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Anthropometric assessment of nutritional status of school going children in urban and rural India - a systematic review and meta analysis

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ABSTRACT:

BACKGROUND: *According to National Family Health Survey (NFHS-4, 2015-16) 37.5% children were underweight in India, out of this 29.1% belongs to urban area and 38.3% belongs to rural area and prevalence of stunting, wasting was 38.4%, 21.0% respectively.*

OBJECTIVES: *The present study aims to find out overall nutritional status of school going children in urban and rural India and synthesize research findings regarding the level of the knowledge of this topic.*

MATERIALS &METHODS: *Present study reviews total 63 papers indicating nutritional status of urban and rural school going children (5-15 years) in India from the electronic databases like PubMed, NCBI, research gate, academia and Google scholar published during the year 2005 to 2020 and using WHO Z score ,NCHS and some are CDC growth system. For systematic review process PRISMA Flow Diagram has been considered. To analyze the data meta-analysis statistical method was done by using MedCalc software version 19.2.*

RESULTS: *The overall prevalence of under nutrition, underweight, stunting, wasting and thinness/underweight in urban and rural area of school going children was found to be 33.12% (95% CI: 22.73 to 44.43), 35.90% (95% CI: 27.96 to 44.25), 23.50% (95% CI: 18.35 to 29.0), 17.15% (95% CI: 11.34 to 23.8), 32.36% (95% CI: 27.69 to 37.20) respectively.*

CONCLUSION: *The present review reveals that nutritional status of school going children in urban and rural areas both was in critical situation. Urgent attention on this aspect is needed.*

Keywords: *Nutritional status, Anthropometry, Children, India, Systematic review, Meta-analysis.*

INTRODUCTION

Nutritional status is considered as a health status that determines the necessity of essential requisites of an individual. Over one fifth of our population comprises children aged 5-14 years i.e. the group covering primary and secondary education (Raghava, 2005).Two hundred million children belong to school age (5-15 years) group and majority of them belongs to rural India (UNICEF, 1999). Period of school age is the leading time to build up the entire body by storing nutrient for rapid growth, during this period the main emphasis must be given for growth, eating patterns and adaptor to environmental influences (Gupta et al. 2015). Normal nutritional status generally managed by balanced food and malnutrition is caused by faulty food intake or lack of food nutrients, poor quality health and care, environments and behaviors, which are shaped by a host of underlying factors in part such as poor economic development, conflict, inequality and some dimensions of globalization (Global Nutrition Report, 2016). Study indicates that nutritional status also associated with socio-demographic factors of school going children (Kaushik et al. 2012). Entire life of a child is determined by food giving to them in the first five years and main problem of health among children in India including West Bengal is malnutrition (Mondal et al. 2015). Consuming healthy food helps to keep normal nutritional status. Some nutrients may take place in the process of nutrition. In the absence of those nutrients malnutrition may occur. "Malnutrition is responsible for delays growth; malnourished people very often lack the power of resistance to different kind of diseases" (Shukla &Rustogi, 2008, p.499). 37.5% children were underweight in India, out of this 29.1% belongs to urban area and 38.3% belongs to rural area and prevalence of stunting, wasting was 38.4%, 21.0% respectively (NFHS-4, 2015-16). Life of school children continues to be poor in India and the condition is still worse in rural areas (WHO, 2000). One of the primary causes behind ill health among children in developing countries like India is under nutrition (Nandy et al. 2005). Problem of under nutrition is more prevalent among children suffer from this problem living in rural areas of our country as compared to urban areas (Rajaram et al, 2007). Poor health and malnutrition may weaken body growth and cognitive development of primary school going children (Das et al. 2012). Socio-cultural practices and life styles are vary between states as well as districts in India and proper care of health and nutrition of school going children is very important at this stage and majority of children suffered from different type of malnutrition, therefore adequate nutrition is much essential for growth and development (WHO,

2005). Child mortality rate one of the reasons in India behind under nutrition in children (Mondal, 2015). Surveys indicate that malnutrition emergence the risk of deaths among infant and child, children who are under weighed is likely to be less cleaver than the well fed children, child's health is more important to rapid growth during this period (Shashi & Bishraj, 1990).

Anthropometry is usually considered to be the most useful tool for assessing the nutritional status, there are some indicators in use to assess underweight and stunting like weight-for-age (WAZ), height-for-age (HAZ) (Bose et al. 2008). These indicators needs some specific reference tables for interpreting data e.g. NCHS, WHO child growth standard to estimate the expected weight or height of child (Hasan et al. 2011). In emergency situations, many clinicians and field workers are using a specific formula which was first introduced by Weetch by using age as variable (Hasan et al. 2011). Underweight is an indicator of low weight-for-age and is used as composite indicator for acute and chronic under nutrition, stunting is an indicator of low height-for-age and is an indicator of chronic under nutrition due to the result of prolonged disease/food deprivation/illness, wasted is used to assess low weight-for-height, thinness is an indicator of low BMI-for-age and used for acute under nutrition (WHO, 1995). More than 20-80% primary school children are suffering from nutritional deprivation (Shivaprakash et.al. 2014).

The purpose of a review is to analyze a segment of a published body of knowledge through summary, classification and prior research studies, reviews of literature and theoretical articles critically. It may be of two types: narrative review and systematic review. Narrative review articles written by one or more experts based on a convenience sample of studies and there is no description of the underlying methodology. Narrative review doesn't statistically combine results from multiple studies (Dey and Bisai, 2019). Systematic review used for minimizing biases and random errors by using some kind of approach and the components of the approach will be documented in a material and method section (Dey and Bisai, 2019) and meta analysis is a quantitative component of systematic review (Chalmers and Haynes, 1995).Meta analysis enables a meticulous comparison to be made rather than a subject eyeballing and the term meta analysis means *an analysis of analyses* (Dey and Bisai, 2019). Meta analysis is a quantitative statistical approach for systematically combining the results of previous research to reach a conclusion about the body of research (Glass, 1976).

This review uses the WHO- Z score, NCHS and some are CDC (Centers for Disease Control and Prevention) growth system to estimate nutritional profile between 5-15 aged school going children of Indian subcontinent.

Since no previous work have done on this kind of statistical analysis on this subject matter hence, the present study is important in the sense that it may identify regional imbalances as well as population specific differences in the form of nutritional status of school going children throughout India. Which, in turn, will help policy makers, administrators and ground level healthcare workers to sensitize about such imbalances as well as overall status of Indian school going children.

Objectives: 1) To find out the prevalence of under nutrition, underweight, stunting, wasting and thinness of school going children in urban and rural India respectively.

2) To find out overall nutritional status of school going children in urban and rural India and synthesize research findings regarding the level of the knowledge of this topic.

MATERIAL AND METHODS:

Study design: The present literature review was done by the evidence of nutritional status of school going children in India. Cross sectional studies published in English language from 2005 to 2020 mainly focusing on the prevalence of under nutrition, underweight, stunting, wasting and thinness aged between 5 to 15 years in urban and rural India were included in this systematic review and meta analysis. A total of 124 articles were scanned and 61 articles were excluded for not fulfilling the inclusion criteria. Total 63articles have been studied (30 from urban, 31 from rural area and 2 papers among them were found to have urban and rural area together) have been evaluated. List of related published articles given in references. These studies used WHO z scores, NCHS(National Center for Health Statistics)and CDC (Centers for Disease Control and Prevention) growth chart for assessing the nutritional status of school children. Specific cut off were considered to assess nutritional status given below:

Condition	Appropriate value	Appropriate cutoff value
Underweight*	Weight-for-age	<-2SD from median of WHO growth charts <-80% of 50th percentile*

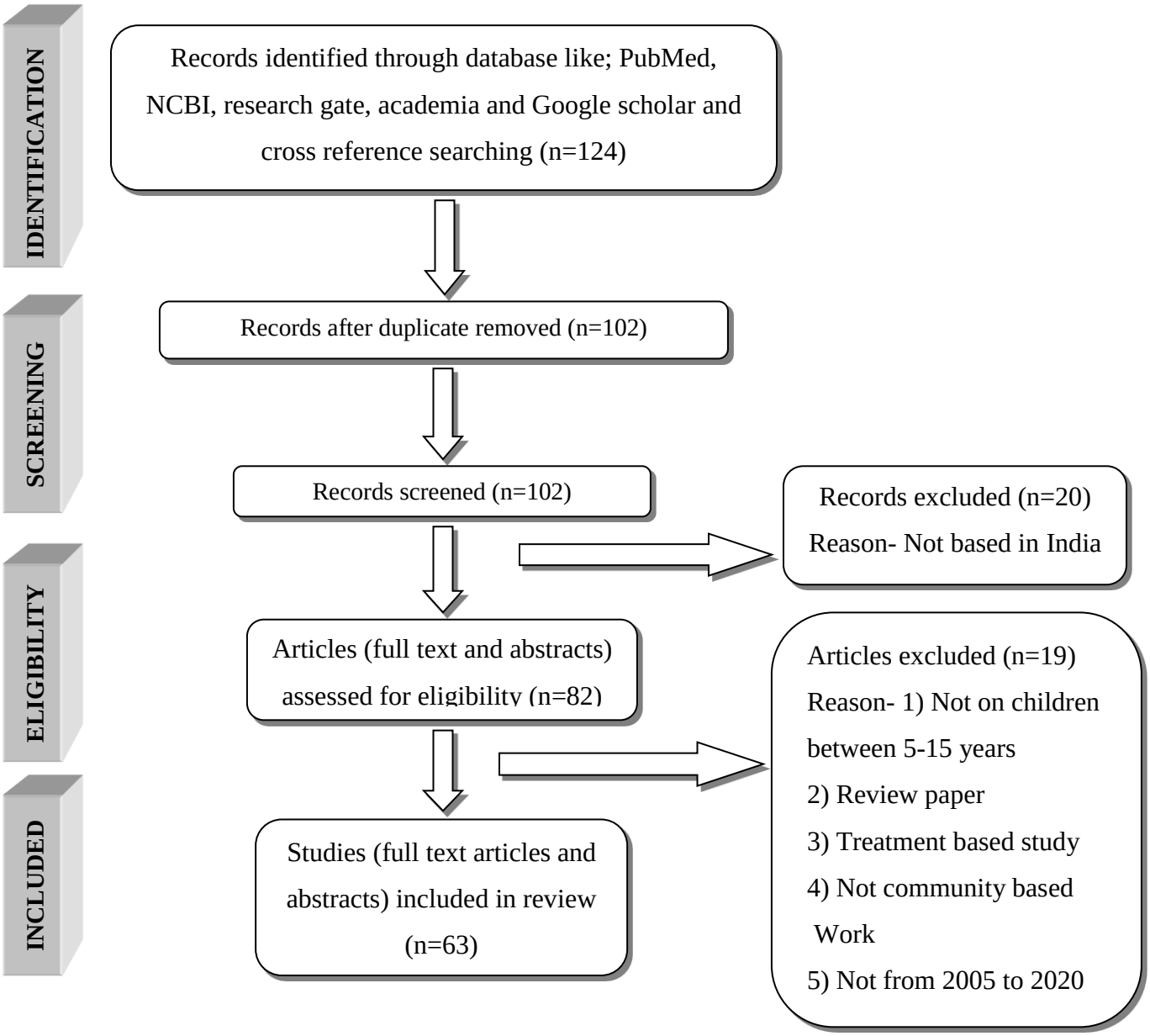
Stunting*	Height-for-age	<-2SD from median of WHO growth charts <-90% of 50th percentile*
Wasted	Weight-for-height	<-2SD from median of WHO growth charts
Thinness Underweight*	BMI-for-age	>+1SD from median of WHO growth reference. <5th percentile**

*Cut off of NCHS (National Center for Health Statistics) &**CDC (Centers for Disease Control and Prevention)

Search strategy: Data related to nutritional status of school children were collected by using e-search engine "Google". As stated earlier, review studies were selected from published articles in English language that showed prevalence of under nutrition, underweight, stunting, wasting and thinness by different age and regions from urban and rural areas in India.

Keywords for search: For this systematic review literature search was carried out by using following keywords- nutritional status, anthropometry, under nutrition, school going children, urban and rural area. Initial search (full text articles and abstracts) was carried out in PubMed, NCBI, research gate, academia and Google scholar. Cross reference was also used to find relevant articles. For systematic review process PRISMA Flow Diagram (Fig.1) has been considered. Some inclusion and exclusion criteria also set up for this systematic review. Reasons for inclusion and exclusion are given below:

Inclusion criteria	Exclusion criteria
1) Articles (full text and abstracts) were limited to India only.	1) Not based in India.
2) Nutritional status related studies from 2005 to 2020	2) Not on children between 5-15 years or adult population
3) Targeted the school going children between 5to 15 years of age.	3) Review paper
4) Community based study	4) Treatment based study
5) Cross sectional studies as well as comparative and combined studies.	5) Not community based



(Fig-1: PRISMA Flow chart for systematic review by using the search terms, strategy, articles that screened for eligibility)

Study analysis: Systemic review was done to minimizing biases and random errors. Meta-analysis statistical method was done by using MedCalc software version 19.2. The graphical display of results is represented by "Forest and Funnel plot" in meta analysis. A black square and a horizontal line (CI: 95%) represented each of the study. The area of the black square reflects the weight of the study as well as the sample size. The diamond at the bottom displayed aggregate effect size of the study. Presence of heterogeneity influences method of analysis based on present and absent,

hence two types of analysis should be done to overcome heterogeneity bias, one is Fixed effects model- it conduct if heterogeneity is absent and secondly Random effect model- it conduct if heterogeneity is present.

Test of heterogeneity: Cochrane's Q-statistic-based on chi-square and I^2 statistic scores heterogeneity between0% and 100 % (25%-low, 50%-moderate and 75%-high heterogeneity). Heterogeneity scores presented by I^2 statistic in this study and it was above 75% so we took random effect model for the analysis. Funnel plot displayed the studies included in the 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 because publication bias is an important factor which affects the result. In our study left corner was not at all empty so we ruled out the publication bias.

Time frame: Duration of this study was from September 2020 to December 2020.

Ethical approval: Not needed.

RESULTS AND DISCUSSION:

Several studies have revealed rural urban variation in growth patterns. Total 63 studies (30 from urban, 31 from rural area and 2 papers among them were found to have urban and rural area together) have been evaluated. Range of sample sizes varies in both contexts, like: in urban area sample sizes were from 70 to 28,256 on the other hand rural area has 86 to 27,544. The entire students were between 5 to 15 years. Table 1 shows the prevalence of under nutrition, underweight, stunting, wasting and thinness of urban school children. Prevalence of under nutrition was highest in Kurnool, Andhra Pradesh (62.38%) among urban area and lowest in Mangalore, Karnataka (5.03%). The prevalence of underweight (76.2%), stunting (67.0%) were highest among all district of west Bengal, Bapu Nagar of Lucknow respectively. Wasting (33.3%), thinness (55.2%) was highest in Bareily of Uttar Pradesh and Chidambaram of Tamil Nadu. Lowest prevalence of underweight (3.2%), stunting (1.5%), wasting (3.0%) were observed in Mumbai of Maharashtra, Allahabad of Uttar Pradesh and thinness (11.50%) was observed in Assam, Northeast India.

Table 2 shows the prevalence of under nutrition, underweight, stunting, wasting and thinness of rural school children. Prevalence of under nutrition was highest in Rampicherla, Chittor of Andhra Pradesh (54.48%) and lowest in Moradabad of Uttar Pradesh (11.52%). Highest prevalence of

underweight (68.26%), stunting (56.1%), wasting (40.64%), thinness (57.14%) was seen in Bikaner of Rajasthan, Tehri of Uttar Pradesh, , Khowai of Tripura, Burdwan of West Bengal and lowest prevalence of underweight (9.82%), stunting (4.64%) was seen in Maner of Patna and wasting (3.7%) was seen in Mysore of Karnataka, thinness (13.0%) was seen in Bellary of Karnataka.Four of them are tribal children i.e. Bodo, Santal, Jenukuruba and Bhumij. Study conducted by Mondal et.al (2015) among Bodo and Chowdhury et.al (2011) among Jenukuruba tribal children in Assam of Northeast India and Mysore of Karnataka shows lowest prevalence of nutritional status among the rest of other two studies on tribal children.

TABLE-1: Nutritional status of urban school going children:

Sl No	Study Area	Sample Size	Age Group (in years)	Prevalence of Undernutrition	Underweight as per Weight-for-Age	Stunting as per Height-for-Age	Wasting as per Weight-for-Height	Underweight/Thinness as per BMI-for-Age	reference
1	Dohra Galli, Chandabowdi-Vijaypura	89	5-9	-----	24.0%	49.0%	-----	-----	Yankanchi et al. 2018
2	Meerut-Uttar Pradesh	800	5-11	49.5%	44.6%	43.8%	-----	-----	Saluja et al. 2009
3	Ahmedabad-Gujrat	28,256	5-13	-----	-----	-----	-----	29.44%	Patel et al. 2015
4	Bareily-Uttar Pradesh	512	5-15	-----	38.4%	19.9%	33.3%	-----	Srivastava et al. 2012
5	Karimnagar-Telengana[#]	410	6-11	-----	22.2%	16.0%	-----	-----	Shaikh et al. 2016
6	Bikaner-Rajasthan	720	6-14	24.17 %	20.42%	9.86%	-----	22.22%	Kumawat et al.2016
7	Chidambaram-Tamil Nadu	125	6-10	-----	62.4%	42.4%	-----	55.2%	Kalyani et al. 2016
8	Kurnool-Andhra Pradesh	101	6-10	62.38 %	-----	-----	-----	-----	Subhaprada CS, 2015

9	All district of West Bengal	3654	8-9	-----	76.2%	49.0%	-----	-----	Mondal et al. 2015
10	North Kolkata-West Bengal	502	5-9	-----	31.10%	-----	-----	-----	Das et al. 2013
11	Mumbai-Maharastra	2336	6-9	-----	3.2%	1.5%	4.1%	-----	Hooshmand et al. 2014
12	Karnataka	76	9-11	-----	------	-----	-----	51.0%	Chandramohan et al.2015
13	Mangalore city-Karnataka	1630	7-11	5.03%	-----	-----	-----	-----	Kamath et al. 2012
14	Azad Nagar-Bangalore	500	5-14	52.0%	-----	28.85%	-----	-----	Hasan et al. 2011
15	North 24 PGS-West Bengal	559	11-14	36.49 %	-----	-----	-----	-----	Mukhopadhay et al. 2005
16	Sullia-South India	424	5-11	-----	26.5%	19.2%	-----	26.5%	Amruth et al. 2015
17	Kalapet-Puducherry	714	5-9	-----	30.7%	10.4%	-----	30.7%	Abraham et al. 2015
18	South 24 parganas-West Bengal	240	6-10	-----	42.08%	-----	-----	-----	Nath et al. 2019
19	Kolkata-West Bengal	204	5-10	18.4%	-----	-----	-----	-----	Deb et al. 2010
20	Bilaspur-Uttar Pradesh	120	7-9	-----	5.8%	-----	-----	-----	Jain et al. 2018
21	Allahabad-Uttar Pradesh	150	7-10	-----	25.0%	17.3%	3.0%	-----	Handa et al. 2008
22	Assam-Northeast India-(Bodo tribal children)	1017	5-11	-----	-----	-----	-----	11.50%	Mondal et al. 2015
23	Silchar-Assam*	216	6-15	-----	------	14.35%	24.33 %	51.38%	Dey et al. 2017
24	Guntur-Andhra Pradesh	1022	5-11	-----	-----	-----	-----	40.3%	Pinni et al. 2019

25	Bikaner-Rajasthan[#]	285	7-9	-----	71.92%	49.12%	-----	-----	Misra et al. 2020
26	Meerut	483	8-12	-----	29.0%	12.0%	-----	22.0%	Agarwal et al. 2018
27	Bhopal-Madhya Pradesh	270	6-15	51.1%	-----	-----	-----	37.4%	Gupta et al. 2015
28	Bapu Nagar Lucknow	70	6-12	-----	74.8%	67.0%	-----	-----	Patel et al. 2019
29	Sri Muktsar Sahib-Punjab	863	6-15	-----	-----	-----	-----	15.41%	Singh et al. 2015
30	Panchkula-Haryana	253	6-8	-----	28.8%	19.4%	-----	17.8%	Talwar et al. 2014
31	Bikaner-Rajasthan	300	6-12	-----	-----	------	-----	30.0%	Inkhiya et al. 2016
32	Pune-Maharastra	823	5-11	-----	-----	4.47%	6.32%	-----	Yadav et al. 2016

*****moderate and severe underweight, stunted and for BMIZ, thin and very thin was combined.

TABLE-2: Nutritional status of rural school going children:

Sl No	Study Area	Sample Size	Age Group (in years)	Prevalence of Under nutrition	Underweight as per Weight-for-Age	Stunting as per Height-for-Age	Wasting as per Weight-for-Height	Underweight/Thinness as per BMI-for-Age	reference
1	Karnataka-Manipal	797	6-12	-----	-----	-----	-----	43.32 %	Kulkarni et al. 2017
2	Moradabad-Uttar Pradesh**	295	6-15	11.52%	-----	-----	-----	-----	Sharma et al. 2017
3	Chiraigaon-Varanasi	816	5-12	-----	52.6%	9.2%	-----	-----	Kaushik et al. 2012
4	Ukkali:Bijapur-Karnataka	284	6-12	-----	34.15%	25.0%	-----	-----	Shashank et al. 2016
5	Karimnagar-Telangana[#]	410	6-11	-----	-----	29.3%	21.5%	-----	Shaikh et al. 2016
6	Kanpur-Uttar Pradesh	360	5-14	-----	39.4%	27.8%	-----	26.6%	Gahlot et al. 2019
7	Mandya-Karnataka	484	6-12	-----	30.3%	27.9%	-----	-----	Shivaprakash et al. 2014

8	Tehri, Garhwal-Uttar Pradesh	499	6-10	-----	60.9%	56.1%	12.2%	-----	Osei et al. 2010
9	Kashmir-North India	940	5-14	-----	11.1%	9.25%	12.3%	29.0%	Fazili et al. 2012
10	Maharastra-Pune	470	5-15	-----	36.2%	23.0%	-----	32.1%	Vaidya et al. 2015
11	Khowai-Tripura	155	6-12	-----	29.67%	15.48 %	40.64 %	-----	Debbarma et al. 2018
12	Hisar-Haryana	200	7-9	-----	55.5%	54.11 %	-----	-----	Sati et al. 2012
13	Trissur, Palakkad-Kerala	244	9-14	37.2%	-----	-----	-----	17.62 %	Srinivas et al. 2019
14	Khammam-Telangana	600	6-10	-----	-----	19.0%	-----	-----	Mondal et al. 2015
15	Bellary-Karnataka	27,544	7-15	16.1%	-----	-----	-----	13.0%	Kamath et al. 2015
16	Mangalore-South India	478	5-10	-----	54.6%	21.3%	-----	51.4%	Kini et al. 2016
17	Bikaner-Rajasthan[#]	542	7-9	------	68.26%	51.29 %	-----	------	Mishra et al. 2020
18	Rampicherla, Chittor-Andhra Pradesh	613	5-15	54.48%	62.96%	-----	-----	-----	Sasikala P, 2016
19	Bankura-West Bengal	86	6-10	-----	29.06%	22.09 %	13.95 %	-----	Patsa et al. 2018
20	Purulia-West Bengal-(Santal tribal children)	442	5-12	-----	33.7%	17.9%	29.4%	-----	Chowdhury et al. 2011
21	North Bihar	1263	6-12	-----	-----	18.2%	-----	23.8%	Kumar et al. 2019
22	Shirur-Bagalkot	1414	6-15	-----		25.7%	-----	35.0%	Kalaskar et al. 2016
23	Lucknow-Uttar Pradesh***	100	7-9	-----	-----	37.0%	27.0%	-----	Saxena et al. 2014
24	Burdwan-West Bengal	224	6-12	-----	-----	-----	-----	57.14 %	Mondal P L, 2015
25	Mysore-Karnataka (jenukurubatr ibal children)	135	6-10	-----	14.8%	6.7%	3.7%	-----	Prabhakar et al. 2009

26	Taravanahelli, Silvepura-Bangalore	582	5-14	-----	20.0%	7.0%	-----	34.0%	Rashmi et al. 2014
27	Palghar-Maharastra (Bhumijtribal children)**	126	6-10	-----	30.15%	-----	-----	------	Gokhale et al. 2018
28	Purbamedinipur-West Bengal	622	6-10	-----	41.9%	31.0%	21.0%	-----	Khanra et al. 2019
29	Bhopal-Madhya Pradesh	200	6-9	-----	-----	-----	-----	55.0%	Murugkar et al. 2013
30	Bangaluru-South India	2730	6-15	-----	35.9%	19.3%	-----	30.0%	Ramesh et al. 2017
31	Mangalore	1312	5-10	-----	-----	-----	-----	40.5%	Aramani et al. 2019
32	Doiwala-Dehradun	559	5-10	-----	34.0%	29.0%	-----	34.0%	Kaur et al. 2015
33	Maner-Patna***	560	5-12	-----	9.82%	4.64%	-----	-----	Rajak et al, 2018

**moderate and severe malnutrition was combined.
***moderate and severe underweight, stunted and wasted was combined.
#same article (Urban & Rural area)

Figure-2 shows the forest plot presented the prevalence of under nutrition among the school going children in various parts of India. Altogether 12 studies were reported in the stipulated time frame of our study so farand selected for meta analysis. Sample sizes were varied from 101 (Subhaprada, 2015) to 27,544 (Kamath et al. 2015). Each horizontal line with box represents every study and 95% confidence interval of the result. The diamond at the bottom displayed aggregate effect size of the study. Prevalence of under nutrition in urban area was highest (62.38% with 95% CI: 52.18 to 71.82) among the study by Subhaprada, 2015 and lower rate of under nutrition (5.03 with 95% CI: 4.02 to 6.20) was found among the study by Kamath et al. 2012. Prevalence of under nutrition in rural area was highest (54.48% with 95% CI: 50.44 to 58.47) among the study by Sasikala, 2016 and lowest prevalence of under nutrition (11.52% with 95% CI: 8.1 to 15.72) was reported among the study by Sharma et al. 2017. The graph indicates that overall prevalence of under nutrition was highest (62.38% with 95% CI: 52.18 to 71.82) among the study by Subhaprada, 2015 whereas, lower rate of under nutrition (5.03 with 95% CI: 4.02 to 6.20) was found among the study by Kamath et al. 2012.

Figure-3 displays funnel plot of the studies included in meta- analysis in a plot of effect size against sample size. In the present study, the left corner of the funnel plot in case of undernutritionwas not at all that empty, so we ruled out the publication bias. Random and fixed effect model and the heterogeneity of the study population (I^2) are tabulated. The fixed effect model shows the overall prevalence of under nutrition was 18.11% (95% CI: 17.60 to 18.42) and on the basis of random effect model the overall prevalence of under nutrition was found 33.12% (95% CI: 22.73 to 44.43). The prevalence of under nutrition, underweight, stunting and wasting and thinness in random and fixed effect model of meta-analysis among the school going children in urban and rural India tabulated in **table 3**. The heterogeneity of the study (I^2) is larger than 75% (99.38%) so we took random effect model. The overall prevalence of under nutrition was found to be 33.12% (95% CI: 22.73 to 44.43).

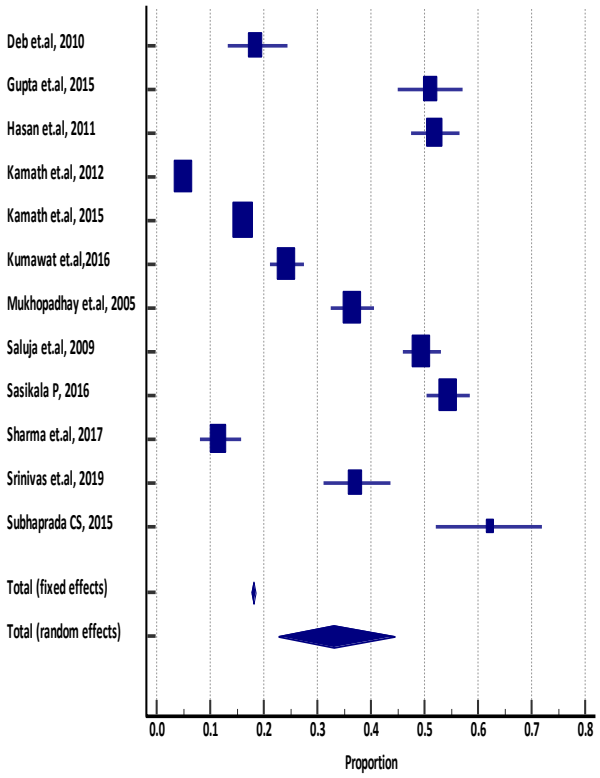


Figure: 2 forest plot of meta- analysis of proportion of under nutrition

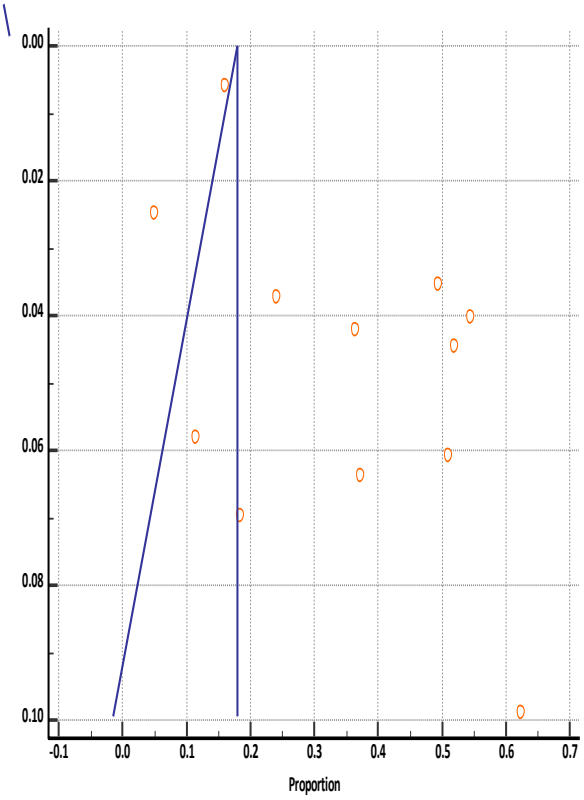


Figure: 3 funnel plot of meta- analysis of proportion of under nutrition

Figure-4shows the forest plot of the prevalence of underweight among the school going children in various parts of India. Altogether 39 studies were reported in the stipulated time frame of our study so farand selected for meta analysis. The sample size of these studies were varied from 70

(Patel et al. 2019) to 3654 (Mondal et al. 2015). Each horizontal line with box represents every study and 95% confidence interval of the result. The diamond at the bottom displayed aggregate effect size of the study. Prevalence of underweight in urban area was highest (76.19% with 95%CI: 74.77 to 77.56) among the study by Mondalet al. 2015 whereas, lower rate of underweight (3.2% with 95%CI: 2.53 to 4.0) was reported among the study by Hooshmand et al. 2014. Prevalence of underweight in rural area was highest (68.26% with 95% CI: 64.16 to 72.16) among the study by Mishra et al. 2020 and the lowest prevalence of underweight (9.82% with 95% CI 7.48 to 12.59) was reported among the study by Rajak et al. 2018. The graph indicates that overall prevalence of underweight was highest (76.19% with 95%CI: 74.77 to 77.56) among the study by Mondal et al. 2015 whereas, lower rate of underweight (3.2% with 95%CI: 2.53 to 4.0) was reported among the study by Hooshmand et al. 2014.

Figure-5 displays funnel plot of the studies included in meta- analysis in a plot of effect size against sample size. In the present study, the left corner of the funnel plot in case of underweight was not at all that empty, so we ruled out the publication bias. Random and fixed effect model and the heterogeneity of the study population (I^2)are tabulated. The fixed effect model shows the overall prevalence of underweight was 37.56% (95%CI: 36.94 to 38.18) and on the basis of random effect model the overall prevalence of underweight was found 35.90% (95%CI: 27.96 to 44.25) among the school going school going children. In the present study the heterogeneity was greater than 75% (99.42%), so we took random effect model in this case.The overall prevalence of underweight was found to be 35.90% (95%CI: 27.96 to 44.25).

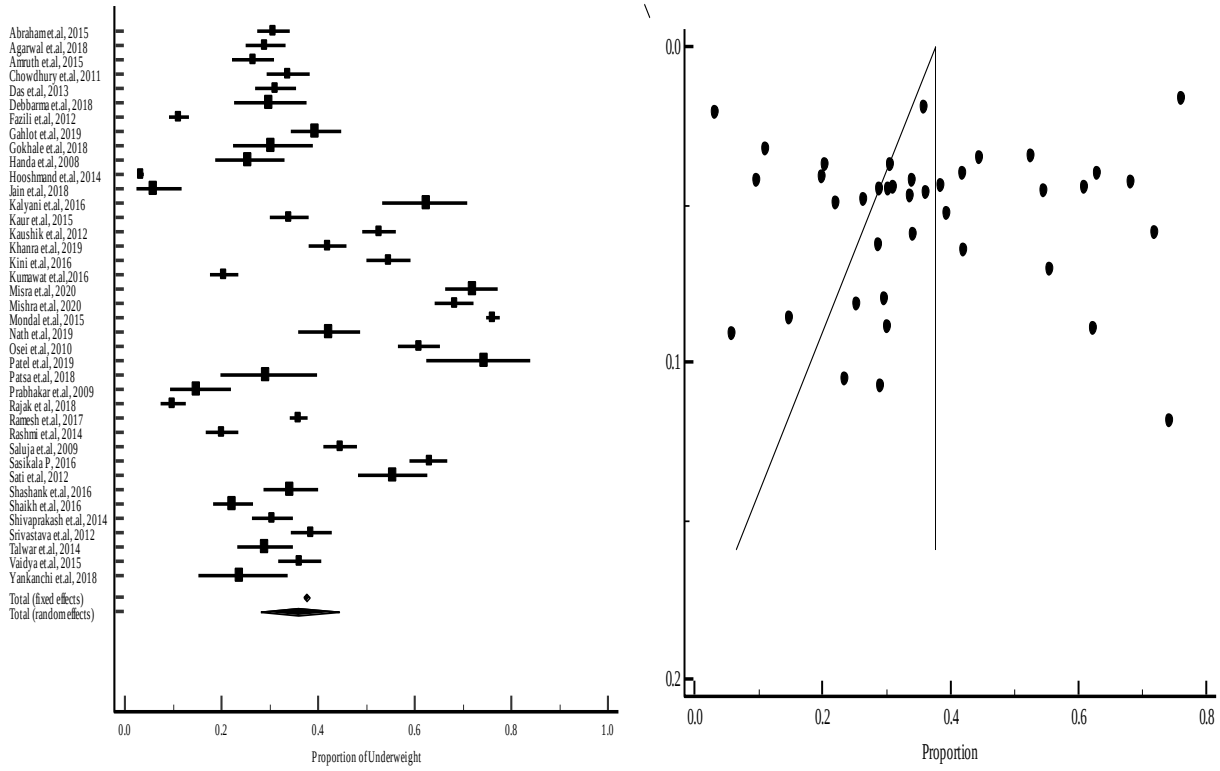
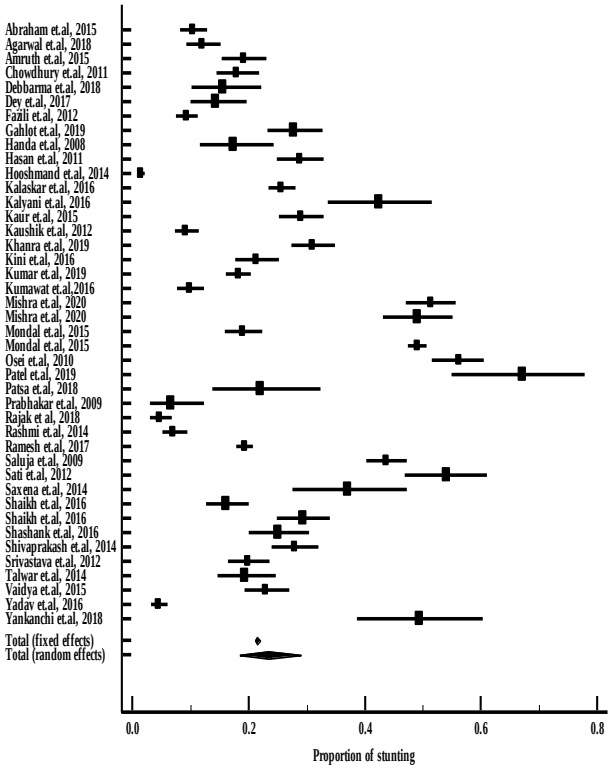


Figure: 4 forest plot of meta- analysis of proportion of underweight **Figure: 5 funnel plot of meta- analysis of proportionof underweight**

Figure-6 shows the forest plot of meta- analysis of proportion of stunting among the school going children of India. Altogether 42 studies were reported in the stipulated time frame of our study so farand selected for meta analysis. The sample size of these studies were varied from 70 (Patel et al. 2019) to 3654 (Mondal et al. 2015). Each horizontal line with box represents every study and 95% confidence interval of the result. The diamond at the bottom displayed aggregate effect size of the study. Prevalence of stunting in urban area was highest (67.14% with 95% CI: 54.87 to 77.90) among the study by Patel et al. 2015 and lower rate of stunting was found (1.49% with 95% 1.04 to 2.07) among the study by Hooshmand et al. 2014. Prevalence of stunting in rural area was highest (56.11% with 95% CI 51.63 to 60.51) by the study Osei et al. 2010 whereas lower rate of stunting was found (4.64% with 95% CI 3.05 to 6.72) by the study Rajak et al. 2018. The graph indicates that overall prevalence of stunting was highest (67.17% with 95% CI: 54.87 to 77.90) of the study by Patel et al. 2015 and the lower rate of stunting (1.49% with 95% CI: 1.04 to 2.07) was found among the study by Hooshmand et al. 2014.

Figure-7 displays funnel plot of the studies included in meta- analysis in a plot of effect size against sample size. In the present study, the left corner of the funnel plot in case of stunting was not at all that empty, so we ruled out the publication bias. Random and fixed effect model and the heterogeneity of the study population (I^2)are tabulated. The fixed effect model shows the overall prevalence of stunting was 21.55% (95% CI: 21.06 to 22.04) and the random effect model shows the overall prevalence of stunting was 23.50% (95% CI: 18.35 to 29.0). The heterogeneity of the study (I^2) is larger than 75% (99.09%) so we took random effect model. The overall prevalence of stunting was found to be 23.50% (95% CI: 18.35 to 29.0).



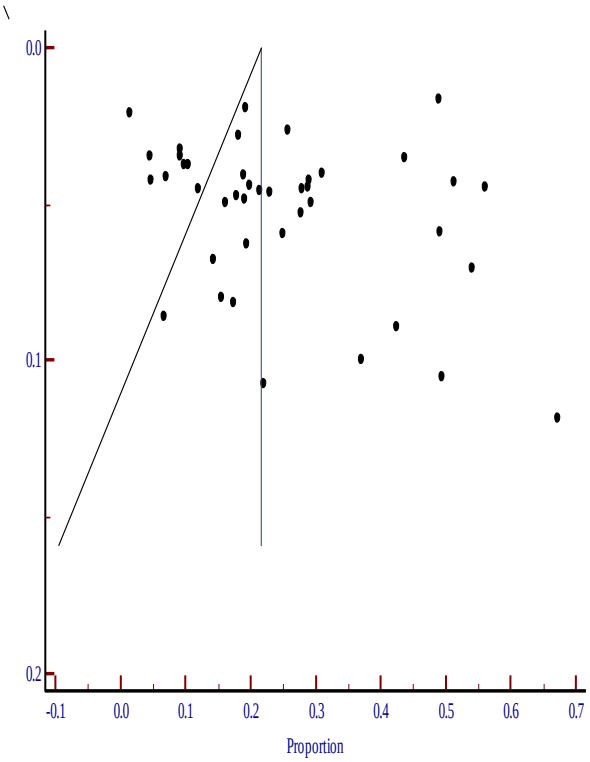


Figure: 6 forest plot of meta- analysis of proportion of stunting

Figure: 7 funnel plot of meta- analysis of proportion of stunting

Figure-8shows the forest plot of meta- analysis of proportion of wasting among the school going children of India. Altogether 15 studies were reported in the stipulated time frame of our study so far and selected for meta analysis. The sample size of these studies were varied from 86 (Patsa et al. 2018) to 2336 (Hooshmand et al. 2014). Each horizontal line with box represents every study and 95% confidence interval of the result. The diamond at the bottom displayed aggregate effect size of the study. In urban area prevalence of wasting was highest (33.20% with 95% CI 29.13 to

37.46) among the study by Srivastava et al. 2012 and prevalence of wasting was lowest (3.33% with 95% CI 1.09 to 7.60) among the study by Handa et al. 2008. Prevalence of wasting in rural area was highest (40.64% with 95% CI 32.83 to 48.81) among the study by Debbarma et al. 2018 and lower rate (3.70% with 95% CI 1.21 to 8.43) was found by the study Prabhakar et al. 2009. The graph indicates that overall prevalence of wasting was highest (40.64% with 95% CI: 32.83 to 48.81) among the study by Debbarma et al. 2018. Overall prevalence of wasting was found lower (3.33% with 95% CI: 1.09 to 7.60) among the study by Handa et al. 2008.

Figure-9 displays funnel plot of the studies included in meta- analysis in a plot of effect size against sample size. In the present study, the left corner of the funnel plot in case of wasting was not at all that empty, so we ruled out the publication bias. Random and fixed effect model and the heterogeneity of the study population (I^2)are tabulated. The fixed effect model shows the overall prevalence of wasting was 12.71% (95% CI: 11.98 to 13.46) and the random effect model shows the overall prevalence of wasting was 17.15% (95% CI: 11.34 to 23.8). The heterogeneity of the study (I^2) is larger than 75% (98.07%) so we took random effect model. The overall prevalence of wasting was found to be 17.15% (95% CI: 11.34 to 23.8).

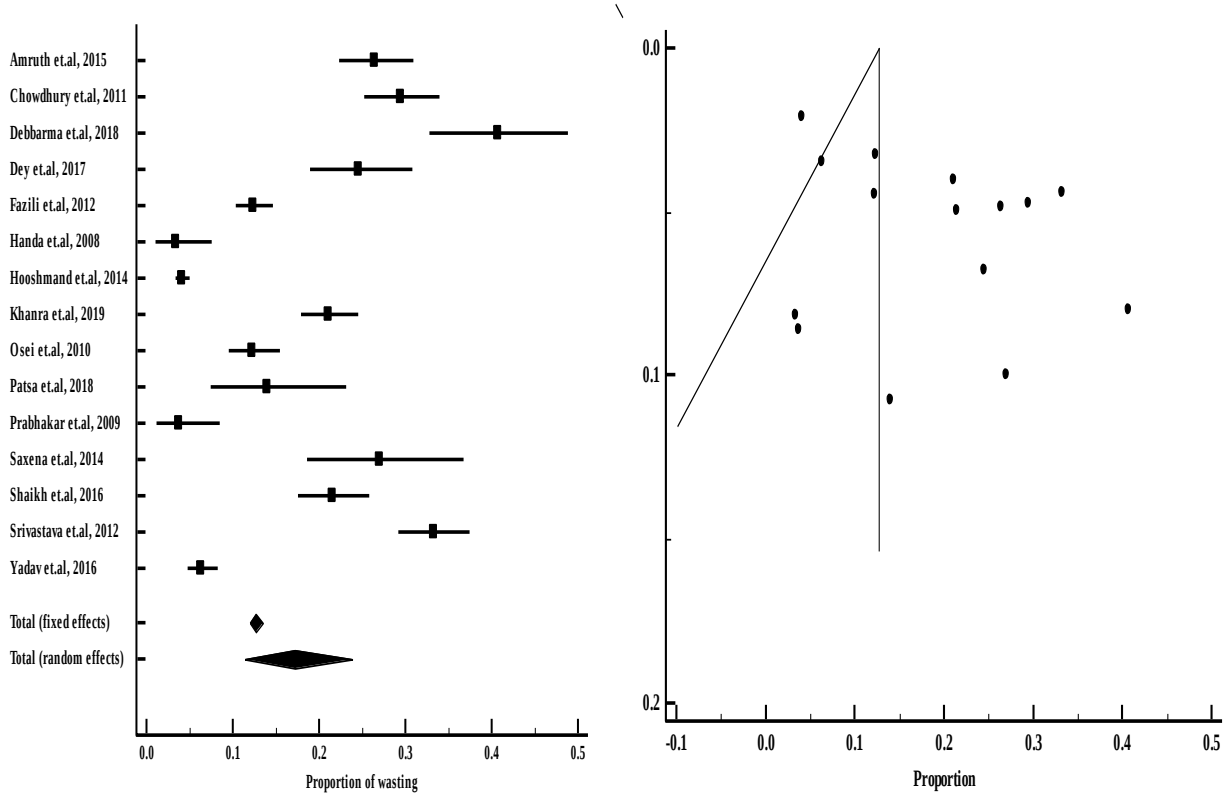


Figure: 8 forest plot of meta- analysis of Figure: 9funnel plot of meta- analysis of proportion of wasting proportion of wasting

Figure-10 shows the forest plot of meta- analysis of proportion of thinness/underweight among the school going children of India. Altogether 29 studies were reported in the stipulated time frame of our study so far and selected for meta analysis. The sample size of these studies were varied from 76 (Chandramohan et al. 2015) to 28,256 (Patel et al. 2015). Each horizontal line with box represents every study and 95% confidence interval of the result. The diamond at the bottom displayed aggregate effect size of the study. The prevalence of thinness/underweight in urban area was higher (55.2% with 95% CI: 46.04 to 64.09) among the study by Kalyani et al. 2016 and lowest prevalence (11.50% with 95% CI: 9.60 to 13.62) was found among the study byMondal et al. 2015.Prevalence of thinness/underweight in rural area was higher (57.14% with 95% CI: 50.37 to 63.71) among the study by Mondal, 2015 whereas lower rate of thinness/underweight (13.0% with 95% CI: 12.60 to 13.40) was found among the study by Kamath et al. 2015. The graph indicates that overall prevalence of thinness/underweight was highest (57.14% with 95% CI: 50.37 to 63.71) among the study by Mondal, 2015. Overall prevalence of thinness/underweight was found lower (11.50% with 95% CI: 9.60 to 13.62) among the study by Mondal et al. 2015.

Figure-11 displays funnel plot of the studies included in meta- analysis in a plot of effect size against sample size. In the present study, the left corner of the funnel plot in case of thinness/underweight was not at all that empty, so we ruled out the publication bias. Random and fixed effect model and the heterogeneity of the study population (I^2)are tabulated. The fixed effect model shows the overall prevalence of thinness/underweight was 23.04% (95% CI: 22.74 to 23.35) and the random effect model shows the overall prevalence of thinness/underweight was 32.36% (95% CI: 27.69 to 37.20).The heterogeneity (I^2) of the study is larger than 75% (99.30%) so we took random effect model. The overall prevalence of thinness/underweight was found to be 32.36% (95% CI: 27.69 to 37.20).

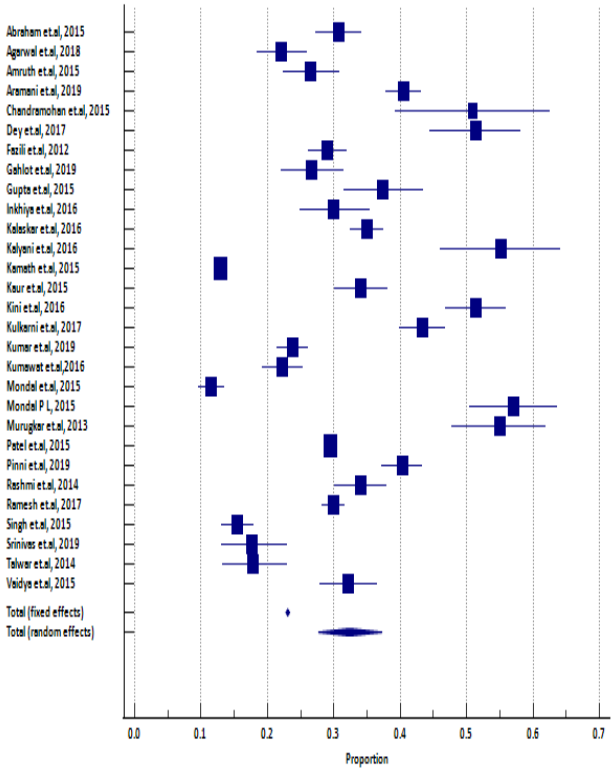


Figure: 10 forest plot of meta- analysis of proportion of thinness/underweight

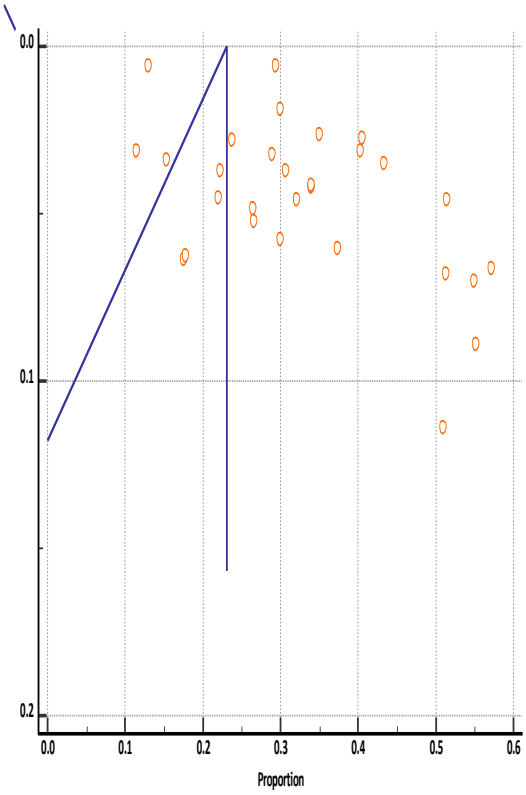


Figure: 11funnel plot of meta- analysis of proportion of thinness/underweight

Table-3: Percentage of heterogeneity (I^2), 95% Confidence Interval (95% CI)and random and fixed effect model of meta-analysis

Nutritional Status	Fixed Effect Model	Random Effect Model	I^2	95% CI for I^2
Under nutrition	18.01	33.12	99.38%	99.26 to 99.49
Underweight	37.55	35.90	99.42%	99.36 to 99.47
Stunting	21.55	23.50	99.09%	98.99 to 99.18
Wasting	12.71	17.15	98.07%	97.56 to 98.47
Thinness/underweight	23.04	32.36	99.30%	99.21 to 99.38

Table-3 represents the prevalence of under nutrition, underweight, stunting, wasting and thinness/underweight in random and fixed effect model of meta-analysis and percentage of heterogeneity (I^2), 95% Confidence Interval (95% CI)among the school going children in urban

and rural India. It is found that the overall prevalence of under nutrition, underweight, stunting, wasting and thinness/underweight among them was found to be 33.12% (95% CI: 22.73 to 44.43), 35.90% (95% CI: 27.96 to 44.25), 23.50% (95% CI: 18.35 to 29.0), 17.15% (95% CI: 11.34 to 23.8),32.36% (95% CI: 27.69 to 37.20) respectively.

LIMITATIONS OF THE STUDY:

We tried as much as possible to reviewed articles about nutritional status in urban and rural India based on some inclusion and exclusion criteria. Though many articles are published each year and it is humanly impossible to read all the articles therefore might have missed some relevant publications. This study is limited only to the selected database source, English language publications.

CONCLUSION:

In this study we determined overall prevalence of under nutrition, underweight, stunting, wasting and thinness/underweight among school going children from 2005 to 2020 in urban and rural India by using systematic review and meta analysis. Q and I^2 statistics were used to check heterogeneity among the collected published papers and forest and funnel plot was applied to find the overall prevalence of under nutrition, underweight, stunting, wasting and thinness/underweight among school going children in urban and rural India. Overall prevalence of under nutrition among school going children in urban and rural area was varied from 62.38% in Kurnool of Andhra Pradesh to 5.03% in Mangalore city of Karnataka. Overall prevalence of underweight in urban and rural area was varied from 76.2% in all district of west Bengal to 3.2% in Mumbai of Maharashtra among school going children. Overall prevalence of stunting among school going children in urban and rural area was varied from 67.0% in Bapu Nagar of Lucknow to 1.5% in Mumbai of Maharashtra. On the other hand overall prevalence of wasting among school going children in urban and rural area was varied from 40.64% in Khowai of Tripura to 3.0% in Allahabad of Uttar Pradesh and overall prevalence thinnesss/underweight in urban and rural area was varied from 57.14% in Burdwan of West Bengal to 11.50% in Assam of Northeast India. This review found that nutritional condition of urban and rural area both were in critical situation. Majority of studied populations was not up-to the mark. Most of the school children were experiencing severe and

critical malnutrition. It is noticed that the prevalence of under nutrition underweight, stunting, wasting, thinness were varied in different areas.

FUTURE SCOPE OF STUDY: Though charity begins at home, many health awareness and nutritional supplementary programs should be arranged in all nearby localities and also in schools based on the findings of these above researches. Improve essential food items for better nutritional quality by fortification and monitor the progress of nutrition programmes and check all the aspects of nutrition. Food intake, hygiene maintain, physical activities related many interventions should be arranged urgently. These interventions should be exhorting regularly and instigate all children and also their parents to participate in it.

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