Assessment of Undernutrition Among Under-Five Children by Using Composite Index of Anthropometric Failure (CIAF)

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ABSTRACT
Undernutrition is acknowledged as a significant public health concern across many developing nations. Anthropometric measures serve as crucial tools for estimating the extent of undernutrition in children globally. The Composite Index of Anthropometric Failure (CIAF), offers a comprehensive assessment of undernutrition, aggregating various anthropometric indices to identify single or multiple anthropometric failures in children under five. This study aims to evaluate the prevalence of undernutrition using anthropometric measures and CIAF among urban slum children. Conducted as a cross-sectional community-based investigation in the slum areas of Sambalpur District, Odisha, India, the study employed standard procedures to measure height and weight anthropometrically. Age-sex-specific Z-score values for weight-for-age, height-for-age, and weight-for-height were calculated. A Z-score below -2.00 for any anthropometric index was indicative of undernourishment. The prevalence of undernutrition was determined using the standard CIAF classification. The study found an overall prevalence of wasting, underweight, stunting, and CIAF at 22.4%, 34.7%, 40.7%, and 58%, respectively. Sex-specific prevalence rates for wasting (23.9% vs. 20.9%), underweight (37.3% vs. 32.2%), stunting (39.9% vs. 41.5%), and CIAF (60.1% vs. 56%) exhibited statistically non-significant differences between boys and girls ($p > 0.05$). Notably, the investigation highlighted the CIAF's utility as it revealed a higher magnitude of undernutrition compared to conventional anthropometric measures.

1. Introduction

Undernutrition among children under the age of five remains a critical public health issue worldwide, contributing to significant morbidity and mortality rates, particularly in low- and middle-income countries (LMICs) (Black et al., 2013). Despite progress in reducing undernutrition in recent decades, millions of children still suffer from stunting, wasting, and underweight, leading to long-term consequences on health and development (UNICEF, 2021). Effective assessment and monitoring of undernutrition are essential for guiding targeted interventions and achieving sustainable improvements in child health outcomes.

Anthropometric measurements, including height-for-age (stunting), weight-for-height (wasting), and weight-for-age (underweight), are widely used indicators to assess nutritional status among children (WHO, 2006). However, relying on individual anthropometric indices alone may overlook the complex nature of undernutrition and fail to capture its multifaceted dimensions. To address this limitation, the Composite Index of Anthropometric Failure (CIAF) has emerged as a comprehensive measure that combines multiple anthropometric indicators into a single index, providing a more holistic assessment of undernutrition among children (Ghattargi et al., 2018).

2. Objectives

1. To estimate the prevalence of undernutrition among under five children.
2. The objective of the present research is to determine the total anthropometric failure by use of CIAF.

3. Material and Methods

The present study was a cross-sectional study conducted in twenty urban slums of Sambalpur

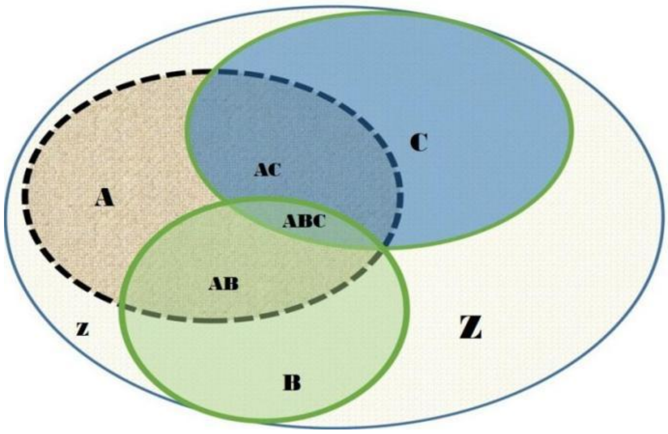
District, Western Odisha, India. The study was carried out from 2022 to 2023. A total of 550 children aged 6 months to 5 years (268 boys and 282 girls) were assessed. Data was collected after obtaining necessary approval from District Social Welfare Officer. Parents were informed about objectives of the present study and their consent was obtained. Information on age, gender, weight and height was collected on a structured pre-tested schedule cum questionnaire by house to house visit. Anthropometric measurements such as height and weight were taken for the calculation of the Composite Index of Anthropometric Failure (CIAF) of the study population. Table-1 represents the classification of children with anthropometric failure (CIAF). UsingWHO growth charts, Weight-for-Age, Height-for-Age and Weight-for-Height were determined for each child and were used to calculate Composite Index of Anthropometric Failure (CIAF). Underweight is defined as Weight for Age Z-score (WAZ) of <-2SD of the WHO (2006) standards.Wasting (acute malnutrition) is defined as a Weight for Height Z-score (WHZ) of <-2SD of the WHO (2006) reference standards. Stunting (chronic malnutrition) is defined as a Height for Age Z-score (HAZ) of < -2SD of the WHO (2006) reference standards. The data was entered in Microsoft Excel. Data analysis was done using SPSS software version 23.0. Association between two categorical variables was analyzed by using odds ratio along with 95% confidence interval (CI). P value < 0.05 was considered to be statistically significant.

Table 1: Classification and interpretation of the CIAF (Composite Index of Anthropometric Failure) categories.

Group	Description	Wasting	Stunting	Underweight
A	No failure	No	No	No
B	Wasting only	Yes	No	No
C	Wasting and underweight	Yes	No	Yes
D	Wasting, Stunting and underweight	Yes	Yes	Yes
E	Stunting and underweight	No	Yes	Yes
F	Stunting only	No	Yes	No
Y	Underweight only	No	No	Yes

Source: Nandy et al. (2005).

Venn diagram



Z=No Anthropometric Failure, A=Underweight, B=Stunted, C=Wasted

AB=Underweight & Stunted, AC=Underweight & Wasted,

ABC=Underweight, Stunted & Wasted

Figure1: Subgroups of undernourished Children

In Figure 1, a Venn diagram delineates the subgroups of undernourished children. Within the diagram, the symbols A, B, and C respectively represent children classified as underweight, stunted, and wasted. The intersections AB, AC, and ABC signify specific combinations of these conditions. AB denotes children concurrently classified as underweight and stunted, AC represents those categorized as underweight and wasted, while ABC encompasses children who are underweight, stunted, and wasted.

4. Result and discussion

Table 2: Prevalence of under nutrition based on the CIAF among under five children according to sex.

CIAF Group	Interpretation	Boys N=268	%	Girls N=282	%	Total N=550	%	
A	No failure	107	39.9	124	44.0	231	42	$\chi2$=5.73 P =0.455
B	Wasting only	8	3.0	9	3.2	17	3.1	
C	Wasting & underweight	41	15.3	26	9.2	67	12.2	
D	Wasting, Stunting & underweight	19	7.1	20	7.1	39	7.1	
E	Stunting & underweight	40	14.9	38	13.5	78	14.2	
F	Stunting only	48	17.9	60	21.3	108	19.6	
Y	Underweight only	5	1.9	5	1.8	10	1.8	
	CIAF	161	60.1	158	56	319	58	

According to CIAF, 58% of children have anthropometric failure. Among those children with wasting only, wasting & underweight, wasting-stunting & underweight, stunting only and underweight alone (group B, C, D, E, F and Y) were 3.1%, 12.2%, 7.1%, 14.2%, 19.6% and 1.8% respectively. The gender specific prevalence group B, C, D, E, F and Y among boys were 3%. 15.3%, 7.1%, 14.9%, 17.9% and 1.9% respectively and 3.2%, 9.2%, 7.1%, 13.5%, 21.3% and 1.8% were in girls respectively. The association between gender and CIAF group was not statistically significant.

Similar findings was observed by **Kauti K B et al (2022)**, where they reported that except for group F, the prevalence of groups Y, E, B, C and D among total school-going children is 5.88%, 4.71%, 7.06%, 28.24% and 16.47% respectively. The sex-specific prevalence of group Y, E, B, C and D among boys are 2.13%, 2.13%, 8.51%, 29.79% and 14.89% respectively; and girls are 10.53%, 7.89%, 5.26%, 26.32% and 18.42% respectively. The association between sex and categories of CIAF was not significant, which is similar to the finding of our study.

Table 3: Prevalence of under nutrition based on the CIAF among under five children according to age.

CIAF Group	Interpretation	6M-1Y	1Y-2Y	2Y-3Y	3Y-4Y	4Y-5Y	Total	%	
A	No failure	24(37.5)	37(34)	37(35.9)	50(39.1)	84(56.4)	231	42	$\chi2$=63.39 P =.000*
B	Wasting only	2(3.1)	3(2.8)	4(3.9)	2(1.6)	6(4)	17	3.1	
C	Wasting & underweight	4(6.3)	9(8.5)	11(10.7)	25(19.5)	18(12.1)	67	12.2	

D	Wasting, Stunting & underweight	1(1.6)	8(7.5)	7(6.8)	11(8.6)	12(26.2)	39	7.1	
E	Stunting & underweight	8(12.5)	15(14.2)	26(25.2)	19(14.8)	10(6.7)	78	14.2	
F	Stunting only	24(37.5)	31(29.2)	17(16.5)	19(14.8)	16(10.7)	108	19.6	
Y	Underweight only	1(1.6)	3(2.8)	1(1)	2(1.6)	3(2)	10	1.8	
	CIAF	40(62.5)	69(65.1)	66(64.1)	78(60.9)	65(43.6)	319	58	

Table 3 represents the proportions of children in each of the subgroups. Out of each CIAF subgroups (B-Y) with undernourished children, group F children who had stunting only was highest (19.6%). children who are only underweight (Group Y), wasting only (Group B) and wasting, stunting & underweight (Group D) showed lower prevalence i. e was 1.8%, 3.1% and 7.1% respectively. Children who were wasting and underweight (Group C) accounted for 12.2 and children who were stunting and underweight (Group E) accounted for 14.2%. Thus CIAF showed a higher prevalence of under-nutrition (58%) i.e. children suffering from anthropometric failure, in comparison to other three conventional indicators (stunting, underweight & wasting). The association between age and CIAF group was statistically highly significant. Similar findings was observed by **Goswami M (2016),** the CIAF prevalence of under-nutrition was 54.4%. Children who had wasting, stunting & underweight was the highest (16.2%). children who are wested only, stunted only & underweight only all were equal i.e 5.1% showed lower prevalence. Children who were stunted & underweight (15.4%) and wasting & underweight (7.4%).

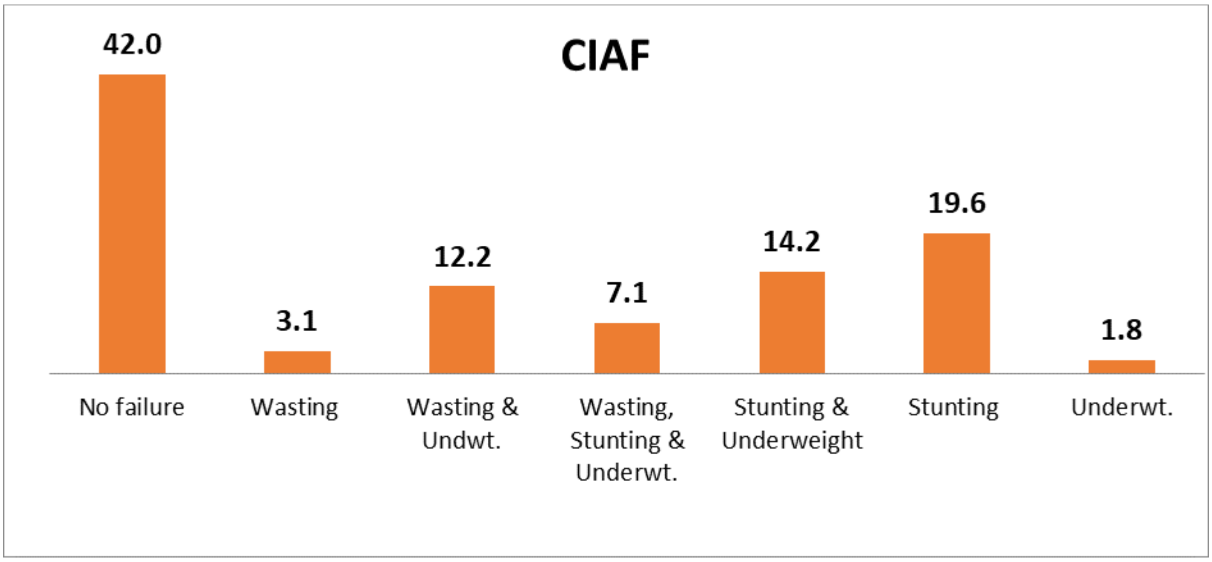


Figure 2: Composite index of anthropometric failure

In the figure No.2, among children under five years, a total of 319 cases of Child Acute Malnutrition (CIAF) were identified, constituting 58% of the total. The most common form of CIAF observed was stunting only, accounting for 19.6% of cases. Stunting and underweight together represented 14.2% of cases, while wasting, stunting, and underweight collectively accounted for 7.1%. Additionally, wasting only and wasting with underweight constituted 3.1% and 12.2% of cases, respectively. Only a small proportion, 1.8%, of cases were identified as underweight only.

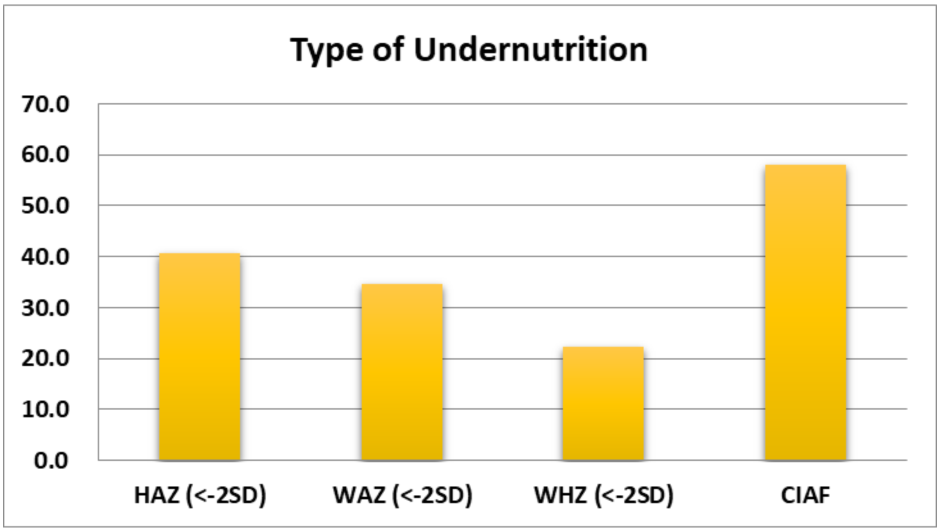


Figure 3:Prevalence of undernutrition in under five children according to various anthropometric indicators.

About 58% children were diagnosed with under-nutrition according to CIAF whereas standard anthropometric indices such as HAZ, WAZ and WHZ prevalence of malnutrition was found to be lower, that is 40.7% (stunting), 34.7% (underweight) and 22.4% (wasting) respectively. Therefore, it is clear that higher magnitude of undernutrition using CIAF over conventional anthropometric indices hence CIAF is better indicator that reflects higher magnitude of undernourishment as compared to any standard anthropometric indices in children.

Table 4**:** The Association between socio-demographic factors and anthropometric failure of children (N=550).

Variable	**Anthropometric Failure**			**Chi Square**	**p value**
	No (%)	**Yes (%)**	**Total (%)**		
Age					
6M-1Y	24(37.5)	40(62.5)	64(11.6)	17.999	0.001*
1Y-2Y	36(34)	70(66)	106(19.3)		
2Y-3Y	37(35.9)	66(64.1)	103(18.7)		
3Y-4Y	50(39.1)	78(60.9)	128(23.3)		
4Y-5Y	84(56.4)	65(43.6)	149(27.1)		
Gender					
Boys	107(39.9)	161(60.1)	268(48.7)	0.924	0.337
Girls	124(44)	158(56)	282(51.3)		
Type of Family					
Nuclear	108(38.3)	174(61.7)	282(51.3)	3.256	0.043*
Extended	123(45.9)	145(54.1)	268(48.7)		
Family Size					
< 4 member	29(40.8)	42(59.2)	71(12.9)	1.67	0.434
4-6 member	161(43.8)	207(56.3)	368(66.9)		
> 6 member	41(36.9)	70(63.1)	111(20.2)		
Religion					
Christian	8(40)	12(60)	20(3.6)	0.034	0.854

Variable	**Anthropometric Failure**			**Chi Square**	**p value**
	No (%)	**Yes (%)**	**Total (%)**		
Hindu	223(42.1)	307(57.9)	530(96.4)		
Father's Education					
Illiterate	30(41.7)	42(58.3)	72(13.1)	5.2	0.074
Upto High School	154(39.6)	235(60.4)	389(70.7)		
> High School	47(52.8)	42(47.2)	89(16.2)		
Mother's Education					
Illiterate	37(37)	63(63)	100(18.2)	8.464	0.015*
Up to High School	143(39.9)	215(60.1)	358(65.1)		
> High School	51(41)	41(44.6)	92(16.7)		
Father's Occupation					
Unemployed & Unskilled	130(39.8)	197(60.2)	327(59.5)	1.668	0.197
Skilled & Professional	101(45.3)	122(54.7)	223(40.5)		
Mother's Occupation					
Unemployed & Unskilled	223(41.9)	309(58.1)	532(96.7)	0.046	0.831
Skilled & Professional	8(44.4	10(55.6)	18(3.3)		
Socio-economic Status					
Lower	6(36.2)	7(53.8)	13(2.4)	13.052	0.005*
Upper Lower	143(38.6)	227(61.4)	370(67.3)		
Lower Middle	57(43.5)	74(56.5)	131(23.8)		
Upper Middle	25(69.4)	11(30.6)	36(6.5)		

*Significant at 5% level.

Table No.4 depicts the association between various socio-demographic factors and anthropometric failure among children. Across different age groups, a significant association was found ($\chi^2 = 17.999$, $p = 0.001$), indicating that age played a crucial role in determining anthropometric failure. Notably, children aged 4 years to 5 years had the lowest prevalence of anthropometric failure compared to other age brackets. Gender did not show a significant association with anthropometric failure ($\chi^2 = 0.924$, $p = 0.337$). However, type of family exhibited a statistically significant association ($\chi^2 = 3.256$, $p = 0.043$), with nuclear families demonstrating a higher prevalence of anthropometric failure compared to extended families. Family size, religion, father's education, father's occupation, mother's occupation, and socio-economic status did not show significant associations with anthropometric failure. Conversely, mother's education displayed a significant association ($\chi^2 = 8.464$, $p = 0.015$), with children of mothers educated up to high school exhibiting a higher prevalence of anthropometric failure. Moreover, socio-economic status also exhibited a significant association ($\chi^2 = 13.052$, $p = 0.005$), with children from the upper middle socio-economic status showing a higher prevalence of anthropometric failure. Factors like age, type of family, mother's education, and socio-economic status were significantly associated with anthropometric failure, other socio-demographic factors such as gender, family size, religion, and parental occupation did not show significant associations.

Table No. 5: Univariate analysis of certain risk factors for anthropometric failure (CIAF).

Risk Factor	**CIAF**		**χ2**	**P value**	**Odd ratio**	**95% CI**
	No(%)	**Yes**				

Risk Factor	**CIAF**		**χ2**	**P value**	**Odd ratio**	**95% CI**
	No(%)	**Yes**				
Mother's age at pregnancy						
≤30 Year	99(39.8)	150(60.2)	0.146	0.702	0.917	(.588-1.430)
> 30 Year	132(43.9)	169(56.1)				
Ordinal position						
1	128(46.7)	146(53.3)	4.894	0.026*	1.473	(1.048-2.070)
≥2	103(37.3)	173(62.7)				
Birth spacing between children						
≤3 Years	165(42.6)	222(57.4)	0.217	0.642	1.092	(.753-1.585)
>3 Years	66(40.5)	97(59.5)				
Colostrum feeding						
No	10(27)	27(73)	3.651	0.056	0.489	(.232-1.032)
Yes	221(43.1)	292(56.9)				
Initiation of breast feeding						
Within 1 Hour	4(28.6)	10(71.4)	1.063	0.302	0.544	(.169-1.758)
> 1 Hour	227(42.4)	309(57.6)				
Complementary feeding						
No	178(39)	278(61)	9.628	0.002*	0.495	(.316-.776)
Yes	53(56.4)	41(43.6)				
Immunization						
No	8(18.6)	35(81.4)	10.41	0.001*	0.291	(.132-.640)
Yes	223(44)	284(56)				
Sanitation facility						
No	145(42.6)	195(57.4)	0.153	0.696	1.072	(.756-1.52)
Yes	86(41)	124(59)				
Source of drinking water						
Unsatisfactory	161(38.9)	253(61.1)	6.652	0.01*	0.6	(.406-.886)
Satisfactory	70(51.5)	66(48.5)				
Worms infestation						
No	75(45.2)	91(54.8)	0.987	0.32	1.205	(.834-1.739)
Yes	156(40.6)	228(59.4)				
Antenatal check-up						
No	3(37.5)	5(62.5)	0.067	0.795	0.826	(.195-3.493)
Yes	228(72.6)	315(57.9)				
Mode of delivery						
Normal	185(42.6)	249(57.4)	0.332	0.565	1.131	(.744-1.717)
Cesarean	46(39.7)	70(60.3)				
Place of delivery						
Hospital	218(42.3)	297(57.7)	0.362	0.547	1.242	(.612-2.52)
Home	13(37.1)	22(62.9)				
Disease in last 3 month						
No	84(51.2)	80(48.8)	8.154	0.004*	1.707	(1.181-2.468)
Yes	147(38.1)	239(61.9)				

*Significant at 5% level.

The table presents the results of a univariate analysis examining various risk factors for anthropometric failure (CIAF) among children. Mother's age at pregnancy, ordinal position, birth spacing between children, colostrum feeding, initiation of breastfeeding, complementary feeding, immunization status, sanitation facility, source of drinking water, worms infestation, antenatal check-up, mode of delivery, place of delivery, and disease occurrence in the last 3 months were evaluated. Among the factors analyzed, ordinal position (p = 0.026), complementary feeding (p = 0.002), immunization status (p = 0.001), source of drinking water (p = 0.01), and disease occurrence in the last 3 months (p = 0.004) showed statistically significant associations with anthropometric failure. Children with an ordinal position of 1 had higher odds of anthropometric failure compared to those with an ordinal position of ≥2 (OR = 1.473, 95% CI: 1.048-2.070). Additionally, those receiving complementary feeding (OR = 0.495, 95% CI: 0.316-0.776), immunization (OR = 0.291, 95% CI: 0.132-0.640), and from households with satisfactory drinking water sources (OR = 0.6, 95% CI: 0.406-0.886) were associated with lower odds of anthropometric failure. Conversely, children who experienced diseases in the last 3 months had higher odds of anthropometric failure (OR = 1.707, 95% CI: 1.181-2.468). Other factors did not show significant associations with anthropometric failure. Several risk factors such as ordinal position, complementary feeding, immunization status, source of drinking water, and disease occurrence were significantly associated with anthropometric failure, suggesting the importance of addressing these factors in interventions aimed at reducing childhood malnutrition.

Table 6: Multiple logistic regression models showing association between CIAF among under five slum children and various factors.

	β	P value	Exp(β)	95% Confidence Interval for Exp(β)
Types of Family				
Nuclear	-0.85	0.001	0.428	(0.256-0.713)
ExtendedR				
Family size				
<4 Members	1.348	0.003	3.848	(1.578-9.385)
4-6 Members	0.74	0.013	2.096	(1.17-3.755)
>6 MembersR				
Religion				
Christian	0.34	0.519	1.406	(0.5-3.951)
HinduR				
Educational status of father				
Illiterate	0.343	0.497	1.409	(0.524-3.784)
Up to High School	0.119	0.75	1.127	(0.54-2.35
> High SchoolR				
Occupation of father				
Unskilled	0.163	0.578	1.177	(0.662-2.092)
SkilledR				
Educational status of mother				
Illiterate	-0.792	0.049	0.453	(0.206-0.998)
Up to High School	-0.771	0.012	0.463	(0.254-0.841)
> High SchoolR				
Occupation of mother				

	β	**P value**	**Exp(β)**	**95% Confidence Interval for Exp(β)**
Unskilled	0.402	0.458	1.495	(0.517-4.32)
SkilledR				
Washing hands				
No	-0.539	0.065	0.583	(0.329-1.034)
YesR				
Monthly income				
<15000	-0.224	0.426	0.799	(0.46-1.387)
15000-20000	0.387	0.151	1.473	(0.868-2.498)
> 20000R				
Socioeconomic status				
Lower	-1.422	0.134	0.241	(0.038-1.546)
Upper lower	-1.687	0.007	0.185	(0.055-0.625)
Lower middle	-1.476	0.006	0.229	(0.08-0.653)
Upper middleR				
Age of children				
6M-1Y	-0.869	0.013	0.42	(0.211-0.832)
1Y-2Y	-0.918	0.002	0.399	(0.222-0.72)
2Y-3Y	-1.025	0.001	0.359	(0.197-0.652)
4Y-5YR				
Gender				
Boys	-0.214	0.29	0.807	(0.544-1.2)
GirlsR				
Birth spacing between children				
1Year	0.066	0.908	1.068	(0.349-3.271)
2Year	0.182	0.592	1.199	(0.617-2.331)
3Year	0.843	0.035	2.324	(1.061-5.088)
> 4 YearR				
Antenatal check-up				
No	1.123	0.238	3.073	(0.476-19.84)
YesR				
Mode of delivery				
Normal	0.649	0.067	1.913	(0.956-3.831)
CesareanR				
Place of delivery				
Home	0.877	0.122	2.403	(0.79-7.309)
HospitalR				
Immunization				
No	-1.831	0.003	0.16	(0.049-0.529)
YesR				
Mothers age at pregnancy				
<20 Years	-0.421	0.514	0.656	(0.185-2.323)
20-30 Years	-0.022	0.936	0.979	(0.576-1.662
>30 YearsR				

	β	P value	Exp(β)	95% Confidence Interval for Exp(β)
Ordinal Position				
First	-0.094	0.847	0.91	(0.35-2.369)
Second	0.239	0.665	1.27	(0.43-3.751)
OthersR				
Sanitation facility				
No	0.386	0.108	1.47	(0.919-2.352)
YesR				
Safe drinking water				
Unsatisfactory	-0.863	0.002	0.422	(0.242-0.735)
SatisfactoryR				
First feed				
Only colostrums	0.526	0.249	1.693	(0.691-4.146)
Colostrum+others	0.358	0.41	1.431	(0.61-3.357)
No ColostrumsR				
Initiation of breast feeding				
Up to 1 Hour	-2.006	0.012	0.134	(0.028-0.638)
>1-6 Hour	-0.716	0.085	0.489	(0.216-1.103)
> 6 HourR				
Worm infestation				
No	0.254	0.257	1.289	(0.831-1.997)
YesR				
Complementary feeding				
6-9 Months	-0.427	0.163	0.652	(0.357-1.19)
9-12 MonthsR				

Note: R=reference category, β=regression coefficient (log odds ratio) and Exp(β)=odds ratio.Model fit statistics: pseudo-R squares-Cox and Snell =0.175, Nagelkerke=0.235 and Mcfadden=0.141.

Among the socio-demographic factors, the type of family and family size emerged as significant predictors of CIAF. Children from nuclear families had significantly lower odds of CIAF compared to those from extended families (β = -0.85, p = 0.001). Similarly, smaller family sizes (<4 members) were associated with higher odds of CIAF compared to larger family sizes (β = 1.348, p = 0.003). Maternal education was found to be a significant predictor, with higher maternal education levels associated with lower odds of CIAF. Mothers educated up to high school or beyond had significantly lower odds of CIAF compared to illiterate mothers. Several maternal and child health practices were also significant predictors of CIAF. For instance, timely initiation of breastfeeding within 1 hour of birth was associated with substantially lower odds of CIAF (β = -2.006, p = 0.012), while the absence of colostrum feeding was associated with higher odds of CIAF, albeit not statistically significant. Environmental factors such as access to safe drinking water and socioeconomic status were significant predictors of CIAF. Children from households with satisfactory drinking water sources had lower odds of CIAF compared to those with unsatisfactory sources (β = -0.863, p = 0.002). Additionally, children from upper lower and lower middle socioeconomic status had significantly lower odds of CIAF compared to those from lower socioeconomic status. The multiple logistic regression analysis revealed several factors associated with CIAF among under-five children in slum areas, including socio-demographic characteristics, maternal and child health practices, and environmental factors. Understanding and addressing these factors are crucial for designing effective interventions to combat childhood malnutrition in slum communities.

Table 7: Prevalence of CIAF in under five children: A comparison with others studies.

Sl. No.	Study area	Sample Size	CIAF (%)	Source
	Urban area of south Delhi	1450	45	Goyal M et al 2023
1.	Urban slum of Southern India	310	39.6	Mohandas A et al 2023
2.	Nagpur, Maharashtra	460	51.49	Kherde A et al 2023
3.	India	221365	52.18	Kundu N R et al 2023
4.	Gairo District, Tanzania	300	57.3	Mohamed MT & Nyaruhucha NC 2023
5.	Nigeria	10,962	41.3	Amusa BL et al 2023
6.	Urbanized Village Delhi	260	69.2	Singh N & Tiwari P 2022
7.	Ethiopia	30,791	61.38	Fenta MH et al 2022
8.	Bagor District, Indonesia	330	42.1	Permatasari EAT & Chadirin Y 2022
9.	Pakistan	3071	52.2	Balogum SO et al 2021
10.	India	38060	48.2	Porwal A et al 2021
11.	India	259627	55.32	Kochupurackal US et al 2021
12.	Slum of Kolkata, W.B	97	41.2	Lahiri S & Lahari K S 2020
13.	Urban slum of Raipur City, Chhatisgarh	602	62.1	Boregowda G S et al 2019
14.	Lakhimpur, Assam	362	48.6	Bharali N et al 2019
15.	Urban slum, Vishakhapatnam, A.P	100	56	Namburi & Seema 2018
16.	Urban slum of Bandra Mumbai, Maharastra	400	58	Akhade KS 2018
17.	Sagar Block, West Bengal	656	61.3	Biswas S et al 2018
18.	Delhi	100	62	Gupta G et al 2017
19.	Northern Odisha	136	54.4	Goswami M 2016
20.	Slum of Kolkata	91	47.25	Sarkar I et al 2015
21.	Agra city, Uttar Pradesh	458	60	Agrwal et al 2015
22.	Urban slums of Sambalpur District, Odisha	550	58	Present study

5. Conclusion

Undernutrition is an important public health problem in India. The prevalence of under nutrition as per CIAF in the urban slum of Sambalpur District Odisha is noted to be 58% and associated with age of children, type & size of family, educational status of mothers, socioeconomic status, immunization and safe drinking water. Improving all above factors will aid in enhancing children's nutritional status. Composite Index of Anthropometric Failure (CIAF) provides a single, aggregated assessment of under nutrition in the communitywhich would otherwise be underestimated if conventional indices were solely relied upon. The use of this tool by field-level workers like ASHA & Anganwadi workers under supportive supervision of Auxiliary nurse midwives will improve the diagnosis of under nutrition and help in the early initiation of treatment. The health experts and policy makers can more effectively quantify the burden of undernutrition at national level by using the CIAF as a tool.

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