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Original Article

Prevalence of under nutrition in under-five tribal children of Melghat: A community based cross sectional study in Central India

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ABSTRACT

Objective: Under nutrition has chronically remained a major public health problem among tribal children population in India. The present study aimed to estimate the prevalence of various forms of under nutrition in 'under five' children in Melghat – a difficult to reach, hilly, forest area of Maharashtra in Central India using different standards.

Methods: A community based cross-sectional study was conducted in Dharni & Chikhaldara blocks in tribal area of Melghat over a period of two months. A representative sample of 2926 under-five children from randomly chosen 33 villages in two blocks was selected with cluster sampling. Information on various demographic and anthropometric characteristics (e.g. age, sex, height, weight) of study subjects was collected in a pre-designed proforma by trained tribal female village health workers (VHWs). Under nutrition was assessed by using Standard WHO criteria like stunting, underweight, wasting, and IAP grades; alone and in combination. Crude and adjusted prevalence estimates accounting for clustering effect were obtained along with 95% Confidence Intervals.

Results: Out of total 2926 U5 children, 1006 (34.4%) were severely stunted, 547 (18.7%) were SUW and 209 (7.1%) were SAM, and 199 (6.8%) were severely under nourished (grade III–IV) according to IAP standards. However, when various WHO criteria & IAP gradations were applied in combination, more number 2241 i.e. (76.59%) of the U5 children in Melghat were found to be severely or moderately under nourished. by one or more standards.

Conclusion: Very high prevalence of severe stunting, severe underweight and severe acute malnutrition was found in tribal U5 children population in Melghat. A combination of more than one criteria may be useful in tracking more number of under nourished children in tribal communities, which otherwise would be missed by any single criterion alone. The study findings will be helpful in planning prevention and planning of programmes that would focus more on populations most affected.

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1. Introduction

Globally, under nutrition remains one of the leading cause of morbidity and mortality among children contributing to 60% of deaths in under-five (U5) children population.^{1,2} The prevalence of underweight children in India is among the highest in the world, and is nearly double that of Sub-Saharan Africa with dire consequences for morbidity, mortality, productivity and economic growth.³

The 2011 Global Hunger Index (GHI) Report ranked India 15th, amongst leading countries with hunger situation. India is placed amongst the three countries, where the GHI between 1996 and 2011 went up from 22.9 to 23.7⁴ Prevalence of under nutrition amongst children still remains alarmingly high in rural and urban communities in India; but it has been particularly reported much higher in tribal populations. An earlier study (2004) conducted in tribal area of Melghat not only showed high (>75%) prevalence of under nutrition (by IAP classification grade I–IV) in U5 children⁵ but also revealed higher (>100/1000 live births) under-five child mortality rate (USMR). Prevalence of severe under nutrition in U5 children (by IAP classification) was found high, i.e. 9.6% in another study (2004) from same setting.⁶

Despite the fact that under nutrition has been a major public health problem among tribal children population, scarce data and little information about prevalence and types of under nutrition is available from this part of India, which is experiencing unusually high infant mortality year after year.⁷ Complete, reliable and valid data regarding prevalence of under nutrition may help in planning and designing effective strategies on important health and nutrition related outcomes in this under privileged and weaker section of the society.

The present study attempts to estimate the prevalence of various forms of under nutrition in U5 children in Melghat area by different standards.

2. Methods

Melghat is a difficult-to-reach, hilly, forest area in the state of Maharashtra, Central India, having population of around 2,80,000 scattered over 320 villages, of which vast majority are tribal. Most of the tribal are small farmers or agricultural labourers, living below poverty line.^{8,9}

A community based cross-sectional study with one-stage cluster sampling method was conducted in Dharni & Chikhaldara blocks in tribal area of Melghat over a period of 2 months (i.e. August–September, 2012) by MAHAN trust. Sample size ($n = 3074$) was estimated assuming prevalence of under nutrition in the tribal community = 20%,⁶ relative precision = 10%, confidence interval = 95%, and Design effect = 2.

Sampling frame comprised of all U5 children from 320 villages in two study blocks. Villages i.e. clusters were the primary sampling units and once the village got selected then all U5 children residing in the selected village were included in sample, except a few who could not be contacted despite seven consecutive visits or had migrated outside the study area temporarily (≥ 6 months). The number of U5 children per village was variable, depending on village

population size. (Table 1 shows village wise distribution of the children.)

Number of villages included in the study sample was decided as per the sample size requirement. A random sample of 33 selected villages was found to be sufficient to fulfil sample size requirement. Thus, our study sample finally included 2926 U5 children from 33 selected villages having usual resident (de-facto) population of >28,000 inhabitants. For sampling purpose, Dharni block was divided into five regions (East, West, North, South and Central). Six villages from each of the five regions of Dharni block and three villages from Chikhaldara block were selected randomly by lottery method.

Written informed consent was sought from the villagers during Gram-sabhas (Village meetings) organized in each of the selected village in the study sample. House to house survey was under-taken by trained tribal female VHWs. Total 5554 households from 33 villages were surveyed, around 7.06% of households were missed due to non-availability during seven consecutive visits (which includes four visits by VHWs, two by supervisors & one by program manager), in each village in two months study period.

Baseline Information on a representative sample of 2926 U5 children on various demographic and anthropometric characteristics (e.g. age, sex, height, weight) was collected in a

Table 1 – Cluster-wise distribution of children.

Sr. No.	Village name	No. of children	Children <5 months
1	Kobdadhana	63	4
2	Padidam	71	7
3	Katkumbh	63	9
4	Kasaikheda	101	7
5	Kinnikheda	22	2
6	Khamda	24	3
7	Kokmar	35	2
8	Chitri	46	4
9	Tarubanda	71	2
10	Keli	100	4
11	Kot	29	0
12	Bhiroja	84	7
13	Kara	137	4
14	Nanduri	117	6
15	Baspani	117	2
16	Pohra	72	7
17	Didamda	65	2
18	Berdaballa	148	13
19	Lawada	150	15
20	Ghota	98	3
21	Jampani	40	1
22	Dabhiya	28	0
23	Hirabambai	162	12
24	Kawalazhiri	112	8
25	Rabang	71	5
26	Dhodra	93	3
27	Mansudhavdi	100	5
28	Mogarda	111	7
29	Dharakot	67	1
30	Tatra	73	2
31	Gadgamalur	161	13
32	Zhilangpati	114	8
33	Dharanmahu	181	18
	Total	2926	186

Fig. 1 – Age and gender wise distribution of study subjects.

pre-designed proforma. Consent from respondent parents was obtained before recording the anthropometric measurements in the community. Accuracy of data was cross checked by the trained supervisors. The digital weighing machine, Infantometer and Stadiometer were used and standardized before measurements in the community. Measurements were recorded to the nearest accuracy of 100 g and 0.5 cm.

Stunting was defined as height for age using standardized Z scores as per WHO growth standards.¹⁰ HAZ e.g. Mild: ($<-1SD$ to $>-2SD$), Moderate: ($<-2SD$ to $>-3SD$) and Severe: $\leq 3SD$.¹⁰

Underweight was defined as weight for age using WHO standardized Z scores, WAZ. Mild underweight is

WAZ $\leq$ ($<-1SD$ to $>-2SD$). Moderate underweight (MUW) is WAZ = ($<-2SD$ to $>-3SD$) and severe underweight (SUW) is WAZ $\leq 3SD$.¹⁰

Global Acute Malnutrition was defined as weight for height using standardized Z scores, WHZ. Moderate Acute Malnutrition (MAM) is WHZ ($<-2SD$ to $>-3SD$) and Severe Acute Malnutrition (SAM) is WHZ $\leq 3SD$.¹⁰ Estimate of severe acute Malnutrition includes bilateral oedema cases.

IAP gradation^{11,12} was defined as per percentage of expected weight: Normal: $>80\%$, Grade I: $70-80\%$, Grade II: $60-70\%$, Grade III: $50-60\%$, Grade IV: $<50\%$ of expected weight.

Table 2 – Prevalence of chronic under nutrition. Stunting – HAZ: WHO criterion.¹⁰

Stunting (Height for age)	Age groups						Total
	0–5 months		6–24 months		25–60 months		
	Male	Female	Male	Female	Male	Female	
Severe (−3SD)							
No.	33	27	218	159	314	255	1006
Percent	37.5	27.5	42.9	33.1	34.9	29.9	34.4
95% CI (%)	274–48.5	19.0–37.5	38.6–47.3	28.9–37.5	31.8–38.1	26.8–33.1	32.7–36.1
Moderate (−2SD to −3SD)							
No.	13	14	132	135	301	333	928
Percent	14.8	14.3	26.0	28.1	33.5	39.0	31.7
95% CI (%)	8.1–23.9	8.0–22.8	22.2–30.1	24.1–32.4	30.4–36.7	35.7–42.4	30.0–33.4
Mild (−1SD)							
No.	8	18	76	91	194	177	564
Percent	9.1	18.4	15.0	19.0	21.6	20.7	19.3
95% CI (%)	4.0–17.1	11.3–27.5	12.0–18.4	15.5–22.8	18.9–24.4	18.1–23.7	17.9–20.7
Normal							
No.	34	39	82	95	90	88	428
Percent	38.6	39.8	16.1	19.8	10.0	10.3	14.6
95% CI (%)	28.4–49.6	30.0–50.2	13.0–19.6	16.3–23.6	8.1–12.2	8.4–12.6	13.4–16.0
TOTAL							
No.	88	98	508	480	899	853	2926
Percent	3.0	3.3	17.4	16.4	30.7	29.1	
95% CI (%) (%)	4.7–7.2	5.6–8.3	31.6–36.4	31.1–36.1	57.6–62.6	57.0–62.2	

Age and under nutrition: Pearson chi square = 158.6, degrees of freedom = 6, p value = 0.0001.

Gender and under nutrition: Pearson chi square = 16.0, degrees of freedom = 3, p value = 0.001.

A customized software –MAHANsoft, version 1.0, 2011 was used for data entry purpose.

The data was analysed by age, gender, weight and height in a statistical software-STATA, version 10.3, 2010. Continuous variables were summarized in the form of mean (or median) and standard deviation. Categorical variables were summarized by frequencies and percentages. Crude and adjusted prevalence estimates accounting for clustering effect were obtained along with 95% Confidence Intervals. Chi-square test was used to test statistical significance of differences in proportions or for assessing trends across different age- and sex-groups. A p -value <0.05 was considered statistically significant.

3. Results

Fig. 1 shows the distribution of study subjects by age and gender. Majority (around 60%) of the study subjects belonged to the age group of 24–60 months; Male: Female ratio being 51:49%. Very high¹³ (85.37%) prevalence of chronic under nutrition was found in tribal U5 children population by stunting – HAZ: WHO criteria (Table 2). As per severity, the prevalence of chronic under nutrition was-mild: 19.3%, moderate: 31.7% and severe: 34.4%. Even when children with only moderate and severe stunting were included, the prevalence was found very high¹³ i.e. 66.1%. Prevalence of severe stunting was found significantly more ($p = 0.0007$) in boys (37.79%) as compared to girls (30.82%). Severe stunting increased significantly ($p = 0.001$) in children aged 6–24 months. Prevalence of moderate stunting was significantly more ($p = 0.025$) in girls (33.68%) as compared to boys (29.83%). A trend in prevalence of moderate stunting was observed by age. As the age of the children advances, prevalence of moderate stunting increased significantly ($p = 0.0001$).

As per underweight criteria, WAZ (Table 3) very high¹³ (58.4%) prevalence of acute on chronic under nutrition (comprising 18.69% SUW and 39.71% MUW) was found in tribal U5 children population (Table 3). The prevalence of SUW was found to be highest in the age groups of 6 months–24 months in boys & 25–60 months in girls. No significant trend in prevalence of underweight was seen by age in boys, but a significant trend was observed in girls ($p = 0.0156$). Although underweight was found more common amongst boys, but no significant difference in prevalence of SUW between male (19.46%) and female (17.89%) was observed. This observation might be reflecting absence of any gender bias for girl child in the tribal community.

As per wasting criteria WHZ prevalence of SAM was very high¹³ (7.1%) in age group of 0–60 months as indicated by weight for height criterion (Table 4). Prevalence of severe wasting was found highest in the age group of 0–5 months. Prevalence of SAM was more amongst boys as compared to girls in all age groups, though statistically not significant ($p = 0.2382$). However, a significant declining trend in prevalence of SAM by age was found both in boys & girls ($p = 0.0001$) in this tribal community. Up-down trend in the prevalence of MAM was observed by age. From 9.67% in age group of 0–5 months, prevalence of MAM jumped to (25.3%) in age group of 6–24 months and again dropped down to (16.15%) in 25–60 months of age group.

Table 5 shows prevalence of severe under nutrition by different grades by IAP standards. Prevalence of severe under nutrition (grade III & IV together) was 6.8% including 5.95% U5 children in grade III and 0.85% in grade IV. The prevalence was found significantly more ($p = 0.014$) in girls (7.97%) than boys (5.69%). Increasing trend in prevalence of grade III under nutrition was observed across various age groups but no such trend was evident amongst study subjects with grade IV under nutrition.

Table 3 – Prevalence of acute on chronic under nutrition. Underweight – WAZ: WHO criterion.¹⁰

Underweight (Weight for age)	Age groups						Total
	0–5 months		6–24 months		25–60 months		
	Male	Female	Male	Female	Male	Female	
SUW ($\leq 3SD$)							
No.	13	12	120	82	158	162	547
Percent	14.8	12.2	23.6	17.1	17.6	19.0	18.7
95% CI (%)	8.1–23.9	6.5–20.4	20.0–27.6	13.8–20.6	15.1–20.2	16.4–21.8	17.3–20.2
MUW ($-2SD$ to $-3SD$)							
No.	30	26	212	181	377	336	1162
Percent	34.1	26.5	41.7	37.7	41.9	39.4	39.7
95% CI (%)	24.3–45.0	18.1–36.4	37.4–46.2	33.4–42.2	38.7–45.2	36.1–42.8	37.9–41.5
Normal							
No.	45	60	176	217	364	355	1217
Percent	51.1	61.2	34.6	45.2	40.5	41.6	41.6
95% CI (%)	40.2–61.9	50.8–70.9	30.5–39.0	40.7–49.8	37.3–43.8	26.8–33.1	39.8–43.4
TOTAL							
No.	88	98	508	480	899	853	2926
Percent	3.0	3.3	17.4	16.4	30.7	29.1	
95% CI (%)	4.7–7.2	5.6–8.3	31.6–36.4	31.1–36.1	57.6–62.6	57.0–62.2	

Age and under nutrition: Pearson chi square = 20.1, degrees of freedom = 4, p value = 0.001.

Gender and under nutrition: Pearson chi square = 7.6, degrees of freedom = 2, p value = 0.022.

Table 4 – Prevalence of acute under nutrition. Wasting – WHZ: WHO criterion.¹⁰

Wasting (Weight for height)	Age groups						Total
	0–5 months		6–24 months		25–60 months		
	Male	Female	Male	Female	Male	Female	
SAM ($\leq 3SD$)							
No.	15	14	55	50	45	30	209
Percent	17.0	14.3	10.8	10.4	5.0	3.5	7.1
95% CI (%)	9.9–26.6	8.0–22.8	8.3–13.9	7.8–13.5	3.7–6.6	2.4–5.0	6.2–8.1
MAM ($-2SD$ to $-3SD$)							
No.	8	10	139	111	155	128	551
Percent	9.1	10.2	27.4	23.0	17.2	15.0	18.83
95% CI (%)	4.0–17.1	5.0–18.0	23.5–31.5	19.4–27.2	14.8–19.9	12.7–17.6	17.5–20.3
Normal							
No.	65	74	314	319	699	695	2166
Percent	73.9	75.5	61.8	66.5	77.7	51.5	74.0
95% CI (%)	63.4–82.7	65.8–83.6	57.4–60.1	62.0–70.7	74.9–80.4	78.7–84.0	72.4–75.7
TOTAL							
No.	88	98	508	480	899	853	2926
Percent	3.0	3.3	17.4	16.4	30.7	29.1	
95% CI (%)	4.7–7.2	5.6–8.3	31.6–36.4	31.1–36.1	57.6–62.6	57.0–62.2	
Age and under nutrition: Pearson chi square = 112.9, degrees of freedom = 4, <i>p</i> value = 0.0001.							
Gender and under nutrition: Pearson chi square = 5.9, degrees of freedom = 2, <i>p</i> value = 0.053.							

Prevalence of severe + moderate under nutrition was assessed by various standards and the comparison is shown in Fig. 2.

Crude and adjusted prevalence estimates of all the under nutrition indicators have been summarized in Table 6. Adjusted estimates were calculated considering Intra Class Correlation Coefficients and Design Effects.

Prevalence of severe wasting, severe underweight, severe stunting (WHO) and severe under nutrition (IAP) was assessed either by one independent criterion or by using a combination of more than one criteria. Out of total 2926 U5 children, 209 (7.1%) were SAM, 547 (18.7%) were SUW and 1006 (34.4%) were severely stunted. According to IAP standards, 199 (6.8%) U5 children were severely under nourished (grade III–IV).

Table 5 – Prevalence of under nutrition. Weight for Age: IAP Criterion.¹¹

IAP grade	Age group						Total
	0–5 months		6–24 months		25–60 months		
	Male	Female	Male	Female	Male	Female	
Grade IV							
No.	01	01	03	03	07	10	25
Percent	1.1	1.0	0.6	0.6	0.8	1.2	0.8
95% CI (%)	0.0–6.2	0.0–5.5	1.2–1.8	1.3–1.8	0.0–1.6	0.1–2.2	0.1–1.3
Grade III							
No.	00	02	15	25	59	73	174
Percent	–	2.0	2.9	5.2	6.6	8.6	5.9
95% CI (%)	–	2.5–7.2	1.7–4.8	3.4–7.6	5.0–8.4	6.8–10.6	5.1–6.9
Grade II							
No.	04	15	99	160	263	331	872
Percent	4.5	15.3	19.5	33.3	29.3	38.8	29.8
95% CI (%)	1.3–11.2	8.8–24.0	16.1–23.2	29.1–37.8	26.6–32.7	35.5–42.2	28.1–31.5
Grade I							
No.	31	33	222	191	375	317	1169
Percent	35.2	33.7	43.7	39.8	41.7	37.8	39.9
95% CI (%)	25.3–46.1	24.4–43.9	39.3–48.1	35.4–34.3	38.5–45.0	33.9–40.5	38.2–41.8
Normal							
No.	52	47	169	101	195	122	686
Percent	59.1	48.0	33.3	21.0	21.7	14.3	23.4
95% CI (%)	48.1–69.5	37.8–58.3	29.2–37.6	17.5–25.0	19.0–24.5	12.0–16.8	21.9–25.0
TOTAL							
No.	88	98	508	480	899	853	2926
Percent	3.0	3.3	17.4	16.4	30.7	29.1	
95% CI (%)	4.7–7.2	5.6–8.3	31.6–36.4	31.1–36.1	57.6–62.6	57.0–62.2

Fig. 2 – Prevalence of severe + moderate under nutrition. Wasting: weight for height; underweight: weight for age; stunting: height for age (WHO criteria) weight for age (IAP); assessment by one or more than one criteria.

However, when WHO criteria like SAM, SUW, severe stunting and IAP (grade III + IV) criteria were applied in combination for assessment of under nutrition, more number (1265 i.e. 43.24%) of the U5 children in Melghat were found to be severely under nourished.

Hence from public health action (early detection and management) point of view a combination of more than one criteria may be useful in identifying more number of under nourished children in tribal communities, which otherwise would have been missed by a single criterion alone.

4. Discussion

This cross sectional study conducted in tribal children population of Melghat is based on a large, representative sample of 2926 U5 children from 33 clusters (villages) comprising 1495 boys and 1431 girls. Preponderance of females was observed in the age group of 0–5 months probably indicative of non-existence of female feticide practice in the tribal community.

Infants and young children in this tribal belt have been chronically suffering from nutrition and health related problems including under nutrition and high mortality. Geographic location, prevailing socio-cultural practices among tribal people and logistic constraints have further aggravated these problems.¹⁴ Present study reveals very

high¹³ prevalence of severe under nutrition (43.24%), and severe + moderate under nutrition combined (76.51%) as assessed by one or more standard (WHO or IAP) criteria in tribal U5 children population.

Prevalence of stunting was found to be 66.1%, underweight 58.4% and wasting 25.9% in our study subjects. These results are comparable with a prevalence of under-nutrition reported by Meshram et al (2008) in another tribal area of Maharashtra. He found the prevalence of stunting, underweight and wasting as 61%, 64% and 29%, respectively in pre-school children of 1–5 years.¹⁴ National Nutrition and Monitoring Bureau (NNMB) survey (2009) found prevalence for stunting, underweight and wasting: 55%, 52%, and 22% respectively in 1 year–5 years age group in tribal India.¹⁵ Respective figures for rural India in another NNMB study were found to be 44.3%, 42.1% and 22.5% respectively among boys of <5 years. While, the corresponding figures for girls were 41.9%, 41.4% and 21.5%, respectively.¹⁶ Whereas for India these figures were: stunting 45.7%, underweight 41.1% and wasting 15.5% respectively.¹⁷ Small variations in findings of the present study and others could be mainly due to age differences; as ages of children in our study sample ranged from 0 to 60 months while in others the range was from 1 to 5 years.

It is evident that burden of under nutrition was much higher in tribal Melghat as compared to those reported in tribal, rural parts of India and India as a whole. The time trend

Table 6 – Crude and adjusted prevalence estimates of under nutrition by various criteria.

Criteria	Prevalence Percentage	95% CI (%) (Crude)	95% CI (%) (Adjusted for design effect)
Wasting (WHO)	25.97	24.4–27.6	22.2–29.7
Underweight (WHO)	58.4	56.6–60.2	55.6–61.2
Stunting (WHO)	66.1	64.4–67.8	62.1–70.1
IAP gradation	36.6	34.9–38.3	34.1–39.1
By any criteria	76.6	75.1–78.1	74.8–78.4

analyses from 2008 Meshram et al¹⁴ to 2012 (present study) did not show much improvement in under nutrition situation in tribal U5 children of Maharashtra.¹⁴

Severe and moderate stunting was found prevalent in more than 2/3rd of total children population. Very high prevalence of stunting reflects wide-spread chronic under nutrition of children population in this region, due to long term inadequate and improper dietary intake. Prevalence of severe stunting increased significantly in children aged 6–24 months as compared to normal amongst both boys ($p = 0.0001$) & girls ($p = 0.001$). This can be explained by widespread and faulty complimentary feeding practices prevailing in tribal communities.

Prevalence of stunting is particularly high as compared to wasting in Melghat. WHO criterion, weight for height is largely used for detecting under nutrition for planning interventions in the communities. In tribal communities of Melghat where majority of U5 children are stunted (85.27%), many moderately and severely under nourished children are bound to be missed if only weight for height criteria was applied. It is therefore important to find stunted, underweight and wasted children while calculating the burden of under nutrition and framing intervention policies for prevention and management of under nutrition. Weight-for-height or wasting – WHZ may be the only WHO criterion appropriate for such communities where height of children is near normal.

The prevalence of wasting ($WHZ \leq 2SD$) i.e. acute malnutrition ($>25\%$) was very high¹³ in the study population reflecting high incidence of infections & poor feeding practices in children.¹⁸

A clear cut trend was also seen in under nourished children by age; as age advances, the prevalence of IAP grade II and grade III increased.

The present study mainly aimed at providing a baseline data that can be used for nutritional surveillance activities, priority setting and planning specific nutritional interventions for under-privileged U5 children populations, with special focus on 6–24 months children, living in remote, difficult to reach and neglected tribal area of India. The study findings will be helpful in planning programmes that would focus more on populations most affected.

This is probably the first scientifically conducted survey on such a large, representative sample of U5 children from a tribal region of Central India with an objective to gain more insight about the factors that substantially contribute to the high prevalence of under nutrition and high infant mortality in this part of Maharashtra. Further studies with more in-depth analysis of the prevalence data are needed to identify the predictors of these common and chronic public health problems of the tribal populations. This will help in framing population-specific interventions like proper antenatal-perinatal care, breast feeding promotion program, hygiene, complementary feeding practices, balanced diet, good referral services, management of under nutrition, BCC regarding proper child rearing practices etc. in tribal areas.^{19–21}

Very high prevalence of under nutrition in a community is a different dimension of capability deprivation for income and expenditure and thus is a measure of poverty. Melghat is a difficult-to-reach, hilly, forest area where majority of the tribal are living below poverty line.⁷ Employment opportunities,

food security, communication and transport facilities are urgently needed to tackle the problem of severe under nutrition.⁸ Provision of special package for tribal area like Melghat is needed to solve the grave situation of under nutrition in India in general and Maharashtra in particular.

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Conflicts of interest

All authors have none to declare.

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