Death clustering in India: Levels, trends, and differentials, 1992–2016

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ABSTRACT

Background: India and many of its bigger states could not achieve the national goal related with child health based on 4th UN Millennium Development Goal. There is a need to look for different approaches which deal with infant mortality. Literature emphasizes clustering of infant deaths in families has implications on infant mortality. **Objective:** The present study attempts to examine the levels, trends, and differentials of clustering of infant deaths in families in India using National Family Health Survey (NFHS) dataset and how they changed over the years. **Materials and Methods:** Study used bivariate analysis and multilevel random effects logit model based intraclass correlation coefficient and median odds ratio to examine the clustering of deaths in families, in India. **Results:** There has been a consistent decline in both infant mortality rate (IMR) and clustering of infant deaths in families in India between 1992 and 2016. However, the pace of decline was faster after 2005. States such as Uttar Pradesh, Madhya Pradesh, and Bihar are the major contributors in clustering of infant deaths in families. In Kerala, clustering of infant deaths has been disappeared in families while among relatively more developed states such as Maharashtra and Tamil Nadu have experienced a reduction in clustering of infant deaths in families by an amount of <1%. **Conclusion:** Between NFHS-3 and NFHS-4 there has been an increase in clustering of infant deaths among mothers with age at first birth >30 years and for mothers who have received higher education. IMR can be reduced to a greater extent if government policies and health resources are directed toward the families experiencing the clustering of infant deaths.

Key words: *Families, Infant death clustering, Infant mortality rate, Intraclass correlation coefficient, Median odds ratio, Relative change*

In the past few decades, India has made significant progress in the social and economic dimensions as infant mortality rate (IMR) has been reduced from 88 infant deaths per 1000 live births in 1990 to 37 infant deaths per 1000 live births in 2015 [1]. This significant fall in IMR to lower level over time shows progress in health dimension within the country. Instead of these achievements, India and many of its bigger states could not achieve the national target of 29 infant deaths per 1000 live births by 2015 as was envisaged for India under 4th UN Millennium Development Goal (MDG) in 2000. Moreover, the states such as Assam, Bihar, Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Odisha, and Rajasthan have high mortality levels ranges from 41 infant deaths per 1000 live births in Chhattisgarh to 50 infant deaths per 1000 live births in Madhya Pradesh [1]. These all possess a question – does the approach toward reducing the infant mortality in the country is on the correct track? Or, there is a need to re-look for a different approach to deal with infant mortality which has been neglected over the years.

In the past, many studies have tried to understand the underlying factors which are affecting infant mortality. It has been found that apart from the known risk factors affecting infant mortality, there is a tendency of infant deaths to cluster among a smaller number of families [2-6]. It implies heterogeneity in the risk of experiencing infant deaths, i.e., in a locality few mothers are more susceptible to experience child deaths than other women. A set of both observed and unobserved factors are hugely affecting this uneven distribution of child deaths among mothers. This is known as deaths clustering in demographic literature. In India, observed factors such as income disparities, uneven regional development levels, mother's educational status, caste, religion, and age of the mother are known to play a major role in affecting the infant mortality [7-14]. However, one of the important predictors, i.e. death of a previous child in the family (i.e., mother) found to be minimally addressed. The main intent of the present paper was to examine the levels, trends, and differentials of clustering of infant deaths in families during the past two and half decades 1992–2016.

MATERIALS AND METHODS

Full retrospective maternity birth history data of India from three survey rounds of National Family Health Surveys (NFHS),

respectively, NFHS-1 (1992–1993), NFHS-3 (2005–2006), and NFHS-4 (2015–2016) have been utilized for the study. The data of NHFS-2 were excluded to maintain the 10-year time gap; furthermore, there were no significant data and changes were observed between NHS-1 and 2. In NFHS-1, an overall sample size of 89, 777 ever-married women in the age group of 13–49 years, had a total birth of 275,172 between 1954 and 1993. NFHS-3 captures information of about 256,782 births which occurred to 124,385 women aged 15–49 years between 1968 and 2006. NFHS-4 has information about 1,315,617 births which are nested within 699,686 mothers in the age of 15–49 years between 1970 and 2016. In all the three survey rounds, different information related to all births such as year of birth, birth order, sex of the child, and current age of the child along with children's survival status and age of death is available for a period spanning nearly 50 years provides an opportunity to examine family level death clustering. Families in the study refer to mothers of the children.

The family-level extent of infant death clustering was examined using bivariate analysis of children ever born to mothers and the number of infant deaths experienced by such mothers/families. Relative change in levels of death clustering over time has been calculated for examining the pattern of change in clustering in various states and background characteristics. Those mothers who had experienced two or more infant deaths are defined as high-risk families and clustered infant deaths have been referred as a child who died as an infant as well as at least one of their siblings born to their biological mother also died as an infant. There are limited studies which addressed this issue for India and some selected states (i.e., bigger states: Madhya Pradesh, Assam, Odisha, Uttar Pradesh, Rajasthan, Chhattisgarh, Bihar, Kerala, Tamil Nadu, Maharashtra, and West Bengal) and studies are scarce which raise this issue for different time periods covering different birth cohort of the time. The states were selected based on their performance in under five child mortality and keeping the United Nations' MDG target for India. As per the Sample Registration System, 2013 first seven states as indicated above have under-five mortality above national level and rest four have levels below the national level.

To have better idea about the effect of previous sibling's survival status on the survival of index child and mother-specific unobserved residual heterogeneity, newly defined measure of clustering, namely intraclass correlation coefficient (ICC) and median odds ratio (MOR) were estimated through a multilevel random effects logit model. In the case of multilevel models or formulating a two-level model, it is common to assume normality for the cluster-level (level 2, i.e., mother) variation and to assume independence of units within cluster conditional on the cluster-/mother-level variable, thus generating a model in which children are marginally correlated within mothers. In case of non-linear logit models, ICC reflects the strength of death clustering at mother level or in other words, the percentage of variation in infant deaths explained due to variation in mother level unobserved heterogeneity factor and MOR reflects for the median case.

If we pick randomly two children of different mothers, the residual heterogeneity between mothers increased or decreased by the times an individual odds of being died as an infant [15]. In other words, MOR is the MOR between the children of higher propensity of experiencing infant death due to their high-risk mothers and the children of the lower propensity of experiencing infant deaths belonging to the low-risk mothers. The measure is always ≥1. If the MOR is 1, there is no variation between mother clusters (no second level variation) due to residual unobserved heterogeneity [15,16]. If there is considerable between-cluster/mother variation, the MOR will be large. MOR is a function of only cluster/mother residual variance. The measure is directly comparable with fixed-effects odds ratios.

RESULTS

Data in Tables 1 and 2 show the level of infant death clustering among families, and its change in India and its selected states, for the duration of two and a half decades. Results showed that in NFHS-1, infant mortality in India was 79 infant deaths per 1000 live births with nearly 7% families have experienced two or more infant deaths, and the extent of infant deaths clustered in them was 52%. Around 3% of the families in the sample contribute three or more deaths which account for almost one-fourth of the total number of infant deaths. There were a large number of states such as Uttar Pradesh, Bihar, Assam, Odisha, and Madhya Pradesh where IMR ranges from 84 infant deaths per 1000 live births in Bihar to 101 infant deaths per 1000 live births in Odisha and hence they were under an enormous burden of infant deaths.

The trends of IMR in India have also improved over time. In NFHS-1, the country had an IMR of 79 which reduced to 57 infant deaths per 1000 live births in 2005–2006. However, in NFHS-3, the disproportionate distribution of infant deaths in families is still there in India, as nearly 46% of infant deaths were concentrated in just 5% families, and almost 1% families experienced three or more infant deaths which contributed nearly 18% of the total infant deaths in the sample (17,796). In NFHS-3, after examining the family level clustering of infant deaths in larger states such as Uttar Pradesh and Madhya Pradesh it was found that in Uttar Pradesh, nearly 9% of families have experienced multiple infant deaths contributed 53% of total infant deaths and in Madhya Pradesh, about 55% of the infant deaths (two or more) were clustered within 8% of families.

In NFHS-4 (2015–2016), IMR for India was 41 infant deaths per 1000 live births and there were almost 2% families who experienced two or more infant deaths. It contributed nearly 37% of the total infant deaths. There were <1% of families in India who experienced three or more infant deaths and contributed nearly 13% of the total infant deaths.

By examining the relative change of clustering of deaths in families and IMR in India, it was found that IMR has reduced 27% from NFHS-1 to 3 and 28% from NFHS-3 to 4. However, there was a reduction of 34% points in families with two or more infant deaths between NFHS-1 and 3 and 57% reduction was observed between NFHS-3 and 4, respectively. Further, there was 12%

Table 1: Levels of clustering of infant deaths in families in India and its selected states, 1992–2016

Country/States	NFHS-1 (1992–1993)						
	Families with ≥2 ID	≥2 ID clustered	Families with ≥3 ID experienced	≥3 ID	Total families experiencing ID (N)	Infant deaths (N)	IMR
India	7.3	52.3	2.39	24.5	79, 350	24,976	79
Uttarakhand	5.6	47.0	1.8	23.0	1,549	534	62
Rajasthan	5.5	51.4	1.8	24.1	4,497	1,237	77
Uttar Pradesh	13.5	61.7	5.4	34.0	8,491	5,058	98
Bihar	9.1	53.1	2.6	22.2	3,973	1,594	84
Assam	8.5	51.0	2.4	21.2	2,717	1,006	91
West Bengal	6.2	46.9	1.8	20.2	3,782	1,289	65
Jharkhand	6.9	52.9	2.1	23.3	1,112	340	70
Odisha	10.8	54.6	3.6	25.5	3,782	1,793	101
Chhattisgarh	8.1	54.5	2.1	21.3	1,022	354	62
MP	9.2	57.4	3.2	28.7	4,369	1,845	89
Gujarat	5.3	43.9	1.4	17.0	3,390	958	62
Maharashtra	4.41	45.9	1.3	20.3	3,673	883	47
Kerala	1.6	31.5	0.3	9.9	3,896	454	28
Tamil Nadu	4.8	43.4	1.3	17.3	3,502	950	65
Country/States	**NFHS-3 (2005–2006)**						
	Families with ≥2 ID	**≥2 ID clustered**	**Families with ≥3 ID experienced**	**≥3 ID**	**Total families experiencing ID (N)**	**Infant deaths (N)**	**IMR**
India	4.8	45.9	1.3	18.2	84,609	17,796	57
Uttarakhand	3.7	44.5	0.8	14.4	1,985	385	41
Rajasthan	7.2	52.4	2.1	23.0	2,821	957	66
Uttar Pradesh	9.2	53.0	2.9	23.0	8,451	3302	73
Bihar	6.1	46.1	1.7	18.5	2,743	850	63
Assam	4.4	46.3	1.1	18.9	2,565	583	67
West Bengal	3.1	38.7	0.8	14.4	4,792	832	48
Jharkhand	5.8	44.6	1.4	15.6	2,134	611	69
Odisha	5.6	44.9	1.6	18.8	3,101	887	63
Chhattisgarh	6.5	47.4	2.0	20.9	2,638	842	72
MP	8.2	54.7	2.5	23.8	4,669	1420	67
Gujarat	3.8	41.0	0.7	11.7	2,654	565	51
Maharashtra	2.1	36.7	0.6	14.1	6,174	855	36
Kerala	0.8	29.3	0.2	8.4	2,479	143	15
Tamil Nadu	2.0	31.9	0.4	10.4	4,154	562	32
Country/States	**NFHS-4 (2015–2016)**						
	Families with ≥2 ID	**≥2 IDs clustered**	**Families with ≥3 ID experienced**	**≥3 ID**	**Total families experiencing ID (N)**	**Infant deaths (N)**	**IMR**
India	2.06	36.8	0.5	12.94	476,619	66,158	41
Uttarakhand	2.0	35.1	0.5	12.38	11,440	1,568	40
Rajasthan	2.1	34.6	0.5	11.6	28,874	4,133	41
Uttar Pradesh	4.5	43.6	1.3	17.53	61,898	15,714	64
Bihar	3.1	40.0	0.8	14.7	32,507	6,036	48
Assam	2.2	38.5	0.5	13.1	19,922	2,631	48
West Bengal	1.1	26.4	0.1	4.76	13,146	1,319	27
Jharkhand	2.4	35.2	0.5	11.1	20,253	3,096	44
Odisha	2.5	37.6	0.6	13.43	22,924	3,793	40
Chhattisgarh	2.8	36.3	0.7	14.0	16,660	2,993	54
MP	3.3	41.7	0.9	15.9	44,295	8,285	51

(Contd...)

Table 1: *(Continued)*

Country/States	NFHS-4 (2015–2016)						
	Families with ≥2 ID	≥2 IDs clustered	Families with ≥3 ID experienced	≥3 ID	Total families experiencing ID (N)	Infant deaths (N)	IMR
Gujarat	1.7	36.1	0.4	12	16,123	1,844	34
Maharashtra	0.7	25.3	0.2	7.2	21,042	1,493	24
Kerala	0.3	29.4	0.1	8.8	7,660	1,79	6
Tamil Nadu	0.6	26.7	0.2	8.97	20,582	1,137	21

NFHS: National Family Health Survey, IMR: Infant mortality rate

Table 2: Relative change in clustering of deaths in India and selected states, 1992–2016

Country/States	Relative change NFHS-3–NFHS-4			Relative change NFHS-1–NFHS-3		
	≥2 IDs clustered	Families with ≥2 ID	IMR	≥2 IDs clustered	Families with ≥2 ID	IMR
India	–20	–57	–28	–12	–34	–27
Uttarakhand	–21	–45	–2	–5	–34	–34
Rajasthan	–34	–71	–38	2	31	–15
Uttar Pradesh	–18	–51	–12	–14	–32	–26
Bihar	–13	–49	–23	–13	–33	–26
Assam	–17	–50	–28	–9	–48	–26
West Bengal	–32	–64	–43	–17	–50	–27
Jharkhand	–21	–59	–36	–16	–16	–2
Odisha	–16	–55	–36	–18	–48	–38
Chhattisgarh	–23	–57	–25	–13	–20	15
Madhya Pradesh	–24	–60	–24	–5	–11	–24
Gujarat	–12	–54	–33	–7	–28	–19
Maharashtra	–31	–66	–33	–20	–52	–24
Kerala	0	–66	–60	–7	–50	–45
Tamil Nadu	–16	–69	–33	–26	–58	–52

NFHS: National Family Health Survey, IMR: Infant mortality rate

reduction in relative change in clustered deaths between NFHS-1 and 3 and 20% between NFHS-3 and 4. Between NFHS-1 and 3, except Rajasthan, all other states experienced a reduction of families with two or more infant deaths as well as a reduction in the percentage of clustered deaths. Between NFHS-1 and NFHS-4, in Kerala, clustering of infant deaths has been almost disappeared in families while among relatively more developed states, except Gujarat both Maharashtra and Tamil Nadu have experienced a reduction in the clustering of infant deaths in families by an amount of <1%.

Table 3 presents the percentage of families with two or more infant deaths (high-risk families) and level of death clustering according to selected background variables in NFHS-1 (1992–1993), NFHS-3 (2005–2006), and NFHS-4 (2015–2016) along with their relative change. Relative change shows that the decline in the percentage of families and clustered deaths among mothers with age at first birth 20 years or less was faster between NFHS-3 and 4 than NFHS-1 and 3. For the mothers with age 30 years or more, it has been found that both percentage of families with two or more deaths and percentage of clustered deaths in them has increased between NFHS-3 and 4.

Between NFHS-1 and 3, among illiterates, there was a 24% reduction in high-risk families and 11% reduction was observed in clustered deaths and between NFHS-3 and 4, there was a 48% reduction in families experiencing two or more deaths and 13% decrease in clustered infant deaths. Among women with higher education, the reduction was seen in families with two or more infant deaths and also clustered infant deaths between NFHS-1 and 3. Among scheduled tribes, the level of families with two or more infant deaths and clustering of infant deaths among them was almost constant between NFHS-1 and 3, but there was a 64% decline in high-risk families and 23% decline in clustered deaths between NFHS-3 and 4. Almost similar level of clustering of infant deaths among families was observed for all three NFHS survey rounds for Hindu and Muslims through the level of both high-risk families and clustered deaths among them reduced between NFHS-1 and NFHS-3 and NFHS-3 and four consistently. Among various wealth quantiles, the level of clustered infant deaths and the percentage of families with two or more infant deaths among poorest families was highest in all survey periods. It has been observed that rural area experienced a higher level of clustering than urban areas though families experiencing multiple child loss decreased by >60% in both between NFHS-1 and 4 and extent of deaths clustered in such families reduced by 1 quarter.

Table 4 presents the ICC and MOR for India and selected states in NFHS-1, 3, and 4. Null model presents the ICC and MOR in the case for without considering any covariates, whereas model 1 presented ICC and MOR when previous death in families was

Table 3: Infant death clustering in families and extent of clustered deaths in families by selected background characteristics, India, 1992–2016

Background characteristics	NFHS-1 (1992–1993)		NFHS-3 (2005–2006)		NFHS-4 (2015–2016)		Relative change NFHS-1–NFHS-3 (7)		Relative change NFHS-3–NFHS-4 (8)	
	Families (1)	≥2 ID (2)	Families (3)	≥2 ID (4)	Families (5)	≥2 ID (6)				
Age at first birth (years)										
≤20	7.6	52.7	5.0	46.2	2.6	39.1	–34	–12	–47	–15
21–30	3.5	43.3	1.8	34.1	1.3	31.9	–50	–21	–26	–6
>30	1.7	35.4	0.4	14.7	0.6	19.6	–75	–58	49	33
Education										
No education	9.9	56.4	7.6	50.1	3.9	43.6	–24	–11	–48	–13
Primary	4.8	42.0	3.8	40.9	2.0	33.1	–21	–3	–47	–19
Secondary	1.7	27.6	1.6	31.2	0.8	24.4	–6	13	–49	–22
Higher	0.3	12.7	0.2	9.6	0.2	14.7	–29	–25	15	54
Caste										
SC	10.3	57.4	6.1	50.0	2.5	38.8	–41	–13	–59	–22
ST	7.3	51.1	7.2	51.7	2.6	40.0	–2	1	–64	–23
Others	6.8	51.3	4.2	43.5	1.9	35.8	–39	–15	–55	–18
Religion										
Hindu	7.6	52.7	5.0	46.7	2.1	36.8	–34	–11	–58	–21
Muslim	7.5	51.8	4.5	42.3	2.3	39.0	–39	–18	–48	–8
Others	3.3	43.3	2.5	38.5	1.0	28.7	–24	–11	–59	–25
Wealth										
Poorest	10.4	57.2	8.7	53.0	4.3	44.4	–16	–7	–51	–16
Poorer	10.4	57.1	6.6	48.8	2.7	38.4	–36	–15	–59	–21
Middle	8.1	52.4	4.6	43.5	1.8	33.1	–43	–17	–61	–24
Richer	5.6	46.1	3.0	38.7	1.2	29.7	–46	–16	–62	–23
Richest	2.6	38.1	1.4	29.9	0.6	24.1	–45	–22	–58	–20
Residence										
Urban	4.2	45.2	2.8	39.9	1.2	31.1	–33	–12	–58	–22
Rural	8.4	53.7	5.7	47.4	2.5	38.4	–32	–12	–56	–19

[#]Table is based on full birth history file, NFHS: National Family Health Survey, STs: Scheduled Tribes, SCs: Scheduled castes

Table 4: ICC and MOR and their relative change for India and selected states, 1992–2016

Country/States	NFHS-1 (1992–1993)				NFHS-3 (2005–2006)				NFHS-4 (2015–2016)				Relative change NFHS 1 and 3 (in %)				Relative change NFHS 3 and 4 (in %)			
	Null model		Model 1		Null model		Model 1		Null model		Model 1		Null model		Model 1		Null model		Model 1	
	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR	ICC	MOR
India	0.24	2.65	0.15	2.05	0.24	2.67	0.16	2.11	0.29	3.05	0.22	2.50	1.2	0.6	7.0	3.0	20.1	14.1	39.1	18.2
Uttarakhand	0.24	2.67	0.16	2.15	0.28	2.98	0.19	2.31	0.25	2.72	0.19	2.33	16.9	11.5	16.1	7.6	–11.8	–8.6	1.5	0.8
Rajasthan	0.32	3.26	0.23	2.57	0.21	2.41	0.10	1.80	0.28	2.90	0.21	2.42	–35.5	–26.0	–54.6	–29.9	34.2	20.5	99.0	34.4
Uttar Pradesh	0.16	2.15	0.09	1.74	0.14	2.04	0.07	1.63	0.22	2.49	0.15	2.06	–12.2	–5.3	–20.6	–6.5	50.6	22.1	100.2	26.3
Bihar	0.18	2.26	0.13	1.95	0.22	2.49	0.13	1.92	0.28	2.91	0.21	2.42	19.2	10.0	–4.1	–1.6	27.3	17.1	65.5	25.8
Assam	0.18	2.26	0.11	1.84	0.31	3.18	0.24	2.62	0.31	3.21	0.25	2.68	70.7	40.9	114.9	42.7	1.0	0.9	3.4	2.2
West Bengal	0.16	2.13	0.08	1.69	0.24	2.61	0.16	2.12	0.25	2.72	0.16	2.15	46.6	22.6	86.1	24.9	6.3	4.2	4.1	1.8
Jharkhand	0.29	3.03	0.20	2.41	0.18	2.25	0.09	1.70	0.26	2.79	0.18	2.22	–37.6	–25.5	–58.0	–29.4	43.8	23.8	103.5	30.6
Odisha	0.15	2.08	0.08	1.66	0.18	2.28	0.10	1.78	0.25	2.74	0.17	2.17	21.1	9.5	25.9	7.1	37.9	20.5	67.6	22.0
Chhattisgarh	0.30	3.10	0.22	2.49	0.21	2.42	0.11	1.85	0.26	2.82	0.19	2.32	–31.1	–22.0	–48.4	–25.6	28.5	16.9	70.7	25.3
Madhya Pradesh	0.25	2.68	0.18	2.23	0.20	2.39	0.11	1.86	0.26	2.82	0.18	2.26	–17.1	–10.6	–35.3	–16.4	29.9	17.7	59.3	21.4
Gujarat	0.21	2.43	0.14	2.00	0.22	2.49	0.13	1.95	0.34	3.48	0.26	2.78	4.3	2.5	–5.5	–2.3	56.6	39.3	99.4	42.8
Maharashtra	0.28	2.97	0.18	2.24	0.32	3.23	0.20	2.35	0.37	3.78	0.28	2.95	11.3	8.8	9.8	4.8	17.9	17.0	43.2	25.5
Kerala	0.24	2.67	0.15	2.06	0.39	3.97	0.36	3.70	0.51	5.75	0.46	4.88	59.0	48.3	145.9	79.8	30.3	45.0	25.4	32.1
Tamil Nadu	0.21	2.42	0.12	1.92	0.25	2.68	0.19	2.29	0.41	4.21	0.33	3.38	18.4	10.8	49.0	19.0	66.6	57.0	78.3	47.9

NFHS: National Family Health Survey, ICC: Intraclass correlation coefficient, MOR: Median odds ratio

included in the regression analysis. ICC demonstrates that there was some degree of correlation between newborn propensities for infant deaths within the same mother. Under null model, ICC value of 0.24 in NFHS-1 and NFHS-3 and 0.29 in NFHS-4 show that nearly 24% variation in NFHS-1 and 3 and 29% variation in the risk of infant death in NFHS-4 were related to unobserved maternal or family characteristics. However, MOR measures the role of between mother residual heterogeneity (which may arise due to genetic and other factors), which increases or decreases the individual odds of infant death when two infants are randomly chosen from two different mothers. Thus under null model, the MOR value of 2.65 in NFHS-1 indicates that an infant born to high-risk mothers would experience (at the median) more than twice the individual risk of having an infant death and the risk remained almost the same in NFHS-3 while in NFHS-4 the MOR of 3.05 indicate that high-risk mothers increase the individual risk of having an infant death by 3 times. Thus, the mother experienced with multiple child loss aggravated the risk of infant death further in NFHS-4.

Similarly for model 1, for India, ICC and MOR remained almost the same between NFHS-1 and 3 and ICC increased by nearly 40% and MOR increased by 18% between NFHS-3 and 4. Relative change for model 1 between NFHS-3 and 4 shows that for all selected states of India ICC was positive and the increase was the maximum for the states of Jharkhand (104%) and Uttar Pradesh (100%). It means there has been a substantial increase in the risk of infant death in Jharkhand and Uttar Pradesh which also resulted into increasing the clustering of infant deaths in these two states. In the adjusted model, model 1, between NFHS-1 and 3 states such as Rajasthan, Uttar Pradesh, Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, and Gujarat experienced a decrease in both ICC and MOR; however, these states showed an increase in both ICC and MOR between NFHS-3 and 4. An increase in ICC between NFHS-3 and 4 in this group of states (mostly backward states of India except for Gujarat) indicates that heterogeneity in the risk of infant deaths increased between families. While an increase in MOR indicates that there has been an increase in the risk of infant deaths among high-risk cluster mothers during this time period. States such as Uttarakhand, Assam, West Bengal, Odisha, Maharashtra, Kerala, and Tamil Nadu have a positive change for ICC and MOR for both survey periods, i.e., between NFHS-1 and 3 and between NFHS-3 and 4, respectively.

DISCUSSION

The study mainly focused on the clustering of infant deaths in families in India among some of its selected states. Infant mortality and clustering of deaths in families in India have declined between NFHS-1 and 3 and NFHS-3 and 4, but the pace of reduction of clustering of infant deaths in families and reduction of high-risk families experiencing such deaths was much faster during NFHS-3 and 4. The larger reduction in clustering of infant deaths in families between 2005 and 2016 can be possibly due to Government of India flagship programs in health, National Rural Health Mission including Janani Suraksha Yojna (JSY). JSY was much popular and effective in India as it had direct linkages for improving various maternal and child health indicators as it encouraged pregnant women, particularly of low socioeconomic backgrounds, to use institutional maternal health care.

Except for Rajasthan, the pattern of other states was quite similar to that of the national pattern of reduction of infant death clustering in families in India. Rajasthan was the only state among the selected states which experienced a relative increase in the percentage of families which experienced two or more infant deaths between NFHS-1 and NFHS-3, but the relative increase in clustered infant deaths was negligible; however, IMR declined during this period. This emphasizes the fact that the reduction in IMR is not resulted into reduction in families experiencing clustered infant deaths. By background characteristics, both families experiencing clustered deaths and extent of clustering of infant deaths in such families have gone up between NFHS-3 and NFHS-4 for mothers having age at first birth >30 years and for mothers who have received higher education.

The possible reasons for such findings could be mothers with higher education also usually have higher age at marriage, and such women engage in an occupation which decreases the time of contact between mothers and child in early years of life and ultimately enhances the risk of infant death. However, between NFHS-1 and NFHS-3 and from NFHS-3 to NFHS-4 women belonging to the different categories of the remaining background characteristics experienced a consistent decline in both families with clustered deaths as well as the extent of clustering. Our model-based results on ICC, a measure to capture clustering of deaths in families, suggests that except few states, families of most of the states have experienced an increase in a number of multiple infant deaths between NFHS-1 and NFHS-3. The situation worsens even to a higher degree between NFHS-3 and 4 as ICC or degree of clustering comes out to be positive for India as well as selected states of India which indicates an increase in clustering of infant deaths in families.

Limitations of the study were that the mortality rate might have been affected as cross-sectional data used and information related to the age of child collected retrospectively. Many of the factors related to utilization of health services in birth history have information for 5 years preceding the survey and information for factors such as antenatal care and postnatal care is collected for most recent birth which does not allow to examine the impact of these factors on clustering of infant deaths.

CONCLUSION

The issue of clustering of infant deaths in families in various states requires differential attention from the government based on the need to address this issue and reduce infant mortality further to a lower level. The states where there is larger proportion of mothers experiencing one infant death, government need to identify such mothers and target them during the time of next

pregnancy so that the chance of again experiencing infant deaths would be minimized.

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