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Undernutrition Among Tribal Children of Odisha: A Meta-analysis

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Abstract: Tribal children in Odisha face a significant problem of malnutrition and have been lower than the national/state average over the last 5 to 10 years. The study aims to collect community-based evidence to estimate the overall prevalence of stunting, wasting and underweight among tribal children in Odisha between 2015 and 2025. A systematic literature search identified studies reporting anthropometric indicators among tribal children in Odisha. Screening was performed using Rayyan software, study quality assessed through AXIS checklist, and meta-analysis was conducted in JAMOVI. The I^2 statistic was used to evaluate heterogeneity and funnel plots; the Egger regression test was employed to assess publication. Based on nine studies involving 2,868 tribal children, this meta-analysis showed that the prevalence of stunting was 46.7% (95% CI: 34.6–58.8), wasting was 38.9% (95% CI: 19.9–57.9), and underweight was 56.9% (95% CI: 4.9–68.9).There was considerable heterogeneity across studies, mainly due to differences in tribal groups, ecological settings, and access to public health services. Egger's test revealed no evidence of publication bias. The findings revealed the disproportionate burden of undernutrition on tribal children in Odisha. This highlights the need for tribe specific health interventions. These findings

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support the development of specific tribal nutrition strategies and longitudinal studies across all tribal children, including PVTGs that include anthropometric, dietary, and sociocultural factors, which are essential for understanding the causes and policy guidance over time.

Keywords: Tribal children, undernutrition, stunting, wasting, underweight, Odisha

INTRODUCTION

Children are the future of the nation, and therefore their development and healthcare are much important for any developing nation or country. However, the ICMR report states that this future is threatened by the double and triple burden of malnutrition. This burden is greater among marginalized communities than others. This shows that the healthcare system is not equitable for all in this society. Tribal communities constitute 8.6% of the population in India (Census 2011) and live in remote and rural areas and maintain their unique cultural traditions. Furthermore, they face greater health risks than others (Behera *et al*., 2024). Odisha has the third highest tribal population among eastern states in India and many of these communities live below the poverty line, making access to proper healthcare even more difficult (Acharya *et al*., 2021). Tribal children in India are more vulnerable than non-tribal children, and limited access to healthcare makes them more vulnerable to malnutrition, infectious diseases, and low birth weight (Das *et al*., 2022; Kumar *et al*., 2023; Satapathy *et al*., 2021). Studies show that malnutrition rates are very high among under 5-year-old PVTG tribal children in Odisha, with 75.26% underweight, 55.42% stunted, and 60% wasted (Das *et al*., 2024). This suggests an urgent need for targeted nutrition interventions, especially for children and their mothers, focusing primarily on food education, poverty reduction, and improving access to foods rich in essential nutrients (Gouda *et al*., 2025). This review and meta-analysis summarize evidence from various studies to better understand the undernutrition among tribal children in Odisha.

METHODOLOGY

Inclusion and Exclusion

Only cross-sectional studies were included and community surveys of nutritional assessments conducted in Odisha and reported only quantitative data. Studies that followed the WHO Child Growth Standards to report at least one anthropometric indicator among children for stunting, wasting, and underweight were eligible. Detailed exclusion criteria are provided in the PRISMA flow chart [Figure 1].

Search Strategy and Study Selection Criteria

A systematic search for studies was done using Google Scholar, Web of Science, PubMed, Science Direct, and JSTOR to identify peer-reviewed studies in English published between 2015 and 2025. The entire search strategy is in Supplementary File 1. We also manually searched the reference lists of included studies. Search results were exported to RefMan format and imported into Rayyan for review management. Duplicates were removed before screening. Titles and abstracts were then screened for eligibility using the PICO framework [Supplementary File 2], followed by full-text assessment. Only articles that met the inclusion criteria and were agreed upon by both reviewers were included. The entire selection and exclusion process is shown in the PRISMA flow diagram [Figure 1].

Data extraction method and quality checking

The data extracted from each study are presented in Table 1. Each study was scored using 20 items of the AXIS criteria (Downes *et al*., 2016) to evaluate the methodological quality of the paper and based on this assessment; the studies were classified into low, medium, or high quality.

Characteristics of include study

Systematic searches of electronic databases yielded 1043 records, of which only nine met the inclusion criteria for the meta-analysis (as shown in the PRISMA flow chart). All studies reported anthropometric indicators based on WHO growth standards, specifically stunting (eight studies), wasting (six studies), and underweight (eight studies). Four high-quality and five medium-quality studies were assessed using the AXIS checklist, and low-quality studies were excluded.

STATISTICAL ANALYSIS

JAMOVI (version 2.6.44) was used to perform the statistical analysis. A random-effects model was applied because the studies differed in tribal groups, time periods, and sample sizes. The DerSimonian-Laird method was then used to combine the results. Heterogeneity reflects how different study results are from one another. The I^2 statistic was used to measure this variation. Forest plots were used to visually display overall prevalence and their 95% confidence intervals. These intervals compare individual study results to the pooled estimate. Publication bias was checked using funnel plots; symmetry in the plot indicates no bias, and asymmetry indicates differences related

to selective publication or study size. To complement the funnel plots, an Egger test was performed to examine whether smaller studies differed from larger studies. A significant result from this test could indicate publication bias or small study effects.

RESULTS

The prevalence of undernutrition varied widely across the included studies. Reported stunting prevalence ranged from 18% to 70%, wasting from 16% to 83%, and underweight from 37% to 80%, indicating variation across studies. The overall prevalence of stunting was estimated at 46.7% (95% CI: 34.6-58.8) based on data from eight studies involving 2,791 tribal children in Odisha. Overall wasting prevalence was 38.9% (95% CI: 19.9-57.9) based on data from six studies involving 2,428 children. Overall underweight prevalence was 56.9% (95% CI: 44.9-68.9) based on eight studies involving 2,632 children (Forest plots showing the overall prevalence are provided in Supplementary File 3). High heterogeneity was observed across studies for all three indicators of malnutrition. I^2 values ranged from 96.7% to 98.8%. Funnel plots are used to visualize publication bias, and Egger's regression test is used to test it statistically. Funnel plots showed asymmetry (shown in Supplementary File 4), but the Egger test p values for stunting, wasting, and underweight were all >0.05 (non-significant), suggesting no publication bias. The asymmetry was likely due to differences between studies rather than selective reporting.

DISCUSSION

Child malnutrition has been a major public health challenge in India over the past two decades. Despite a decline in the national average, tribal communities, especially in states with a high Scheduled Tribe (ST) population like Odisha, continue to bear a higher burden than non-tribal groups (Rekha *et al.*, 2023). However, existing studies provide fragmented data on malnutrition and health inequalities. This prevalence synthesis of undernutrition among tribal children in Odisha is the first quantitative synthesis to our knowledge. The 2015-2025 timeframe aligns with recent National Health and Nutrition Surveys (NFHS), which reflect current trends in tribal health. While NFHS-5 lacks tribe-specific anthropometric data for ST groups in Odisha, hence it cannot reveal inter-tribe differences; this meta-analysis of tribe-specific studies generates accurate item-specific prevalence estimates to inform reliable equitable health outcomes that support evidence-based strategies for equitable health services in underserved tribal areas.

To situate the findings within a broader national context, it is important to recognize that undernutrition among tribal children is not unique to Odisha but reflects a widespread structural public health challenge across major tribal-dominated states such as Jharkhand, Maharashtra, Madhya Pradesh, and Rajasthan. Evidence from the NFHS-5 indicates that India continues to face a substantial burden of child undernutrition, with 35.5% stunting, 19.3% wasting, and 32.1% underweight among under-five children nationally (International Institute for Population Sciences & Ministry of Health and Family Welfare, 2021). These averages often mask significantly higher levels among ST populations and socioeconomically marginalized regions (Singh *et al.*,2019). However, present evidence is limited to children under five years of age, as comparable data for older children and adolescents are limited. Comparative state-level data demonstrate that several tribal-dominated states report persistently high levels of undernutrition. In Jharkhand, the prevalence of stunting (39.6%), wasting (22.4%), and underweight (39.4%) remains among the highest in the country (IIPS & MoHFW, 2021). Similarly, Madhya Pradesh reports 35.7% stunting, 19% wasting, and 33% underweight, with particularly severe conditions in tribal districts such as Dhar and Barwani. Maharashtra, especially in tribal regions like Melghat, shows 35.2% stunting, 25.6% wasting, and 36.1% underweight, reflecting persistent nutritional stress despite economic development. Rajasthan also exhibits a considerable burden, with 31.8% stunting, 16.8% wasting, and 27.6% underweight, influenced by ecological constraints and limited dietary diversity (IIPS & MoHFW, 2021). In comparison, the present meta-analysis demonstrates that Odisha exhibits a markedly higher burden, with pooled estimates of 46.7% stunting, 38.9% wasting, and 56.9% underweight, exceeding both national averages and most state-level estimates. While NFHS-5 reports lower state averages for Odisha (31.0% stunting, 18.1% wasting, and 29.7% underweight), the substantially higher pooled estimates observed in this study underscore the limitations of aggregated data in capturing intra-state disparities, particularly among tribal and PVTG populations (IIPS & MoHFW, 2021). This comparison pattern is summarized in Table 3.

Present study synthesized pooled evidence from nine community-based studies to quantify the pooled prevalence of undernutrition among tribal children in Odisha. The overall prevalence of stunting was 46.7% (95% CI: 34.6-58.8), indicating long-term undernutrition. This estimate is like previous tribal research across India. Similar results were reported in Dey *et al.*, (2019) systematic review and

are consistent with trends reported in NFHS-5 for tribal children. Several studies have reported high stunting rates, such as 47.2% among tribal children under 2 years of age (Sethi *et al*., 2018), 55.42% among PVTG children (Das *et al*., 2024), 70% among tribal preschoolers in Khardaha district (Barik *et al*., 2024), and 62.5% among Bonda children in Malkangiri (Nayak *et al*., 2024). Moderate levels were observed in Goswami *et al*., (2016) (32.4%) and Singh *et al*., (2018) (33%), while Kuiti *et al*., (2022) reported the lowest prevalence of 18%. This wide range may be due to differences in the tribal groups studied, ecological settings, access to food, maternal nutrition, and public service delivery.

Wasting, an indicator of acute malnutrition had an overall prevalence of 38.9% (95% CI: 19.9–57.9). This estimate falls within the WHO "high" category but is lower than some district-specific reports. Barik *et al*., (2024) reported a very high prevalence of wasting at 83.33% among tribal children, while Nayak *et al*., (2024) reported 33.2% among Bonda children, and Singh *et al*., (2018) reported 18% among Bhumij children, while Goswami *et al*., (2016) reported 25%. The lowest prevalence was again observed in Kuiti *et al*., (2022) (16%). This significant variation reflects differences in disease burden, food availability, seasonal variations, and access to ICDS/health services in Odisha's tribal areas.

The pooled underweight prevalence was 56.9% (95% CI: 44.9-68.9) exceeding both the national and state average. This result aligns with the findings of Das *et al*., (2024) among Odisha's PVTGs 75.26%. Similarly high prevalence was reported among Juang children of Jajpur by Bindhani *et al*., (2023) and Barik *et al*., (2024). However comparatively lower prevalence was documented by Goswami *et al*., (2016) and Singh *et al*., (2018) 42.6% and 43% respectively both among the Bhumij children in Mayurbhanj and Balasore district. The lowest prevalence was documented in Kuiti *et al*., (2022) where only 37% of Juang children were classified as underweight. These variations highlight significant heterogeneity in the undernutrition burden across different tribal groups and geographic settings within Odisha.

Study shows that nutritional levels vary across tribal groups, with PVTGs such as the Bonda and Juang consistently showing higher levels of malnutrition (Nayak *et al*., 2024; Kuiti *et al*., 2022; Bindhani *et al*., 2023). A study reported significantly higher levels of malnutrition across all three anthropometric indicators in PVTGs (Das *et al*., 2024). A similar study conducted in Jajpur district, Odisha, revealed widespread malnutrition among Juang children, with 19 children previously reported to have died from severe malnutrition in that area (Bindhani *et al*., 2025).

Social, economic, cultural, and environmental factors contribute to malnutrition among tribal children in Odisha (Das *et al*., 2024). Poverty is a major cause of malnutrition. A study found that long-term poverty and various maternal factors significantly impact stunting (Sethi *et al*., 2018). Subsistence farming and forest resource gathering create economic insecurity, often leading to inadequate nutrition (Kuiti *et al*., 2022). Factors such as low maternal education, early marriage, and young age at first birth also increase the risk of stunting in children (Sethi *et al*., 2018). Furthermore, poor living conditions and poor sanitation practices, such as open defecation in tribal households, increase health problems and contribute to the spread of diseases, further worsening nutritional status (Sethi *et al*., 2018). The persistence of undernutrition across these states reflects a shared set of structural determinants. Poverty remains a central driver, as most tribal households rely on subsistence agriculture and forest-based livelihoods, which are highly vulnerable to seasonal fluctuations (Pothal, 2024). Limited dietary diversity and food insecurity significantly contribute to chronic undernutrition (Sethi *et al*., 2018). Maternal factors, including low education, early marriage, and poor maternal nutrition, further exacerbate the risk of stunting and underweight among children (Black *et al*., 2013). Geographical isolation and inadequate infrastructure also restrict access to essential healthcare and nutrition services, including Integrated Child Development Services (ICDS) and maternal-child health programs (IIPS & MoHFW, 2021). Environmental conditions such as drought-prone regions in Rajasthan and Maharashtra, along with forested and hilly terrains in Odisha and Madhya Pradesh, further limit food availability and healthcare access. Poor sanitation and a high burden of infectious diseases contribute to acute malnutrition and wasting (Black *et al*., 2013). Additionally, social exclusion and marginalization of tribal communities reduce the utilization of available services, reinforcing intergenerational cycles of undernutrition (Sreena *et al*., 2025).

Persistent gaps in access to healthcare and nutrition services are contributing to the growing prevalence of malnutrition among tribal populations. Evidence suggests that tribal and non-tribal groups in some settings face similar structural barriers to care, while intra-tribal inequities further shape nutritional outcomes, as seen among Juang children and adolescent girls living in hostels received better food, but adolescent boys living without hostels did not, highlighting service gaps (Sethi *et al*., 2018; Kuiti *et al*., 2022). According to studies in PVTGS, children (below 5 years of age) and women of reproductive age are more vulnerable, hence there is an urgent

need to formulate public health policies and focus on nutritional health (Das *et al.*, 2024). It recommends interventions to reduce poverty, improve healthcare access, promote sustainable agriculture, and ensure food security. The findings suggest the need for tribal-specific strategies and policies to effectively address malnutrition and improve the health status of tribal children. This study was limited to cross-sectional studies, having high heterogeneity among included studies and has a small number of studies that restricted subgroup analyses. Inconsistent anthropometric reporting created gaps that limited pooled analyses. Furthermore, as the review covers only Odisha, findings cannot be generalized to other Indian tribal populations.

CONCLUSION

This meta-analysis reveals that undernutriton is a significant problem among tribal children in Odisha. Key findings indicate a high pooled prevalence of 46.7% for stunting, 38.9% for wasting, and 56.9% for underweight, driven by factors such as limited access to healthcare, poverty, and inadequate dietary diversity. While the robustness of the methods enhances the reliability of these overall estimates, heterogeneity across studies remains a significant limitation. The findings suggest that specific public health actions and improved social support systems are necessary. Future longitudinal studies are essential to include all PVTGs and interventions that incorporate anthropometric indicators, dietary diversity patterns, and sociocultural factors. Further studies are needed over time to clarify the determining factors and develop effective policies to reduce the nutritional gap in marginalized tribal populations. Immediate action is needed to address the nutritional gap and provide nutrition to tribal children in Odisha.

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References

Acharya, A., Pradhan, M. R., & Das, A. K. (2021). Determinants of minimum acceptable diet feeding among children aged 6–23 months in Odisha, India. *Public Health Nutrition*, *24*(12), 3834. https://doi.org/10.1017/s1368980021002172

Barik, S., Ayushree, B. A., Sahu, A., & Bhoi, B. (2024). A comparative study on nutritional aspect of tribal and non-tribal preschool children residing in urban areas of Odisha. *YMER Digital 2025; 23:656–65.*

Behera, N., Pandey, K., & Shankar, S. (2024). Physical and Mental Health Status of Tribal People in Odisha: A Systematic Literature Review. *Global Social Welfare*. https://doi.org/10.1007/s40609-024-00355-5

Bindhani, B. K., Prakash, V., Suokhrie, S., & Nayak, J. K. (2025). Nutritional status of children and adolescents in nagada and guhiasala. *Ind. J. Phys. Anthrop & hum. Genet. Vol. 2023; 42*(1):11-7.

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., … Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet, 382*(9890), 427–451. https://doi.org/10.1016/S0140-6736(13)60937-X

Das, A., Ghosal, J., Khuntia, H. K., Dixit, S., Pati, S., Kaur, H., Ota, A. B., Bal, M., & Ranjit, M. (2024). Malnutrition and Anemia Among Particularly Vulnerable Tribal Groups of Odisha, India: Needs for Context-Specific Intervention. *Indian Journal of Community Medicine*, *49*(3), 519. https://doi.org/10.4103/ijcm.ijcm_452_23

Das, S., Mollick, S. A., & Ray, S. (2022). Consequences of Low Birth Weight among Tribal Populations in India: A Review Analysis. *International Journal of Health Sciences and Research*, *12*(9), 108. Galore Knowledge Publication Pvt. Ltd. https://doi.org/10.52403/ijhsr.20220914

Dey, U., & Bisai, S. (2019). The prevalence of under-nutrition among the tribal children in India: a systematic review. *Anthropological Review*, *82*(2), 203. De Gruyter Open. https://doi.org/10.2478/anre-2019-0014

Downes, M., Brennan, M., Williams, H. C., & Dean, R. (2016). Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ Open*, *6*(12). https://doi.org/10.1136/bmjopen-2016-011458

Goswami, M. (2016). Prevalence of Under-Nutrition Measured by Composite Index of Anthropometric Failure (CIAF) Among the Bhumij Children of Northern Odisha, India. *Journal of Nepal Paediatric Society*, *36*(1), 61. https://doi.org/10.3126/jnps.v36i1.14390

Gouda, P., Sarkar, B., Nayak, J. K., Srinivas, B. K., & Bindhani, B. K. (2025). *Nutritional Status and Dietary Diversity among Adolescents in Rural Koraput, India*.

International Institute for Population Sciences (IIPS), & Ministry of Health and Family Welfare (MoHFW). (2021). *National Family Health Survey (NFHS-5), 2019–21: India Fact Sheet*. Mumbai: IIPS.

Kuiti BK, Acharya S, Satapathy KC, Barik DK, Patra PK. (2022). Composite index of anthropometric failure (CIAF) among juang children and adolescents of keonjhar district in Odisha, India. Man, environment and society. 2022; 3(1):133 https://doi.org/10.47509/MES.2022.v03i01.10

Kumar, D., Kumar, V., & Tirkey, A. (2023). Assessment of Health Aspects of Tribal Adolescent Girls in India's Most Populous Tribal State: A Two-Decadal Review. *International Journal of Health Sciences and Research*, *13*(2), 127. Galore Knowledge Publication Pvt. Ltd. https://doi.org/10.52403/ijhsr.20230219

Nayak, R., Kaushal, S., & Sharma, A. N. (2025). *Prevalence of Nutritional Status among Bonda Children Under Five Years of Khairput Block of Malkangiri District, Odisha, India*.

Pothal, Dr. S. P. (2024). Livelihood, Poverty and Multiple Deprivation among Tribals in Odisha. *IOSR Journal of Economics and Finance*, *15*(5), 15–26. https://doi.org/10.9790/5933-1505011526

Rekha, S., Shirisha, P., Muraleedharan, V. R., Vaidyanathan, G., & Dash, U. (2023). Wealth inequalities in nutritional status among the tribal under-5 children in India: A temporal trend analysis using NFHS data of Jharkhand and Odisha states - 2006-21. *Dialogues in Health*, *2*, 100135. https://doi.org/10.1016/j.dialog.2023.100135

Satapathy, A., Satapathy, A., Rout, D. S., Prusty, A. K., & Rout, S. (2021). Prevalence of Protein Energy Malnutrition among Under-five children in Odisha: A Review. *The Journal of Phytopharmacology*, *10*(4), 272. https://doi.org/10.31254/phyto.2021.10410

Sethi, V., Lakhara, K., Kumar, D., Maiti, K. D., Bhattacharjee, S., Dev, V. K., Ahuja, A., Sareen, N., & Agrawal, S. (2018). Severity and determinants of stunting in children under age 2 years in Odisha (India): a tribal v/s non-tribal analysis. *Asian Ethnicity*, *19*(4), 489. https://doi.org/10.1080/14631369.2018.1465339

Singh, K., & Patra, P. K. (2018). *Assessment of Nutritional Status among the Bhumija Pre-school Children of Mayurbhanj District of Odisha*.

Siva, N., Mohanty, K., Rath, R., Mishra, S., Mishra, M., Samal, K., Das, S., & Rath, N. (2025). A systematic scoping review of health-seeking behavior and healthcare utilization in tribal communities of odisha, india: concentration on maternal and child health. *BMC Public Health*, *25*(1), 2801. BioMed Central. https://doi.org/10.1186/s12889-025-24079-z

Sreena, T. V., Divya, K. L., & Anil, D. (2025). Structural barriers to infant nutrition among tribal communities in South India. *BMJ Case Reports*, *18*(12). https://doi.org/10.1136/bcr-2025-265922

Table 1: Summary of anthropometric outcomes reported in studies on tribal children in Odisha

Author & Year	*Study Area*	*Study Design*	*Tribe*	*Sample Size (n)*	*Age Group*	*Key Prevalence Findings*	*Total Score*	*Quality Rating*
Sethi *et al.* (2018)	Odisha (state-level)	Cross-sectional	Tribal children	287	0–23 months	Stunting: 47.2%	18	High
Nayak *et al.* (2024)	Malkangiri district	Cross-sectional	Bonda (PVTG)	464	0-5 Years	Stunting: 62.5%, Wasting: 33.2%, Underweight: 64.5%	13.5	Moderate
Goswami *et al.* (2016)	Northern Odisha (Baleswar)	Cross-sectional	Bhumij	136	1–6 years	Stunting: 32.4, Wasting: 25%%, Underweight: 42.6%.	14	Moderate
Kuiti *et al.* (2022)	Keonjhar district	Cross-sectional	Juang (PVTG)	237	1–17 years	Stunting: 18, Wasting: 16%%, Underweight: 37%	15.5	High
Das *et al.* (2024)	12 districts (17 micro-project areas)	Large cross-sectional state-wide survey	13 PVTGs	1461	Under-five & all ages	Stunting: 55.42, Wasting: 60%%, Underweight: 75.26%	17.5	High
Bindhani *et al.* (2023)	Jajpur (Nagada & Guhiasala)	Cross-sectional	Juang	77	5–13 years	Underweight: 53%	13	Moderate
Singh & Patra (2018)	Mayurbhanj district	Cross-sectional	Bhumija	100	0–6 years	Stunting: 33%, Wasting: 18%, Underweight: 43%.	14	Moderate
Barik *et al.* (2024)	Khordha (Bhubaneswar urban)	Community-based, urban	Tribal pre-schoolers	30	3–6 years	Stunting: 70%, Wasting: 83.33%, Underweight: 80%	15	High
Joshi *et al.* (2021)	Gajapati district	Cross-sectional	Tribal (mixed groups)	76	0–16 years	Stunting: 58.82%, Underweight: 61.2%	12.5	Moderate

Table 2: Summary of meta-analysis findings for nutritional indicators among tribal children in Odisha

Indicator	*No.of Studies (k)*	*Sample Size (n)*	*Range (%)*	*Pooled Prevalence (%)*	*95% CI (%)*	*I^2 (%)*	*Egger value*	*p- value*
Stunting (Height-for-age)	8	2791	18% – 70%	46.7	34.6 – 58.8	97.23	0.810	0.418
Wasting (Weight-for-height)	6	2428	16% – 83%	38.9	19.9– 57.9	98.82	1.102	0.270
Underweight (Weight-for-age)	8	2632	37% – 80%	56.9	44.9 – 68.9	96.72	-0.037	0.970

Table 3: State-wise comparison of undernutrition indicators among children in selected Indian states and tribal children of Odisha

State	*Stunting (%)*	*Wasting (%)*	*Underweight (%)*
Jharkhand	39.6	22.4	39.4
Madhya Pradesh	35.7	19	33
Maharashtra	35.2	25.6	36.1
Rajasthan	31.8	16.8	27.6
Odisha (NFHS-5)	31	18.1	29.7
Odisha (Present study)	46.7	38.9	56.9

Source: NFHS-5 (2019–21); Present meta-analysis; NFHS-5 estimates represent all the state level, whereas the present study estimate refers to tribal children of Odisha based on meta-analysis.

Table 4: Key determinants of undernutrition among tribal children in India

Determinant	*Description*	*Impact*
Poverty	Subsistence livelihoods, low income	Inadequate calorie intake
Dietary diversity	Limited access to nutritious foods	Micronutrient deficiencies
Maternal factors	Early marriage, low education	Poor child feeding practices
Healthcare access	Remote locations, weak infrastructure	Delayed care and monitoring
Environmental factors	Drought, forest ecology	Food insecurity
Sanitation & disease	Poor hygiene, infections	Increased wasting
Social exclusion	Marginalization of tribal groups	Low service utilization

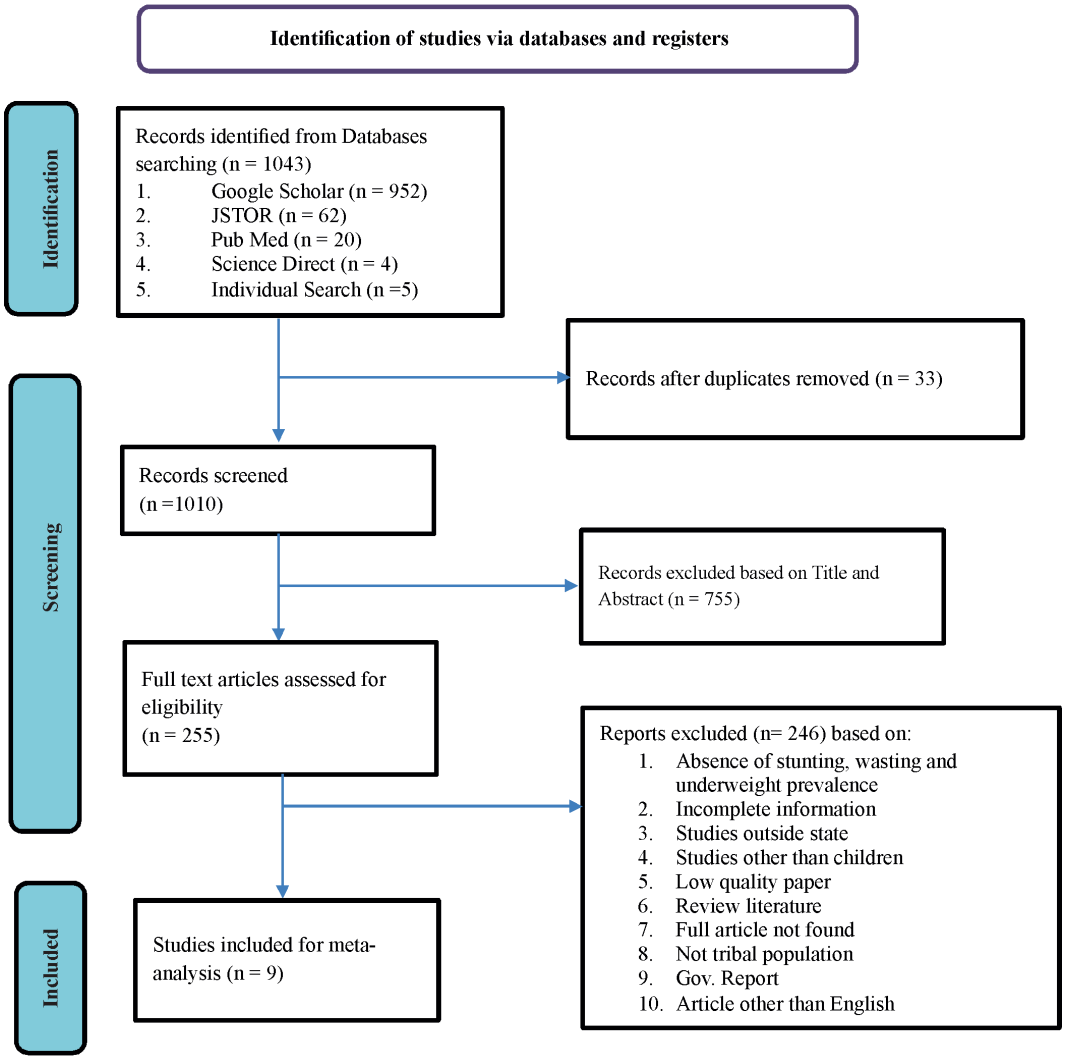


Figure 1: Flow diagram of study selection process following PRISMA 2020 guidelines

Supplementary file 1. Search strategy

Database	*Search string*	*Filters applied*	*Number of results*
Google Scholar	("stunting" OR "wasting" OR "underweight" OR "malnutrition" OR "undernutrition" OR "nutritional status") AND ("tribal children" OR "indigenous children") AND ("Odisha" OR "Orissa")	English, Last 10 years	952
JSTOR	("child nutrition" OR "malnutrition") AND ("stunting" OR "wasting" OR "underweight") AND ("tribal" OR "marginalised communities" OR "India") AND ("Odisha")	English, Last 10 years	62
PubMed	(("Stunting"[Title/Abstract] OR "Wasting"[Title/Abstract] OR "Undernutrition"[MeSH Terms] OR "Underweight"[MeSH Terms]) AND ("Anemia"[MeSH Terms] OR "anaemia"[Title/Abstract]) AND ("Child"[MeSH Terms] OR "Children"[Title/Abstract]) AND ("India"[MeSH Terms] OR "Tribal Population"[MeSH Terms]))	Last 10 years, Humans, English	20
Science Direct	("health status" OR "nutritional status" OR "malnutrition") AND ("tribal children" OR "indigenous children") AND (Odisha OR Orissa)	English, Articles	4

Detailed electronic search strategies applied across databases, including keywords, Medical Subject Headings (MeSH), and Boolean operators.

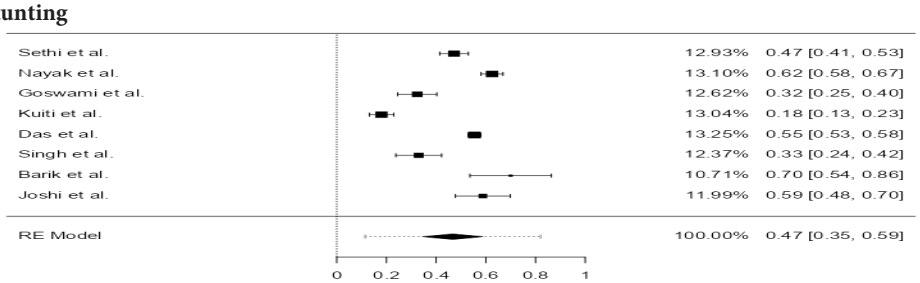
Supplementary file 2. PICO Framework

Component	*Description*
Population	Tribal children in Odisha, India, experiencing nutritional challenges.
Intervention	Nutritional status assessment among the tribal children of Odisha.
Comparison	Non-tribal children, general rural population, or children from other socio-economic groups in Odisha or similar contexts.
Outcome	Prevalence of undernutrition (stunting, wasting, underweight)

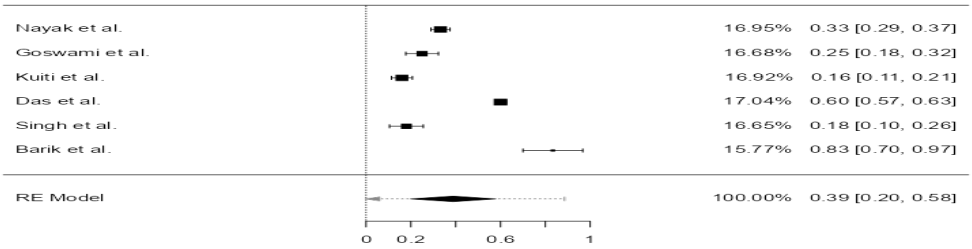
PICO framework outlining eligibility criteria for selecting studies on the nutritional status of tribal children in Odisha

Supplementary file 3. Forest plots (figures 2–4)

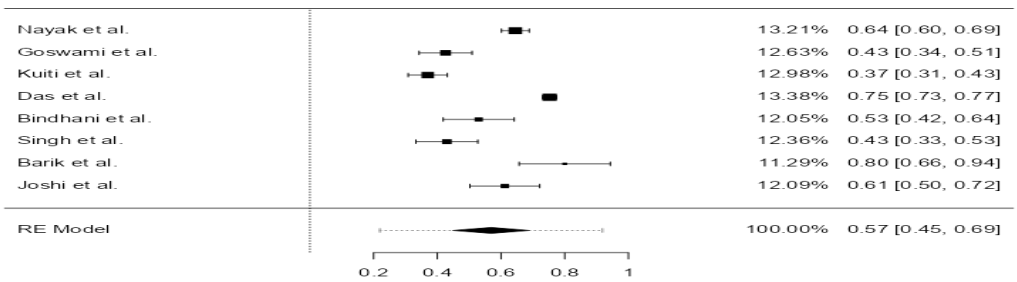
Stunting



Wasting



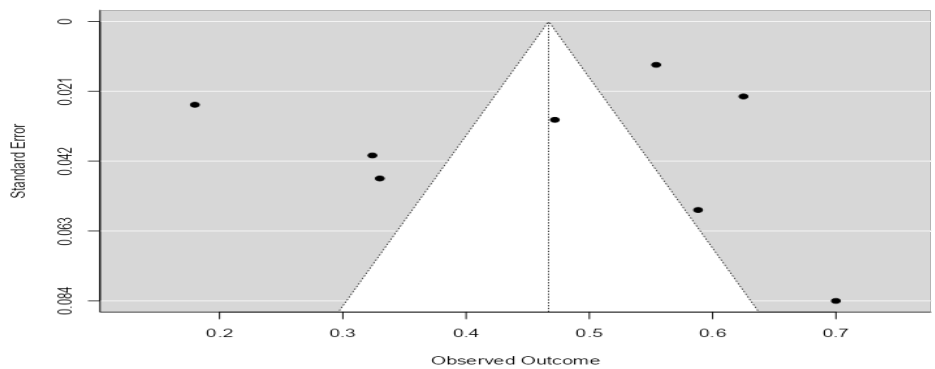
Underweight



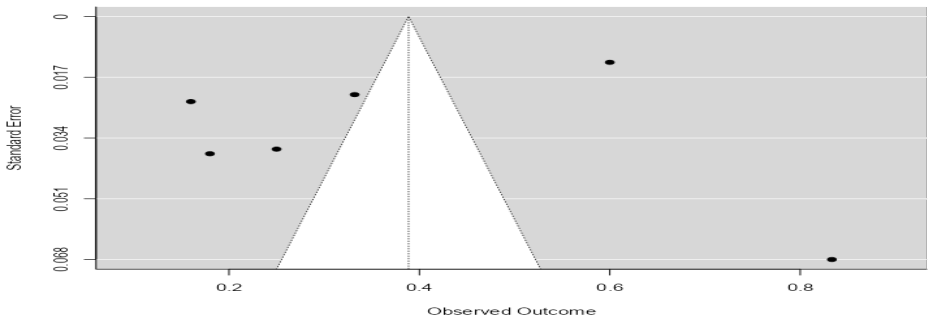
Forest plots presenting pooled prevalence estimates of stunting, wasting, and underweight among tribal children in Odisha.

Supplementary file 4. Funnel plots (figures 5–7)

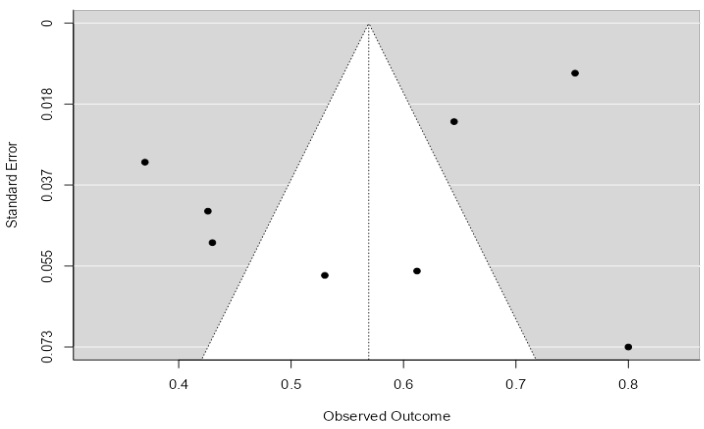
Stunting



Wasting



Underweight



Funnel plots assessing publication bias for pooled estimates of stunting, wasting and underweight.