (2015-16 and 2019-20) and across the time periods across the districts of Maharashtra. The study also attempts to show the spatial-temporal changes between the time periods across the districts of Maharashtra between the same time periods.

Materials and Methods

Data source

The recent study is based on the data from the National Family Health Survey (NFHS-4) conducted in the year 2015-16 in India. It had covered 35 states/UTs including 640 districts in the country [26]. This all-India survey was conducted under the supervision of the Ministry of Health and Family Welfare, Government of India with International Institute for Population Sciences (IIPS), Mumbai, being the nodal agency. It provides information regarding demography and health for men, women and children.

This study used diarrhoea and Acute Respiratory infection (ARI) as outcome variables. During the survey direct question about diarrhoea was asked to the mother. of the under 5 child/children of the sampled household. The response was recorded as '1' for yes and '0' for no. Furthermore, responses related to ARI was collected based on two questions: whether a child had short, rapid breathing which was chest-related and/or difficulty in breathing which was chest-related in the two weeks preceding the survey and the response was coded 1 'yes' and '0' no, otherwise. To show the temporal changes the recently published factsheet of recent round of NFHS-5 (2019-20) has been used [26].

Methodology

Bivariate analysis was performed to execute the prevalence of diarrhoea and Ari with the help of STATA-14. To examine the spatial prevalence and spatial-temporal changes of these childhood diseases the study uses spatial analysis software ArcGIS 10.8.

Results

Prevalence of diarrhoea and ARI among under five children with geographical variation in Maharashtra

Table 1 represents the geographical variation of diarrhoea and ARI among children under-five years of age in all districts of Maharashtra (2015-16 to 2019-20). The prevalence of diarrhoea among under 5 children has increased 8.5% to 8.9% from the year 2015-16 to 2019-20 in Maharashtra. In 2015-16 the prevalence of diarrhoea was highest in Latur (16.1%) followed by Satara (15.7%), Parbhani (12.1%). On the other hand, prevalence was comparatively lower in Chandrapur (7.4%), Gadchiroli (4.1%) and Gondia (4.2%) districts of Maharashtra. In 2019-20, Nashik (19.2%) represents the highest prevalence followed by Washim (19.2%) and Jalna (19%) district; Whereas, Sindhudurg (0.6%), Mumbai Suburban (1.7%) and Palghar (1.8%) districts had reported a low prevalence of diarrhoea among children under five years of age. Temporal Changes results show that the highest negative change has taken place in Kolhapur (-8.1%) district and lowest in Osmanabad (-1.0%) district of Maharashtra from the year 2015-16 to 2019-20. Furthermore, Washim (12.2%), Nashik (11.1%), Jalna (10.8), and Bid (7.8%) districts show highest positive changes; whereas, Gondia (0.3%), Akola (0.3%) and Gadchiroli (0.6%) show lower positive changes between the same time period.

Districts	Prevalence of Diarrhoea (In percentage)			Prevalence of ARI (In percentage)		
	@	%	Temporal Changes	@	%	Temporal Changes
Ahmednagar	10.1	15.9	5.8	2.4	2.7	0.4
Akola	11.7	12.0	0.3	2.4	6.5	4.1
Amravati	8.8	11.6	2.8	2.0	5.2	3.2
Aurangabad	9.1	12.6	3.5	4.0	4.1	0.1
Bhandara	8.0	3.9	-4.1	0.9	2.7	1.8
Bid	7.9	15.7	7.8	0.6	2.1	1.5
Buldhana	12.1	8.8	-3.3	2.2	6.3	4.1
Chandrapur	3.7	5.7	2.0	1.2	7.3	6.1
Dhule	11.1	15.7	4.6	2.1	2.1	0.1
Gadchiroli	4.1	4.7	0.6	0.5	3.2	2.7
Gondia	4.2	4.5	0.3	1.2	2.6	1.4
Hingoli	9.2	10.1	0.9	2.7	3.2	0.5
Jalgaon	12.0	6.7	-5.3	1.7	4.1	2.4
Jalna	8.2	19.0	10.8	3.5	7	3.5
Kolhapur	12.0	3.9	-8.1	3.9	3.2	-0.7
Latur	16.1	9.8	-6.3	1.9	3.3	1.4
Mumbai	6.2	3.5	-2.7	1.8	1.7	-0.1
Mumbai Suburban	5.5	1.7	-3.8	1.6	3.9	2.3

Nagpur	5.7	4.0	-1.7	1.2	1	-0.2
Nanded	11.3	14.4	3.2	1.7	4.7	3.0
Nandurbar	6.1	9.8	3.7	2.4	4.7	2.3
Nashik	8.2	19.2	11.1	3.2	4.1	0.9
Osmanabad	10.2	9.2	-1.0	0.8	4.7	3.9
Palghar	NA	1.8	-	NA	1.4	-
Parbhani	12.1	18.6	6.6	1.7	3.3	1.6
Pune	7.9	6.7	-1.2	2.9	2.6	-0.3
Raigarh	6.0	3.8	-2.2	7.7	2.4	-5.3
Ratnagiri	8.0	2.7	-5.3	4.2	0.3	-3.9
Sangli	9.6	3.8	-5.8	4.3	5.9	1.6
Satara	15.7	10.4	-5.3	2.1	1.4	-0.7
Sindhudurg	5.0	0.6	-4.4	3.6	2.4	-1.2
Solapur	8.0	11.4	3.4	0.7	1.7	1.1
Thane	6.3	3.0	-3.3	2.2	0.4	-1.8
Wardha	9.6	6.0	-3.6	1.4	2.5	1.1
Washim	7.0	19.2	12.2	1.4	5.1	3.7
Yavatmal	9.0	7.4	-1.6	1.2	0	-1.2
Total	8.5	8.9	0.4	2.4	3.2	0.8

Table 1: *Prevalence of Diarrhoea and Acute Respiratory Infection (ARI) among children in districts of Maharashtra, India. Note: NA: Data not Available, Negative changes (-): Decrease the prevalence, @=NFHS-4 (2015-16), %= NFHS-5 (2019-20).*

The prevalence of ARI has increased from 2.4% to 3.2% from 2015-16 to 2019-20 in Maharashtra. The prevalence was highest in Raigarh (7.7%) followed by Sangli (4.3%) and Ratnagiri (4.2%) in the year 2015-16 in Maharashtra. On the other hand, Gadchiroli (0.5%), Bid (0.6%), and Solapur (0.7%) represented lower prevalence of ARI among children under five years of age in Maharashtra. Contrastingly, in 2019-20 the prevalence is highest in Chandrapur (7.3%), Jalna (7%), and Akola (6.5%) districts of Maharashtra whereas Yavatmal, Ratnagiri (0.3%), Thane (0.4%) had shown low level of ARI prevalence in same time periods. Chandrapur (6.1%) districts represent the highest positive change of ARI followed by Akola (4.1%) Buldhana (4.1%) and Osmanabad (3.9%) respectively. On the other hand Raigarh (-5.3%), Ratnagiri (-3.9%) and Thane (-1.8%) represent the negative changes that is reduction in the occurrence of ARI among children from 2015-16 to 2019-20.

Spatial prevalence of diarrhoea and ARI among under five children in the districts of Maharashtra in the year 2015-16 and 2019-20

Figure 1 illustrates the spatial prevalence of diarrhoea for two different time periods in districts of Maharashtra. The study shows that, whereas only two districts (Latur and Satara) had more than 13% of childhood diarrhoea prevalence during 2015-16 (Figure 1A). In 2019-20, 8 districts (Nanded, Bid, Dhule, Ahmednagar, Parbhani, Jalna, Washim and Nashik) have shown the prevalence by more than 13% for Maharashtra (Figure 1B). For 10 districts (i.e. Chandrapur, Gadchiroli, Gondia, Sindhudurg, Mumbai Suburban, Nagpur, Raigarh, Nandurbar, Mumbai and Thane) the prevalence was under less than 6.8% in 2015-16 (Figure 1A) and in 2019-20 the number of such districts has increased to 17. (Sindhudurg, Mumbai Suburban, Palghar, Ratnagiri, Thane, Mumbai, Raigarh, Sangali, Bhandara, Kolhapur, Nagpur, Gondiya, Gadchiroli, Chandrapur, Wardha, Pune and Jalgaon (Figure 1B).

The remaining 24 and 12 districts are under the range 6.8% t13% of diarrhoea prevalence between the year 2015-16 and 2019-20 respectively (Figure 1A and 1B).

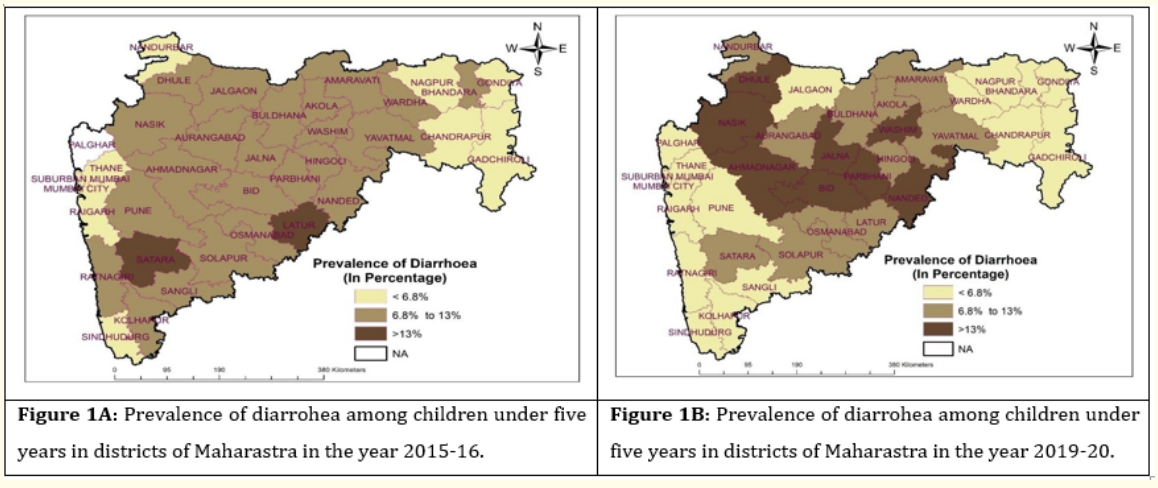

Figure 1A: Prevalence of diarrohea among children under five years in districts of Maharastra in the year 2015-16.

Figure 1B: Prevalence of diarrohea among children under five years in districts of Maharastra in the year 2019-20.

Figure 1: *Spatial prevalence of Diarrohea among children under five years in districts of Maharastra in the year 2015-16 and 2019-20.*

Figure 2 shows the spatial prevalence of ARI among children for the time periods 2015-16 and 2019-20 across the districts in Maharashtra. The prevalence of ARI by greater than 5.12% has increased from 1 district to 6 districts between 2019-20 and 2015-16. During 2015-16, only Raigarh district had more than 5.12% of ARI prevalence (Figure 2A) whereas, 6 districts viz. Amravati, Sangali, Buldhana, Akola, Jalna and Chandrapur are showing the same level of ARI prevalence in 2019-20 (Figure 2B). 26 districts were having less than 2.6% level of ARI prevalence in the 2015-16 (Figure 2A) but in 2019-20 only 13 districts showed the same level of ARI prevalence in Maharashtra (Figure 2B). The remaining 9 districts and 18 districts are under the range between 2.6% to 5.12% in the 2015-16 and the 2019-20 respectively (Figure 2A and 2B).

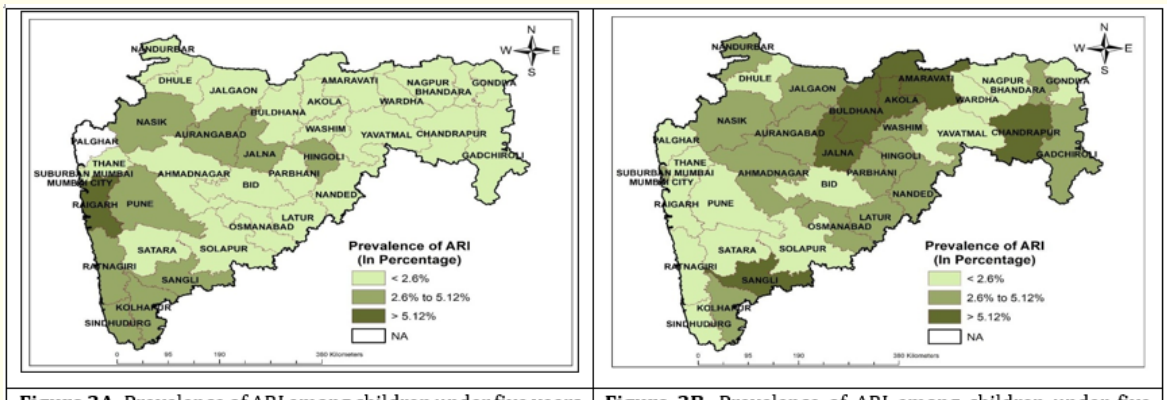

Figure 2A: Prevalence of ARI among children under five years in districts of Maharastra in the year 2015-16

Figure 2B: Prevalence of ARI among children under five years in districts of Maharastra in the year 2019-20

Figure 2: *Spatial prevalence of ARI among children under five years in districts of Maharastra in the year 2015-16 and 2019-20.*

Spatial-temporal changes of ARI and Diarrhoea among under five children from 2015-16 to 2019-20 in districts of Maharashtra

Figure 3 shows the temporal changes of prevalence of Diarrhoea and ARI between 2015-16 and 2019-20 in all districts of Maharashtra. Figure 3A shows a total 18 districts have shown negative changes (decrease the prevalence between the years) of diarrhoea prevalence in Maharashtra between the time periods. For example, Kolhapur district shows highest reduction of diarrhoea prevalence among children under 5 years of age from 2019-20 to 2020-21 followed by Latur, Sangli, and Jalgaon district etc. On the other hand, remaining 17 districts show positive changes (increase in the prevalence) between the times. The increase in the prevalence of diarrhoea has been highest in Washim (12.2%) followed by Nashik (11.1%) and Jalna (10.8%). Out of the 17 districts showing increasing prevalence 7 belong in the high-level (More than 5% changes) and 11 are in the low level (less than 5% of changes).

The temporal changes of ARI among children between the time periods has been demonstrated in figure 3B. On an average the prevalence of ARI among children has increased by 0.8% from 2015-16 to 2019-20 in Maharashtra. A total of 25 districts of Maharashtra shows increase in prevalence between the time periods. In which Chandrapur district shows greater than 5% increase and remaining 24 districts show less than 5% increase in the prevalence of. As already mentioned, Chandrapur district shows highest increase followed by Buldhana, Akola, Osmanabad, Washim, Jalna and Amravati districts; whereas Aurangabad, Dhule and Ahmednagar districts show lower level of increase in the prevalence of ARI. Surprisingly, only 10 districts of Maharashtra show the improvement (negative changes) in prevalence of child ARI. The highest reduction has taken place in Raigarh district, followed by Ratnagiri, Thane, Sindhudurg, Yavatmal, Kolhapur, Satara, Pune, Nagpur and Mumbai.

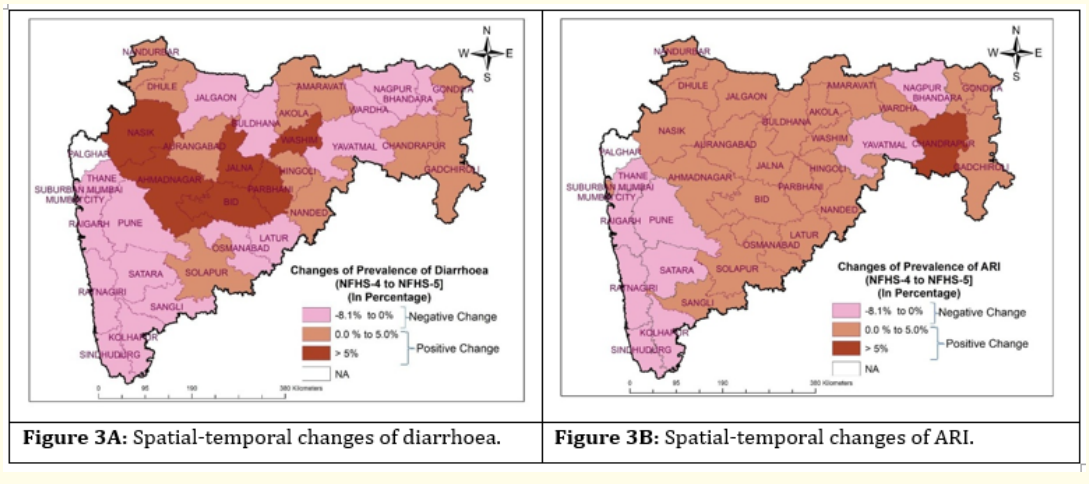

Figure 3A: Spatial-temporal changes of diarrhoea.

Figure 3B: Spatial-temporal changes of ARI.

Figure 3: *Spatial-temporal changes of ARI and Diarrhoea among under five children from 2015-16 to 2019-20 in districts of Maharashtra.*

Discussion

The present study shows that the prevalence of diarrhoea and ARI among under five children of Maharashtra districts. In this particular study a spatial tool was used to present a spatial-temporal changes across the districts of the state. The prevalence of diarrhoea disease and ARI was depicted in two points of time of 2015 to 2020. The analysis has been carried out using latest NFHS fourth round data of districts of Maharashtra. For spatial-temporal changes study was incorporated latest published fact sheet reports of NFHS fifth round of data of Maharashtra [26,28].

The prevalence of diarrhoea was increased by 0.4% and ARI was 0.8% in last half decade in Maharashtra. The result of spatial prevalence maps depict that in 2015 there was only two districts in high prevalence (> 13%) of diarrhoea; which was increased in 8 districts in 2020 of the state. On the other hand, in case of ARI, it has increased from 1 to 5 districts in last half decade in Maharashtra. In Maharashtra, maximum proportion of anganwadi children family practices dumping refuse discriminately around house, open air defecation but private school children had protected water supply, practice sanitary disposal of refuse and use of sanitary latrines. Moreover, mother's education had great role for children suffering from diarrhoea [36].

The prevalence of diarrhoea and ARI in Maharashtra among under-five children has been increased in latest NFHS reports. Which shows the intervention and initiative was taken by state government was not sufficient enough for overall women and child health. Despite largely low improvement of the under-five health of the state, the Kolhapur district shows highest improvement of diarrhoea disease followed by Latur, Sangli, and Jalgaon districts of Maharashtra. Palghar district of Maharashtra, 47% children was used of well as their drinking source for water consumption. Further, almost 99% household had open drains and 50% household use open defecation as latrine practices. Furthermore, 33.4% of diarrhoea among children was found from poor household [35].

On the other hand, Washim district represents higher increase in the prevalence of diarrohea followed by Nashik and Jalna districts respectively. In the case of ARI, 10 districts were showing negative changes status; whereas 25 districts were showing the increase in (positive changes) prevalence in Maharashtra. Chandrapur district was showing highest increase in prevalence followed by Buldhana, Akola, Osmanabad and Washim districts etc. whereas Raigarh, Ratnagiri, Thane, and Sindhudurg districts are showing a reduction of prevalence of childhood ARI in Maharashtra.

The preventable interventions like awareness generation on exclusive breastfeeding [23,30,31], provision of safe drinking water and food, sanitation and hygienic practices, improved nutrition, and ensuring adequate health care access [32-34] with improving mothers' education [16] which altogether can help to prevent the incidence of diarrhoea and ARI among under five children can be adopted with a special focus on those districts which are showing less improvement in overtime changes.

Conclusion

The study highlights the most vulnerable districts of diarrhoea and ARI diseases of Maharashtra. The study used spatial tools to present the temporal changes in two points of time. The districts which have shown positive changes of Diarrhoea among state's districts indicates the improvements in terms of interventions and initiatives taken by state and central government. However, few remaining districts have shown negative changes that means the necessary strategies could not be sufficient for prevention of diarrhoea diseases and tools for Acute Respiratory Infection. Therefore, state government must focus on specific districts where prevalence is high and launch various programme and schemes targeting to child and mother's health, especially programme related for immunization and prevention of diarrheal disease and ARI.

Similar to other studies, this present has some limitations. Firstly, the response for diarrhoea and ARI was self-reported. Therefore, a recall bias may be present during the data collection. Secondly, the study is only based on the spatial prevalence and temporal changes between NFHS-4 and NFHS-5. The recent NFHS-5 has released the factsheet only for 22 states/UTs till the date. Therefore, the study does not provide the information on the socioeconomic and demographic characteristics of the child suffering from this morbidity. However, even after the above limitations, this study will have significant contribution to find out some of the determinants through the existing literature.

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