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A Comparative Study of Serum Trace Mineral Magnesium, Phosphorus, Copper and Albumin in Level Healthy Children and Sever Acute Malnutriaon in Low Socio-Economic Group of Children

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KEYWORDS
hypophosphatemia, hypomagnesaemia.

ABSTRACT:

Background: Children with severe acute malnutrition (SAM) have increased requirements for phosphorus and magnesium during recovery. If requirements are not met, the children may develop Refeeding hypophosphatemia and hypomagnesaemia. Copper is required for the functioning of many enzymes such as Cytochrome c oxidase, which is complex 4th in the mitochondrial electrontransport chain.

Aim: Therefore, the aim of this study is to make comparative study of Trace Mineral Magnesium, phosphorus, and Copper in level a healthy child and sever acute Malnutriaon in low Socio-economic group children to record frequency of serum magnesium, serum phosphate and serum copper level in children presenting with acute severe malnutrition.

Materials & methods: After institutional ethics committee approval, research authors would commence. Participants gave informed consent before in this study, a total of 200 cases ≤.5 year of either gender, diagnosed as sever malnourished were enrolled from Pediatric Department**.**The study included 100 SAM patients and 100 healthy controls from Indore's Index Medical College & Research Centre (IMCRC) departments of pediatrics OPD. This prospective observational study follows Indore IMCHRC rules & regulations. However, the study's limitations, including its cross- sectional design, call for longitudinal investigations to establish causality between macronutrient deficiencies and levels in SAM-affected children. Additionally, the research primarily focused on a specific geographical region.

Conclusion:A healthy diet in children is important for providing nutrients that support optimal physical growth and cognitive development, as well as establishing healthy eating habits that reduce the risk of chronic diseases in adulthood.

Introduction:

Globally, malnutrition in children below five years of age is a challenging health issue.[1] The rate of malnourished children is more than 50% in South Asian countries, while an alarming magnitude of this morbidity is reported from Pakistan, Bangladesh and

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India.[2] The significance of adequate nutrition in early years of life may not be denied as the nutrition has a higher effect on mental, physical, intellectual and social development of a children. Assessment of malnourished cases at the time of admission in ICU is supportive.[3] Magnesium (Mg) is inevitable for usual cellular functions [4] Malnutrition is a broad and encompassing phrase. Malnutrition often pertains to the condition of undernutrition, which arises due to insufficient intake, inadequate absorption, or excessive nutrient loss. However, this word also incorporates overnutrition, which occurs as a consequence of excessive ingestion of certain nutrients. Severe acute malnutrition (SAM) is correlated with heightened severity of prevalent infectious illnesses, and mortality in children afflicted with SAM is predominantly attributable to infection.SAM is associated withRefeeding with diets high in carbohydrate but with inadequate amount of magnesium can result in refeeding syndrome, characterized by hypomagnesemia, sometimes resulting in respiratory or circulatory failure or even death[5]Although concentrations of serum magnesium(S- magnesium) maynot adequately reflect bodystatus, low levels maystill be suggestive of inadequate intake. Copper is required for the functioning of many enzymes, such as cytochrome c oxidase, which is complex IV in the mitochondrial electron transport chain, ceruloplasmin, Cu/Zn superoxide dismutase, these enzymes catalyze reactions for oxidative phosphorylation, iron transportation, antioxidant and free radical scavenging and neutralization, and neurotransmitter synthesis, respectively. Andrarelyoptic neuropathy. Menke disease is a congenital disease that is a cause of copper deficiency.

Research on the dietary causes of SAM, especially the role and relative importance of dietary protein, in the etiology of edematous malnutrition, has led to considerable debates and controversies. The importance of energy as a bigger problem than protein malnutrition. However, important Nttoexamine the protein quality of the diets in light of the new information on the lysine requirements[6].Over the last century, significant contributions have been made to the research on various aspectsof severe life-threatening malnutrition in children that have been identified with different names such as protein-calorie malnutrition, protein-energy malnutrition (PEM), edematous malnutrition, nutritional oedema, severe wasting or with names based on clinical manifestations such as Marasmus, Kwashiorkor or marasmus K w a s h i o r k o r [7]. The effective identification and referral of children in the community who are suffering from severe acute malnutrition (SAM), as well as ensuring proper referral and back referral, necessitate the presence of robust health systems. Enhancing grass roots services not only facilitates the management of Severe Acute Malnutrition (SAM), but also enhances the overall provision of baby and young child feeding and nutrition. The endorsement of ready-to-use therapeutic food (RUTF)for the homecare of severe acute malnutrition (SAM) without problems remains limited in some countries due to challenges related to its (RUTF) might avail themselves of assistance from neighboring countries in the region that possess the necessary production capacity. It is imperative that health institutions in all nations facing a high burden of malnutrition are adequately staffed and prepared to provide comprehensive treatment for children suffering from severe acute malnutrition (SAM). The implementation of a consistent and ongoing training program for health care personnel about the management of severe acute malnutrition (SAM) might effectively mitigate the negative consequences arising from staff attrition or transfers. It is imperative to expand the implementation of fundamental nutrition treatments in Asian nations grappling with the prevalence of malnutrition. These interventions encompass breastfeeding, suitable supplemental feeding, micronutrient supplementation, and the effective management of acute malnutrition [8].One of the most significant challenges facing the public health systems of the majority of developing nations, including India, is that of severe acute malnutrition. It is a deficiency condition that is extremely common among children whose families have low socioeconomic status. According to the collaborative estimate of malnutrition produced by UNICEF, WHO, and the World Bank Group for 2021 edition There are 149 million children under the age of five who are afflicted by stunting, 145 million children under the age of five who are affected by wasting, and 39 million children under the age of five who are impacted by overweight [9].A person is considered to

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have severe acute malnutrition if they have a very low weight- for-height-and-length ratio (a Z-score that is below -3 SD of the median WHO child growth criteria),or if they have amid upper arm circumference that is less than115mm, or if they have nutritional oedema. The illness known as Severe Acute Malnutrition can be attributed to both medical and societal causes. Severe Acute Malnutrition (SAM) can be caused by a number of different things, including a lack of exclusive breast feeding, a late introduction of supplemental feeds, providing diluted feeds that have a lower quantity of nutrients, frequent enteric and respiratorytract infections, ignorance, and poverty, to name a few of these things. In children younger than five years old, the likelihood of passing away from SAM is dramatically

increased. It can be a direct or indirect cause of child mortality by raising the case fatality rate in children suffering from common diseases such as diarrhea, acute respiratory infections, malaria, and measles. This can be a direct cause of child death. According to the third installment of the National Family Health Survey (2005-2006), an estimated 6.4% of children under the age of 60 months, or almost 8.1million, were suffering from severe acute malnutrition. A kid is considered to have moderate acute malnutrition if their weight-to-height ratio is between 70and 80 percent of the median (Z score of -3SD to -2SD), or if their mid-upper arm circumference is between 115 and 125 cm and they do not have oedema. Outpatient treatment is an option for children who are suffering from mild acute malnutrition.

Methods:

In this study, a total of 100 cases 3 loose stools, < 14 days), already diagnosed/under treatment of hypomagnesaemia were excluded from the study. All these cases were enrolled from Pediatric Department,Index Medical College Hospital & RC, Indore, MP After detailed history and physical examination, 2 ml blood samples were collected for measurement of serum magnesium Serum Phosphate and Serum copper. On arrival of reports, we analyzed.

Result and discussion:

Table-1age distribution.

	CASE		CONTROL		P value
	GROUP1		GROUP2		
AGE	**Number**	**%**	**Number**	**%**	
<1YR	39	39%	12	12%	0.437
1YR	27	27%	36	36%	
2YR	11	11%	19	19%	
3YR	11	11%	19	19%	
4YR	11	11%	13	13%	
5YR	1	1%	1	1%	
Total	**100**	100%	**100**	100%	

In our study, 39% of cases were in the age group of <1 year in Group 1 (case), 27% of cases were in the age group of 1 year, 11% of cases were in the age group

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of 2 year, 11% of cases were in the age group of 3 year, 11% of cases were in the age group of 4 year, and 1% of cases were in the age group of 5 year. In Group 2 (control), 36% of cases were in the age group of 1 year, 19% of cases were in the age group of 2 year, 19% of cases were in the age group of 3 year, 13% of cases were in the age group of 4 year, and 1% of cases were in the age group of 5 year and when we compared the mean age between cases and control there is not much significant difference between cases and control.

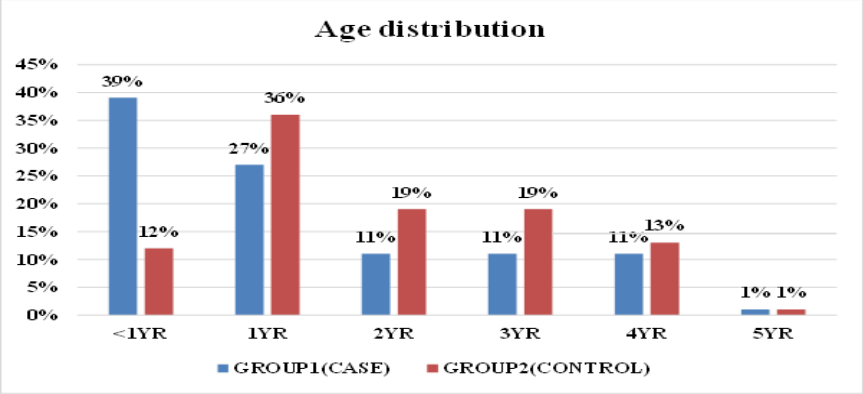

Table-2 Gender Distribution

	CASE		CONTROL		
	GROUP-1		GROUP- 2		
SEX	**Number**	**%**	**Number**	**%**	**P value**
MALE	74	74%	70	70%	0.783
FEMALE	26	26%	30	30%	0.812
Total	**100**	100%	**100**	100%	

In our study, 74% of cases were male and 26% were female in Group 1 (case), and 70% of cases were male and 30% were female in Group 2 control and there is not much significant difference between males and females in cases and control.

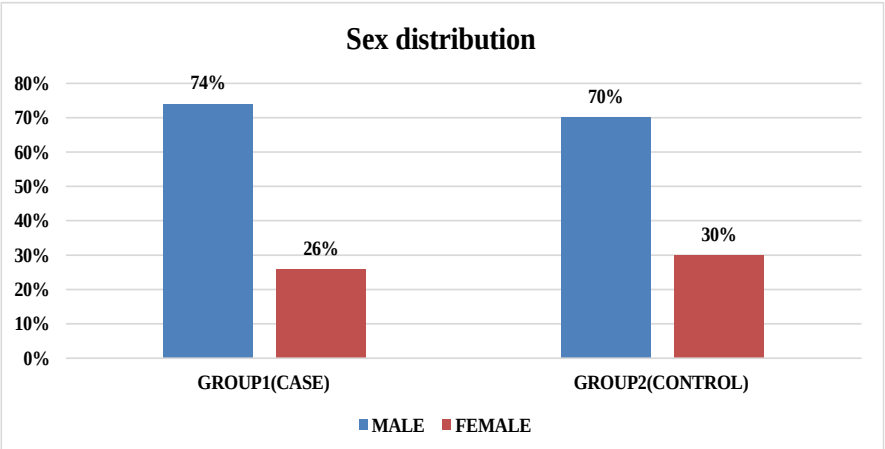

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TABLE-3 Descriptive Table

DESCRIPTIVE DATA						
PARAMETER		**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**P value**
MUAC	**Group1**	9.79	2.47	5.1	12.5	<0.001
	Group2	12.76	0.72	10.2	14.2	
LENGTH (CM)	**Group1**	68.08	12.91	42.0	98.0	<0.001
	Group2	80.99	9.20	61.3	97.3	
WEIGHT FOR HEIGHT KG	**Group1**	5.98	2.38	2.1	10.5	<0.001
	Group2	9.08	1.98	4.2	12.8	
CALCIUM mg/dl	**Group1**	5.93	1.17	3.4	9.5	<0.001
	Group2	7.87	0.42	7.2	8.4	
IRON mcg/dl	**Group1**	46.12	9.33	29.0	66.0	<0.001
	Group2	63.21	13.46	34.1	90.3	
ZINC mcg/dl	**Group1**	100	0.41	0.23	0.1	<0.001
	Group2	100	0.88	0.17	0.6	

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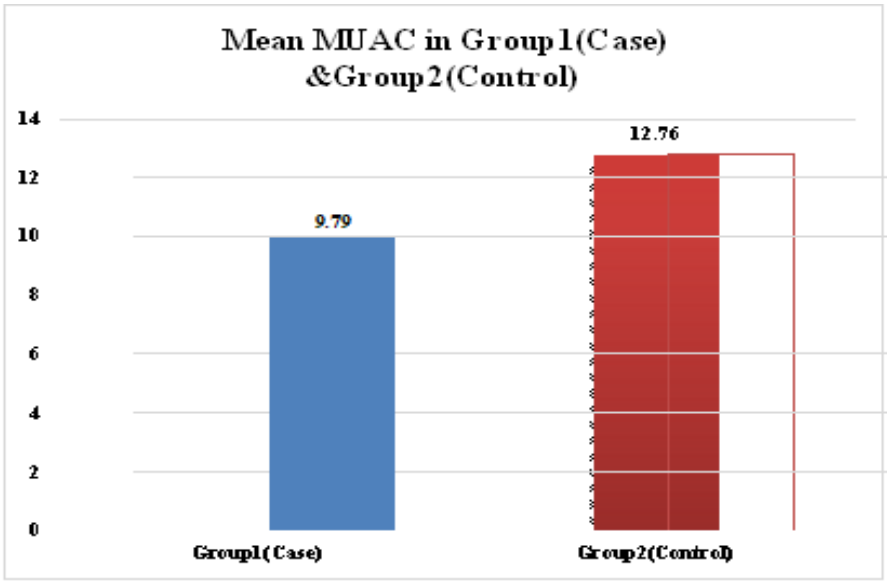

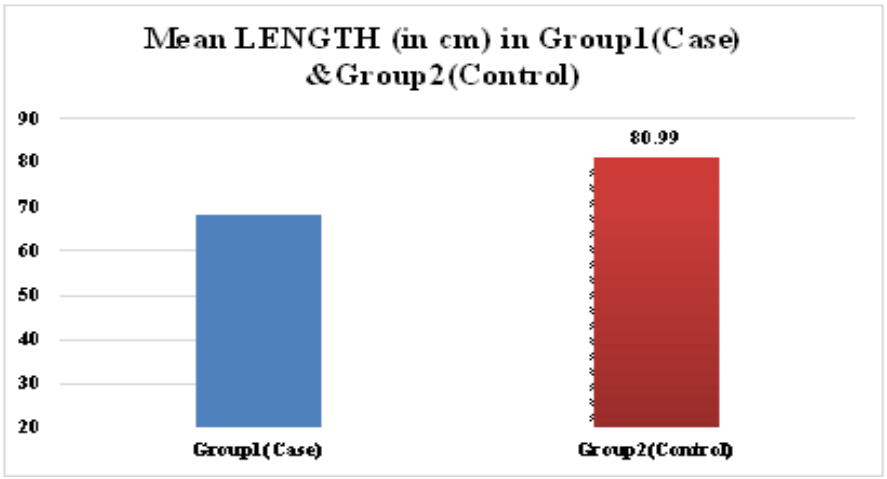

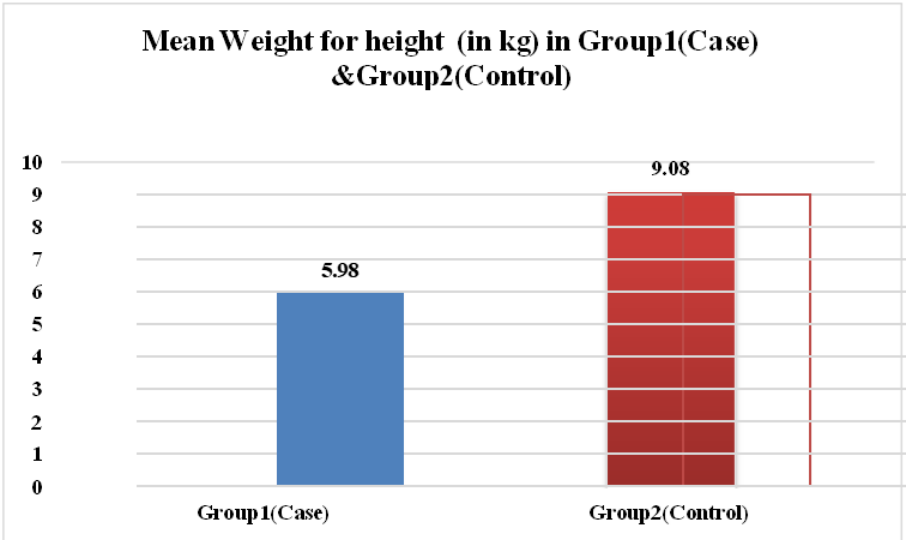

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Table- 7-Comparison Of Mean Magnesium Mg/Dlin Case & Control Group

		MAGNESIUM mg/dl			
Group	**N**	**Mean**	**Std. Deviation**	**P-Value**	**Result**
Group1(Case)	100	2.27	0.39	<0.001*	(highly significant)
Group2(Control)	100	1.90	0.30		

In our study, the mean magnesium was 2.27 ± 0.39 mg/dl in Group 1 (case), and the mean magnesium was 1.90 ± 0.30 mg/dl in Group 2 (control). Mean magnesium was higher in the control group as compared to the malnutrition group, and there was a significant difference in mean magnesium between Group 1 (case) and Group 2 (control).

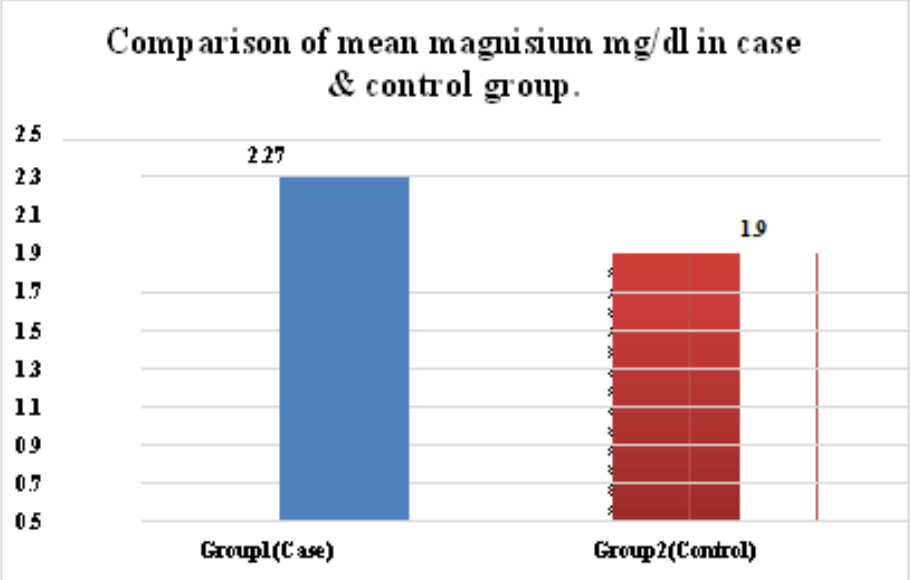

TABLE-6-COMPARISON OF MEAN PHOSPHORUS MG/DL IN CASE & CONTROL GROUP

		PHOSPHORUS Mg/dl			
Group	**N**	**Mean**	**Std. Deviation**	**P-Value**	**Result**
Group1(Case)	100	2.28	0.43		

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Group2(Control)	100	2.28	0.44	0.961	(not significant)

In our study, the mean phosphorus was 2.28 ± 0.43 mg/dl in Group 1 (case), and the mean phosphorus was 2.28 ± 0.44 mg/dl in Group 2 (control). The mean phosphorus was higher in the control group as compared to the malnutrition group, and there was a significant difference in mean phosphorus between Group 1 (case) and Group 2 (control).

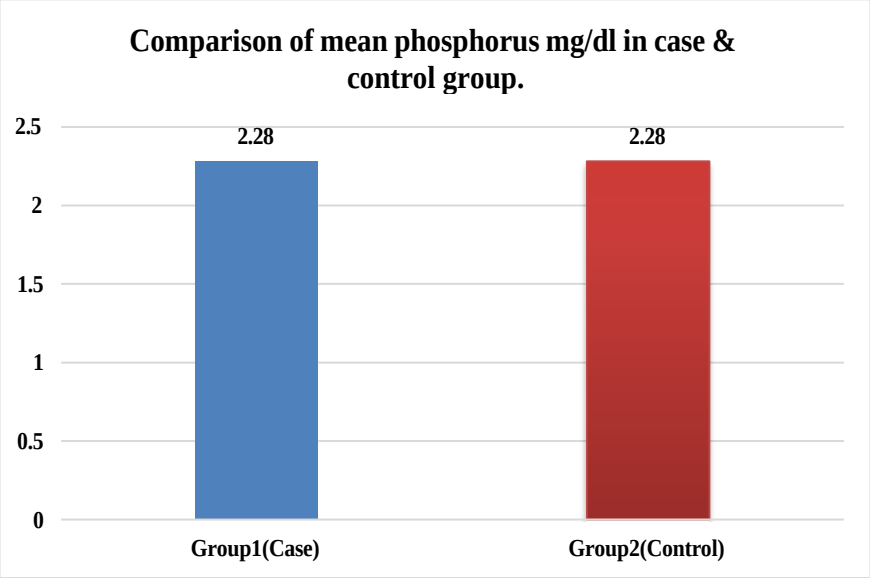

TABLE-5 COMPARISON OF MEAN COPPER µg/L IN CASE & CONTROL GROUP.

		Copper µg/l			
Group	**N**	**Mean**	**Std. Deviation**	**P-Value**	**Result**
Group1(Case)	100	1.27	0.23	0.804	(not significant)
Group2(Control)	100	1.28	0.23		

In our study, the mean copper was 1.27 ± 0.23 **µg/l**in Group 1 (case), and the mean copper was 1.28

± 0.23 **µg/l**in Group 2 (control). Mean copper was higher in the control group as compared to the malnutrition group, and there was a significant difference in mean copper between Group 1 (case) and Group 2 (control).

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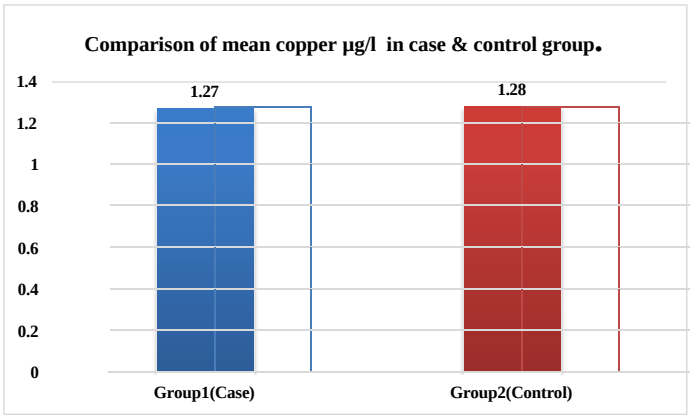

Correlation Between MUAC and Copper

The value of r is 0.0027

According to above graph Copper is positively correlated with MUAC Where, X= MUAC, Y= COPPER

Correlation Between MUAC and Phosphorous

The value of r is 0.2055

Where: X= MUAC, Y= PHOSPHOROUS

According to above graph phosphorous is positively correlated with MUAC

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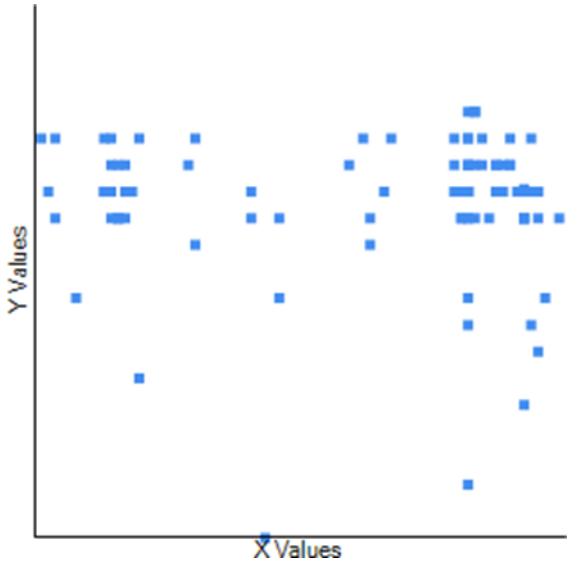
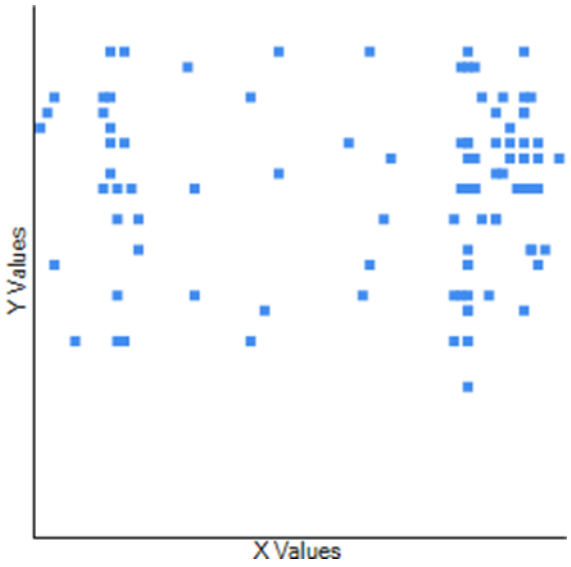
Correlation Between MUAC and Magnesium



Correlation Between MUAC and Albumin



Discussion:

Where: X= MUAC, Y= ALBUMIN

According to above graph albumin is positively correlated with MUAC The value of r is 0.0005

A healthy diet in children is important to provide nutrients that support optimum physical growth and cognitive development and to also establish healthy eating behaviours that lower risk of chronic diseases in adulthood. Although it is generally advised that micronutrients should be obtained from food, many children do not reach daily intake recommendations for select micronutrients, including vitamins A, C, D, and E, and some minerals, such as calcium and magnesium. Therefore, with our study we found that there is significant difference in calcium, magnesium, iron, zinc and albumin level between cases and control. But there is not much significant difference in copper and phosphorous level between cases and control. So there is significant need for assessment of macronutrients, which further helps in decreasing complications associated with macronutrient's and there is strict need for maintaining macro as well as micronutrients which further helps in decreasing

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morbidities and mortalities among children's.by**Kang-Sheng *et al, (2015)***they included minerals such as zinc, copper, selenium, calcium, and magnesium. They evaluated the distribution and correlation of nonessential (lead) and essential elements in whole blood from 1- to 72-month-old children. Levels of copper and magnesium were 18.09 ± 4.42 µmol/L and 1.42 ± 0.12 mmol/L, respectively. 6.04% of all children showed copper levels below the normal threshold, the levels of

Magnesium were stable in different age groups. Though the overall mean blood zinc and iron concentrations (61.19 ± 11.30 µmol/L and 8.24 ± 0.59 mmol/L, respectively) gradually increased with age and the overall deficiency levels (24.1% and 36.0%, respectively) decreased with age, zinc and iron deficiencies were still very stable. Controlling for gender and age, significant positive correlations were found when comparing copper to zinc, calcium, magnesium, and iron ((r = 0.333, 0.241, 0.417, 0.314, $p < 0.01$); zinc to magnesium and iron (r = 0.440, 0.497$p < 0.01$); and magnesium to Calcium and iron (r = 0.349, 0.645, $p < 0.01$). The overall mean blood lead levels (41.16 ± 16.10) were relatively unstable among different age groups. The prevalence of lead intoxication in all children was 1.3%. Calcium levels decreased gradually with age, with an overall concentration of 1.78 ± 0.13 mmol/L. In another study by ***Raza M et al.*** **(2020)** conducted across- sectional study aimed to determine the frequency of electrolyte imbalance in children with SAM admitted at a tertiary care hospital. This cross-sectional study includes 184 patients with SAM aged between 6 and 60 months, who were admitted at the inpatient Department of Paediatrics, Civil Hospital, Karachi, Pakistan, from January to July, 2017. Out of 184 children, 62% (n = 114) were males and 38% (n = 70) were females and 172 (93.5%) patients had electrolyte imbalance. Hypokalaemia was present in 79.9%, whereas hypocalcaemia, hyponatremia, and hypomagnesemia were present in 71.7%, 48.9%, and 13.6%, respectively. They found that electrolyte disturbances are common in SAM. Serum electrolytes of every malnourished child admitted should be assessed and corrected to avoid fatal outcomes. Study concluded that hypokalaemia followed by hypocalcaemia as the common electrolyte abnormalities in children with SAM. They suggested that, serum electrolytes of every malnourished child admitted should be evaluated and corrected at the earliest to avoid any life-threatening outcomes. In another study by **Ha F *al.* (2022)** effects of malnutrition in the optimal growth, development, and health of infants, and the reference intervals (RIs) from these trace elements in the blood are very important for an accurate assessment of the status of the elements. In their study, blood samples from a total of 13,446 infants (7206 boys and 6240 girls) were used, and the copper (Cu), zinc (Zn), calcium (Ca), magnesium (Mg), and iron (Fe) in their blood were determined using atomic absorption spectrometry. In their multivariable analysis, after making the relevant adjustments for the confounding factors, the age of the infants showed a significant positive correlation with the concentrations of Zn, Ca, Mg, and Fe found in the blood ($p<0.01$). Furthermore, there were obvious differences in the Cu, Zn, and Ca levels in the blood according to the gender of the infants ($p<0.01$). similar to this study we also found that there is positive correlation of MUAC with calcium, magnesium, phosphorous, copper, zinc and albumin levels. So, with our study we also suggested that same that there is strong need for assessment of macronutrients for proper

development of children to achieve their milestones in times and to further decrease mortality, morbidity and complications associated with deficiency of this minerals included in our study.

Conclusion:

A healthy diet in children is important to provide nutrients that support optimum physical growth and cognitive development and to also establish healthy eating behaviours that lower risk of chronic diseases in adulthood. Although it is generally advised that micronutrients should be obtained from food, many children do not reach daily intake recommendations for select micronutrients, including vitamins A, C, D, and E, and some minerals, such as calcium and magnesium. Therefore, with our study we found that there is significant difference in calcium, iron, andzinc level between cases and control. So, there is significant need for assessment of calcium, iron, and zinc level, which further helps in decreasing

complications associated with calcium, iron, and zinc level and there is strict need for maintaining it, which further helps in decreasing morbidities and mortalities among children's.

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