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Evaluation of malnutrition using some anthropometric measures at Kirkuk Pediatric General hospital

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ABSTRACT:

Background Worldwide, malnutrition is common and is responsible directly or indirectly for about a third of all deaths of children under 5 years of age. Primary malnutrition also continues to occur in developing countries as a result of poverty, parental neglect or poor education. Specific nutritional deficiencies, particularly of iron, remain also common in developing countries. Restrictive diets may be iatrogenic as a result of exclusion diets or parental food fads, or may be self-inflicted.

Aim of The Study: This study was done to determine the role of Head to Chest Ratio as screening test in early detection of malnutrition .

Patient and Methods: A case control analytic study was done on children attending the pediatric department , and Nutrition Department in Kirkuk Pediatric General Hospital from 29th of March 2015 to the last of August 2015. The study included 150 malnourished children (study cases) and 100 control children (control cases) , their age from (2months -5years). Each child included in the study was assessed by a prepared questionnaire. Screening done by measuring Weight for age, Height for age, Occipitofrontal Circumference for age, and Mid-arm circumference , chest circumference and the diagnostic test weight for height.

Results: The total number of cases 150 study cases (63% boys and 37% girls)and 100 control cases(65% boys and 35% girls). All the malnutrition cases looked wasted (100%) followed by pallor(48.7%) and looking ill(44.7%).Anthropometric measures Weight/age sensitivity(73%) and specificity(75%), Mid arm circumference sensitivity(75%) and specificity (79%) , Length/Height for age sensitivity (30%) and specificity(18%) .Head circumference in males sensitivity (1.4%) and specificity(78.3%) and Head circumference in females sensitivity (100%) and specificity(10%) , Chest circumference in males sensitivity (92%) and specificity(30%) and Chest circumference in females sensitivity (87%) and specificity(20%) ,Head: Chest Ratio in males sensitivity (93%) and specificity(26%) and Head :Chest Ratio in females sensitivity (92%) and specificity(25%) .

Conclusion: Finally the present study concluded that still Mid arm circumference is the most sensitive and specific method for screening of the malnutrition .Head to Chest Ratio is a good method for early detection of malnutrition all thought it is more sensitive and less specific than Mid arm circumference..

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Introduction:

Malnutrition is usually a diagnosis of infant and children below 5 years of age whose growth is less than that of their peers. Although there is no one set of growth parameters provide a criteria for universal definition, but it classically refers to as either weight below 5th percentile or change in weight that crossed 2 major percentiles in a short time[1].

The cumulative evidence suggests that undernutrition has pervasive effects on immediate health and survival as well as on subsequent performance. These include not only acute effects on morbidity and mortality but also longer-term effects on cognitive and social development, physical work capacity, productivity, and economic growth. The magnitude of both the acute and the longer-term effects is considerable[2].

Head circumference are routinely recorded until 5 years of age, it is measured by passing a non elastic tape over the occipital protuberance on the back and supra orbital in front[2]. During first year there is 12 cm increase in head circumference while (1-5) years age only 5cm gain occur in head size [3]. Chest circumference is usually measured at the level of nipples, preferably in mid inspiration .In children <5 years ,usually taken by lying down position while in children >5 years, it is taken at standing position[2]. Head circumference and chest size measurements are often taken on newborns and infants by a pediatrician to measure growth levels and development. These growth milestones reveal healthy brain growth and development. While a slowdown in growth after several months is expected, failure to grow at a steady rate may be an indication of a more serious condition[4] Measuring the ratio between head circumference and chest size in infants and young children can also indicate a possible lack of nutrients and proper sustenance for the child. For a newborn and infant, the initial head circumference of the child is developing and growing at a higher rate than the child's chest[5]. After several months, this begins to slow down. With proper nourishment, the body and chest size of the child should begin to increase at a higher rate. If this ratio does not start to even out after the first few months of the child's life, this may be an indication that the child is not eating or absorbing nutrients properly. Several studies were found that the ratio of the head circumference to the chest circumference was valuable in predicting malnutrition. An increase in the ratio occurred 2-3 months before drop in weight was noted decrease in ratio was follow 2-3 months later by a gain in weight. Hence, this can

used in field work to forestall malnutrition[6].

The aim of this study is for early detection of patients with malnutrition by using head to chest ratio as a screening test.

Subject, Patient and Methods:

A case control hospital based selective study were done on patients with malnutrition attending General Pediatric Hospital in Kirkuk during the period from 29th of March to the last of August 2015 aged from 2 months_5 years.

A comparable number of apparently healthy children with normal Wt/Ht of similar age group were taken as a control group .The cases where taken by simple random selection. The anthropometric measurements were measured for each case included in the study (both malnourished and study cases).These include Wt/age , Ht/age ,OFC/age ,Wt/Ht , MAC , chest circumference and H:C Ratio. Each case were assessed for weight using Unisef weight scale for children who can not stand and digital scale for older children who can stand.

Each case weighed with minimum clothes with 2 measurement at least and the mean were taken , the weight taken to the minimum of 5 gram. Cases less than 2years age were assessed for supine length using standeometer. Cases >2 year a standing height were taken using anon_ stretchable fibroglass tape measure fixed on wall. The Ht / length were taken with bare foot with the head straight. Measure taken to the minimum of (0.1 cm). The measurement put on Ht/length growth chart for age and sex[68]. By non stretchable fiberglass tape measure OFC taken thrice for each malnourished patient in three different levels and the widest diameter were considered as the OFC of the patient , then the measure put on special chart for OFC according to age and sex[69]. (Appendix VI,VII). The Wt and Ht/Length for each malnourished patient and control were put on special chart for Wt/Ht/Length according to sex[70]. (Appendix VIII) The case was considered as malnutrition if had Wt/Ht less than the mean for age and sex (means from _1SD, _2SD and _3SD and more[67]. (appendix VIII) While the patient is standing or holding by his or her parents , with the arm in resting posture (semi flexed at 90^0) midpoint between the acromion and the olecranon were labeled , then a vertical line crossing the horizontal line above to make a central point (the mid arm point) at which the MAC were considered.[71] Measure >11.5cm considered normal , and measure <11.5cm considered abnormal[72].

Each case included in the study(both malnutrition and control cases) where asses for chest circumference. The chest circumference where taken at the level of nipple twice both inspiration and expiration in cooperative patient, if the different between the two reading <1cm the mean was taken, if the different>1cm the two measure repeated .In this study the mean of chest circumference of the control cases were consider as the reference value for the malnutrition cases.

Head circumference to chest circumference ratio where taken . The ratio in well nourish cases was taken as control for the malnutrition cases. The reference value for head to chest ratio where different according to age as follow:

.At birth head circumference > chest circumference by up to 3cm.

.At around 9 months to 1 year of age :head circumference = chest circumference.

.But thereafter chest grows more rapidly compare to brain[3].

Results:

The Total number of malnourished cases were 150 cases, while the total control cases were100 .

Table (1)shows the distribution of the study cases according to anthropometric measurements . In regard to weight for age, most of the cases were with -2 SD (46%). In regard to genders both males and females cases were had -2 SD decrease in weight .In regard to length/height for age, most of the cases were with normal (58%). In regard to OFC for age, most of the cases were with normal OFC (95.3%). In regard to weight for height , most of the cases were with -1 SD (39.3%). In regard to genders both males and females cases were had -2 SD decrease in weight .

Table (1):The anthropometric measurements of study cases .

		Male	Female	Total
Weight for age	Normal	22(23.2%)	16(29.1%)	38(25.3%)
	<5th percentile	73(76.8%)	39(70.9%)	112 (74.7%)
	>95th	0 %	0 (%)	0(0%)
	Total	95(100%)	55 (100%)	150(100%)
Length/ Height for age	Normal	53 (55,7%)	35 (63,6%)	88(58%)
	<5th percentile	29(30.4%)	33 (59,9%)	62(41,3%)
	>95th	0 %	0 (%)	0(0%)
	Total	95(%)	55(%)	150(%)
OFC for age	Normal	89 (93,6%)	54 (%)	143(95,3%)
	<5th percentile	6 (3,15%)	1(%)	7(4,6%)
	>95th	0%	0(0%)	0(0%)
	Total	95 (100%)	55 %	150(100%)
Weight for length/Height	Normal	23 (24,2%)	10 (18,1%)	33 (22%)
	-1SD	27 (28,4%)	32 (58,1%)	59(39,3%)
	-2 SD	33(34,7%)	18 (32,7%)	51 (34%)
	-3 SD	3 (3,1%)	4 (7,2%)	7(4,6%)
	Total	95 (100%)	55 (100%)	150(100%)

P-value were not significant for all the measures (>0.05)

Table (2) shows the distribution of the study cases according to MAC. High percet of the cases had MAC less than 11.5 cm (63%) . The same were for both genders males and females.

Table (2) : The distribution of the study cases according to MAC

MAC	Male	Female	Total
<11cm	56 (58,9%)	38 (69,1%)	95 (63,%)
11 and >11 cm	39(41,1%)	17 (30,9%)	56 (37,%)
Total	95 (100%)	55 (100%)	150 (100%)

P-value < 0.05 (significant).

Table (3) shows the distribution of the control cases according to MAC. Most of the cases had MAC more than 11.5 cm (71%) . The same were for both genders males and females.

Table (3) : The distribution of the control cases according to MAC .

MAC	Male	Female	Total
<11cm	17 (26,1%)	12 (34,29%)	29(29%)
11 and>11 cm	48 (73,9%)	23 (65,71%)	71 (71%)
Total	65 (100%)	35 (100%)	100 (100%)

Table (4) shows the distribution of the control cases according to head circumference in regard to age. The mean head circumference for males was nearly similar to that of females at all age groups.

Table (4) : The distribution of the control cases according to head circumference in regard to age .

Age (months)	Mean Head Circumference	
	Male	Female
2	39±1	39±1
12	47±2	47±2
24	49±1	49±1
36	51.5±0.5	51±0.5
48	52.5±0.5	52±0.5
60	53.5±0.5	53±0.5

Table (5) shows the distribution of the study cases according to head circumference in regard to age. The mean head circumference for males was nearly similar to that of females at all age groups.

Table (5) : The distribution of the study cases according to head circumference in regard to age .

Age (months)	Mean Head Circumference	
	Male	Female
2	39±1	39±0.5
12	46±2	46±2
24	48± 1	48± 1
36	51±1	51±1
48	52±0.5	52±0.5
60	53 ±0.5	53±0.5

Table (6) shows the distribution of the control cases according to chest circumference in regard to age. The mean chest circumference for males was nearly similar to that of females at all age groups.

Table (6) : The distribution of the control cases according to chest circumference in regard to age .

Age (months)	Mean Chest Circumference	
	Male	Female
2	37±1	37±1
12	45±2	45±2
24	47± 1	47± 1
36	49±1	49±0.5
48	49.5±0.5	49±0.5
60	49±1	49±1

Table (7) shows the distribution of the study cases according to chest circumference in regard to age. The mean chest circumference for males was nearly similar to that of females at all age groups.

Table (7) : The distribution of the study cases according to chest circumference in regard to age .

Age (months)	Mean Chest Circumference	
	Male	Female
2	35±1	35±0.5
12	43±1	43±2
24	45± 0.5	46± 1
36	47±0.5	46±0.5
48	47.5±0.5	46±0.5
60	47.5±0.5	46±0.5

Table (8) shows the distribution of the control cases according to Mean Head to Chest ratio in regard to age. The Mean Head to Chest ratio for males was nearly similar to that of females at all age groups.

Table (8) : The distribution of the control cases according to Mean Head to Chest ratio in regard to age .

Age (months)	Mean Head to Chest ratio	
	Male	Female
2	1.1±0.3	1.1±0.2
12	1.1±0.3	1.1±0.2
24	1.1± 0.2	1.1± 0.3
36	1.1±0.1	1.1±0.1
48	1.1±0.2	1.1±0.1
60	1.1±0.1	1.1±0.2

Table (9) shows the distribution of the study cases according to Mean Head to Chest ratio in regard to age. The Mean Head to Chest ratio for males was nearly similar to that of females at all age groups.

Table (9) : The distribution of the study cases according to Mean Head to Chest ratio in regard to age .

Age (months)	Mean Head to Chest ratio	
	Male	Female
2	1.2±0.3	1.2±0.2
12	1.2±0.3	1.2±0.2
24	1.2± 0.2	1.2± 0.2
36	1.2±0.1	1.2±0.1
48	1.2±0.2	1.2±0.1
60	1.2±0.2	1.2±0.2

The Wt/Ht measure were used as diagnostic test and Wt/age ,length/Ht for age ,OFC/age and Mid arm circumference as screening test for malnutrition .

Table (10) show that, Wt/age as screening test and wt/ht as diagnostic test .The sensitivity was 73% and the specificity was 75%.

Table (10): the use of Wt/age as screening test and Wt/Ht as diagnostic test in children :

Screening test Wt/age	Diagnostic test Wt/Ht		
	Malnourished	**Normal**	**Total**
Malnourished	**96**	**16**	**112**
Normal	**21**	**17**	**38**
Total	**117**	**33**	**150**
Sensitivity = 73 %	false +ve test :25 %	predictive value+ve : 91 %	
Specificity = 75 %	false –ve test: 23 %	predictive value –ve: 45 %	

Table (11)show that the MAC is as screening test for malnutrition and the wt/ht as diagnostic test . The sensitivity was 75% and the specificity was 79%.

Table (11): the use of MAC as screening test and Wt/Ht as diagnostic test in children :

Screening test MAC	Diagnostic test Wt/Ht		
	Malnourished	**Normal**	**Total**
Malnourished	**88**	**7**	**95**
Normal	**29**	**26**	**55**
Total	**117**	**33**	**150**
Sensitivity = 75 %	false +ve test :21 %	predictive value+ve : 93 %	
Specificity = 79 %	false –ve test: 25 %	predictive value –ve: 47 %	

Table (12) show that the sensitivity of length/Ht for age as screening test and the wt/ht as a diagnostic test. The sensitivity was 30% and the specificity was 18%.

Table (12): the use of length/Ht for age as screening test and Wt/Ht as diagnostic test in children :

Screening test Length /Ht for age	Diagnostic test Wt/Ht		
	Malnourished	**Normal**	**Total**
Malnourished	**35**	**27**	**62**
Normal	**82**	**6**	**88**
Total	**117**	**33**	**150**
Sensitivity = 30 %	false +ve test : 82 %	predictive value+ve : 57 %	
Specificity = 18 %	false –ve test: 70 %	predictive value –ve: 6.8 %	

Table(13) show that the sensitivity of OFC/age as screening test and wt/ht as diagnostic test in males .The sensitivity was 1.4 % and the specificity was 78.3 %.

Table (13): the use of head circumference as screening test and Wt/ht as diagnostic test in males:

Screening test OFC circumference	Diagnostic test Wt/Ht		
	Malnourished	Normal	Total
Malnourished	1	5	6
Normal	71	18	89
Total	72	23	95
Sensitivity =1.4 % false +ve test :22 % predictive value+ve :17 % Specificity = 78.3% false –ve test: 99 % predictive value –ve: 20.2 % Mean head C. for normal males:(According to age) Mean head C. for malnourished males :(According to age)			

Table(14) show that the sensitivity of head circumference as screening test and wt/ht as diagnostic test in females.The sensitivity was 100 % and the specificity was 10 %.

Table (14): the use of head circumference. as screening test and Wt/ht as diagnostic test in females :

Screening test Head C.	Diagnostic test Wt/Ht		
	Malnourished	Normal	Total
Malnourished	45	9	54
Normal	0	1	1
Total	45	10	55
Sensitivity:100 % false +ve test :14.1 % predictive value+ve :0 % Specificity =10 % false –ve test: 0 % predictive value –ve:70.3 % Mean head C. for normal females:(According to age) Mean head C. for malnourished females :(According to age)			

Table(15) show that the sensitivity of chest circumference as screening test and wt/ht as diagnostic test in males.The sensitivity was 92 % and the specificity was 30 %.

Table (15): the use of chest circumference as screening test and Wt/ht as diagnostic test in males:

Screening test Chest C.	Diagnostic test Wt/Ht		
	Malnourished	Normal	Total
Malnourished	66	**16**	82
Normal	6	**7**	13
Total	72	**23**	95
Sensitivity = 92% false +ve test :70 % predictive value+ve :81 % Specificity =30 % false –ve test: 8.3% predictive value –ve: 54 % Mean chest C. for normal males:(According to age) Mean chest C. for malnourished males :(According to age)			

Table(16) show that the sensitivity of chest circumference as screening test and wt/ht as diagnostic test in females.The sensitivity was 87 % and the specificity was 20 %.

Table (16): the use of chest circumference as screening test and Wt/ht as diagnostic test in females :

Screening test Chest C.	Diagnostic test Wt/Ht		
	Malnourished	Normal	Total
Malnourished	39	8	47
Normal	6	2	8
Total	45	10	55
Sensitivity:87 % false +ve test :80 % predictive value+ve :83 % Specificity = 20 % false –ve test: 13 % predictive value –ve:25 % Mean chest C. for normal females:(According to age) Mean chest C. for malnourished females :(According to age)			

Table(17) show that the sensitivity of head/chest ratio as screening test and wt/ht as diagnostic test in males.The sensitivity was 93 % and the specificity was 26 %.

Table (17): the use of Head circumference /Chest circumference as screening test and Wt/ht as diagnostic test in males:

Screening test Head/Chest ratio	Diagnostic test Wt/Ht		
	Malnourished	Normal	Total
Malnourished	67	17	11
Normal	5	6	84
Total	72	23	95
Sensitivity =93 % false +ve test :74 % predictive value+ve :80 % Specificity =26 % false –ve test: 7% predictive value –ve: 55 % Mean head to chest ratio for normal male:(according to age) Mean head to chest ratio for malnourished male:(according to age)			

Table(18) show that the sensitivity of head/chest ratio as screening test and wt/ht as diagnostic test in females.The sensitivity was 92 % and the specificity was 25 %.

Table (18): the use of Head circumference /Chest circumference as screening test and Wt/ht as diagnostic test in females:

Screening test Head/Chest ratio	Diagnostic test Wt/Ht		
	Malnourished	Normal	Total
Malnourished	15	4	19
Normal	30	6	36
Total	45	10	55
Sensitivity = 92 % false +ve test : 75 % predictive value+ve : 73 % Specificity = 25 % false –ve test: 8 % predictive value –ve: 52 % Mean head to chest ratio for malnourished female:(according to age) Mean head to chest ratio for malnourished female:(according to age)			

Discussion:

Worldwide, malnutrition is common and is responsible directly or indirectly for about a third of all deaths of children under 5 years of age. Primary malnutrition also continues to occur in developed countries as a result of poverty, parental neglect or poor education[7].

Height/Age , OFC/age, There was no sign relation regarding Weight/Age and Weight/Height .This does not go with several other studies[8]. which show that these measures usually affected to a variable extent in cases with malnutrition this different maybe due to different in sample size. There was significant result regarding the MAC this goes with WHO reference value as the MAC is the best screening test for malnutrition. The mean size of head circumference was nearly similar to that of mean head circumference for control this goes with other study by[9]. In which OFC little affected in malnutrition as malnutrition usually occur later in life by which it does not affect the OFC.OFC is usually affected in congenital or very early in case with malnutrition[10]. The mean chest circumference in study cases slightly lower than the mean chest circumference in control cases. This may be due to that chest circumference might be affected in malnutrition due to loss in subcutaneous fat or as part of small body size in case of malnutrition as compared to control cases

The mean head to chest ratio among the control cases as well as the malnutrition cases were high as compare to reference value for Head to Chest ratio[11].The reason why control cases H:C ratio were higher than the reference may be due to different in sample size may be the study patients were of border line growth that affect the ratio negatively .The mean Head to Chest ratio in malnutrition were higher than the control cases as well as the reference value and this may be due to that most our cases have malnutrition later in life ,so the Head circumference is not affected while the Chest circumference is affected significantly . Regarding the sensitivity and specificity of anthropometric measure as screening test and weight/Height as diagnostic test ,still the MAC is the most sensitive and highly specific one compare to other measures.This is goes with other study and WHO value[12]. As the MAC is proved to be the best screening test for malnutrition. Regarding this study of OFC measures was less sensitive but highly specific in males and in females by which it is 100%sensitive and less sp Regarding the Chest circumference for males and females and the Head :Chest ratio in males and females they were highly sensitive but less specific and this different may be due to different in

sample size ,So still MAC is the best screening test and Head :Chest ratio is highly sensitive. For detection malnutrition all thoughts it is less specific as it can be affected by other diseases like diseases in brain and delay in milestone.

Maximum Arm Circumference is highly sensitive test for detection of malnutrition and Wt/age is highly specific test .This does not goes with study in UK by Burden ST, Stoppard E, Maximum arm Circumference <5th percentile had a high specificity but low sensitivity when compared with indicators of malnutrition. Although MAC could be reliably measured, it has poor validity and is thus unlikely to be a good predictor of clinical outcome. Percentiles based on healthy populations do not generalize well to the individuals seen in clinical practice. Other study done in Kasturba by Mohanan P, Kamath A, the best method of assessing malnutrition using various anthropometric measurements is weight for age[13].

Conclusions

Anthropometric measures ,MAC is highly specific test(79%) for detection of malnutrition and Wt/age is specific test (75%) . The head to chest ratio for normal males nearly similar to that of normal females ,also for malnourished males were similar to malnourished females. The sensitivity of OFC is high in females(100%)and specific in males(78.3%). The sensitivity of chest circumference is high in male (92%) and sensitivity in female(87%),Both males and females were high sensitive H:C ratio,(93%),(92%) respectively but less specific in detection of malnutrition.

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