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Vitamin A supplementation programmes are missing children from scheduled castes and scheduled tribes. New evidence from India

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Abstract

Background: Surveys have indicated that 62 % of preschool-age Indian children suffer from sub-clinical vitamin A deficiency (VAD), with a threefold higher prevalence of severe forms of VAD among children from schedule castes (SC) or schedule tribes (ST). The objective of this analysis is to assess whether India's national vitamin A supplementation (VAS) programme is reaching the districts with higher concentration of SC/ST children in the seven states with the largest burden of under-five mortality (74 % of India's under-five deaths).

Methods: Disaggregated analyses of trends in and outcome VAS coverage and full VAS coverage were conducted between 2006 and 2011 by state and SC/ST concentration quintile using three data sources—India's national VAS programme, Office of the Registrar General and Census Commissioner, and District-Level Household Survey—to compute exposure (SC and/or ST concentration) and outcome (VAS coverage and full VAS coverage) were conducted.

Results: Between 2006 and 2011, all SC/ST concentration quintiles reported significant increases in full VAS coverage (two doses/child/year). The mean full VAS coverage over the 6-year period was positively correlated with the SC/ST concentration quintile: the district quintile with the highest concentration of SC/ST households reported the highest full VAS coverage (62.5 %), while the district quintile with the lowest concentration of SC/ST households reported the lowest coverage (47.9 %). The estimated number of children not fully covered by the VAS programme decreased by 39.0 % among children from SC/ST households and by 51.7 % among children from non-SC/ST households. The mean annual number of SC/ST children not fully covered was similar across SC/ST concentration quintiles (1.1 to 1.3 million).

Conclusions: Indian states have achieved significant progress in expanding the coverage of the VAS programme. However, a large proportion of children are not benefitting from this child survival intervention, particularly among SC/ST children. These children are potentially among the most vulnerable to VAD and its consequences. India's national VAS programme needs to be strengthened in sub-district-level units (i.e. blocks and villages) with higher concentrations of SC/ST children, with particular emphasis on SC children.

Background

Several population-based intervention trials have assessed the contribution of vitamin A deficiency (VAD) to child mortality [1–8]. Independent meta-analyses of these trials have indicated that in areas where VAD is prevalent, child mortality is reduced by 23–34 % following vitamin A interventions [9–12]. This significant improvement in child survival has been largely attributed to a reduction in mortality from measles, severe diarrhoea, dysentery, and possibly falciparum malaria [7, 13–15]. A recent Cochrane review has concluded that vitamin A supplementation (VAS) should be given to all children at risk of deficiency, particularly in low and middle income countries [16, 17]. In light of this compelling evidence, WHO recommends that in settings where VAD is a public health problem, children 6–59 months old be provided vitamin A supplements to reduce child morbidity and mortality [18].

In India, VAD has long been recognized as a public health problem [19–21]. Surveys carried out between

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2002 and 2005 found that 62 % of preschool-age children had sub-clinical VAD (serum retinol < 20 μg/dl). These surveys indicated that the prevalence of more severe forms of VAD was three times higher among children from schedule caste (SC) or schedule tribe (ST) households [22, 23]. Furthermore, India's 2006 National Family Health Survey indicated that the proportion of SC/ST children 6–59 months who had received vitamin A supplements in the 6 months preceding the survey was a mere 17 % [24].

Since 2006, the Government of India and India's State Governments have made a concerted effort to increase the coverage of the VAS programme by strengthening the implementation of bi-annual VAS rounds as part of the national VAS programme, managed by the Ministry of Health and Family Welfare. The programme aims at delivering preventive VAS to children 6–59 months old. For programmatic convenience, the first VAS dose (100,000 IU) is administered with the measles vaccination at ~9 months, while the subsequent eight doses (200,000 IU each) are administered every 6 months up to the age of 59 months using bi-annual VAS rounds as the main delivery platform [25]. The delivery of vitamin A supplements is ensured by the Auxiliary Nurse Midwife (ANM) of the Health Department, supported by the Accredited Social Health Activist (ASHA), the frontline worker of the National Rural Health Mission (NRHM), and the Anganwadi Worker, the frontline worker of Integrated Child Development Services (ICDS) programme, India's flagship programmes for child health, nutrition and development.

In 2006, the states of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh—with 52 % of India's under-five population (i.e. 59.4 million)—were home to 74 % of the under-five deaths in India, with a combined under-five mortality rate of 84 deaths for every 1000 live births (63 in India) [24, 26, 27]. Furthermore, 32.9 % of the combined population in these seven states survived below a minimum standard of living, with poverty levels as high as 47.3 % in the population quintile with the highest proportion of SC/ST households [28]. The objective of this analysis is to assess whether India's national VAS programme is reaching the districts with a higher concentration of children who belong to SC/ST households in the seven states of India with the largest burden of under-five mortality.

Methods

We used the latest publicly available data by the Office of the Registrar General and Census Commissioner of India to determine the population size, population composition (including the proportion of SC/ST households), and the number of children 6–59 months (SC, ST, and non-SC/ST) in each of the seven states and 255 districts included in our analysis [29].

Data collection and collation procedures took into account the number of children 6–11 months old who received VAS through the routine immunization programme (measles vaccination at ~9 months) and the number of children 12–59 months old who received VAS through the bi-annual rounds. The number of children 6–59 months old who benefitted from the VAS programme in each district was determined using standardized bottom-up data collection and collation approach with data flowing up from the VAS supplementation sites in the village to the block, from the block to the district, and from the district to the state in each given calendar semester (semester 1: Jan 1–June 30; semester 2: Jul 1–Dec 31).

Following international recommendations, *VAS coverage* was defined as the proportion of eligible children who received at least one VAS dose in a given calendar year while *full VAS coverage* was defined as the proportion of eligible children who received two VAS doses in a given calendar year. For any given district and calendar year, VAS coverage was computed as that of the semester with the highest VAS coverage whereas full VAS coverage was computed as that of the semester with the lowest VAS coverage, thus assuming that all children who benefitted from the VAS programme in the semester with the lowest VAS coverage also did in the semester with the highest VAS coverage [30].

STATA12 (StataCorp. 2009; Stata: Release 12. Statistical Software. College Station, TX: StataCorp LP) was used for all data analyses. Ethical approval was not sought as we analyse anonymous data that cannot be linked to individual children, caregivers, or household identity.

Results

The coverage and full coverage of the VAS programme was analysed by SC/ST concentration quintile, dividing the 255 districts into five quintiles (~51 districts per quintile): the lowest quintile comprising the 20 % districts with the lowest concentration of SC/ST households at one end and the highest quintile comprising the 20 % districts with the highest concentration of SC/ST households at the other end (Table 1).

In 2006, the highest SC/ST quintile reported the highest full VAS coverage (52.6 %) while the two lower SC/ST quintiles reported the lowest full VAS coverage (~37.0 %). Between 2006 and 2011, the full VAS coverage increased in all SC/ST quintiles. This increase was inversely correlated with the SC/ST concentration quintile: highest (42.5 percentage points) in the lowest SC/ST quintile and lowest (8.6 percentage points) in the highest SC/ST quintile (Table 1). However, the mean full VAS coverage over the 6-year period (2006–2011) was positively correlated with the SC/ST concentration quintile: highest (62.5 %) in

Table 1 Vitamin A supplementation coverage (at least one dose/child/year) and full VAS coverage (two doses/child/year) by SC/ST concentration quintile, India 2006–2011

		SC/ST concentration quintile				
	Year	Lowest	Lower	Middle	Higher	Highest
VAS coverage	2006	45.9	50.5	63.9	69.7	70.4
	2007	71.6	74.6	74.4	83.6	86.4
	2008	84.2	85.7	93.6	95.6	97.4
	2009	93.0	96.3	98.1	94.7	96.8
	2010	85.8	78.6	92.0	93.6	97.4
	2011	95.1	96.9	90.1	89.2	88.1
	2006–11	79.3	80.4	85.2	87.7	89.4
Full VAS coverage	2006	37.2	37.0	47.4	49.3	52.6
	2007	10.5	40.8	44.7	57.5	56.1
	2008	69.1	55.1	60.8	53.1	64.6
	2009	84.5	85.1	77.7	66.8	65.4
	2010	6.1	34.0	43.4	65.6	75.8
	2011	79.7	70.3	65.4	60.0	61.2
	2006–11	47.9	53.7	56.5	58.6	62.5

Note: Coverage figures are indicated as percentages

Table 2 Vitamin A supplementation coverage (at least one dose/child/year) and full VAS coverage (two doses/child/year) by ST concentration quintile, India 2006–2011

		ST concentration quintile				
	Year	Lowest	Lower	Middle	Higher	Highest
VAS coverage	2006	26.5	55.9	77.3	71.5	70.0
	2007	35.1	84.5	90.6	92.1	90.2
	2008	61.7	96.3	97.0	103.7	99.1
	2009	86.9	101.5	93.8	98.7	98.4
	2010	61.0	93.9	95.8	99.0	98.6
	2011	81.9	99.7	100.4	93.5	84.9
	2006–11	58.6	88.7	92.5	93.0	90.2
Full VAS coverage	2006	9.5	47.3	60.8	58.7	48.6
	2007	23.2	16.3	39.9	67.3	62.6
	2008	32.1	76.7	68.7	71.6	55.3
	2009	75.5	93.1	64.1	74.9	73.1
	2010	0.0	13.1	46.1	81.0	85.1
	2011	48.2	84.9	69.9	72.6	62.5
	2006–11	31.3	55.3	58.2	70.9	64.5

Note: Coverage figures are indicated as percentages

the highest SC/ST quintile and lowest (47.9 %) in the lowest SC/ST quintile.

Additionally, we analysed the VAS coverage and full VAS coverage by ST concentration by dividing the 255 districts into five quintiles: the lowest quintile comprising the 20 % districts with the lowest concentration of ST households and the highest quintile comprising the 20 % districts with the highest concentration of ST households (Table 2). In 2006, the lowest ST quintile reported the lowest full VAS coverage (9.5 %) while the remaining ST quintiles reported full VAS coverage ranging between 47.3 % and 60.8 %. Between 2006 and 2011, the full VAS coverage increased in all ST quintiles. The highest increase (≥37.6 percentage points) was observed in the two lowest ST quintiles. However, the mean full VAS coverage over the 6-year period (2006–2011) was lowest (31.3 %) in the lowest ST quintile while it was highest (>64.5 %) in the two highest ST quintiles (Table 2; Fig. 1).

The analysis of the VAS coverage and full VAS coverage by SC concentration followed the same approach but revealed a different pattern. In 2006, the quintile with the lowest concentration of SC households reported the highest full VAS coverage (52.0 %). Between 2006 and 2011, the full VAS coverage increased in all quintiles. The lowest increase (3.4 percentage points) was observed in the highest SC quintile. Importantly, the mean full VAS coverage over the 6-year period was negatively correlated with the SC concentration: highest (64.9 %) in the lowest SC quintile and lowest (49.3 %) in the highest SC quintile (Table 3; Fig. 1).

The estimated number of non-fully covered children decreased from 31.4 million in 2006 to 16.1 million in 2011 (49 % decrease). Over the 6-year period, the mean number of children who were not fully covered by the VAS programme annually was highest (8.0 million) in the lowest SC/ST quintile and lowest (2.3 million) in the highest SC/ST quintile (Table 4). The number of non-fully covered SC/ST children in each given year was estimated by combining the population of children 6–59 months old in the district, the proportion of children from SC/ST households in the district, and the full coverage of the VAS programme in the district. The estimated number of children from SC/ST households who were not fully covered decreased by 39.0 % (from 7.6 million in 2006 to 4.6 million in 2011), while the number of children from non-SC/ST households who were not fully covered by the VAS programme decreased by 51.7 % (from 23.8 million in 2006 to 11.5 million in 2011). The mean number of non-fully covered SC/ST children annually between 2006 and 2011 was similar across the five SC/ST quintiles, ranging between 1.1 and 1.3 million children (Table 5).

Discussion

Between 2006 and 2011, India's national VAS programme experienced a significant expansion in the seven states with the highest burden of child mortality. The increase in full VAS coverage was observed in all SC/ST quintiles. Importantly, the 2006–11 mean full VAS coverage was highest in the district quintiles with the highest concentration of SC/ST households. A recent review indicates that the

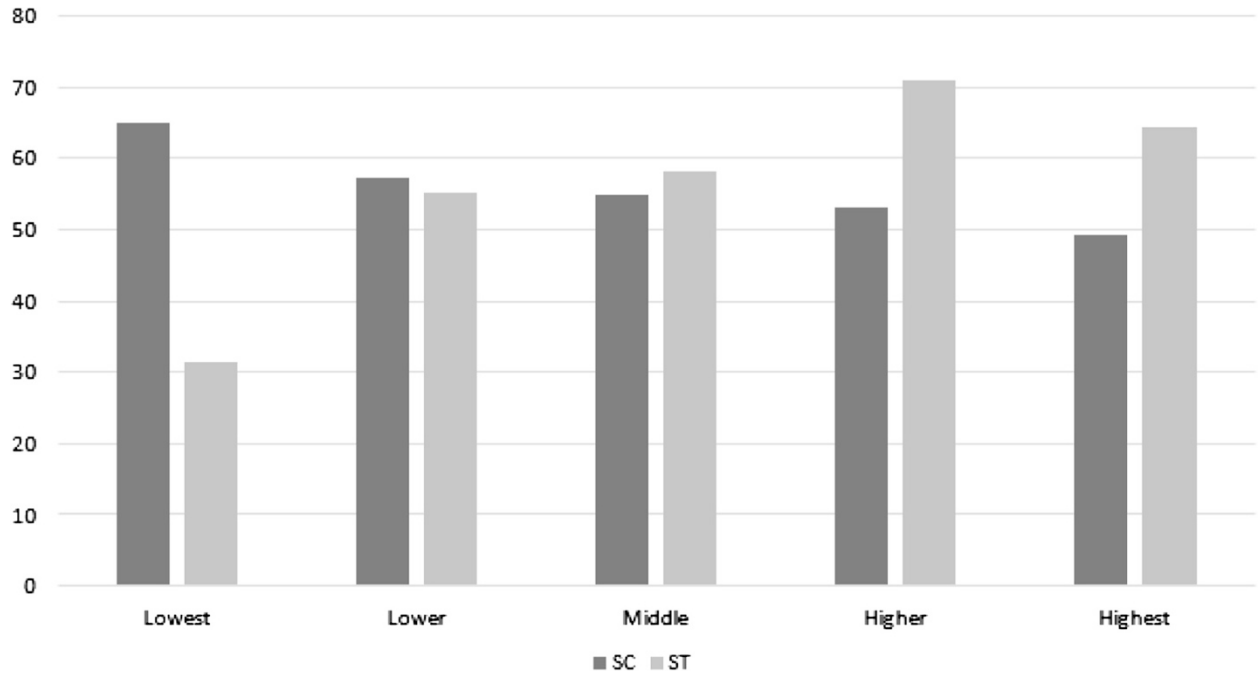

Fig. 1 Mean annual vitamin A supplementation coverage (two doses/child/year) by SC/ST district concentration quintile. India, 2006–2011. Note: Coverage figures are indicated as percentages

critical success factors of the VAS programme in Bihar and Odisha—two of the seven states included in our analysis—have been: strong leadership by the state government, close coordination between the departments of Health and Family Welfare and Women and Child Development, effective district-level planning prior to each biannual VAS round, a stable procurement and distribution mechanism, appropriate training and supervision of staff, and intensive social mobilization and communication [31].

Table 3 Vitamin A supplementation coverage (at least one dose/child/year) and full VAS coverage (two doses/child/year) by SC concentration quintile, India 2006–2011

		SC concentration quintile				
	Year	Lowest	Lower	Middle	Higher	Highest
VAS coverage	2006	67.7	63.2	53.9	53.8	61.4
	2007	94.5	83.7	73.1	69.5	69.7
	2008	101.2	96.6	81.5	87.3	89.9
	2009	102.4	94.6	91.4	95.9	94.6
	2010	99.4	95.6	86.0	79.2	86.8
	2011	86.3	93.9	94.9	93.1	91.3
	2006–11	91.9	88.0	80.1	79.7	82.2
Full VAS coverage	2006	52.0	49.0	40.5	34.8	47.0
	2007	56.2	28.7	42.8	44.5	37.3
	2008	63.9	73.9	47.9	51.5	65.4
	2009	77.1	78.6	78.2	83.3	62.6
	2010	73.1	38.7	44.8	34.3	33.9
	2011	67.6	74.0	74.1	70.6	50.4
	2006–11	64.9	57.2	54.8	53.1	49.3

Note: Coverage figures are indicated as percentages

Besides documenting the significant expansion of the VAS programme in India's seven high burden states, our analysis highlights substantial differences in full VAS coverage between districts with a high concentration of SC households and districts with a high concentration of ST households. The 6-year period mean full VAS coverage was highest in the district quintiles with the highest concentration of ST households but was lowest in the district quintiles with the highest concentration of SC households. This is potentially the result of geographic targeting/emphasis by the VAS programme as ST households tend to cluster in the same geographic area due to their ancestral link to the land where they live. SC households, on the contrary, tend to be geographically mixed with non-SC households and therefore are less likely to benefit from geographical targeting by public health programmes.

Despite impressive increases in full VAS coverage—including in districts with a high concentration of socially disadvantaged households—a large a proportion of children are not fully covered, particularly among SC and ST children, who are potentially among the most vulnerable to VAD and its consequences. Furthermore, as full VAS coverage increases across all SC/ST concentration quintiles, the SC and ST children who are not covered

Table 4 Estimated number of children 6–59 months old not covered (at least one dose/child/year) and not fully covered (two doses/child/year) by SC/ST concentration quintile. Vitamin A supplementation (VAS) programme, India 2006–2011

		All children by SC/ST concentration quintile					
	Year	Lowest	Lower	Middle	Higher	Highest	All
VAS coverage	2006	8,442,301	7,072,482	4,077,309	2,883,883	1,708,795	24,184,770
	2007	4,084,300	4,728,549	3,064,163	1,875,644	816,136	14,568,792
	2008	2,333,348	2,592,873	1,120,340	763,628	230,042	7,040,231
	2009	1,083,499	999,222	532,191	677,110	301,656	3,593,678
	2010	2,284,914	3,269,948	1,260,174	787,566	312,240	7,914,842
	2011	614,275	1,044,155	1,479,768	1,095,910	815,157	5,049,265
	2006–11	3,140,440	3,284,538	1,922,324	1,347,290	697,338	10,391,930
Full VAS coverage	2006	9,624,633	8,885,007	5,690,288	4,492,419	2,725,837	31,418,184
	2007	14,028,919	8,727,647	5,994,887	4,158,163	2,730,845	35,640,461
	2008	4,639,824	6,162,087	3,992,398	3,844,499	2,137,010	20,775,818
	2009	1,851,397	2,346,013	2,630,179	2,714,318	2,111,155	11,653,062
	2010	15,060,604	9,540,668	6,141,544	3,824,121	1,476,686	36,043,623
	2011	2,636,713	3,858,949	3,812,448	3,477,274	2,342,865	16,128,249
	2006–11	7,973,682	6,586,729	4,710,291	3,751,799	2,254,066	25,276,566

by the programme are increasingly evenly distributed across SC/ST quintiles. Thus, in addition to efforts to scale up and/or consolidate the VAS programme in the states where VAS coverage is low or erratic, states need to give particular attention to expanding the coverage of the programme in sub-district-level units (i.e. blocks and villages) with higher concentrations of SC/ST children, keeping in mind that SC children are less likely to benefit from geographical targeting/emphasis and therefore may require more innovative programming approaches.

It will also be crucial that the state VAS programmes be part of an integrated and sustained assault on VAD that encompasses improved child feeding and increased vitamin A intakes through the life cycle. Studies have documented that 42 % of Indian children are not fed vitamin A-rich foods regularly and that most children do not even meet 50 % of the recommended vitamin A requirements [22–24, 32, 33]. Importantly, studies have shown that Indian children who are not fed vitamin A-rich foods tend to be younger and are less likely to have

Table 5 Estimated number of SC/ST children 6–59 months old not covered (at least one dose/child/year) and not fully covered (two doses/child/year) by SC/ST concentration quintile. Vitamin A supplementation (VAS) programme, India 2006–2011

		SC/ST children by SC/ST concentration quintiles					
	Year	Lowest	Lower	Middle	Higher	Highest	All
Not covered	2006	1,258,261	1,315,724	952,295	815,549	1,058,085	5,399,914
	2007	663,490	672,275	672,743	440,884	486,825	2,936,217
	2008	370,823	376,910	167,556	118,151	93,205	1,126,645
	2009	165,063	97,124	49,560	142,164	114,886	568,797
	2010	336,459	559,498	207,916	171,496	93,491	1,368,860
	2011	116,676	80,731	256,379	289,125	428,595	1,171,506
	2006–11	485,129	517,044	384,408	329,562	379,181	2,095,323
Not fully covered	2006	1,460,606	1,674,558	1,387,554	1,364,632	1,694,366	7,581,716
	2007	2,090,929	1,566,876	1,453,231	1,142,536	1,571,443	7,825,015
	2008	725,217	1,183,445	1,026,282	1,259,377	1,269,016	5,463,337
	2009	365,497	391,121	581,677	890,537	1,242,207	3,471,039
	2010	2,224,894	1,725,555	1,471,009	921,790	870,186	7,213,434
	2011	483,371	773,457	896,030	1,070,832	1,397,436	4,621,126
	2006–11	1,225,086	1,219,169	1,135,964	1,108,284	1,340,776	6,029,278

received vitamin A supplementation in the previous 6 months [34]. This situation underscores: (1) the importance of breast milk as a major source of preformed retinol for children in the first 2 years of life; (2) the importance of vitamin A-rich complementary foods for children 6–23 months old; and (3) the need to universalize the coverage of the VAS programme to enhance children's vitamin A intake, particularly among the most vulnerable children: the youngest and the socially excluded.

Conclusions

Indian states have achieved significant progress in expanding the coverage of the VAS programme. However, a large proportion of children are not benefitting from this child survival intervention, particularly among SC/ST children. These children are potentially among the most vulnerable to VAD and its consequences. India's national VAS programme needs to be strengthened in sub-district-level units (i.e. blocks and villages) with higher concentrations of SC/ST children, with particular emphasis on SC children. To accelerate progress in equitable programme coverage, it will be important to strengthen monitoring and reporting mechanisms so that state-level programme planners and managers have access to real-time and accurate information on programme performance by village, block, and district.

In addition, as India approaches the 2015 deadline to achieve the Millennium Development Goals (MDG) targets for child survival, it will be important to reassess the prevalence of clinical and sub-clinical VAD in preschool age children (with appropriate geographic and socio-economic data disaggregation). This will address recent concerns about the extent and severity of VAD in India and the relevance of the national VAS programme [35, 36] and will provide the evidence base to design India's way forward post 2015.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

VMA designed the research, led data analysis and wrote the paper; NB ensured data management; JR contributed to the final manuscript. All authors read and approved the final manuscript.

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