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INFANT AND CHILD MORTALITY AND ITS MAJOR DETERMINANTS: A CASE STUDY OF UTTARAKHAND STATE, INDIA

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Abstract

The human development of a country is directly associated with the health of its population, especially of its children. In this context, present study analyses spatial variations in infant, and child mortality and identifies its determinants in Uttarakhand. The study is based on secondary data collected from the Annual Health Survey (AHS) for the period of 2010-11 to 2012-13 and National Family Health Survey (NFHS) for the period of 1998-99 to 2019-21. Data have been processed with coefficient of variance and linear regression. The results reveal that Infant Mortality Rate (IMR) in Uttarakhand has declined from 58 in 1998-99 to 39 in 2019-21 recording a reduction of 19 points. Similarly, under 5 Mortality Rate (U5MR) has declined from 79 to 46 registering a reduction of 33 points during the same period. The study further reveals that infant and child mortality rates have significantly declined in Rudraprayag and Almora districts. However, Uttarkashi and Pithoragarh districts have recorded an increase in IMR and U5MR during the study period.

Keywords: Infants, Health, Infant mortality, Child mortality, Uttarakhand.

Introduction

Health is the real wealth of any region and the health of infants and children is more crucial. Health has been defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 1948). Health is one of the important indicators considered for controlling the socio-economic wellbeing of the people of a nation. Thus, health is a crucial factor for human prosperity. The human development of any region is directly connected with the health of its population and mostly by the health of its children. Healthy infants and children are the pride of humanity.

The global average of infant and child deaths has been 28 and 38 per 1,000 live births respectively, during 2019. The lowest IMR has been recorded in Europe and Central Asia (3 per 1,000 live births) followed by North America (5 per 1,000 live births), East Asia and Pacific (12 per 1,000 live births) and Latin America and Caribbean (14 per 1,000 live births). In the same year (2019), sub-Sahara Africa and Asia have recorded very high IMR of 52 and 33 deaths per 1,000 live births, respectively (World Bank, 2020).

India is one of the developing countries having high IMR and U5MR rates. All-India average of IMR has declined from 62 to 41 per 1,000 live births and U5MR from 85 to 53 per 1,000 live births during 2004 to 2013 (Kundu, 2017). India could not achieve the Millennium Development Goal-4, targeting at the reduction of IMR and U5MR to the extent of 27 and 42 per 1,000 live births respectively by the end

of 2015 (United Nations, 2015). Although, a decreasing trend of IMR from 57 to 35 deaths and of U5MR, from 74 to 42 deaths per 1,000 live births has been observed in India during 2005-06 and 2019-21, yet it is still too high (IIPS, 2006, 2021). At the same time, there are wide regional and temporal variations in mortality rates of infants and children among the Indian states. For example, Orissa has recorded the highest mortality rates for infants and children among the Indian states in 2005-06 (Pradhan and Arokiasamy, 2006). However, the position has transformed in 2019-21, when Bihar recorded the highest infant and child deaths (47 and 56 per 1,000 live births respectively) in India (IIPS, 2006, 2021).

Many studies have highlighted the causes of infant and children's deaths. Singh (2013) has found that about 31 per cent of the deaths have been due to infections, tetanus and other diseases in India. Seventy per cent of the total infant's deaths and more than half of under five deaths fell in the neo-natal period (Sankar et al., 2016). A hospital-based study on immunization status in western Uttar Pradesh has revealed that 40.66 per cent children have been completely immunised, and 45.11 per cent have been partially immunised (Agarwal and Kumari, 2014). The study has further revealed that the gender of child, family income and parental education have special impact on the status of immunization. Similarly, Khismatrao et al. (2015) have identified that the major cause for partial immunization in Pune district of Maharashtra has been the lack of awareness about vaccines and illness of children. Empowered Action Group (EAG) states in India have reported very high mortality, creating huge gaps with progressive states. Uttarakhand is also one of the EAG states where infant and child health condition is abnormally poor. Therefore, this study has been taken up to examine the spatial variations in infant and child mortality in Uttarakhand.

Objectives

Major objectives of the study are:

- to examine the spatial variations in IMR and U5MR in Uttarakhand and
- to identify the associated determinants of IMR and U5MR.

Study Area

Uttarakhand, a small hilly state located in northern part of India, lies between 30° 19' to 18° 89' N latitudes and 78° 01' to 35° 82' E longitudes. The state has 13 districts of which seven districts namely Chamoli, Dehradun, Haridwar, Pauri Garhwal, Rudraprayag, Tehri Garhwal and Uttarkashi fall in Garhwal division and six districts namely Almora, Bageshwar, Champawat, Nainital, Pithoragarh and Udham Singh Nagar fall in Kumaon division. Four of these districts namely, Nainital, Haridwar, Dehradun and Udham Singh Nagar have a large area in the plains, whereas the other nine districts comprise of the hilly region. Located in the foothills of western Himalayas, Dehradun, the capital of the state, is the largest city. According to 2011 Census, Uttarakhand has a population of 1,00,86,292 persons comprising of 51,37,773 males and 49,48,519 females. The state has recorded a 78.82 per cent literacy rate which is more than the national average of 74.04 per cent. The climate of the state is temperate in general. However, there are two distinct climatic zones associated with hilly terrain and plain topography of the state. Agriculture is the major economic activity of the state and about 70 per cent of the population resides in rural areas.

Database and Methodology

This study is based on secondary data obtained from the Annual Health Survey (AHS) for the years of 2010-11, 2011-12, 2012-13 and National Family Health Survey (NFHS) for the years of 1998-99, 2005-06, 2015-16, and 2019-21. NFHS data have been used to show the trends in IMR and U5MR in the study area as it is available only at the state level. Mortality data are not available at district level in NFHS. Therefore, to examine the inter-district variations in IMR and U5MR, AHS data have been used. For the analysis of consistency and variability in IMR and U5MR, coefficient of variation has been calculated. Further, maps and scatter diagrams have been drawn to interpret the results.

Results and Discussion

Trends in Infant and Under 5 Mortality Rate

The study reveals that both IMR and U5MR have declined with time in Uttarakhand (Fig. 1). Infant mortality has declined from 58 deaths per 1,000 live births in 1998-99 to 39 deaths in 2019-21, thereby recording a reduction of 19 points. Similarly, U5MR has also declined from 79 deaths to 46 deaths per 1,000 live births during the same period. These declines suggest improvement in child care during the study period. The NFHS (IIPS, 2006, 2021) has recorded an improvement in women's rate of literacy in Uttarakhand from 64.70 per cent to 79.80 per cent, thereby resulting in a decline in Total Fertility Rate (TFR) from 2.6 to 1.9. The NFHS has further witnessed that with the improvement in women's literacy, breastfeeding has increased from 31.20 to 52.50 per cent during this period in Uttarakhand. These findings suggest that decline in infant and child mortality is significantly associated with the socio-economic development such as increase in women's literacy rate, breastfeeding etc. Despite a substantial decline in both IMR and U5MR due to improvements in socio-economic development in the state, still these are very high in comparison to progressive states of India like Kerala where IMR and U5MR are 4.4 and 5.2 respectively, followed by Goa (5.6 and 10.6 respectively) in 2019-21(IIPS, 2021). There are a number of constraints due to which health

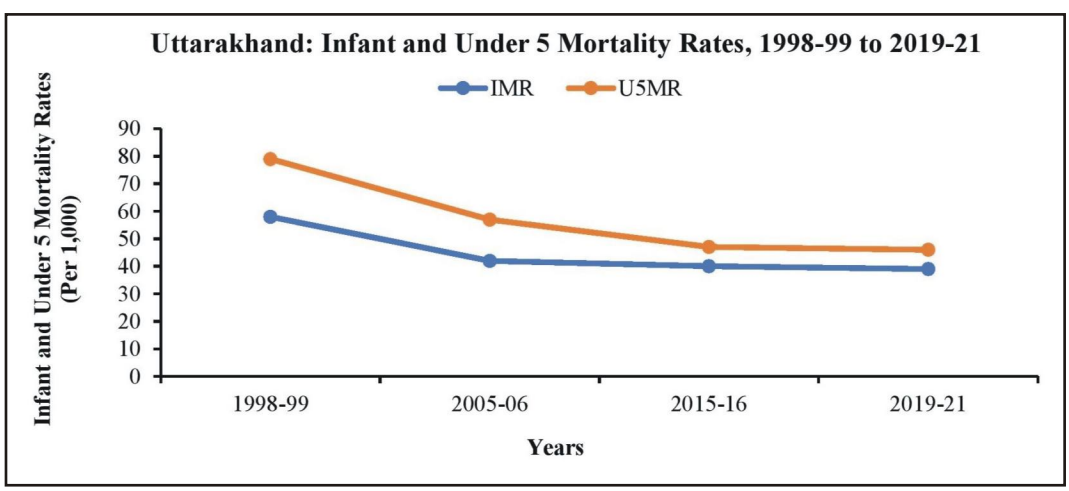

Fig. 1

infrastructure is under developed in Uttarakhand. The population served by each Primary Health Centre (PHC) i.e., 28,646 persons and Community Health Centre (CHC) i.e., 1,09,881 persons is much higher than the national average of 20,000 and 80,000 persons, respectively (Rural Health Statistics in India, 2019), duly proving a shortage of health facilities. Consequently, both IMR and U5MR are still high in the state as compared to the progressive states.

Spatial Pattern of Infant Mortality Rate

Fig. 2 depicts the spatial and temporal pattern of infant mortality rate in Uttarakhand for the years 2010-11, 2011-12, and 2012-13. The average rate of infant mortality has declined marginally from 43 in 2010-11 to 40 in 2012-13. Haridwar and Tehri Garhwal districts have recorded very high infant mortality rates, while Pauri Garhwal district has witnessed high IMR in 2010-11. Haridwar is the only district that consistently performed poorly which is reflected in its very high IMR in all the years under study. However, Tehri Garhwal is the only district that has improved its position from very high IMR in 2010-11 to the category of high IMR in 2011-12 and 2012-13. Pauri Garhwal has been the only district placed in the high category in 2010-11 but in the successive year 2011-12 Uttarkashi and Tehri Garhwal districts also joined this category. Pauri Garhwal has improved its position to the moderate category in 2012-13, while the position of Uttarkashi and Tehri Garhwal remained unchanged in 2012-13. Unfort-unately, Uttarkashi district which has been placed in moderate category in 2010-11 has slipped to the high category and remained there in the successive years of 2011-12 and 2012-13. Similarlay, Pithoragarh district joined the moderate category in 2012-13 from its position in low category in 2010-11 and 2011-12. Remarkably, Uttarkashi and Pithoragarh are the only districts that have recorded improvement in the IMR during the study period. Rudraprayag and Almora are the only districts which remained in the low

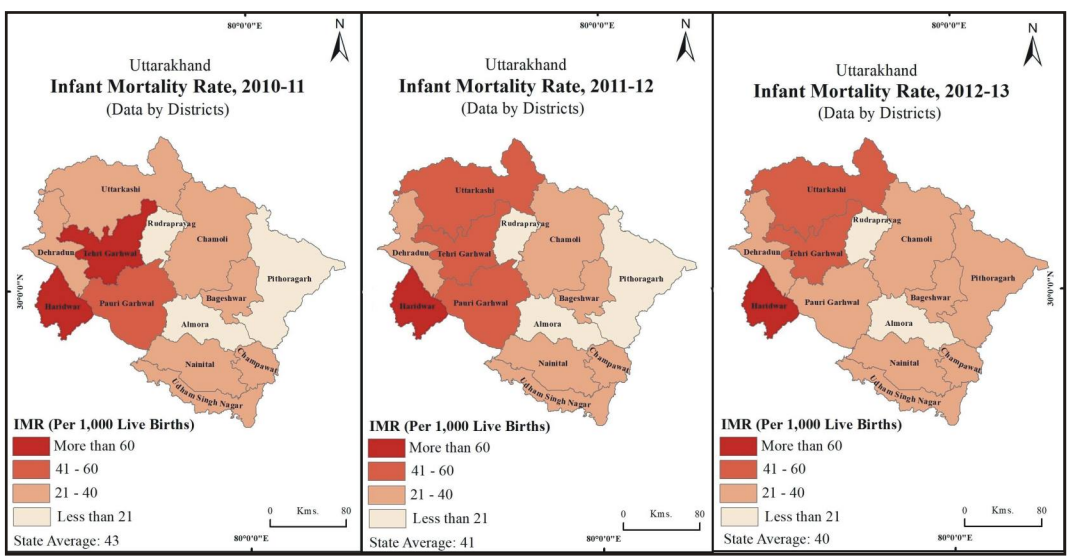

Fig. 2

category of IMR throughout the study period. All other districts namely Nainital, Champawat, Udham Singh Nagar, Bageshwar, Chamoli, and Dehradun recorded moderate IMR ranging from 20 to 40 during the study period.

Determinants of Infant Mortality Rate

The study reveals that the variables like levels of female rate of literacy, children exclusively breastfed for at least 6 months, children who have received 3 doses of polio vaccine, and children who have been fully immunized are negatively related with the IMR (Fig. 3, Table 1). The study, therefore, suggests that with the improvement in the educational status of females, increase in breastfeeding and proper immunization of children, the IMR has declined. The study has shown positive relationship with the total fertility rate and children who have not received any vaccination (Fig. 3, Table 1). This relationship suggests that higher TFR and indifferent attitude towards vaccination of children have substantial adverse impact on the health of infants, resulting in an increase in IMR.

Spatial Pattern of Under 5 Mortality Rate

The spatial pattern of U5MR for the years of 2010-11, 2011-12, and 2012-13 have been presented in Fig. 4. The U5MR pattern exhibits some similarity with the infant mortality rate (Fig. 2). Districts such as Haridwar and Tehri Garhwal have recorded very high U5MR in 2010-11. Tehri Garhwal however, has shown some improvement and shifted to the high category of U5MR in 2011-12 and 2012-13. Intrestingly, Haridwar has not reflected any major decline in U5MR and therefore remained consistently in the very

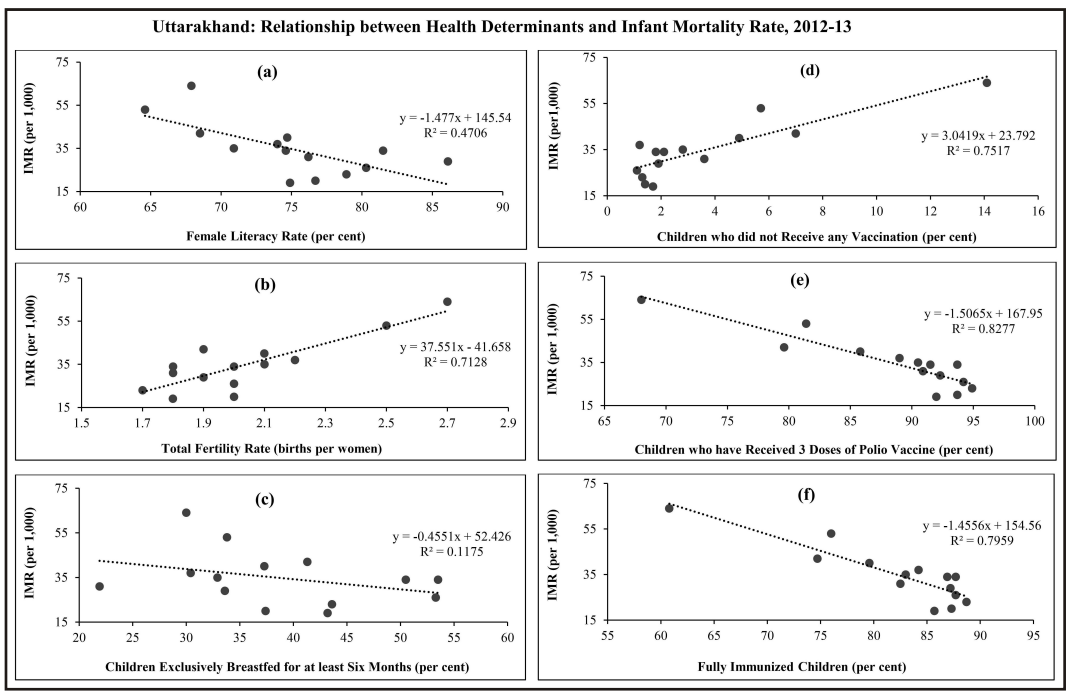

Fig. 3

Table 1
Uttarakhand: Relationship of Health Determinants with IMR and U5MR

Health Determinants	IMR (per 1,000 live births)	U5MR (per 1,000 live births)
	Coefficient of Correlation	Coefficient of Correlation
Female Literacy Rate	-0.6860	-0.7131
Total Fertility Rate (births per woman)	0.8442	0.8445
Mother who had Full Ante-natal Care Visits	-0.0900	-0.0692
Children Exclusively Breastfed for at Least Six Months	-0.3427	-0.3718
Children who did not Receive any Vaccination	0.8670	0.8651
Children with Birth Weight Less than 2.5 kg.	0.2905	0.2805
Children who have Received 3 Doses of Polio Vaccine	-0.9097	-0.9114
New-born who was Checked up within 24 Hours of Birth	-0.0173	-0.0173
Full Immunized Children	-0.8921	-0.8950
Mother who did not Receive any Post-natal Check-ups	0.1944	0.1889

Source: Compiled by Author

high category during the study period. Pauri Garhwal has been the only district under high category in 2010-11 but due to a decline in U5MR, it has slipped in moderate category in successive years of 2011-12 and 2012-13. Astonishingly, Uttarkashi district have experienced an increase in U5MR with time and has joined high category in 2012-13 from moderate position in 2010-11 and 2011-12. Likewise, Pithoragarh is the another district which has shown an increase in U5MR. Earlier, it has been in the low category with Almora district in 2010-11 and 2011-12, but slipped to moderate category in 2012-13. It is worth mentioning that Almora is the only district that remained in low category throughout the study period. Similarly, the districts like Rudra-prayag, Chamoli, Nainital, Bageshwar,

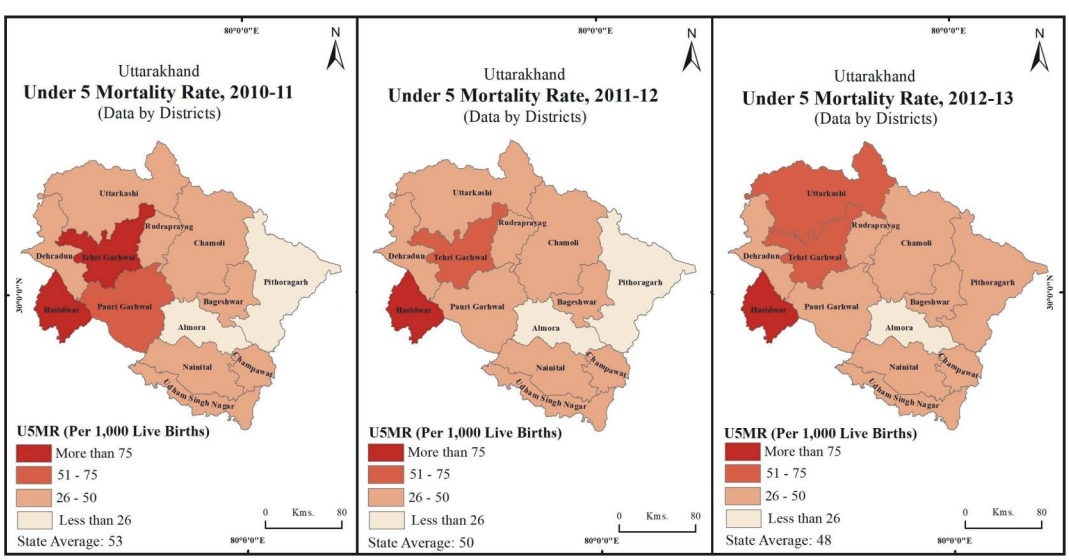

Fig. 4

Dehradun, Champawat, and Udham Singh Nagar have been observed in moderate category all through the study period reflecting slow or almost no improvement in their U5MR (Fig. 4).

Determinants of Under 5 Mortality Rate

The study reflects that U5MR is negatively associated with its determinants like women's rate of literacy, children exclusively breastfed for at least 6 months, children who have received 3 doses of polio vaccine and fully immunized children (Fig. 5, Table 1). It indicates that the improvement in education of women, increase in immunization of children and enhancement in the period of breastfeeding will go a long way to reduce the U5MR. The study further reveals that U5MR is positively related with total fertility rate and children who have not received any vaccination (Fig. 5, Table 1). It indicates that with an increase in total fertility rate and children who have not been vaccinated, the U5MR will also increase. It has also been observed that the mothers who did not have a full antenatal check-up, children with birth weight less than 2.5 kg, new-born who have been checked up within 24 hours of birth, and mothers who have not received any post-natal check-ups have no impact on the U5MR (Table 1). In the light of above, the study points out that to control both the IMR and U5MR in the study area, there is a need to stress on female education, immunization and vaccination of children; breastfeeding and providing 3 doses of polio vaccine to the children.

Disparities in IMR and U5MR

Table 2 indicates that with time the disparities in the infants' deaths have decreased in the study area as coefficient of variation has decreased from 42.78 in 2010-11 to 37.29 in

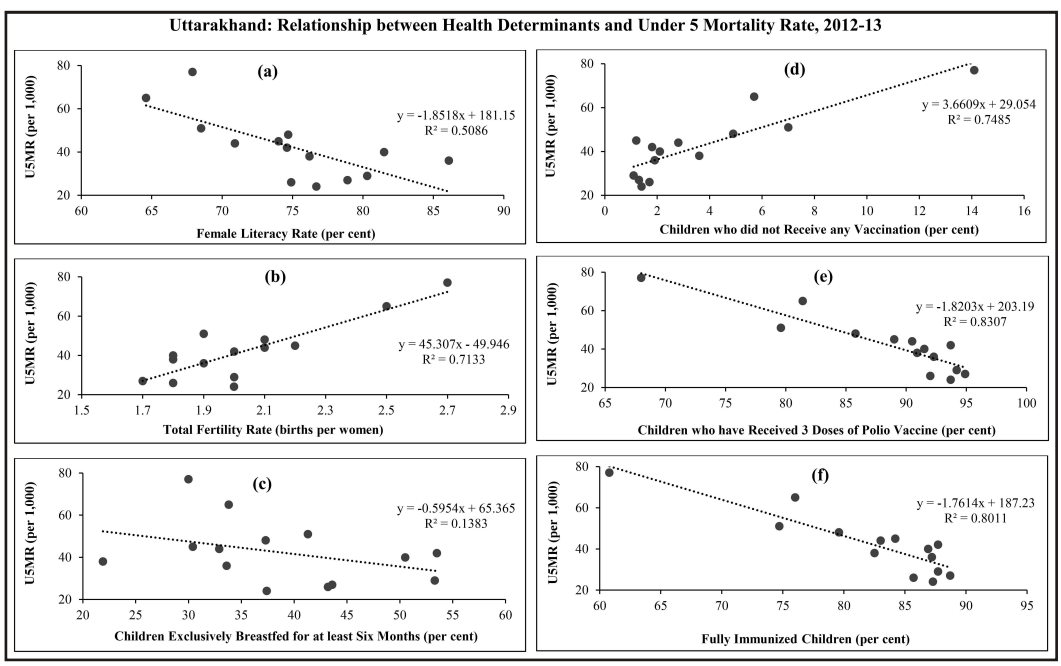

Fig. 5

Table 2
Uttarakhand: Consistency and Variability of IMR and U5MR

Parameters	Mean			Standard Deviation			Coefficient of Variation (per cent)		
	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13
IMR	36.38	35.69	34.38	15.56	14.19	12.82	42.78	39.76	37.29
U5MR	44.85	43.15	41.85	20.24	17.44	15.49	45.13	40.42	37.01

Source: Compiled by Author

2012-13. The high value of the coefficient of variation indicates a high inequality in the rates of infant deaths and vice versa. Although the regional pattern in U5MR follows the IMR pattern, yet U5MR's standard deviation (20.24) and coefficient of variation (45.13 per cent) in 2010-11 indicate a higher variation as compared to 2012-13 (Table 2). The variables which have a significant impact on the health status of children are the female rate of literacy, total fertility rate, children exclusively breastfed for at least 6 months, children who have not received any vaccination, children who have received 3 doses of the polio vaccine, and fully immunized children.

Conclusions

The study points out that U5MR has declined more than the IMR during the study period. Haridwar is the only district which have recorded very high IMR and U5MR throughtout the study period. Conversely, Rudraprayag and Almora districts have depicted the least IMR in all the years under study. The study reveals that infant and children's mortalities are high in two clusters; one in foothill district of Haridwar and other one in the middle Himalayan districts of Tehri Garhwal and Uttarkashi. Interestingly, Uttarkashi and Pithoragarh districts recorded an increase both in IMR and U5MR during the study period. Further, the linear regression analysis shows a negative association of women's literacy rates, children who have been exclusively breastfed for at least 6 months, children who have received 3 doses of the polio vaccine, and children who have been fully immunized with IMR and U5MR. At the same time, IMR and U5MR have shown positive relationship with total fertility rate and children who have not received any vaccine. Further, the study shows that the factors like the overall level of education of women, births per women, children exclusively breastfed for at least 6 months, children who have got vaccination, children who have received 3 doses of the polio vaccine, and children who have been fully immunized play a significant role in reducing infant and child mortality. Consequently, all these factors should be taken care to bring the state at par with the progressive states in terms of IMR and U5MR. Finally, a special drive is required towards reduction of IMR and U5MR in Uttarkashi and Pithoragarh to bring these districts at par with the other districts of the state.

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