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Sex Variation of Chronic Energy Deficiency among Adult Asian Indian Indigenous Population: A Systematic Review & Meta analysis

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KEYWORDS

BMI, Chronic Energy Deficiency, PVTG, Malnutrition, Sex variation, Tribal, India,

ABSTRACT

The nutritional status of an adult individual is significant for the better upbringing of their future generations. Notwithstanding, the nutritional status of the adult tribal population of India is not palatable. Consequently, an endeavour has been made in this review to get an impression of overall chronic energy deficiency (CED) and sex variation of CED among adult tribal population of India as assessed by Body Mass Index (BMI) less than 18.5 kg/m^2. Study was selected through literature search following standard protocol. The Meta-analyses were performed by MedCalc statistical software version 20. A total 41954 sample from 140 studies published during 2000-2021 on nutritional status among 82 tribal communities, including 30 particularly vulnerable tribal groups (PVTGs) from 21 states and union territories have been considered for the present analysis. Out of the total, 124 and 91 studies have been accounted for male and female nutritional status. Pool analysis indicates overall prevalence of CED among males and females were 44.9% and 49.1%, respectively. It was estimated that around 28 million (13 million male and 15 million female) tribal population to be undernourished as of 2011. According to the WHO classification of severity of malnutrition, the rate of CED in both PVTG and non-PVTGs adult tribal population of India is very high, indicating critical situation. Therefore, urgent nutrition supplemental programme may be implemented especially for PVTG female considering their culture and food habits.

Introduction:

Food intake in relation to the body's energy needs can be considered as nutrition. For having good health, a well-balanced diet and normal metabolic integrity are very much needed. On the other side, poor nutrition can lead to reduced immunity, weakened physical and mental development, and reduced productivity which in turn can negatively influence on a nation's economic growth. There are ways to measure the nutritional status of the target population, but the most convenient and universally applicable non-invasive method to assess the size, proportion and composition of the human body is anthropometry (WHO, 1995). In the 19th century, mathematician Lambert Adolphe Jacques Quetelet attempted to define the relation between body weight and stature in humans. He measured body weight (in kg) and divided it by stature (in m^2) and named it as Quetelet's index (Quetelet, 1842) better known as Body Mass Index or BMI (Keys, 1972). Studies have shown evaluation of BMI can be considered as a reasonable indicator of nutritional status as well as the socio-economic condition of a population. The World Health Organization in 1995 has recommended, internationally accepted BMI guidelines which mark BMI less than 18.5 kg/m^2 as low BMI or Chronic Energy Deficiency (CED). It can also be called as hunger deficiency. Several nutritional surveys go across the world to measure the overall prevalence of CED as well as variations with age, sex, socio-economic status etc. It targets to identify populations

with increased nutritional needs. And to advocate those necessities awareness of nutritional problems to be raised, policies should be designed, and programmes should be promoted.

India, being a country going through developing stages, faces both the burden of undernutrition as well as lifestyle-related degenerative diseases like diabetes, hypertension etc. In a country like ours, where most of the crowd is poverty-stricken and having dietary constraints, meeting both ends with adequate nutrient requirement becomes a challenge. According to the report of GHI 2018, India suffers from a 'serious' level of hunger with a score of about 31 (Global Hunger Index, 2018).

India gives home to the largest tribal population on earth comprising 705 tribal communities and 75 Particularly Vulnerable Tribal Groups (PVTGs). They constitute 8.6% of the total population in India (Census of India, 2011, Bisai *et al*. 2014). These populations are recognised as socially and economically vulnerable. They have varied culture and tradition. Their food habits are different from others as most of them are dependent on the vagaries of nature. Nationwide health surveys done earlier have reported that the prevalence of malnutrition was very high among marginalised communities (NFHS-3; IIPS, 2007). Poor growth performance and high rates of malnutrition among tribal communities in India have been reported through many studies (Bisai & Bose, 2008; 2009; 2012). Food deprivation, inadequate maternal health or childcare practices; or insufficient access to health services, safe drinking water, and sanitation are the factors for undernutrition. Though limited but such studies on the nutritional status of tribal communities in India are scattered over many journals, reports etc. Thus, the present review work summarizes the nutritional status (CED) of the tribal adults in India with a following aim and objectives: 1. to summaries the existing literatures on CED among the adult tribal population in India, 2. to find out sex-variation of CED among adult tribal population of India.

Material and Methods:

A literature review discusses published information in a particular subject area within a specific period. It can be just a simple summary of the sources, but it usually has an organizational pattern and combines both summary and synthesis. Generally, the purpose of a review is to critically analyse a segment of a published body of knowledge through summary, classification, and comparison of prior research studies, reviews of literature, and theoretical articles.

This review work has considered published papers between 2000 to 2021 following computerized databases searching as Google Scholors, Pubmed/Medline, Indmed, Academia, Research gate following MeSH term as 'Tribe', 'Tribal', 'PVTG', 'BMI', 'CED', "India', 'Malnutrition', 'Undernutrition'. Further, combinations of different MeSH terms were also used to search published literature. Systematic approach was adapted to minimizing biases and random errors (Figure 1) following inclusion and exclusion criteria. Inclusion criterion were: reporting of sample size, specific ethnic group (s) studied, sex specific prevalence of CED. Exclusion Crition were: No sex specific data, study reported tribe in general, sample size not reported and study area not mentioned. While, PVTG status were identified as notified by constitution of India. State wise name of PVTGs are available elsewhere (Census of India, 2011; Bisai *et al.*, 2014).

In total, 140 published papers of undernutrition amid tribal adult has been considered, among which 124 and 91 studies of adult tribal male and female has been included in the quantitative synthesis. All studies are cross-sectional in nature. Overall, 82 tribal communities have been identified through literature search including 30 Particularly Vulnerable Tribal Groups (PVTGs) belonging to 20 states and 1 Union Territory of India. In total, 73 ethnic communities have been included in quantitative analysis for CED among tribal male and 61 ethnic communities have been included in quantitative analysis

for CED among tribal female. Total sample size was 41954, among them adult tribal male was 22279 (Non-PVTG =15576, PVTG =6703) and that for adult tribal female was 19675 (Non-PVTG = 11807, PVTG = 7868). Standard statistical method was employed to calculate pool estimate for male and female separately and sub-group for PVTG and Non-PVTG following fixed and random effect model. Heterogeneity (Cohran's Q & I^2 statistic) and publication biases were also performed following standard statistical method (Higgins et. al. 2003; Begg & Mazumder, 1994; Egger *et al*. 1997). For the present review, all statistical analyses were performed using MedCalc statistical software version 20. A P-value less than 0.05 (0.10 for I^2) is considered as statistically significance.

Results:

The present review work was carried out to grasp the magnitude of malnutrition (undernutrition) among adult tribal male and female of India. State and community wise prevalence of CED among adult tribal males of India is presented in table 1. A total of 124 studies have been accounted for tribal male (adult) nutritional status. The overall prevalence of CED, state and community, combined is 44.9%. The pool analysis found there was no significant publication bias according to Egger's and Begg's statistics. Results revealed that males from Non-PVTG and PVTG shares 43.8% and 46.9% of CED, respectively. The prevalence of CED among PVTG male was significantly higher than the Non-PVTG male ($\chi 2 = 18.215$, df = 1, $p<0.0001$). Moreover, PVTG male had 13% (OR = 1.13; 95% CI: 1.07-1.20) greater risk to be suffering from CED.

Table 2 shows the state and community wise prevalence of CED among adult tribal female in India. In total, 91 studies have been accounted for tribal female nutritional status. The overall prevalence of CED, state and community, combined is 49.1%. The pool indicated there was no publication bias according to Egger's and Begg's test. It was found that females from Non-PVTG and PVTG shares 47.7% and 51.3% of CED, respectively. The prevalence of CED among PVTG female was significantly higher than the Non-PVTG female ($\chi^2 = 24.483$, df = 1, $p<0.0001$). They had 17% (OR = 1.17; 95% CI: 1.11-1.23) greater chance to be developed CED.

Moreover, it was found that the prevalence of CED was significantly higher in PVTG females than PVTG males. They were 21% (OR = 1.21; 95% CI: 1.13-1.29) greater risk to developing CED. Similarly, Non-PVTG females had 17% (OR = 1.17; 95% CI: 1.12-1.23) greater chance of being CED than their male counterpart. Thus, it shows that significant rate of undernutrition among tribal women which depicts gender disparity in the matter of nutrient intake.

Community wise prevalence of CED among adult tribal males and females are presented in table 3. A total of 82 ethnic communities have been included in the quantitive analysis for CED among tribal male and females. The Jenukuruba tribal community shows 100% prevalence of CED among their adult male, followed by the Garasia community (94.9%). The Garasia again shows the maximum prevalence of undernutrition in their adult females (98.0%), followed by Jenukuruba females (96.8%).

The state-wise prevalence of undernutrition among adult tribal male and female of India indicate that highest rate of CED among the adult tribal male (75.5%) and female (90.7%) has been found in Karnataka and Jammu & Kashmir state of India (Figure 2).

Discussion

We have instinctively known for a very long time that poor nutritional status is associated with morbidity and mortality. Noteworthy, nutrition is said as one of the best indicators of development for any nation. Thus, malnutrition matters like a real threat to human progress which in turn affects the

development across of that nation. The present review work displays the prevalence of undernutrition among both the sexes of adult tribal. Thinness among adult populations is indicated by body mass index (BMI) less than 18.5 kg/m^2. The result of this review work shows that significant rate of undernutrition among tribal women which depicts gender disparity in the matter of nutrient intake. The result equalizes with the national data of National Family Health Survey (NFHS-4) done in 2015-2016, which shows higher undernutrition among females (23%) than males (20%). The highest prevalence of undernutrition was reported among scheduled tribal females (31.7% CED) than other caste or community (IIPS, 2017). The highest proportion of CED of tribal women was reported in Gujarat (40.6%) followed by Maharashtra (38.3%), Rajasthan (37.5%), Odisha (36.5%), Jharkhand (35.0%), Madhya Pradesh (34.4), Chhattisgarh (34.0), and West Bengal (33.2%), respectively (IIPS 2017). Nutritional status of men belonging to scheduled tribe shows 25.2% of total thinness which is higher than men from other caste or community (NFHS 4, 2015-2016). According to NFHS report, the highest proportion of CED of tribal men has been found in Gujarat (38.4%) followed by Rajasthan (32.6%) and Madhya Pradesh (30.3%), respectively (IIPS 2017). Many studies have reported females were higher risk for undernutrition in comparison to males (Kshatriya & Acharya, 2016; Legesse *et al*. 2019; Marcoux, 2002).

Gender disparity causes a high prevalence of undernutrition during infancy and childhood, which plays a significant role in causing undernutrition in the adolescent, youth and the later stages of life (Strupp & Levitsky, 1995). Health problems like stunting or wasting can be the result of high undernutrition in the first two years of life (Mendez & Addair, 1999). It also contributes to micro-nutrient deficiency in the youth and the advanced age (Morgane *et al*., 1993). Severe undernutrition among tribes carries a very high risk of taking forward the undernutrition status for the tribal infants and children further to the adolescence as well as to later stages in their lives. Thus, the present review work demonstrates the load of undernutrition among tribal adult, which resonates in the severe stress of infant and childhood undernutrition.

Intending to achieve zero hunger by 2030, the Global Hunger Index has not been in track to meet it. India is among the 45 countries that have "serious levels of hunger". Present Review studies show different levels of undernutrition among various tribal populations across the country. The result shows the prevalence of undernutrition has been signified among tribal adult females. It is even higher among females from PVTGs. A national survey done in 2015-2016 to see the relation between mother's nutritional status and its effect on nutritional status of child shows a significant result regarding undernutrition (IIPS, 2017). Children of underweight mothers (BMI<18.5 kg/m^2) have the highest rate of stunting (45.8%) and wasting (26.7%) and are mostly underweight (47.8%) (IIPS, 2017). Adequate nutrition of mother plays a significant role in child health for their optimum nutrition in early life which latterly becomes the foundation for long-term health (Cetin & Laoreti, 2015).

Moreover, severe anaemia during pregnancy is linked to increased mortality at labour. India contributes about 80% of the maternal deaths caused due to anaemia (WHO, 1986; Ezzati et. al., 2002). Thus, pregnant and lactating women and young children less than three years are most vulnerable to malnutrition. Researches has shown that socio-cultural issues like marriage at an early age, high rate of school drop-outs are the crucial causes of nutritional status extreme among the females in their youth (Ransom and Elder, 2003). These may result in more undernourished children to be born to mothers with no schooling and children in the lowest wealth quintile (IIPS, 2017). Hunger and lack of food (Mohankumar and Velvizhi, 2018), inadequate health facilities, poverty, lack of awareness (Khan and Nayak, 2017) along with beliefs and practices of food taboo during pregnancy which results in the loss of valuable nutrients during antenatal period (Lakshmi, 2013), can be the key factors for persisting undernutrition among females among indigenous population of India.

Conclusion

Present review brings forth the scenario of nutritional condition of our tribal populus. According to the study 45% and 49% of tribal adult male and female respectively are suffering from severe grade malnutrition. India is home to 104 million tribal populations according to the census 2011. Among this, almost 60 million tribal people belong to the age group of eighteen and above. The total number of tribal adult male and female in India according to the census 2011 is 30179206 and 30657997 respectively. Going abide by the present study, 28 million (13 million male and 15 million female) tribal adult population might be undernourished. These estimates show a severe threat to a country's health and progress and indicate us of the scale of malnutrition. The present review summarizes that female suffering from undernutrition will adversely affect the health of children involving the health and development of a nation. Thus, maternal malnutrition will increase the risk of poor pregnancy outcomes and continue the vicious cycle of bearing babies with low birth weight, and postpartum haemorrhage which again may lead to low stature among females and in turn will result in low birth weight babies. Low-birth-weight is a significant contributor to infant mortality. Firming up of maternal nutrition and health, hold the key to arrest the nutritional problem from being inherited. Therefore, it is the need of the hour to spread awareness of the importance of maternal nutrition, especially during the preconception, pregnancy and postpartum stages. Supplementation of quality food can make a contribution when recommended micronutrient intakes are challenging to be met through diet alone. Policies can be raised to uplift the present deprived situation and to improve the nutrition and well-being of women. Policies should be made without harming their culture and tradition as well as food habits. Moreover, community-based intervention programmes, supplementary feeding programs, effective nutritional education can be implemented especially for particularly vulnerable tribal groups of India.

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Tables

Table 1. State & Community wise prevalence of CED among males

Sl.no.	Study State	Community	Status	CED (%)	References
1	Andaman & Nicobar Island	Jarwa	PVTG	48.0	Sahani, 2003
2	Andaman & Nicobar Island	Onge	PVTG	14.3	Rao *et al*., 2006
3	Andaman & Nicobar Island	Onge	PVTG	7.4	Sahani, 2013
4	Andaman & Nicobar Island	Car Nicobarese	Non-PVTG	1.2	Kapoor *et al*., 2010
5	Andaman & Nicobar Island	Great Andamanese	PVTG	0.0	Sahani, 2013
6	Andhra Pradesh	Sugali	Non -PVTG	51.2	Reddy & Rao, 2000
7	Andhra Pradesh	Dulia	Non -PVTG	20.3	Srinivas *et al*., 2013
8	Andhra Pradesh & Telangana	Chenchu	PVTG	41.0	Rao *et al*., 2015
9	Arunachal Pradesh	Apatani	Non -PVTG	2.3	Bam & Malagi, 2016
10	Assam	Thengal Kachari	Non -PVTG	13.0	Dutta & Kropi, 2019
11	Assam	Dibongiya Deori	Non -PVTG	9.0	Dutta & Kropi, 2019
12	Assam	Dibongiya Deori	Non -PVTG	21.4	Gogoi & Sengupta, 2002
13	Assam	Boro-Kachari	Non -PVTG	11.2	Khongsdier, 2001
14	Assam	Lalung	Non -PVTG	34.7	Khongsdier, 2001
15	Assam	Mech	Non -PVTG	6.0	Khongsdier, 2001
16	Assam	Miri	Non -PVTG	34.0	Khongsdier, 2001
17	Assam	Sonowal Kachari	Non -PVTG	40.4	Sonowal & Choudhury, 2017
18	Bihar	Munda	Non -PVTG	49.0	Chakrabarty *et al*., 2008
19	Bihar	Santal	Non -PVTG	62.2	Chakrabarty *et al*., 2008
20	Bihar	Oraon	Non -PVTG	66.8	Chakrabarty *et al*., 2008
21	Bihar	Ho	Non -PVTG	70.0	Chakrabarty *et al*., 2008
22	Bihar	Tharu	Non -PVTG	28.0	Chakrabarty *et al*., 2008
23	Gujarat	Dhodia	Non -PVTG	28.1	Kshatriya & Acharya, 2016
24	Gujarat	Kukna	Non -PVTG	28.3	Kshatriya & Acharya , 2016
25	Gujarat	Chaudhari	Non -PVTG	40.0	Kshatriya & Acharya, 2016
26	Jharkhand	Oraon	Non -PVTG	63.9	Chakraborty & Bose, 2007
27	Jharkhand	Oraon	Non -PVTG	53.1	Banik , 2008
28	Karnataka	Soliga	Non -PVTG	37.6	Krishna *et al*., 2017
29	Karnataka	Jenukuruba	PVTG	100.0	Pujar *et al*., 2016
30	Karnataka	Koraga	PVTG	93.2	Pujar *et al*., 2017
31	Madhya Pradesh	Bhil	Non -PVTG	66.5	Adak *et al*., 2006
32	Madhya Pradesh	Gond	Non -PVTG	62.0	Adak *et al*., 2006
33	Madhya Pradesh	Kol	Non -PVTG	46.0	Adak *et al*., 2006
34	Madhya Pradesh	Korku	Non -PVTG	54.0	Adak *et al*., 2006
35	Madhya Pradesh	Oraon	Non -PVTG	28.3	Adak *et al*., 2006
36	Madhya Pradesh	Saharia	PVTG	60.8	Adak *et al*., 2006

37	Madhya Pradesh	Sonr	Non -PVTG	73.2	Adak *et al*., 2006
38	Madhya Pradesh	Majhi	Non -PVTG	24.0	Adak *et al*., 2006
39	Madhya Pradesh	Korwa	PVTG	7.8	Adak *et al*., 2006
40	Madhya Pradesh	Baiga	PVTG	47.9	Chakma, 2010b
41	Madhya Pradesh	Bharia	PVTG	42.1	Chakma, 2010c
42	Madhya Pradesh	Bharia	PVTG	50.2	Chakma, 2012
43	Madhya Pradesh	Baiga	PVTG	78.1	Chakma *et al*., 2009
44	Madhya Pradesh	Baiga	PVTG	55.8	Chakma *et al*., 2014
45	Madhya Pradesh	Pando	Non -PVTG	48.3	Dolla *et al*., 2006
46	Madhya Pradesh	Kamar	PVTG	64.0	Gangopadhyay, 2006
47	Madhya Pradesh	Bhumia	PVTG	77.8	Jaiswal, 2013
48	Madhya Pradesh	Saharia	PVTG	48.7	Kapoor *et al*., 2010
49	Madhya Pradesh	Baiga	PVTG	46.6	Saini *et al*., 2015
50	Madhya Pradesh	Gond	Non -PVTG	30.3	Saini *et al*., 2015
51	Madhya Pradesh	Saharia	PVTG	39.1	Sharma, 2014
52	Maharastra	Andh	Non -PVTG	82.0	Adak *et al*., 2006
53	Maharastra	Bhil	Non -PVTG	88.0	Adak *et al*., 2006
54	Maharastra	Gond	Non -PVTG	62.0	Adak et. Al., 2006
55	Maharastra	Kathodi	PVTG	90.0	Adak et. al., 2006
56	Maharastra	Korku	Non -PVTG	54.0	Adak et. Al., 2006
57	Maharastra	Mahadeokali	Non -PVTG	61.0	Adak et. al., 2006
58	Maharastra	Warli	Non -PVTG	88.0	Adak et. Al., 2006
59	Maharastra	Katkari	Non -PVTG	36.7	Deo et. al., 2017
60	Maharastra	Kolam	PVTG	18.6	Gangopadhyay & Gangopadhyay, 2006
61	Meghalaya	Pnars Khasi	Non -PVTG	14.3	Khongsdier, 2001
62	Meghalaya	War Khasi	Non -PVTG	35.0	Khongsdier, 2002
63	Odisha	Bondo	Non -PVTG	51.5	Bhattacharya e*et al*., 2006
64	Odisha	Savar	Non -PVTG	38.0	Bisai & Bose, 2012
65	Odisha	Bathudi	Non -PVTG	52.9	Bose & Chakrabarty, 2005
66	Odisha	Santal	Non -PVTG	26.2	Bose *et al*., 2006
67	Odisha	Dongria Khond	PVTG	60.7	Bulliyya *et al*., 2005
68	Odisha	Savar	Non -PVTG	44.6	Chakrabarty & Bharati, 2010
69	Odisha	Paroja	PVTG	80.0	Chakrabarty *et al*., 2008
70	Odisha	Bhuiya	PVTG	30.0	Chakrabarty *et al*., 2008
71	Odisha	Gond	Non -PVTG	64.6	Chakrabarty *et al*., 2008
72	Odisha	Khond	PVTG	35.0	Chakrabarty *et al*., 2008
73	Odisha	Munda	Non -PVTG	34.0	Chakrabarty *et al*., 2008
74	Odisha	Santal	Non -PVTG	63.2	Chakrabarty *et al*., 2008
75	Odisha	Savar	Non -PVTG	53.0	Chakrabarty *et al*., 2008

76	Odisha	Bhuiya	PVTG	58.7	Goswami, 2016
77	Odisha	Juang	PVTG	51.9	Goswami, 2016
78	Odisha	Kharia	PVTG	50.3	Goswami, 2016
79	Odisha	Lodha	PVTG	53.8	Goswami, 2016
80	Odisha	Mankidia	PVTG	48.4	Goswami, 2016
81	Odisha	Bhumij	Non -PVTG	48.5	Goswami *et al*., 2010
82	Odisha	Santal	Non -PVTG	62.6	Ho & Mishra, 2018
83	Odisha	Munda	Non -PVTG	50.6	Ho & Mishra, 2018
84	Odisha	Santal	Non -PVTG	28.1	Kshatriya & Acharya, 2016
85	Odisha	Bhumij	PVTG	19.0	Kshatriya & Acharya, 2016
86	Odisha	Bathudi	Non -PVTG	39.5	Kshatriya & Acharya , 2016
87	Rajasthan	Mina	Non -PVTG	38.3	Bhasin & Jain, 2007
88	Rajasthan	Bhil	Non -PVTG	81.9	Bhasin & Jain, 2007
89	Rajasthan	Garasia	Non -PVTG	94.9	Bhasin & Jain, 2007
90	Rajasthan	Sahariya	PVTG	71.1	Bhasin & Jain, 2007
91	Rajasthan	Damor	Non -PVTG	69.4	Bhasin & Jain, 2007
92	Rajasthan	Kathodi	Non -PVTG	93.0	Bhasin & Jain, 2007
93	Rajasthan	Sahariya	PVTG	59.5	Rao *et al*., 2006
94	Tamil Nadu	Kaani	Non -PVTG	47.9	Mohankumar & Velvizhi, 2018
95	Uttar Pradesh	Raji	PVTG	55.8	Alam *et al*., 2013
96	Uttar Pradesh	Kharwar	Non -PVTG	19.4	Jaiswal, 2015
97	Uttarakhand	Bhotia	Non -PVTG	24.3	Mandal *et al*., 2011
98	Uttarakhand	Tharu	Non -PVTG	26.4	Mukherjee *et al*., 2015
99	West Bengal	Sabar	Non -PVTG	52.0	Bhandari *et al*., 2019
100	West Bengal	Kora Mudi	Non -PVTG	51.7	Bisai *et al*., 2008
101	West Bengal	Kora Mudi	Non -PVTG	48.0	Bose *et al*, 2006b
102	West Bengal	Santal	Non -PVTG	31.5	Bose *et al*., 2006c
103	West Bengal	Lodha	PVTG	42.3	Bisai & Dutta, 2021a
104	West Bengal	Lodha	PVTG	45.2	Bose *et al*., 2008
105	West Bengal	Bhumij	Non -PVTG	48.4	Bose *et al*., 2008
106	West Bengal	Munda	Non -PVTG	35.8	Bose *et al*., 2011
107	West Bengal	Oraon	Non -PVTG	37.5	Bose *et al*., 2011
108	West Bengal	Santal	Non -PVTG	30.6	Das & Bose, 2010
109	West Bengal	Hill Kheria	Non -PVTG	41.2	Das & Bose. 2014
110	West Bengal	Birhor	PVTG	34.4	Bisai & Dutta, 2021b
111	West Bengal	Birhor	PVTG	19.4	Das *et al*., 2013
112	West Bengal	Lodha	PVTG	48.5	Dash *et al*., 2019
113	West Bengal	Munda	Non -PVTG	50.3	Dash *et al*., 2019
114	West Bengal	Munda	Non -PVTG	49.0	Ghosh & Bharati, 2006

115	West Bengal	Bhumij	Non -PVTG	52.3	Ghosh & Bose, 2015
116	West Bengal	Santal	Non -PVTG	55.0	Ghosh & Malik, 2007
117	West Bengal	Santal	Non -PVTG	44.3	Ghosh, 2014
118	West Bengal	Santal	Non -PVTG	30.1	Kshatriya & Acharya, 2016
119	West Bengal	Kora	Non -PVTG	41.2	Kshatriya & Acharya, 2016
120	West Bengal	Oraon	Non -PVTG	34.8	Kshatriya & Acharya, 2016
121	West Bengal	Oraon	Non -PVTG	47.0	Mittal & Srivastava, 2006
122	West Bengal	Santal	Non -PVTG	30.5	Mukhopadhyay, 2009
123	West Bengal	Toto	PVTG	3.5	Bhattacharya *et al*., 2006
124	West Bengal	Toto	PVTG	4.9	Bisai & Dutta, 2021c

Table 2. State & community wise prevalence of CED among females

Sl.no.	Study State	Community	Status	CED (%)	Reference
1	Andaman & Nicobar Island	Jarwa	PVTG	31.3	Sahani, 2003
2	Andaman & Nicobar Island	Onge	PVTG	27.8	Sahani, 2013
3	Andaman & Nicobar Island	Onge	PVTG	30.7	Rao *et al*., 2006
4	Andaman & Nicobar Island	Great Andamanese	PVTG	0.0	Sahani, 2013
5	Andhra Pradesh	Sugali	Non -PVTG	49.1	Reddy & Rao, 2000
6	Andhra Pradesh & Telangana	Chenchu	PVTG	42.0	Rao *et al*., 2015
7	Arunachal Pradesh	Apatani	Non -PVTG	1.0	Bam & Malagi, 2016
8	Arunachal Pradesh	Nyishi	Non -PVTG	10.5	Bharali *et al*., 2017
9	Assam	Karbi	Non -PVTG	11.7	Goswami & Bhattacharyya, 2015
10	Assam	Sonowal Kachari	Non -PVTG	30.2	Sonowal & Choudhury, 2017
11	Chhattisgarh	Hill Korwa	PVTG	35.8	Khan and Nayak, 2019
12	Chhattisgarh	Bhunjia	Non -PVTG	71.8	Kosariya & Chakravarty, 2017
13	Chhattisgarh	Bhaina	Non -PVTG	27.0	Singh *et al*., 2014
14	Gujarat	Tadvi	Non -PVTG	63.5	Kapoor *et al*., 2010
15	Gujarat	Chaudhari	Non -PVTG	48.8	Kshatriya & Acharya, 2016
16	Gujarat	Dhodia	Non -PVTG	29.2	Kshatriya & Acharya , 2016
17	Gujarat	Kukna	Non -PVTG	40.0	Kshatriya & Acharya, 2016
18	Jammu and Kashmir	Gujjar & Bakerwal	Non -PVTG	90.7	Hamid & Vaida, 2017
19	Karnataka	Soliga	Non -PVTG	40.9	Krishna *et. al*., 2017
20	Karnataka	Jenukuruba	PVTG	96.8	Pujar *et. al*., 2016
21	Karnataka	Koraga	PVTG	93.3	Pujar *et. al*., 2017
22	Madhya Pradesh	Baiga	PVTG	57.6	Chakma, 2010b
23	Madhya Pradesh	Bharia	PVTG	48.1	Chakma, 2010c
24	Madhya Pradesh	Bharia	PVTG	39.4	Chakma, 2012
25	Madhya Pradesh	Baiga	PVTG	73.6	Chakma *et. al*., 2009
26	Madhya Pradesh	Baiga	PVTG	62.9	Chakma *et. al*., 2014

27	Madhya Pradesh	Pando	Non -PVTG	55.5	Dolla *et al*., 2006
28	Madhya Pradesh	Kamar	PVTG	64.0	Gangopadhyay, 2006
29	Madhya Pradesh	Saharia	PVTG	42.4	Ghosh-Jerath *et al*., 2013
30	Madhya Pradesh	Bhumia	PVTG	73.6	Jaiswal, 2013
31	Madhya Pradesh	Saharia	PVTG	36.7	Kapoor *et al*., 2010
32	Madhya Pradesh	Saharia	PVTG	37.7	Sharma, 2014
33	Maharastra	Katkari	Non -PVTG	50.0	Deo *et. al*., 2017
34	Maharastra	Kolam	PVTG	40.0	Gangopadhyay & Gangopadhyay, 2006
35	Manipur	Tangkhul Naga	Non -PVTG	16.2	Mungreiphy *et al*., 2012
36	Nagaland	Chakhesang	Non -PVTG	10	Longvah *et al*., 2017
37	Odisha	Bondo	Non -PVTG	31.9	Bhattacharya *et al*., 2006
38	Odisha	Savar	Non -PVTG	49.0	Bisai & Bose, 2012
39	Odisha	Bathudi	Non -PVTG	64.4	Bose & Chakrabarty, 2005
40	Odisha	Dongria Khond	PVTG	54.3	Bulliyya *et al*., 2005
41	Odisha	Savar	Non -PVTG	59.5	Chakrabarty & Bharati, 2010
42	Odisha	Bhuyan	PVTG	77.7	Goswami, 2016
43	Odisha	Juang	PVTG	62.9	Goswami, 2016
44	Odisha	Kharia	PVTG	56.5	Goswami, 2016
45	Odisha	Mankidia	PVTG	59.5	Goswami, 2016
46	Odisha	Lodha	PVTG	58.8	Goswami, 2016
47	Odisha	Bhumij	Non -PVTG	54.8	Goswami *et al*., 2010
48	Odisha	Munda	Non -PVTG	56.0	Ho & Mishra, 2018
49	Odisha	Santal	Non -PVTG	60	Ho & Mishra, 2018
50	Odisha	Bathudi	Non -PVTG	62.8	Kshatriya & Acharya, 2016
51	Odisha	Bhumij	Non -PVTG	37.0	Kshatriya & Acharya, 2016
52	Odisha	Santal	Non -PVTG	31.1	Kshatriya & Acharya, 2016
53	Rajasthan	Sahariya	PVTG	35.8	Bairwa et. al., 2017
54	Rajasthan	Bhil	Non -PVTG	95.2	Bhasin & Jain, 2007
55	Rajasthan	Damor	Non -PVTG	87.8	Bhasin & Jain, 2007
56	Rajasthan	Garasia	Non -PVTG	98.0	Bhasin & Jain, 2007
57	Rajasthan	Kathodi	Non -PVTG	93.0	Bhasin & Jain, 2007
58	Rajasthan	Mina	Non -PVTG	66.2	Bhasin & Jain, 2007
59	Rajasthan	Sahariya	PVTG	93.8	Bhasin & Jain, 2007
60	Rajasthan	Sahariya	PVTG	53.2	Rao *et al*., 2006
61	Tamil Nadu	Kaani	Non -PVTG	50.4	Mohankumar & Velvizhi, 2018
62	Uttar Pradesh	Raji	PVTG	37.3	Alam *et al*., 2013
63	Uttar Pradesh	Kharwar	Non -PVTG	33.3	Jaiswal, 2015
64	Uttar Pradesh	Bhoksa	PVTG	64.2	Lamba & Garg, 2017
65	Uttarakhand	Bhotia	Non -PVTG	8.8	Mandal *et al*., 2011

66	Uttarakhand	Tharu	Non -PVTG	18.0	Mukherjee *et al*., 2015
67	West Bengal	Lodha	PVTG	40.7	Adhikary, 2007
68	West Bengal	Lodha	PVTG	80.0	Bepari *et al*., 2015
69	West Bengal	Lodha	PVTG	66.7	Bisai & Dutta, 2021a
70	West Bengal	Sabar	Non -PVTG	65.0	Bhandari *et al*., 2019
71	West Bengal	Kora Mudi	Non -PVTG	55.3	Bisai *et al*., 2008
72	West Bengal	Bhumij	Non -PVTG	58.9	Biswas, 2007
73	West Bengal	Kora Mudi	Non -PVTG	56.4	Bose *et al*., 2006b
74	West Bengal	Santal	Non -PVTG	41.8	Bose *et al*., 2006c
75	West Bengal	Santal	Non -PVTG	63.4	Das & Bose, 2010
76	West Bengal	Hill Kheria	Non -PVTG	60.9	Das & Bose, 2014
77	West Bengal	Birhor	PVTG	46.5	Bisai & Dutta, 2021b
78	West Bengal	Birhor	PVTG	33.3	Das *et al*., 2013
79	West Bengal	Santal	Non -PVTG	34.0	Dash & Adhikary, 2018
80	West Bengal	Lodha	PVTG	33.1	De & Kundu, 2016
81	West Bengal	Santal	Non -PVTG	8.7	De & Kundu, 2016
82	West Bengal	Munda	Non -PVTG	67.9	Ghosh & Bharati, 2006
83	West Bengal	Santal	Non -PVTG	52.5	Ghosh & Malik, 2007
84	West Bengal	Santal	Non -PVTG	50.0	Ghosh, 2014
85	West Bengal	Kora	Non -PVTG	62.0	Kshatriya & Acharya, 2016
86	West Bengal	Oraon	Non -PVTG	62.9	Kshatriya & Acharya, 2016
87	West Bengal	Santal	Non -PVTG	45.1	Kshatriya & Acharya, 2016
88	West Bengal	Oraon	Non -PVTG	31.7	Mittal & Srivastava, 2006
89	West Bengal	Santal	Non -PVTG	38.5	Mukhopadhyay, 2009
90	West Bengal	Toto	PVTG	1.3	Bhattacharya *et al*., 2006
91	West Bengal	Toto	PVTG	15.4	Bisai & Dutta, 2021c

Table 3. Community wise prevalence of CED of adult tribal males and females

Sl. No.	Community	Male		Female	
		n	CED (%)	n	CED (%)
1	Andh	50	82.0	--	--
2	Apatani	132	2.3	149	1.0
3	Baiga	1353	61.3	1355	64.8
4	Bathudi	238	46.2	239	63.5
5	Bhaina	--	--	100	27.0
6	Bharia	276	46.0	366	43.7
7	Bhil	667	75.2	66	95.2
8	Bhoksa	--	--	120	64.2
9	Bhotia	938	24.3	937	8.8

10	Bhuiya	353	54.6	324	77.7
11	Bhumia	250	77.8	235	73.6
12	Bhumij	538	43.1	380	51.0
13	Bhunjia	--	--	174	71.8
14	Birhor	104	24.0	118	38.1
15	Bondo	68	51.5	94	31.9
16	Boro-Kachari	98	11.2	--	--
17	Car Nicobarese	165	1.2	--	--
18	Chakesang	--	--	540	10.0
19	Chaudhari	120	40.0	121	48.8
20	Chenchu	209	41.0	431	42.0
21	Damor	41	69.4	36	87.8
22	Dhodia	121	28.1	120	29.2
23	Dibongiya Deori	243	13.8	--	--
24	Dongria Khond	549	60.7	665	54.3
25	Dulia	340	20.3	--	--
26	Garasia	50	94.9	39	98.0
27	Gond	1192	59.8	--	--
28	Great Andamanese	11	0.0	8	0.0
29	Gujjar and Bakerwal	--	--	410	90.7
30	Hill Kheria	68	41.2	92	60.9
31	Hill Korwa	--	--	131	35.8
32	Ho	50	70.0	--	--
33	Jarwa	25	48.0	16	31.3
34	Jenukuruba	310	100.0	341	96.8
35	Juang	414	51.9	423	62.9
36	Kaani	199	47.9	136	50.4
37	Kamar	50	64.0	50	64.0
38	Karbi	--	--	300	11.7
39	Kathodi	93	90.6	43	93.0
40	Katkari	191	36.7	219	50.0
41	Kharia	157	50.3	191	56.5
42	Kharwar	75	19.4	76	33.3
43	Khond	100	35.0	--	--
44	Kol	200	46.0	--	--
45	Kolam	70	18.6	50	40.0
46	Kora Mudi	337	49.0	494	34.7
47	Koraga	243	93.2	257	93.3
48	Korku	151	54.2	--	--

49	Korwa	51	7.8	--	--
50	Kukna	120	28.3	120	40.0
51	Lalung	49	34.7	--	--
52	Lodha	677	49.3	809	54.1
53	Mahadeokali	100	61.0	--	--
54	Majhi	50	24.0	--	--
55	Mankidia	124	48.4	136	59.5
56	Mech	50	6.0	--	--
57	Mina	89	38.3	76	66.2
58	Miri	50	34.0	--	--
59	Munda	639	46.2	309	65.0
60	Nyishi	--	--	543	10.5
61	Onge	62	12.3	44	30.4
62	Oraon	1209	51.1	274	45.9
63	Pando	732	48.3	715	55.5
64	Paroja	50	80.0	--	--
65	Pnars Khasi	49	14.3	--	--
66	Raji	43	55.8	51	37.3
67	Sabar	111	52.0	115	65.0
68	Saharia	653	48.4	1195	39.9
69	Sahariya	276	63.0	423	57.0
70	Santal	2757	42.9	2275	46.3
71	Savar	944	44.3	789	55.5
72	Soliga	540	37.6	460	40.9
73	Sonowal Kachari	136	40.4	129	30.2
74	Sonr	56	73.2	--	--
75	Sugali	705	51.2	717	49.1
76	Tadvi	--	--	85	63.5
77	Tangkhul Naga	--	--	346	16.2
78	Tharu	137	27.3	89	18.0
79	Thengal Kachari	115	13.0	--	--
80	Toto	127	3.9	129	6.9
81	War Khasi	575	35.0	--	--
82	Warli	50	88.0	--	--

Figures

Figure 1. Flow Diagram for Selection of Studies

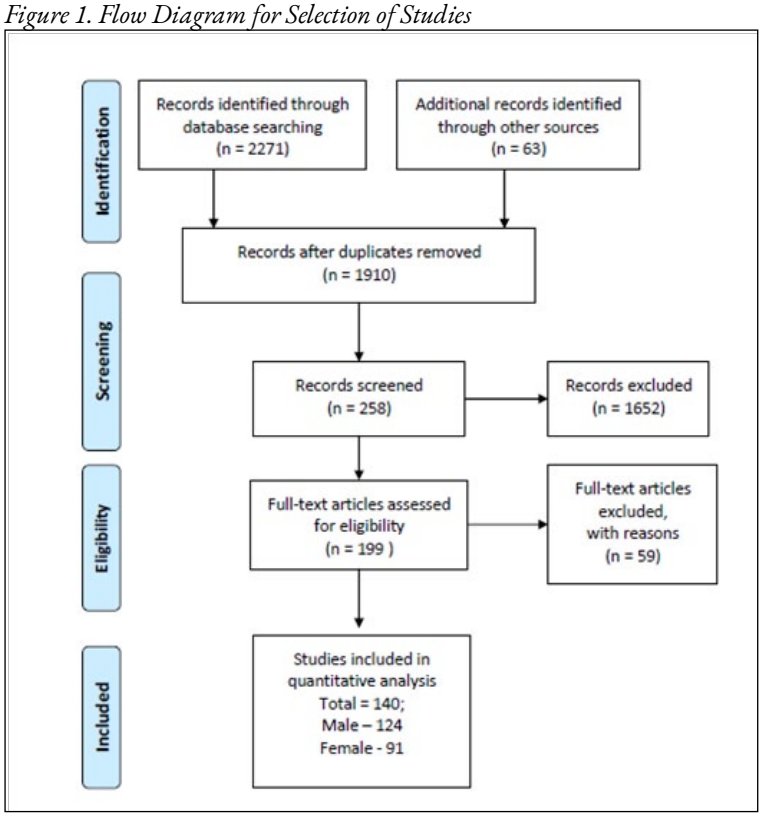

Figure 2. State-wise prevalence of CED (%) of tribal adult male and female