ORIGINAL ARTICLE

USE OF DIFFERENT ANTHROPOMETRIC TOOLS IN GENDER ANALYSIS OF MALNUTRITION IN DIVISION BAHAWALPUR

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Background: Previous studies highlighted that CIAF is the better tool for malnutrition assessment which screen more children compared to other anthropometric approaches like MUAC, BMI for age, and conventional indices (Stunting, Wasting and Underweight). In the literature, none of the studies has mentioned CIAF performance by gender in comparison with other anthropometric approaches. The study solves this puzzle, of whether CIAF has the same performance in gender analysis too or not. Data from 1152 homes were gathered using a purposive random sample approach. The CIAF detects more malnourished children (63%) compared to other methods. Results show that male children in the study region had a greater frequency of malnutrition than female children. The results of the chi-square showed that the age and gender of the child have a significant relationship with CIAF than other approaches. The CIAF is a superior instrument for assessing child malnutritional status since it detects more malnourished children even with gender analysis.

Keywords: Malnourishment; Gender Analysis; BMI, CIAF; MUAC

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INTRODUCTION

Worldwide, 30 per cent - 170 million- of children below five years of age are stunted, and 19 per cent - 110 million- are severely underweight.[1] Asia is home to almost two-thirds of malnourished children.[2,3] The Pakistan Demographic and Health Survey (PDHS) of 2017–18 stated that, in Pakistan 38% of children are underdeveloped, 23% are underweight, and 8% are withering away. Conventional anthropometric measures including underweight; wasted; and stunted have been widely used for assessing children's nutritious status. These indicators, according to the WHO, represent distinctive biological processes: underweight is a combination of chronic and acute malnutrition with no difference, wasting is acute malnutrition, and stunting is chronic malnutrition.[4] These three categories represent various aspects of malnutrition, yet they frequently coexist and are not mutually exclusive.[5] Thus, it has been claimed that standard indicators are insufficient for determining the occurrence of malnutrition amongst young children. A new set of indicators was suggested to be developed to address this deficiency.[6,7]

Svedberg[8] suggested the CIAF, which provides separate statistics in a populace for the overall assessment of malnourished children, and, further particularly, its numerous subcategories of anthropometric deficiencies can predict the risk of illness and fatality. These characteristics set it apart from other contemporary signs, which are difficult to assess individually with higher accuracy.[9,10] Even though the CIAF was thought to be a useful composite measure, it ignores the individual commitment, the importance of being underweight, overweight, as well as wasting relative to the overall prevalence of malnutrition. Adolphe Quetelet developed the BMI, a quick method for estimating an adult's nutritional state, in the 19th century. Researchers thought that BMI was a decent proxy for issues with adiposity and being overweight in the 1970s.[11] Catch-up development might help identify which children are more likely to catch up and which are more likely to fall farther behind or remain there. A new measurement instrument called the MUAC tape was made available, and in May 2009, the WHO and UNICEF released a mutual declaration defining WHO development guidelines to diagnose severe malnourishment in infants and children.[11,12]

The various anthropometric measuring techniques have been evaluated and debated in several research comparisons. The majority of them examine whether using conventional indices or the CIAF is a more effective strategy for identifying malnourished children; however, only a small number of studies have compared using

more than two anthropometric measurement instruments to identify malnourished children. To the best of the current inquiry's knowledge, no similar study from Pakistan has assessed the instruments for detecting malnutrition or made a comparison of the prevalence of malnutrition using various methods. Furthermore, gender analysis for comparing the incidence of malnutrition using various methodologies has not yet been studied in Pakistan. Therefore, the current study examines not only the findings of several anthropometric screening methods for malnourishment amongst children in one of Punjab's disadvantaged and high- malnourishment occurrence locations but also the results according to the gender of the child. Additionally, current investigation discovers the correlation between children's age and gender and their malnutrition status as determined by various methods.

MATERIAL AND METHODS

One of the poorest parts of Punjab, Pakistan, is Division Bahawalpur, where around 50 per cent of residents lack access to adequate sanitation.[13] Additionally, it is one of Punjab province's top incidence divisions for malnutrition (MICS-2014). Nearly 77 per cent of women in one district in the division of Bahawalpur lack literacy, 91 per cent of households lack access to necessities, and roughly 58 per cent of families earn less than fifty thousand Rupees annually, while 26 per cent of families make less than a hundred thousand Rupees annually.[14–16]

The basic data for this study was obtained from families in rural parts of the administrative division of Bahawalpur using a self-administered survey and a proportional purposive simple random selection approach. A proportionate amount of the sample was distributed among the districts of Rahimyar Khan, Bahawalpur, and Bahawalnagar) and further to 14 tehsils and 42 union councils.

Because of time and financial restrictions, we only carefully chose three rural UCs among every tehsil. In all selected districts of the Bahawalpur division, the sample design was constructed based on the probability proportionate to size. All of the division's rural homes made up the sample frame. With the help of the lady health worker registry record, random rural houses for the survey were selected. If many families or joint families are living in a single home, the poll n= total size of sample deemed them nuclear if they prepare their own meals. Female health professionals performed the anthropometric measurements because they had the necessary training before being given the responsibility of taking anthropometric measures.

Between November 2020 and April 2021, six months of data collection were placed in the research region. To get their unwritten agreement and desire to take part in the survey, lady health workers (LHWs) told women and their immediate relatives about it two days before data collection in the local languages, i.e., Punjabi and Saraiki. Mothers gave their unwritten agreement during the pre-interview meeting, and all mothers from the 1152 families consented to participate freely in the study.

Since the majority of the moms lacked formal education and were hesitant because of cultural norms, a written agreement was not requested. The final sample size for each district was 384 homes, with a 95% confidence level and a 5% confidence interval. In division Bahawalpur, the 384-sample size was maintained uniformly for each district. Thus, 1152 responses made up the whole sample size for the three districts.

The following provides more information on sample size calculation:

The sample size is equal to Z 2 (p) (1-p) / c 2. In this case, Z Equals Z value (1.96, at a 95% confidence level).

p is the decimal representation of the proportion of choices made (.5 applied for the required size of sample)

Confidence interval c is given in decimal form (e.g.,.04 = 4).

Size of sample = (1.96) 2 × (0.5) × (1-0.5) / (0.05) 2 = 384.16 = 384

The total sample for the District of Bahawalpur is 1152 (District Rahim Yar Khan 384, District of Bahawalpur 384, and District of Bahawalnagar 384).

The explanation about the proportional division of each district n=384 in tehsils to Union Councils is mentioned in Table 1:

NI= n × Ni/N

The formula for each UC sample calculation = Population of UC 1, 2, 3/total Population of 3 unions councils × sample size of tehsil

NI= Number of sampled participants in each union council

The number of UCs in the area of research, i.e., 1, 2, 3…., 42

Table-1: Districts sample distribution

Division /Region	Districts	Tehsils	Union Council No	Proportionate Sample/HH
Bahawalpur	1. District Rahimyar Khan	Khanpur Sample=96	1st uc	26
			2nd uc	34
			3rd uc	36
		Liaquatpur Sample=81	4th uc	25
			5th uc	26
			6th uc	30
		Rahimyar Khan Sample=115	7th uc	34
			8th uc	46
			9th uc	35
		Sadiqabad Sample=92	10th uc	33
			11th uc	32
			12th uc	27
	2. District Bahawalpur	Bahawalpur Sample=111	13th uc	29
			14th uc	39
			15th uc	43
		Hasilpur Sample=65	16th uc	27
			17th uc	11
			18th uc	27
		Khairpur Tamewali Sample=54	19th uc	18
			20th uc	23
			21ist uc	13
		Yazman Sample=77	22nd uc	10
			23rd uc	41
			24th uc	26
		Ahmad Pur East Sample=77	25th uc	36
			26th uc	20
			27th uc	21
	3. District Bahawalnagar	Bahawalnagar Sample=100	28th uc	37
			29th uc	48
			30th uc	15
		Chishtian Sample=92	31st uc	20
			32nd uc	54
			33rd uc	14
		Fort Abbas Sample=54	34th uc	7
			35th uc	23
			36th uc	26
		Haroonabad Sample=73	37th uc	55
			38th uc	12
			39th uc	7
		Minchinabad Sample=65	40th uc	10
			41st uc	27
			42nd uc	29
	Districts=3	**Tehsils=14**	**Total UCs=42**	**HH=1152**

The Departmental Doctoral Program Coordination Committee (DDPCC) of the University of the Punjab, Lahore authorized the research on 22 March 2022. The study's instruments and methods were also examined and approved by the Institute of Social & Cultural Studies (ISCS). Before obtaining the data, health officials, mothers, and LHWs were informed of all the study's specifics.

Stunting was defined as having a Z-Score below minus 2 SD of Height-For-Age, wasting is having a Z-Score below minus 2 SD of Weight-For-Height, and underweight is having a Z-Score below minus 2 SD of Weight-For-Age. The CIAF observes that malnutrition among children is a widespread problem. Children are divided into 7 groups based on this classification: group A is designated as "no failure"; B shows "only stunting"; C shows "only wasting"; D shows "only underweight"; E shows "stunting and underweight"; F shows "wasting and underweight"; G shows "stunting and wasting"; and finally, H shows "stunting, wasting and underweight".

The overall prevalence of undernourishment is assessed by merging all clusters' eliminating A. CIAF was dichotomized, "1" for the malnourished kid and "0" for the not malnourished kid. The CIAF is displayed under 3 indexes for example stunted, wasted, and underweight which are indicated by the World Health Organization' kids growth criteria guidelines via anthropometric methods.[11] Study measured Z-Scores of BMI-for-ages, if it is less than minus 2 standard deviations then known as malnutrition. Likewise, MUAC tape shows that if red color: is 0-11.5 cm called SAM; if yellow color: is 11.5-12.5 cm called MAM; so, if green color: is greater than or equal to 12.5 cm called normal child. This means MUAC less than 12.5 cm shows

undernourishment and further, MUAC greater than and equal to 12.5 cm shows the child is not malnourished.[11,12]

The collected data was cleaned and outliers were identified before the anthropometric indicators were created. While estimating the CIAF, Z-scores from the data set that did not match the WHO flags were removed. Data entry was done using Excel 2013; analysis was done using the STATA statistical software 15 version, Excel version 2013, and the WHO software Anthro. Different anthropometric methodologies were applied to conclude and then liken the rates of malnourishment via descriptive statistics. The chi-square analysis was also employed to measure the influence of children's age and gender dynamics on nutritional status.

RESULTS

The nutritious status of 1551 below-5 children was the subject of the current investigation. 55.32% of the total number of kids were boys and 44.68% were girls. Following the anthropometric evaluation, it is crucial to first examine the distribution of survey data. Furthermore, within the distribution of data, z-scores in between -1 and >-2 show normal category, z-scores in between -2 and >-3 show moderate malnutrition, and z-scores between -3 and >-5 or -6 indicate severe malnourishment. The WHO does not take z-scores over -6 into consideration. Despite a simply exact and restricted sign of wasting and BMI-for-age, Figures 1 indicate that inadequacies in HAZ (stunting) and WAZ (underweight) occur.

Figure 2 shows the distribution of data by children age group. It shows that most of the children belongs 12 to 59 months' age group.

Figure 3 shows the MUAC-for-age z-score development curves by the child's gender. For 59 months of age, both boy and girl cases' MUAC-for-age z-score values were within 1 mm of WHO 2006 growth guidelines in either direction for z-scores -3 to +2, and 3 mm [male child] / 2 mm [female child] at z-scores +3. Children followed along similar lines between 12 and 23 months old for both genders. After this point (12–23 months), however, boys continued to develop more quickly than girls. Z-scores -2 and -3 in figure 3 show moderate and severe undernutrition, respectively.

Figure 4's gender analysis findings show that in the research region, male children had a greater frequency of malnutrition than female children. Additionally, CIAF identified more malnourished children than other methods.

Table 2 displays the frequencies and percentages of malnourishment occurrence through different methodologies of outcome amongst children of preschool in the region of Rahimyar Khan.

The findings in Figure 5 demonstrate the numerous anthropometric inadequacies among children by gender in the subcategories of the CIAF grouping. The findings exhibited that among male children, stunting and underweight rates are respectively 20.63 per cent and 21.68 per cent. While CIAF categories were used to test female children for 27.27 per cent stunting and 21.21 per cent underweight.

Figure 5: Total prevalence of malnourishment (numerous anthropometric failures) displayed by the Subcategories of CIAF grouping by gender.

This study examined the relationship between indicators of child health and the kid's age and gender. To rule out any possible associations between age and sex and a child's nutritional condition, the influence of age and gender on undernutrition was examined in this study. The findings of the chi-square test showed that, in contrast to other techniques like the BMI-for-age, MUAC, and the traditional indices such as stunted, wasted, and underweight, age and gender of the child had a significant association with CIAF.

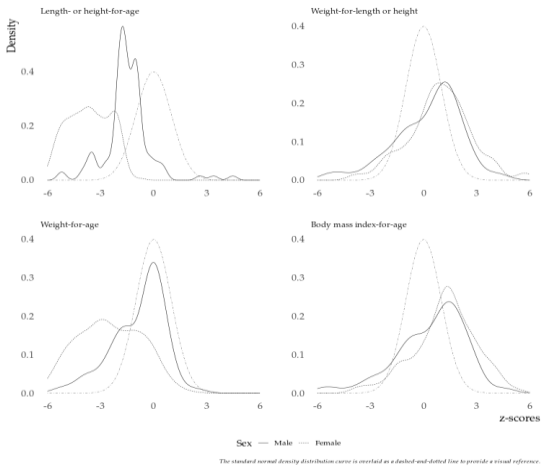

Figure-1: Current investigation sample distribution of Z-Scores (Source: Authors)

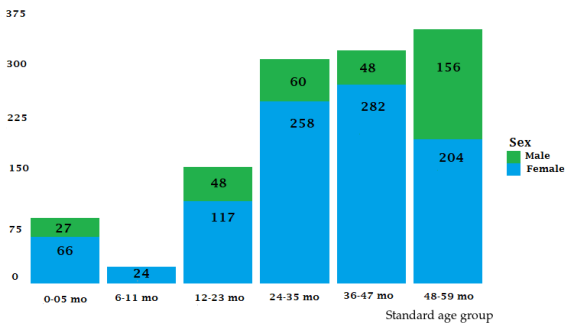

Figure-2: Distribution of data by children's age group

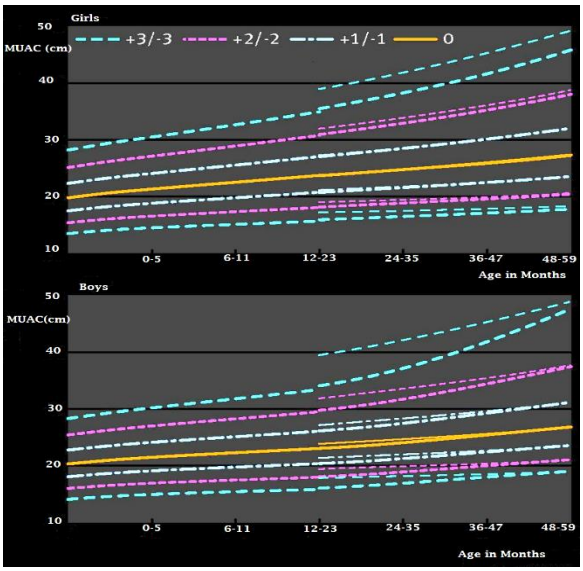

Figure-3: MUAC reference curves for girls and boys aged 0 to 5 years.

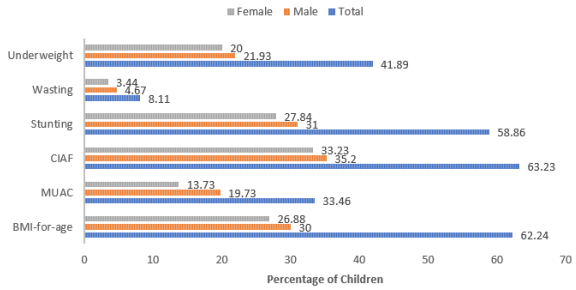

Figure-4: Malnutrition prevalence among children by different approaches, dis-aggregation by gender

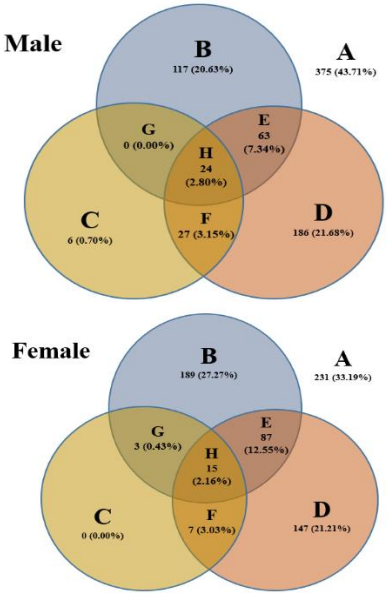

Figure-5: ……..

A: No failure. B: Stunted only. C: Wasted only. D: Underweight only. E: Stunted+Underweight. F: Wasted+Underweight. G: Stunted+Wasted. H: Stunted+Wasted+Underweight

Table-2: Prevalence of Malnourishment (Frequencies and percentages) amongst children by gender

Symptoms	Frequencies and Percentages	
	Male	Female
BMI-for-age	279 (30%)	417 (26.88%)
MUAC	306 (19.73%)	213 (13.73%)
CIAF	546 (35.20%)	309 (33.23)
Stunting	294 (31%)	264 (27.84%)
Underweight	300 (21.93%)	273 (20%)
Wasting	57 (4.67%)	42 (3.44%)

Table-3: Link between different indicators of anthropometric with age and gender of child

Explanatory variables	CIAF Chi-square value & *p*-value	MUAC Chi-square value & *p*-value	CBMI-for-age Chi-square value & *p*-value	Conventional Indices		
				Stunting Chi-square value & *p*-value	Underweight Chi-square value & *p*-value	Wasting Chi-square value & *p*-value
Age in Months	37.6 [0.000***]	113.26 [0.000***]	83.056 [0.000***]	39.81 [0.000***]	58.73 [0.000***]	18.27 [0.195]
Child gender	9.68 [0.008***]	3.60 [0.165]	0.69 [0.87]	1.63 [0.20]	0.06 [0.795]	0.179 [0.67]

Note: *p*-values are established on chi-square analysis. Level of significance: ****p*<0.01, ***p*<0.05, **p*<0.1

DISCUSSION

Preschool-age children in the area of rural Southern Punjab, Pakistan were assessed to be malnourished by conventional indices like HAZ, WAZ, WHZ, CIAF, BMI-for-age, and MUAC. Results for all children indicated that the CIAF method detected 63.23 per cent, MUAC identified 33.46 per cent, and BMI-for-age identified 62.24 per cent; traditional indices revealed stunting at 58.86 per cent, wasting at 8.11 per cent, and underweight at 41.89 per cent. Compared to other methods, including traditional indices, CIAF examined a greater number of malnourished children.

The findings of the gender analysis also show that male children in the study region had a greater frequency of malnutrition than female children. Additionally, CIAF screened more malnourished children than other methods, regardless of gender. Our findings and those of research carried out in the Middle East and Africa appear to be reliable. Malnutrition was compared in a rural Nigerian community using CIAF and traditional markers. The conventional indicators were as follows: underweight at 23.2%, 14.1%

wasting, and 33.1 per cent stunting. On the other hand, the CIAF found more malnourished kids with several failures (a total of 47.5 per cent).[17] Research in rural Yemen evaluated the nutritious status of kids using the CIAF and regular indices and found that the CIAF identified additional undernourished kids (70.1 per cent) than regular indices, which had prevalence rates of stunting, wasting, and underweight of 38.5%, 39.9%, and 55.1%.[18]

When we compare our results to local research, we discover that in Bangladesh and India, CIAF detected more undernourished kids than could be determined by traditional indices like BMI and MUAC. With 43.1%, 35.2%, and 31.5% for stunting, underweight, and wasting, research in areas of rural Varanasi, India, found that CIAF testified 62.5 per cent of undernourished kids as likened to traditional indices.[19] Additionally, research in Karnataka showed that 58.4 per cent of the children were concurrently tested using the CIAF method for wasting, underweight, and stunting, which is greater than the corresponding percentages using traditional indices and the MUAC, which was only 19.3 per cent.[20] According to different research conducted in Haryana, CIAF detected 45.25 per cent more malnourished children than did traditional indices (13.8 per cent wasting, 31.2 per cent stunting, and 21.4 per cent underweight).[21] Similar to this, studies in West of Bengal revealed that extra kids (32.7 per cent) had been informed to be undernourished by CIAF, compared to 15 per cent of stunting, underweight, and 17.7 per cent wasting through traditional methods.[22]

Additional investigation in the area of West Bengal found that CIAF (61.6 per cent) had a higher prevalence of malnutrition than MUAC (15.3 per cent), BMI (13.4 per cent), and traditional indices of stunting (51.9 per cent), underweight (49.2 per cent), and wasting (19 per cent). Once more, studies in West Bengal revealed that the CIAF was 36.1%, but that the incidence of stunting, wasting, and being underweight was 4.9 per cent, 2.1 per cent, and 2.8 per cent, correspondingly.[24] After that, an investigation done in Kolkata found that the anthropometry method discovered higher levels of undernutrition in kids mal five (29 per cent stunting, 30.5 per cent underweight, and 28.8 per cent wasting) than those found by the MUAC (20.3 per cent) and BMI (28.8 per cent).[25]

Additionally, research in Gujarat brings into being that the prevalence of malnutrition as assessed by the CIAF was 73.4 per cent, compared to 50 per cent for underweight as measured by traditional indices.[26] According to research conducted in Chhattisgarh's slum regions, 62.1 per cent of children were found to be malnourished using the CIAF tool, compared to 45.2 per cent, 46.6 per cent, and 17.8 per cent of children who were revealed to be underweight, stunted, and wasted using traditional screening techniques.[27] Another study found that the Muslim populace in Western Bengal, India, had a high prevalence of malnutrition through MUAC (91.28 per cent in boy kids and 88.55 per cent in girl kids), likened to the anthropometric method as assessed by stunting (39.74 percent in boy kids and 41.49 percent in girl kids) and wasting (19.55 percent in boy kids and 15.74 percent in girl kids).[28]

In a different study, the nutritional outcomes in Delhi, India were compared using the CIAF, MUAC, and traditional indices. It was noted that the CIAF identified 60.5 per cent of children who were malnourished, which is greater than the traditional indices of stunting at 44.5 per cent, underweight at 35.4 per cent, wasting at 26.4 per cent, and malnutrition detected by the MUAC at 23.7 per cent of children.[29]

The findings of the chi-square test showed that in contrast to other measures like the MUAC, BMI, and traditional indices like stunting, wasting, and underweight, the age and gender of the kid had a momentous link with CIAF. According to several studies, parents typically favour their sons over their daughters when it comes to food and nutrition. Because of this gender discrimination at home, girls are more expected to be underweight as compared to boys.[30–32] While some studies claimed that because of the poor socioeconomic status of the household, male children experience higher levels of malnutrition than their female counterparts.[33–35] Nutrition and gender are hard components of the poverty spiral. Sex prejudice, gender preferences, and discrimination are the most prevalent issues in impoverished homes in developing nations. Better treatment of males than female offspring is one of the harmful values prevalent in impoverished homes.[36] In poor countries, men are preferred since they will provide the family with revenue while daughters will be a burden.[36] This parental preference belief leads to discrimination in food and health every time. Inequity in food distribution is also present in underprivileged households where women initially provide food for their husbands and boys before providing it to their daughters, and occasionally inadequate and food of low quality is left for the girls.[37] In Pakistan, poverty is more prevalent in both deprived urban and rural regions, and girls and women suffer worse nutritional outcomes and health outcomes.[38] A study from Pakistan also depicted that CIAF is a better tool which screens more malnutrition children with multiple disorders compared to other approaches I.e., conventional indices (stunting, wasting, and underweight), MUAC, and BMI-for-age.[39]

CIAF encompassed all clusters of undernourished kids[19]: underweight and wasted; underweight and

stunted; stunted wasted and underweight; stunted and wasted. Conventional indices only enclosed malnourishment in three clusters of kids (underweight only; wasted alone; stunted only). As a result, CIAF appears to be a reliable measure for assessing malnutrition because it detected more children than traditional indices. It is created by combining these three traditional indexes. The extra aspects of malnutrition that CIAF revealed are its main contribution and may have practical significance for legislators who want to track the trajectory of malnourishment and provide resources as needed at the local level.

Limitation of the study:

Due to the fact that it only examines one impoverished district in Pakistan's Punjab province, this research has certain limitations. These conclusions are based on data gathered from Pakistan's poorest division. These results can be hard to generalize. Furthermore, because there isn't much research on gender-based comparisons of various nutritional screening procedures, the discussion is focused on a generic comparison of various nutritional screening methodologies.

CONCLUSION

The prevalence of malnutrition is lower using the BMI-for-age, MUAC, and traditional indices compared to using CIAF method. The findings of the gender analysis also show that male children in the study region had a greater frequency of malnutrition than female children. Additionally, CIAF screened more malnourished children than other methods, regardless of gender. The findings of the chi-square test showed that in contrast to other measures like the MUAC, BMI, and traditional indices like stunting, wasting, and underweight, the age and sex of the kid had a momentous link with CIAF. The research outcomes recommend that the CIAF is a superior instrument for assessing a child's nutritional needs since it provides more precise estimations of malnutrition despite having severe anthropometric flaws. Even with gender analysis, it detects more kids.

AUTHORS' CONTRIBUTION

MBA: Conceptualization of the study design. MBA, RZ, MZH: Dat collection, data analysis, data interpretation, write-up, proofreading.

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