

Dedication

**To my lovely family.....father, mother,
sisters and brothers**

.....To

**Friends and colleagues, who stood firm
behind me and gave me a great push
forward**

.....To

**People who participated fully and helped
me a lot to achieve this work**

.....To

Everyone from whom I learned

Rehab Abdelrahman

Acknowledgements

I would like to express my profound thanks to my supervisor *Dr. Ghada Abdelrahman Elfadil*, for her fruitful guidance, unlimited assistance . encouragement and sustained interest throughout the course of this work
I wish to extend warmest thank to the staff of clinical chemistry department, Sudan university of science and technology, for their continuous support and encouragement . Also I am grateful to all people from whom sample .were taken

Contents

Subject	Page
Dedication.....	i
Acknowledgements.....	ii
Contents.....	iii
Abbreviations	vi
List of table.....	vii
List of figure.....	viii
Abstract in English.....	ix
مستخلص الدراسه	x
Chapter One	
1.1 Introduction.....	1
1.2 Rationale.....	3
1.3 Objectives.....	4
1.3.1 General objective.....	4
1.3.2 Specific objectives.....	4
Chapter Two Literature review	
2.1 Protein energy malnutrition PEM.....	5
2.1.1 Classification of PEM.....	5
2.1.1.1 Gomez classification.....	5
2.1.1.2 Waterlow classification.....	5
2.1.1.3 Welcome classification.....	6
2.1.1.4 WHO classification.....	6
2.1.3 Types of PEM.....	6
2.1.3.1 Kwashiorkor.....	6
2.1.3.1.1 Signs and symptoms.....	7

2.1.3.1.2 Causes of kwashiorkor.....	7
2.1.3.2 Marasmus.....	9
2.1.3.2.1 Signs and symptoms.....	9
2.1.3.2.2 Causes of marasmus.....	10
2.1.3.3 Marasmic kwashiorkor.....	10
2.1.3.4 Underweight.....	10
2.1.4 Pathophysiology.....	10
2.1.5 Method of evaluation PEM.....	11
2.1.5.1 Physical examination.....	11
2.1.5.2 Biochemical tests of PEM.....	13
2.1.6 Prognosis of PEM.....	13
2.1.7 Complication of PEM.....	13
2.1.8 Mortality of PEM.....	13
2.1.9 Treatment of PEM.....	14
2.2 Minerals.....	14
2.2.1 Types of minerals.....	15
2.2.1.1 Macro elements.....	15
2.2.1.2 Trace elements.....	15
2.2.1.2.1 Trace elements in clinical chemistry.....	16
2.2.1.2.2 Biochemical functions of trace elements.....	16
2.2.1.2.3 Zinc.....	17
2.2.1.2.3.1 Zinc metabolism.....	17
2.2.1.2.3.2 Zinc sources.....	17
2.2.1.2.3.3 Zinc functions.....	18
2.2.1.2.3.4 Clinical significance of zinc.....	18
2.2.1.2.3.4.1 Zinc deficiency.....	18
2.2.1.2.3.4.2 Zinc toxicity.....	18
2.2.1.2.3.5 Zinc and growth.....	19

2.2.1.2.3.6 Association between zinc and PEM.....	20
---	----

Chapter Three Materials and Methods

3.1 Study design.....	22
3.2 Study area.....	22
3.3 Study subject.....	22
3.3.1 Excluding criteria	22
3.3.2 Inclusion criteria.....	22
3.3.3 Ethical consideration.....	22
3.3.4 Sample collection and processing.....	22
3.2 Method.....	23
3.2.1 Zinc determination.....	23
3.2.1 Principle.....	23
3.2.1.2 Specimen collection and preparation.....	23
3.2.1.3 Apparatus.....	23
3.2.1.5Quality control.....	23
3.2.1.5 Reagents.....	23
3.2.1.6 Procedure.....	23
3.3 Statistical analysis.....	24

Chapter Four:

Result	25
--------------	----

Chapter Five:

Discussion	35
Conclusion	38
Recommendations	39

References.....	40
------------------------	-----------

Appendixes:

Appendix 1.....	45
Appendix 2.....	46

Abbreviations

BMI	Body mass index
CRSP	Center of Research in security prices
INCAP	Institute of Nutrition of Central America and Panama
IQ	Intelligent quotation
IUGR	Intrauterine Growth Restriction
LBW	Low Birth Weight
LDH	Lactate Dehydrogenase
PEM	Protein energy malnutrition
Z-scores	Standard scores

List of Tables

List	Page
Table 2-1 Gomez classification	8
Table 2-2 Waterlow classification	8
Table 2-3 Welcome classification	8
Table 2-4 Comparison between Kwashiorkor and Marasmus .according to physical signs of nutritional deficiency	12
Table 2-5 Essential trace elements in clinical chemistry.	19
Table 4-1 Means,SD and P.value of weight, height and serum zinc conc in study group.	29
Table 4-2 Means,SD,P.value of zinc conc in patient according .to sex	30
Table 4-3 Means, SD of zinc conc and P.value in Marasmus, .Kwashiorkor and Marasmic kwashiorkor	31

List of figures

- | | |
|------------|--|
| Figure 4-1 | Frequency of sex among Sudanese children under five years
with PEM |
| Figure 4-2 | Distribution of PEM types |
| Figure 4-3 | A scatter plot shows the relationship between BMI and Serum
Zinc level |
| Figure 4-4 | A scatter plot shows the relationship between Height and
Serum zinc level |
| Figure 4-5 | A scatter plot shows the relationship between Weight and
Serum zinc level |

Abstract

This study was held to determine serum zinc level in Sudanese children under five .years with protein energy malnutrition

This study was cross- sectional hospital based conducted during the period from March to July 2011. The study included 80 blood sample collected from Omdurman Teaching Hospital for Pediatric, 50 patient with PEM (aged 6-47 month), 30 control (aged 8-46 month).The weight and height were measured and BMI was calculated for study groups .The serum zinc level was measured used Atomic absorption spectrophotometer (GBC vante ver 1.331 Analysis 1-nal) . The data were analyzed .using SPSS program

The study showed that PEM was more common in boys (62%) than girls (38%), also showed the most common type of PEM is marasmus (78%) then kwashiorkor (12%) and marasmic kwashiorkor (10%). Results showed there was significant decreased in the means of weight (7.0 ± 2.3 kg), height (65 ± 0.016 cm) BMI (12.7 ± 2.7 kg/m²) and serum zinc (0.55 ± 0.18 mg/dl) in children with PEM compared to the control group (12.5 ± 2.4 kg) $P=0.000$, (77 ± 0.022 cm) $P=0.000$, (21.2 ± 3.9 kg/m²) $P=0.000$, (0.94 ± 0.12 mg/dl) $P=0.000 < 0.05$ respectively . Also there was insignificant difference in means of serum zinc level in patient group according to sex boys (0.54 ± 0.2 mg/dl) girls (0.56 ± 0.16 mg/dl) $P=0.713$. Also there was no difference in means of serum zinc level in the three types of PEM marasmus (0.54 ± 0.19 mg/dl), kwashiorkor (0.48 ± 0.07 mg/dl), marasmic .kwashiorkor (0.05 ± 0.15 mg/dl) $P=0.982 > 0.05$

From this study it is concluded that there is a significant decrease in weight, .height, BMI and serum zinc in children with PEM

المناقشة

اجريت هذه الدراسة المقطعية لقياس مستوى الخارصين فى مصل دم الأطفال السودانيين المصابين بسوء التغذية اعمارهم اقل من خمس سنوات .

اجريت هذه الدراسة خلال الفترة من مارس الى يوليو 2011 .حيث شملت هذه الدراسة 80 عينة جمعت من مستشفى امدرمان التعليمى للأطفال , 50 مصابين بسوء التغذية اعمارهم 6-47 شهر, 30من المتطوعين الاصحاء غير مصابين بسوء التغذية كمجموعه ضابطه اعمارهم 8-46 شهر. تم قياس الوزن والطول و حساب مساحة سطح الجسم لمجوعات الدراسة , و قياس الخارصين بواسطه جهاز الامتصاص الذرى.

بينت الدراسة ان سوء التغذية اكثر شيوعا فى الذكور (62%) من الاناث (38%)و كما بينت ان اكثر الانواع شيوعا القرح (78%) ثم كواش كور (12%) ثم القرح الكواشى (10%). ايضا كان هناك انخفاض ذو دلالة احصائية معنويه فى المستوى الوسطى للطول و الوزن و للخارصين و مساحة سطح الجسم عند مقارنه المستويات الوسطى للمجموعه الدراسه بالمجموعه الضابطه حيث كان الاحتمال اقل من 0.05, كما وجد ان ليس هناك فرق فى مستوى الخارصين بين الذكور (0.54ملج) و الاناث (0.56ملجم) فى مجموعه المصابين بسوء التغذية , ايضا ليس هناك فرق فى مستوى الخارصين بين انواع مرض سوء التغذية للمجموعه الدراسه حيث كان القرح (0.54ملج) كواش كور (0.48ملج), القرح الكواشى (0.5ملج) .

النتائج الحالية تعني ان هناك انخفاض فى الوزن والطول و مستوى الخارصين فى الدم فى الاطفال المصابين بسوء التغذية.

