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The prevalence of under-nutrition among the tribal children in India: a systematic review

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ABSTRACT: Tribal population of India constitutes 8.6% of the total population. They are more susceptible to undernutrition which is recognized as a prevalent health problem mainly because of their uncertainty of food supply, which has serious long term consequences for the child and adversely influences the development of the nation. The assessment of nutritional status is paramount importance because it impels to identify malnutrition which is an aggravation of morbidity and mortality. This review was aimed to find out the overall nutritional status of tribal preschool children. It also seek the major socio-cultural causes which influence the nutritional status from bio-cultural perspectives among the tribal children in India in order to make foundation of new research. In the present review, 41 papers on nutritional status of tribal preschool children published from January 1st 2000 till date, have been identified and included for analysis. To analyze the data, meta-analysis was done using MedCalc software.

The meta-analysis revealed the average rate of prevalence of underweight, stunting and wasting among the preschool tribal children of India was 42.96%; 44.82% and 23.69%. Among the 41 different studies these rates vary among the different tribal groups of different states associated with their socio-economic status (10%), their cultures of food consumption (10%), maternal education (15%), child feeding practices (20%), dietary deficit during pregnancy (25%) and poor nutrition of the child (52%).

Prevalence rate of under-nutrition and stunting is relatively high in comparison to WHO in India whereas, rate of wasting was lower in comparison to national level which reflect that immediate nutritional status was poor but chronic deficiency of nutrition was less. Nutritional education and short term appropriately planned nutritional intervention programs may also be useful for enhancing their nutritional status.

KEY WORDS: preschool children, tribal, nutritional status, meta-analysis, underweight

Introduction

Malnourishment, particularly undernutrition is becoming one of the major public health problems in India and all the developing countries. Undernutrition severely affects child survival, growth and development, and it even decreases the national growth in the long run. It is a silent killer, which is mostly indiscernible. It is widespread among children and women, and is on verge of becoming acute and even alarming. As per a Global Survey Report, India is ranked at

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112 among the 141 nations as regards to Child Development Index (CDI) (Save the children, UNICEF 2012)

In India, every year, 7.6 million children die before they reach the age of 5, most of them from preventable or treatable illnesses. Malnutrition is an underlying cause of more than 35 percent of these deaths. A malnourished child is up to 10 times as likely to die from an easily preventable or treatable disease as a well-nourished child (Tubid 2015). The infant mortality rate in West Bengal is estimated at 28 deaths before the age of one year per 1,000 live births, down from the NFHS-3 estimate of 48 (IIPS 2007). Boys have a higher mortality rate than girls during the early childhood days (IIPS 2017).

Undernutrition in children can evident itself in several ways, and it is most commonly assessed through the measurement of weight and height. A child can be too short for his or her age is called stunted, have low weight for his or her height is termed as wasted, or have low weight for his or her age is referred as underweight. A child who is underweight can also be stunted or wasted or both. Each of these indicators captures a certain aspect of the problem. Weight is known to be a sensitive indicator of acute deficiencies, whereas height captures more chronic exposure to deficiencies and infections (UNICEF 2009). According to UNICEF (2009), wasting is used as a way to identify severe acute malnutrition. Despite of various national programs implemented by Central Government as well as State Government that contribute to improve nutritional outcomes include the Integrated Child Development Schemes, National Rural Health Mission including Janani Suraksha Yojana, Total Sanitation Campaign, National Rural Drinking Water Programme, Mid Day Meal Scheme, Targeted Public Distribution System, National Horticulture Mission, Mahatma Gandhi National Rural Employment Guarantee Scheme, National Food Security Mission and National Rural Livelihood Mission these programs are still unable to reach children under three – the age window during which nutrition interventions can have the most effect.

A prevalence of underweight above 30% and wasting above 10% are considered serious public health problems (WHO 1995). India contributes to one-third of severely wasted children under five in the world. In West Bengal, 32.1% boys and 32.9% girls under the age of five years are stunted; 20.8% boys and 19.8% girls are underweight; and nearly 30.7% boys and 32.5% girls are wasted(NFHS-4 2017). There are 104 million people from 705 distinct scheduled tribes. Within this population, 11.5 million are under the age of five years. More than half (54%), or 6.2 million of these tribal children are stunted in India whereas, in West Bengal the rate of stunting, underweight and wasting are 37.3%, 27.8% and 42.0% respectively among the tribal children (NFHS-4 2017).

Tribal population constitutes 8.6% of the total population of India. As per the recent report entitled "Nourishing India's Tribal Children" (UNICEF 2014) India's tribal communities continue to remain the most nutritionally underprivileged social groups in the country. They traditionally lead diverse life style and their way of life is indigenous. They are more susceptible to undernutrition which is recognized as a prevalent health problem mainly because of under usage of various government facilities, which has serious long term consequences for

the child and adversely influences the development of the nation. It is undeniable that their backwardness is influenced by a cobweb of factors ranging from poverty and hunger due to loss of forest land and livelihood, poor re-habitation measures, poor reach and quality of essential food and nutrition services during critical periods of life, geographical remoteness, weak governance and inadequate accountability mechanisms. More than half of tribal children under five years of age in India are stunted and fail to meet their potential for growth and development. Tribal Children at early age are more prone to be under nourished due to the lack of the awareness among the parents, like importance of breast feeding, proper nutritious food intake, immunization, care during sickness, clean drinking water, sanitation practices etc. The assessment of nutritional status is paramount importance because it impels to identify malnutrition which is a potential cause and or an aggravation of morbidity and mortality.

The followings are the main objectives of the present review study (i) to summaries the existing literatures among the tribal children in India in order to make foundation of new research; (ii) to find out the overall nutritional status of tribal preschool children in India, and (iii) seek the major socio-cultural causes which influence the nutritional status

Material and Methods

A literature review discusses published information in a particular subject area, and sometimes information in a particular subject area within a certain time period. It can be just a simple summary of the sources, but it usually has an organizational pattern and combines both summary and synthesis. More than 100000 articles are published each year in more than 20,000 journals. It is humanly impossible to read through the articles published in any field. Generally, the purpose of a review is to analyze critically a segment of a published body of knowledge through summary, classification, and comparison of prior research studies, reviews of literature, and theoretical articles. It may be of two types.

Narrative Review: Review articles written by one or more experts based on a convenience sample of studies with no description of the underlying methodology. It does not statistically combine results from multiple studies.

Systematic Review: Using some kind of systematic approach to minimizing biases and random errors, and that the components of the approach will be documented in a materials and methods section (Chalmers and Haynes 1995). It's quantitative component is meta-analysis (Figure 1).

The term meta-analysis means *an analysis of analyses*. It enables a rigorous comparison to be made rather than a subjective *eyeballing*. According to Glass (1976), "It is a quantitative and statistical approach for systematically combining results of previous research to arrive at conclusions about the body of research."

The graphical display of results from individual studies on a common scale

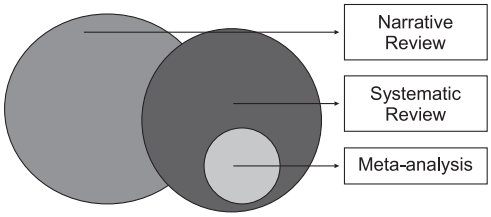

Fig. 1. Literature reviewing-conceptual relations

is represented by "Forest plot" in meta-analysis. Each study is represented by a black square and a horizontal line (CI: 95%). The area of the black square reflects the weight of the study (roughly the sample size). A logarithmic scale should be used for plotting the relative risk or odds ratio. Aggregate effect size displayed as a diamond. Presence of heterogeneity influences method of analysis. Therefore, two types of analysis should be done to overcome heterogeneity biases i.e. *Fixed effects model*: conduct, if heterogeneity is absent; *Random effects model*: Conduct, if heterogeneity is present.

Test for existence of heterogeneity:

Cochrane's Q-statistic-based on chi-square and I^2 statistic- scores heterogeneity between 0% and 100% (25% – low heterogeneity; 50% – moderate heterogeneity; 75% – high heterogeneity). In our study heterogeneity scores by I^2 statistic and it was above 75%. So, we took random effect model for the analysis.

Publication bias is another factor which affects the result. Funnel plot display the studies included in meta-analysis in a plot of effect size against sample size. If the lower left corner where negative or null studies are located, is empty then it indicates publication bias. In our study, the left corner was not at all that empty, so we ruled out the publication bias. Meta-analysis was performed using MedCalc v.18.11 software.

Study selection

Study design: It is a cross sectional study to find out the nutritional status of tribal children aged 0–5 years of both sex. *Data searching*: Computerized databases: Pubmed / Medline (www.ncbi.nim.nih.gov/entrez/query.fcgi), EMBASE, Science Direct (wwww.sciencedirect.com), Scirus (www.scirus.com/srsapp), personal references and emails, web, conference programs, dissertations, review articles, Government reports. *Time frame*: January 2001 to June 2018. Altogether, 40 studies were selected for meta-analysis (Figure 2).

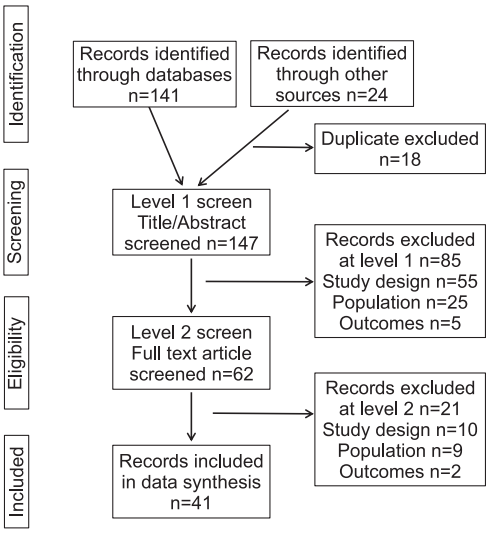

Fig. 2. Flow chart for study selection

Results

Figure 3 shows the forest plot of meta-analysis of proportion of undernutrition among the tribal children in India. Each horizontal line represents an individual study with the result plotted as a box and the 95% confidence interval of the result displayed as the line. The diamond at the bottom of the forest plot shows the result when all the individual studies are combined together and averaged. The horizontal points of the diamond are the limits of the 95% confidence intervals and are subject to the same interpretation as any of the other

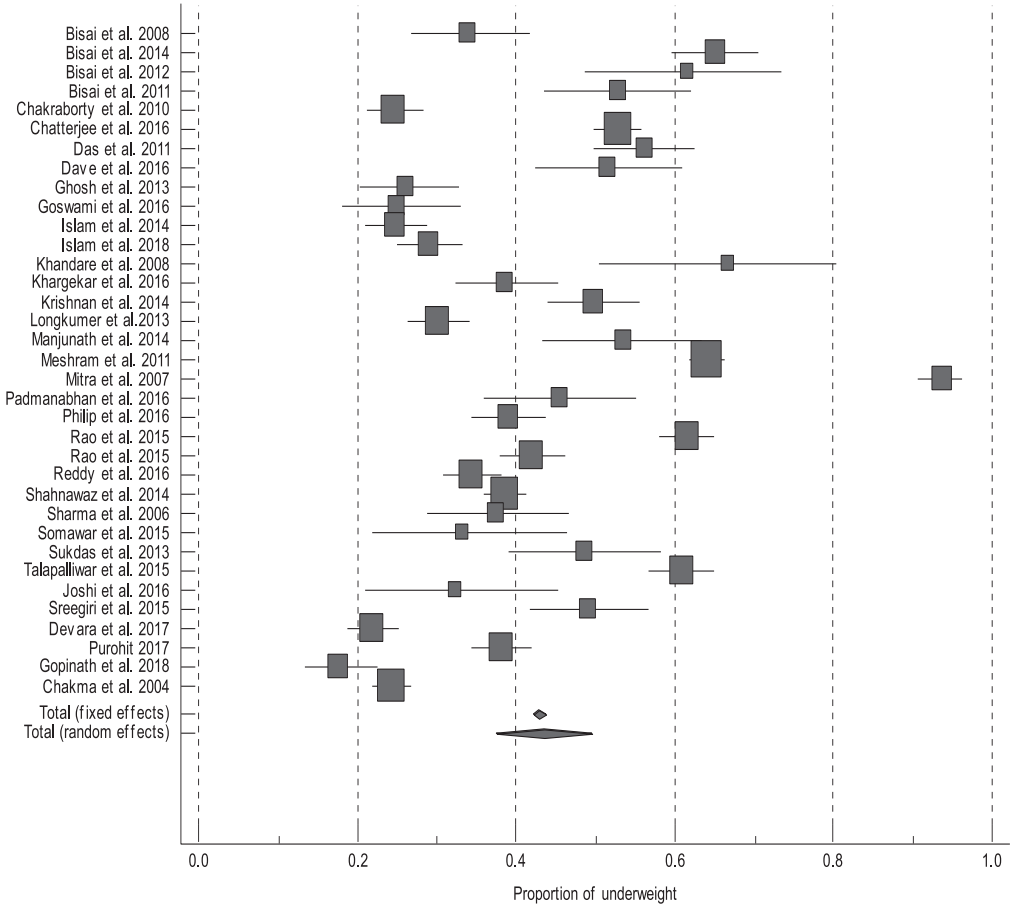

Fig. 3. Forest plot of undernutrition among the tribal children in India

individual studies on the plot. There are 35 studies selected for meta-analysis. The figure indicates that prevalence of undernutrition was highest (90.6% with 95%CI 90.6 to 96.3) among Kamars of Chattisgarh in the study of Mitra et al. whereas, the prevalence rate was lowest (9.3% with 95%CI 3.8 to 18.3) among the tribal children of Kerala as done by Vidya et al. in their study.

Figure 4 shows the forest plot of meta-analysis of proportion of wasting among the tribal children in India. Each horizontal line represents an individual study with the result plotted as a box and the 95% confidence interval of the result displayed as the line. The diamond at the bottom of the forest plot shows the result when all the individual studies are combined together and averaged. The horizontal points of the diamond are the limits of the 95% confidence intervals and are subject to the same interpretation as any of the other individual studies on the plot. There are 3 studies selected for meta-analysis. The figure indicates that prevalence of wasting was highest (60.4% with 95%CI 44.1

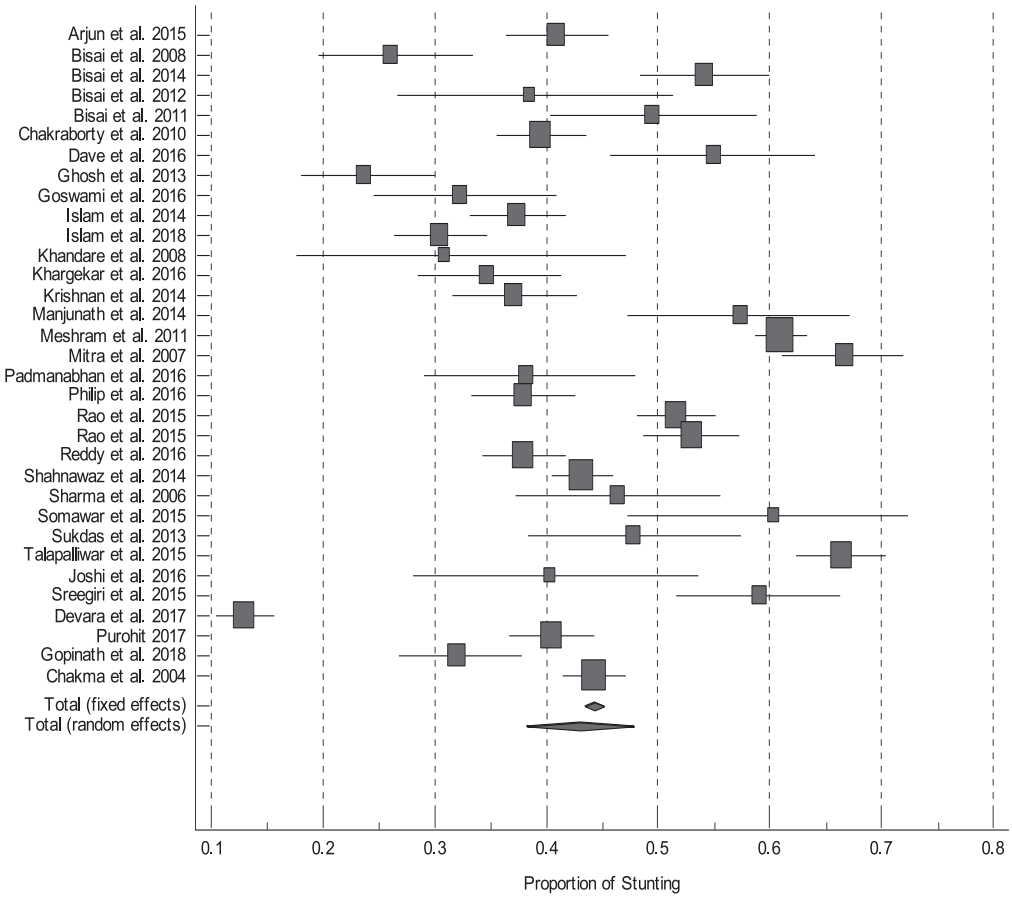

Fig. 4. Forest plot of wasting among the tribal children in India

to 75.1) among tribal children of Maharashtra in the study of Khandare et al. whereas; the prevalence rate was lowest (7.6% with 95%CI 5.6 to 10.1) among the Shabar children of Orissa as done by Chakraborty et al. (2005) in their study.

Figure 5 shows the forest plot of meta-analysis of proportion of stunting among the tribal children in India. Each horizontal line represents an individual study with the result plotted as a box and the 95% confidence interval of the result displayed as the line. The diamond at the bottom of the forest plot shows the result when all the individual studies are combined together and averaged. The horizontal points of the diamond are the limits of the 95% confidence intervals and are subject to the same interpretation as any of the other individual studies on the plot. There are 3 studies selected for meta-analysis. The figure indicates that prevalence of stunting was highest (66.6% with 95%CI 61.1 to 71.9) among the Kamars of Chattisgarh in the study of Mitra et al. (2007) whereas; the prevalence rate was lowest (12.90% with 95%CI 10.5 to 15.6) among the tribal children of Maharasthra as done by Devara et al. (2017) in their study.

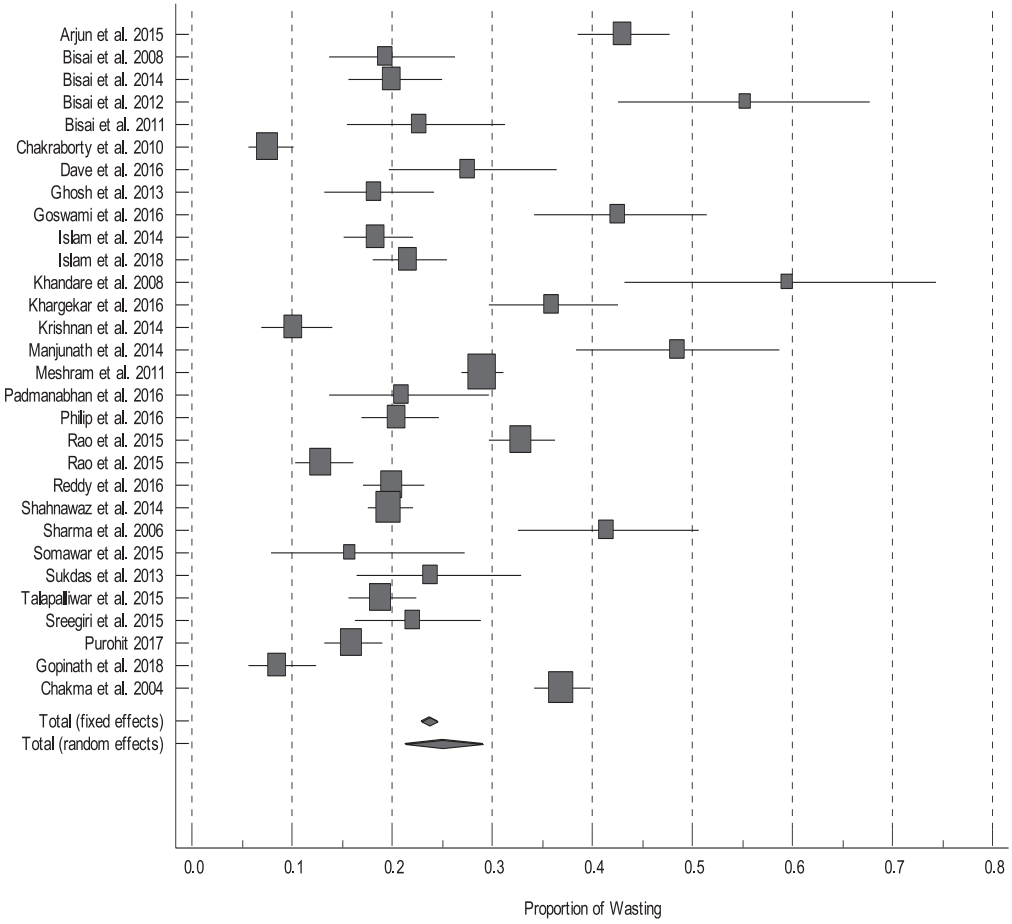

Fig. 5. Forest plot of stunting among the tribal children in India

Table 1 shows the selected studies on the nutritional status of the tribal pre-school children in India. Altogether 41 studies are finally selected for meta-analysis. Altogether 7 studies are selected from West Bengal, 5 studies from Maharasthra, 3 studies from Kerala and Madhya Pradesh each were included in the present review. Mostly nutritional status of pre-school children is taken to find out the overall nutritional status of pre-school children in India. Methods used in these studies were mainly WHO, NCHS and ICMR. Sample size varies from 42 (Khandare et al. 2008) to 1751 (Meshram et al.2011).

Table 2 illustrates the prevalence of undernutrition, stunting and wasting among the tribal pre-school children in India. The heterogeneity of the study is greater than 75% (I^2) so we took random effect model. The overall rate of prevalence of undernutrition is 43.4% (95%CI 97.9 to 98.4); prevalence of stunting is 43.03 (95% CI 96.2 to 97.3) and prevalence of wasting is 25.0 (95% CI 94.9 to 96.7) as depicted by random effect model of meta analysis.

Table 1. Selected studies of nutritional status of tribal children in India

Source	N Year	Tribe Place of study	Method	UW n (%)	ST n (%)	WT n (%)
Arjun et al. 2015	469 2015	Tribes	WHO	291 (62.0)	192 (41.0)	202 (43.0)
Bisai et al. 2008	165 2008	Lodha Paschim Medinipur	NCHS	56 (33.9)	43 (26.1)	32 (19.4)
Bisai et al. 2014	299 2012	Santal Paschim Medinipur	NCHS	195 (65.2)	162 (54.2)	60 (20.1)
Bisai et al. 2012	65 2012	Munda, Oraon Paschim Medinipur	WHO	40 (61.5)	25 (38.5)	36 (55.4)
Bisai et al. 2011	119 2009	Kora Paschim Medinipur	NCHS	63 (52.9)	59 (49.6)	27 (22.7)
Chakraborty et al. 2010	577	Shabar Orisha	NCHS	142 (24.6)	228 (39.5)	44 (7.6)
Chatterjee et al. 2016	1070 2014	Tribes,OBC Jharkhand	N.A	565 (52.8)		
Das et al. 2011	251 2010	Santal Purulia	WHO	141 (56.2)		
Dave et al. 2016	120 2006	Tribes Gujrat	ICMR WHO	62 (51.9)	66 (54.7)	33 (27.1)
Ghosh et al. 2013	203 2013	Santal Birbhum	WHO	53 (26.1)	48 (23.7)	37 (18.3)
Ghosh et al. 2015	119	Santal, Munda North 24 Paraganas	WHO	46 (38.6)	25 (21.0)	39 (32.7)
Goswami et al. 2016	136 2013	Bhumij Northern Odisha	NCHS	34 (25.0)	44 (32.4)	58 (42.6)
Islam et al. 2014	500 2012	Tribes Assam	WHO	124 (24.8)	187 (37.4)	92 (18.4)
Islam et al. 2018	500 2018	Tribes Assam	WHO	145 (29.0)	152 (30.4)	108 (21.5)
Khandare et al. 2008	42 2008	Tribes Maharasthra	ICMR	28 (66.7)	13 (30.2)	25 (60.4)
Khargekar et al. 2016	225	Tribes Maharasthra	WHO	87 (38.6)	78 (34.6)	81 (36.0)
Krishnan et al. 2014	297 2004	Tribes Kerala	WHO NCHS	148 (49.8)	110 (37.2)	30 (10.2)
Longkumer et al.2013	571 2000	Naga Nagaland	Cole et al.	172 (30.1)		
Manjunath et al. 2014	101 2013	Kudukuruba Mysore	WHO	54 (53.8)	58 (57.7)	49 (49.0)
Meshram et al. 2011	1751	Tribes Maharasthra	WHO	1121 (64.0)	1068 (61.0)	508 (29.0)
Mitra et al. 2007	309	Kamar Chattisgarh	WHO	290 (93.8)	206 (66.7)	0
Padmanabhan et al. 2016	110 2015	Tribes Tamilnadu	WHO	50 (45.8)	42 (38.1)	23 (20.5)
Philip et al. 2016	438 2010	Tribes Kerala	WHO	171 (39.0)	166 (38.0)	90 (20.5)

Table 1 continued

Source	N Year	Tribe Place of study	Method	UW n (%)	ST n (%)	WT n (%)
Probhokar et al. 2016	135	Tribes Karnataka	N.A	66 (48.7)		
Rao et al. 2015	817 2001	Gond M.P.	WHO	503 (61.6)	422 (51.6)	269 (32.9)
Rao et al. 2015	547 2013	Chenchus Andhra Pradesh	ICMR	230 (42.0)	290 (53.0)	71 (13.0)
Reddy et al. 2016	669	Sugali Tripura	WHO	230 (34.4)	254 (38.0)	134 (20.1)
Shahnawaz et al. 2014	1286	Tribes Rajasthan	WHO	496 (38.6)	556 (43.2)	254 (19.8)
Sharma et al. 2006	123 2003	Gond M.P.	WHO NCHS	46 (37.4)	57 (46.3)	51 (41.5)
Sil 2011	608	Tribes Tripura		0	144 (23.7)	0
Singh et al. 2016	350	Tribes Himachal Pradesh	WHO	75 (21.4)	96 (27.4)	39 (11.1)
Somawar et al. 2015	63 2014	Birhor Raigarh	WHO	21 (33.3)	38 (61.9)	10 (15.9)
Sukdas et al. 2013	113 2007	Tribes Andhra Pradesh	WHO	55 (48.4)	54 (48.2)	27 (23.6)
Talapalliwar et al. 2015	540 2014	Tribes Central India	WHO	329 (60.9)	359 (66.4)	102 (18.8)
Vidya et al. 2018	75	Tribes Kerala	ICMR	7 (9.3)		
Joshi et al. 2016	62	Bhumija Munda Mayurbhanj	WHO	20 (32.6)	25 (39.5)	0
Sreegiri et al. 2015	181	Tribes Visakapatnam	WHO	89 (49.2)	107 (59.0)	40 (22.2)
Devara et al. 2017	690 2015	Tribes Maharasthra	N.A	151 (21.9)	89 (12.9)	0
Purohit 2017	650 2011	Tribes Maharashthra	N.A	248 (38.1)	263 (40.5)	104 (16.0)
Gopinath et al. 2018	290 2015	Tribes Tamilnadu	WHO	51 (17.7)	93 (32.0)	25 (8.5)
Chakma et al. 2004	1197 2003	Baiga Madhya Pradesh	N.A	291 (24.3)	530 (44.3)	443 (37.0)

Abbreviations: N.A – Not available; UW – underweight, ST – stunting and WT – wasting.

Table 2. Percentage of heterogeneity (I^2), 95% Confidence interval (95%CI) and proportion of undernutrition, stunting and wasting among the tribal children in India

Nutritional Status	Fixed Effect Model	Random Effect Model	I^2	95%CI
Underweight	42.96	43.34	98.2%	97.9 to 98.4
Stunting	44.28	43.03	96.8%	96.2 to 97.4
Wasting	23.69	5.00	95.9%	94.6 to 96.7

Discussion

For the recent years, there has been a rise in world hunger. The absolute number of undernourished people, i.e. those facing chronic food deprivation, has increased to nearly 821 million in 2017, from around 804 million in 2016 (FAO 2018). In India, 15% populations are undernourished and she secured 97th position of 118 countries in the 2016 Global Health Index (GHI) released by Inter Food Policy Research Institute (IFPRI). In 2013, according to GHI score, India falls under 'alarming 'country but in 2016 there was an improvement noticed in GHI score (28.5). But still it falls under 'serious hunger level' (FAO 2009).

The present review summarized the prevalence of undernutrition among the tribal pre-school children in India for a 10-year period (2000–2018). In India, the prevalence of underweight among tribal preschool children ranged from 37.4% to 93.9% (Bisai et al. 2011). In our study the pooled prevalence of underweight (as per WHO standards) was found to be 43.4% (95% CI 97.9 to 98.4). The pooled prevalence of underweight is higher than the current national (36%) level estimate. Large CI indicates there had lots of variation in the data set ranging from 90.56% (Mitra et al. 2007) to 9.33% (Vidya et al. 2018) for prevalence of undernutriotion. The prevalence of undernutrition was low in the studies of Gopinath et al. (2018) (17.7%), Singh et al. (2016) (21.4%), Devara et al. (2017) (21.9%), Chakraborty et al. (2010) (24.6%) whereas, the prevalence was high in the studies of Khandare et al. (2008) (66.7%), Bisai et al. (2014) (65.2%), Bisai et al. (2012) (65.2%), Rao et al. (2015) (61.6%).

Prevalence of stunting among tribal preschool children in India varies from 35.1% to 67.8% and the overall prevalence of wasting among tribal preschool children in India ranged between 13.4% and 85.6% (Bisai et al. 2011). In this review, we found that the pooled prevalence of stunting was 43.03 (95% CI: 96.2 to 97.3). This study finding is consistent with the previous study and also with the current National Family Health survey report of the country. The prevalence of stunting and wasting in India is 38% and 28.5% respectively. On the other hand, prevalence of wasting from the pooled data was 25.0 (95% CI 94.9 to 96.7) which support the previous study on tribal preschool children but lower than the National Family Health survey report (28.5%) (NFHS-4 2016). The prevalence of stunting and wasting was found in the study done by Talapalliwar et al. (2015) (66.4% and 18.8%), Somawar et al. (2015) (61.9% and 15.9%), Sreegiri et al. (2015) (59.0% and 22.2%), Dave et al. (2016) (54.7% and 27.1%), Manjunath et al. (2014) (57.7% and 49.0%) respectively.

These studies also highlighted the underlying causes of undernutrition. The most immediate determinants of undernutrition are poor diet and disease, which are caused by a set of underlying factors: household food security, education, income, nutritional status of mother, access to clean water and sanitation, access to primary health care, sex and age of child. Most of the studies indicated education of the mother was an important risk factor for undernutrition (Meshram et al. 2011, Bepari et al. 2015, Reddy et al. 2016, Islam et al. 2018). Children of women with higher education were less likely to be undernourished. Education could be related to increased productivity, better methods of feeding and use of health-care facilities. Women having

higher education, owing to their exposure to the outside world, are more aware of personal hygiene, curative health care than that of uneducated or less educated women (Debnath et al. 2016).

Although poverty and illiteracy of parents are important determinants of undernutrition, factors such as improper introduction of complementary foods, low birth weight (LBW), intrauterine growth retardation, inadequate birth spacing and increased morbidities such as diarrhoeal diseases, acute respiratory infections (ARIs) and food insecurity are also accelerate the rate of prevalence of undernutrition in India (Meshram et al. 2011).

The risk of undernutition was significantly higher among scheduled castes and scheduled tribes compared to the upper or middle social class (Uppal 2005; NIN 2000). This may be because of availability and accessibility of heath care services in rural areas and they are socially the most backward groups having little exposure to the outside world; probably stick to their traditional beliefs related to food preparation methods, child care, feeding practices, etc. These have serious implications for child nutrition. In addition to this, they live in inaccessible remote areas and hence, there is an issue of availability and accessibility.

The pooled study showed that socially, economically and educationally weaker sections were more likely to be undernourished. In addition to the existing universal education program, there is a need to provide mass education regarding health and child nutrition in the rural regions, particularly among the educationally lagging poor socioeconomic groups. In this endeavor, cooperation is necessary among the government, non-governmental organizations, medical personnel and the local people. Thus, the services should be strengthened, especially for under-two children with respect to exclusive breast feeding, supplementary feeding practices, regular growth monitoring, prevention of infections, immunization, health and nutrition education of mothers with necessary follow-up, and corrective actions. At the lower strata of the society, planning and integration of the work of Anganwadi workers under Integrated Child Development Service (ICDS), Accredited Social Health Activists (ASHA) under National Rural Health Mission and active community participation will result in better delivery of services to target groups. However, valuable implementation of the services requires adequate manpower, infrastructure development, regular supply of quality food items, and logistic support. Food supplement need to be adopted for children with severe acute malnutrition, those with poor appetite or acute medical complications. encouragement for low-cost sustainable solutions like optimal infant and young child feeding practices need to be facilitated for preventing the occurrence of severe acute malnutrition. On the other hand, rapid population growth and political commitment have an indirect effect on malnutrition. Therefore, socioeconomic development of the country with involvement of all the stakeholders concerned could result in reduction of malnutrition. According to Millenium Development Goal 2012 the target of reducing undernutrition by 2015 was 26% (MDM 2012) but to come down only to about 33% in India in spite of invention of various policies and schemes on reducing the rate of undernutrition (Patwari 2013). The results of the present study will be useful for policy makers and programmers to formulate various developmental and health care programs.

Study limitation

The present study has some limitations which are need to be mentioned. The study is limited only to the selected database source, English-language publications and therefore might have missed some relevant publications. Overall, a high degree of heterogeneity was observed in the included studies.

Conclusion

Our pooled results support the finding that the malnutrition among the tribal children is still a health issue in India. Despite many interventional programs from both the Governments it remains a serious problem which in long term affects the growth of the country. Therefore, increasing health literacy and promoting the culture of proper nutrition, equitable distribution of health care and services, solving economic obstacles, regular monthly weighting and growth monitoring for children, emphasizing on the importance of breastfeeding and the proper use of complementary feeding and finally the principled spacing between births and improving the quality of maternal care should be undertaken as an effective public health strategy to combat child malnutrition among the socio-economically vulnerable communities in India. The findings of this review reflect the importance of nutrition in under-five-year children and proper policy making in this area.

Authors' contributions

SB conceived study design and data analyses; UD made literature search and drafting the manuscript. Both the authors are equally responsible for writing the paper.

Conflict of interest

The authors declare that they have no conflict regarding the manuscript and have no intention that might raise the question of bias in the work reported.

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