ASSESSMENT OF THE NUTRITIONAL STATUS OF CHILDREN WITH CHRONIC KIDNEY DISEASE

By

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ABSTRACT

Background: *Poor nutritional intake is a common concern in children with CKD, and this often leads to severe growth retardation. Maintaining adequate nutrition and normal body composition is important for patients with chronic kidney disease (CKD) as well as those with end-stage renal disease (ESRD). This study was carried out to assess the growth and the nutritional status in children with CKD and to correlate their caloric and protein intake with anthropometric measurements.*

Objectives*: to assess the growth and the nutritional status in children with CKD and to correlate their caloric and protein intake with different variables (anthropometric measurements and duration of CKD).*

Patients and Methods: *This is a descreptive cross sectional study carried out on 50 child attending Pediatric Nephrology Clinic at Al-Hussein university Hospital. Their age ranged from 2 year to 18 year. The time of the study was 6 months from June 2017-november 2017.They were 34 males & 16 females. Patients were subjected to full history taking including dietary intake, full medical examination including anthropometric measurements, and laboratory investigations including complete blood picture, serum calcium, phosphorus, , and serum albumin. Data were collected, tabulated and statistically analyzed.*

Results: *The study revealed that; weight was the most affected anthropometric parameter, as 70% of the patients were < 5th percentile (mean 21.3 ± 9.6), height is less affected than weight, as 50% of patients were less than 5th percentile (mean 116.6 ± 21.8). In addition the body mass index of 38% of the patient were < 5th percentile, while only 2% of the patient were > 50th percentile. The BMI ranged from 8.9 – 23.4 (mean 15.04 ± 1.9).This retardation was significantly related to duration of CKD.*

Conclusion*: Growth of patients with CKD is markedly affected despite of adequacy of their caloriec intake. the longer the duration of hemodialysis, the more severe the affection of growth parameters.*

Key words: *CKD, nutrition, anthropometric measurements,children.*

INTRODUCTION

Malnutrition is recognized to be a serious and common complication of chronic kidney disease (CKD) and is associated with increased morbidity and mortality **(Foster and Leonard, 2004)**. Contributing factors to this malnutrition include poor appetite, various co-morbidities, dietary restrictions, inflammation and infection, metabolic acidosis and oxidative stress **(Morais et al, 2005)**.

Nutritional status is particularly important in children as it influences growth, sexual development and neurocognitive development, thus its accurate and regular assessment is highly recommended in patients with CKD. **(Cameron, 1996)**

Malnutrition includes several aspects. One of the important aspects is the state of decreased body protein mass and fuel reserves (body protein and fat mass), now better known as protein- energy wasting (PEW) **(Fouque et al, 2008)**. Given the complexity of the pathogenesis and clinical picture of PEW, no single measure, but rather panels of nutritional measures are necessary to diagnose the condition **(Edefouti et al, 2009)**.

The Kidney Disease Outcome Quality Initiative (K/DOQI) recommended the following measures for evaluation of protein-energy nutritional status for children with CKD: Dietary intake (interview or diary), serum albumin, height or length, head circumference (for children < 3 months), estimated dry weight, Height standard deviation score (SD), weight/height index / midarm anthropometric measures and skin fold thickness **(National Kidney foundation, 2000)**.

AIM OF THE WORK

The aim of this study is to assess the growth and the nutritional status in children with CKD and to correlate their caloric intake with different variables (anthropometric measurements and duration of CKD). The severity of wasting and/or stunting will be corelated with the severity and duration of chronic kidney disease.

PATIENT AND METHODS

This is a descreptive cross sectional study carried out on 50 child attending Pediatric Nephrology Clinic at Al-Hussein university Hospital. Their age ranged from 2 year to 18 year. The time of the study was 6 months from June 2017-November 2017. They were 34 males & 16 females.

Inclusion criteria:

Any pediatric patient from 2 years to 18 years with CKD regardless the aetiology. CKD is defined by a presence of kidney damage (for example, any structural or functional abnormality involving pathological, laboratory or imaging findings) for ≥ 3 months or a GFR < 60 ml/min/ 1.73 m2 for ≥ 3 months.

Examples: developmental anomalies, obstructive uropathy, nephrotic syndrome, pyelonephritis.

Exclusion criteria:

1. Patients with multi-organ dysfunction.
2. Age < 2 years.
3. Patients with other systemic diseases as cardiac or hepatic patients.
4. Hospitalization in the last 30 days for medical or surgical problem.

Methods:

1. Full medical history taking including:

- Demographic data (age, sex, residence, education and socioeconomics)
- Presenting complaint (e.g. recurrent UTI, incontinence, FTT.)
- Duration of CKD.

2. Dietary assessment:

A 24 hours dietary recall will be collected carefully and all nutrients will be evaluated regarding calories and protein content.

3. Full clinical examination including anthropometric measurement:

The anthropometric measurements t .will be takenhe landmarks and technique used for measurement were those recommended by **WHO Child Growth Standard (2006**) using standard methods, percentiles and z scores will be used as follows:

- Body weight (in kg)
- Standing height (in cm)
- Body mass index (BMI)

4. Laboratory investigations: CBC, serum creatinine, serum albumin, urea.

5. Ethical consideration:

- Written consent for the study was obtained from the patients or parents.
- Approval of the local committee in the pediatrics department, college and university were obtained before the study.
- There is no conflict of interest regarding the study, authorship and publication.
- The data of the patients and the results of the study are confidential and the patients have the right to keep.

- The authors received no financial support for the study and publication.

The patient has the right to withdraw from the study at any time.

RESULTS

Table (1): Age and sex in studied patients

		Male	Female
Sex		34 (68%)	16 (32%)
Age (years)	**Mean ±SD**	8.8 ± 4.6	
	Min	2	
	Max	17	
	Median (IQR)	8 (6 – 14)	

IQR= interquartile range; (25th percentile – 75th percentile).

This table shows age and sex distribution in all studied cases. There were 68% males and 32% females. Their age is 8.8 ± 4.6 years.

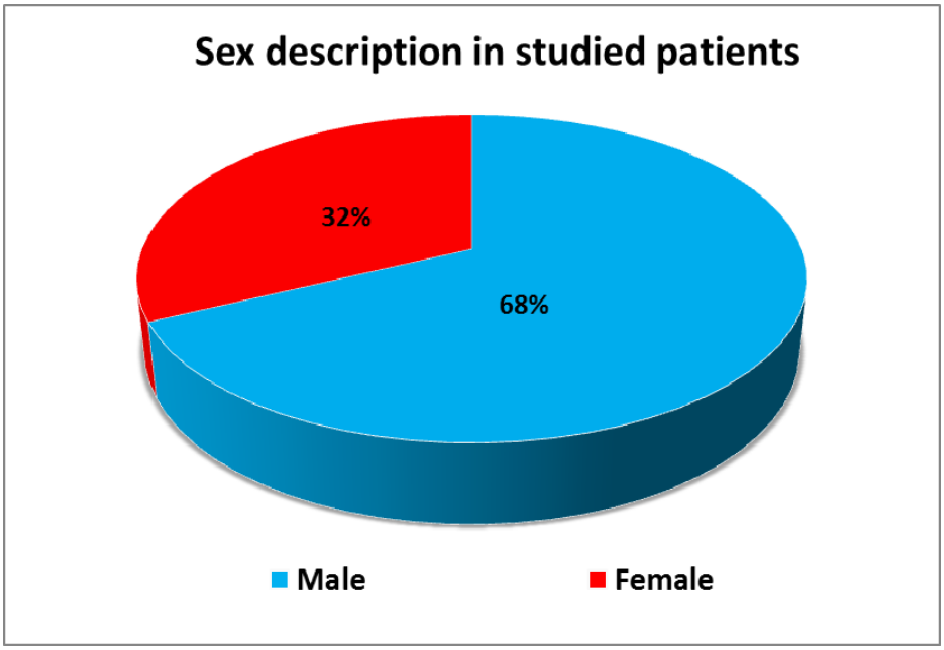

Figure (1): Sex description in studied patients.

Table (2): Description of weight among studied cases.

Weight percentile	n	%
<5th	35	70 %
5th	2	4 %
10th	6	12 %
10th-25th	1	2 %
25th	3	6 %
25th-50th	1	2 %
50th	2	4 %
Weight (Kg)	**Mean ±SD: 21.3±9.6** **Median : 19.2**	**IQR:** **13 (14 – 27)**

This table shows description of weight among studied cases. The highest percentage of cases (70%) was below the 5th percentile.

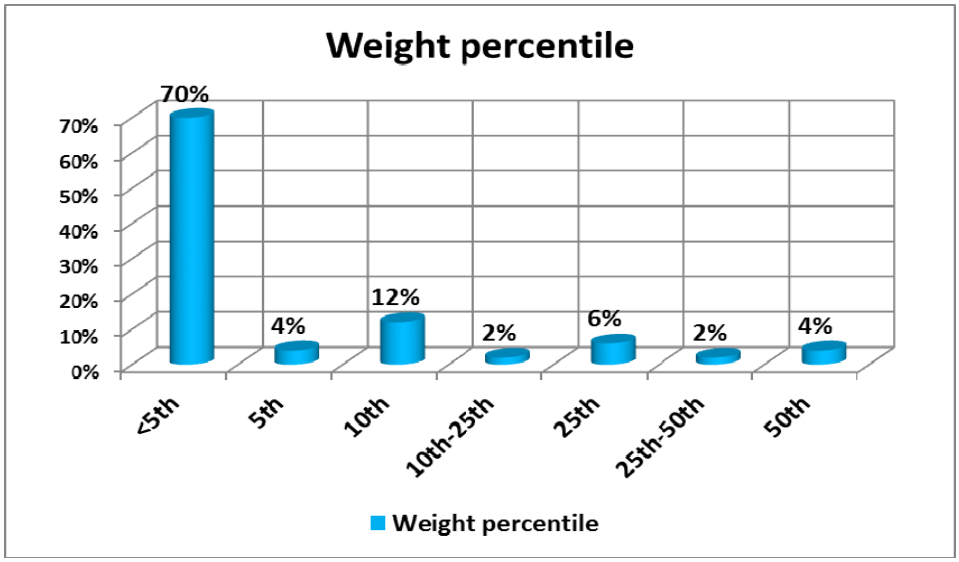

Figure (2): Description of weight among studied cases.

Table (3): Description of height among studied cases.

Height percentile	n	%
<5th	25	50 %
5th	5	10 %
10th	8	16 %
10th-25th	2	4 %
25th	2	4 %
50th	1	2 %
75th	1	2 %
90th	6	12 %
Height (cm)	**Mean ±SD: 116.6±21.8 Median : 116**	**IQR: 35 (100 – 135)**

This table shows description of height among studied cases. The highest percentage of cases (50%) was below the 5th percentile.

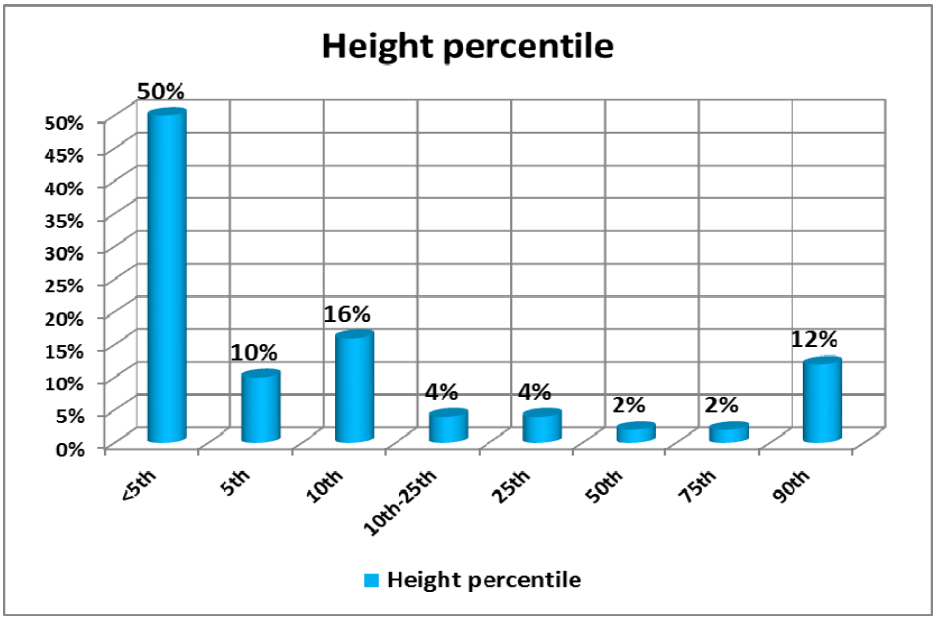

Figure (3): Description of height among studied cases.

Table (4): Description of MAC among studied cases.

MAC percentile	n	%
<5th	35	70 %
5th	2	4 %
10th	6	12 %
10th-25th	1	2 %
25th	4	8 %
50th	2	4 %
MAC (cm)	**Mean ±SD: 15.1±1.7** **Median : 15**	**IQR:** **2.5 (14 – 16.5)**

This table shows description of MAC among studied cases. The highest percentage of cases (70%) was below the 5th percentile.

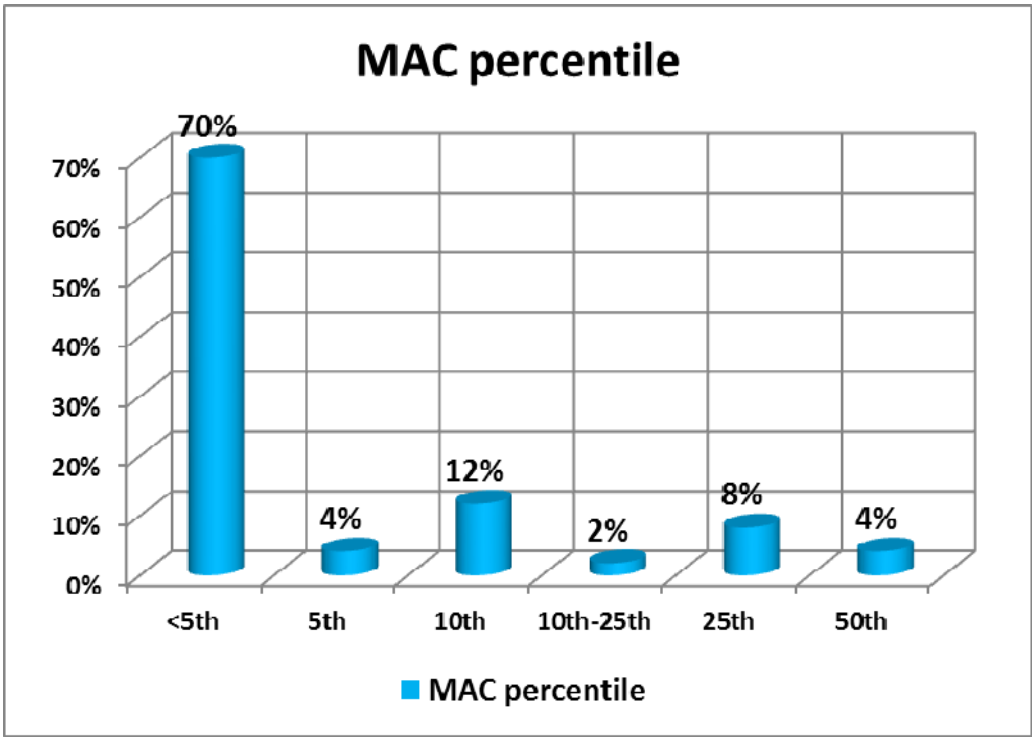

Figure (4): Description of MAC among studied cases.

Table (5): Description of BMI among studied cases.

BMI percentile	n	%
<5th	19	38 %
5th	8	16 %
10th	5	10 %
10th-25th	6	12 %
25th	4	8 %
25th - 50th	1	2 %
50th	6	12 %
50th-75th	1	2 %
BMI (%)	**Mean ±SD: 15.04±1.9 Median : 14.8**	**IQR: 2 (13.8 – 15.8)**

This table shows description of BMI among studied cases. The highest percentage of cases (38%) was below the 5th percentile.

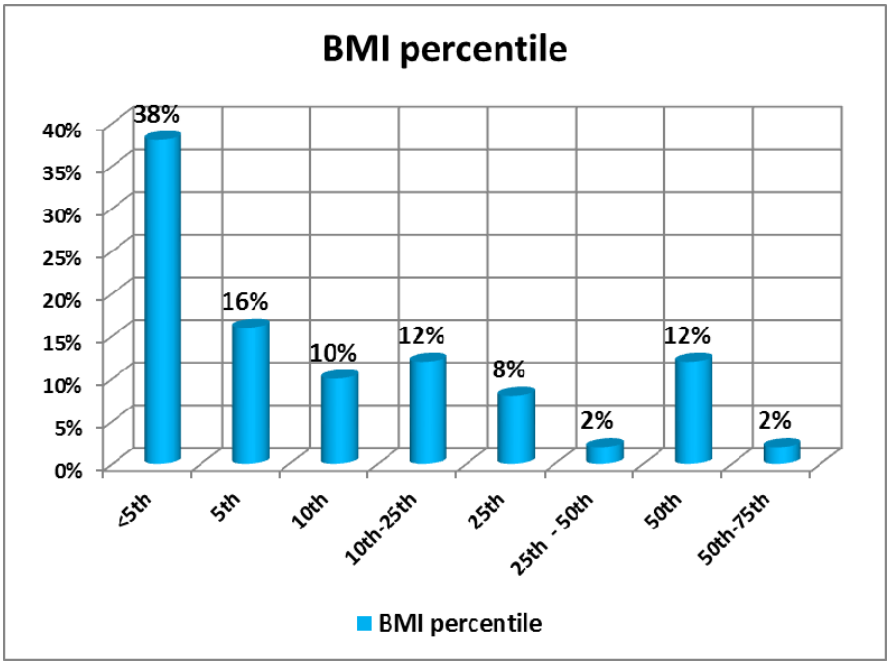

Figure (5): Description of BMI among studied cases.

Table (6): Description of presenting complaint among studied cases.

Presenting complaint	n	%
Recurrent UTI	13	26 %
Primary incontinence	4	8 %
Nocturnal enuresis	7	14 %
Accidental discovery by obstetric U/S	5	10 %
Elevated Renal functions	4	8 %
Fever and abdominal pain	10	20 %
Failure to thrive	7	14 %
Total	**50**	**100%**

This table shows description of presenting complaint among studied cases. The highest percentage of cases (26%) presented with symptoms of recurrent UTI.

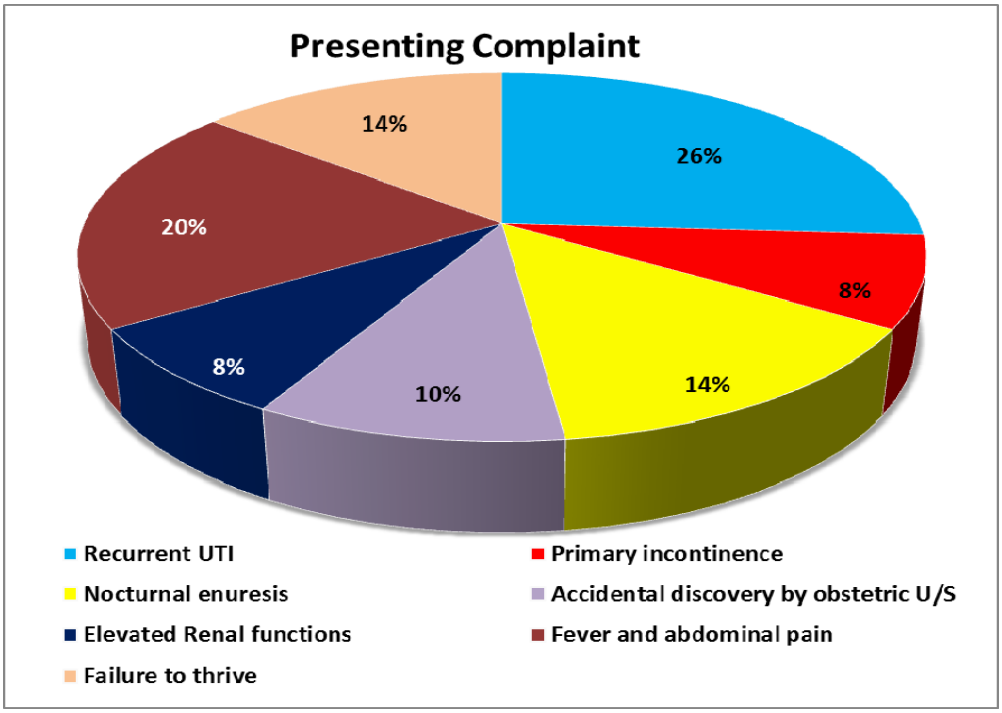

Figure (6): Description of presenting complaint among studied cases.

Table (7): Correlation study between duration of CKD and (weight, height and BMI in studied patients group.

Parameters	(r)	p-value
Duration of CKD vs weight	0.6	**< 0.001***
Duration of CKD vs height	0.7	**< 0.001***
Duration of CKD vs BMI	0.1	0.3

(r): Pearson correlation coefficient.
***: p-value < 0.05 is considered highly significant.**

This table shows:

- **Highly** statistical **significant (p-value < 0.001) positive** correlation between (Duration of CKD vs weight) and (Duration of CKD vs height) in studied patients.
- **No** statistical **significant (p-value > 0.05) positive** correlation between Duration of CKD vs BMI in studied patients.

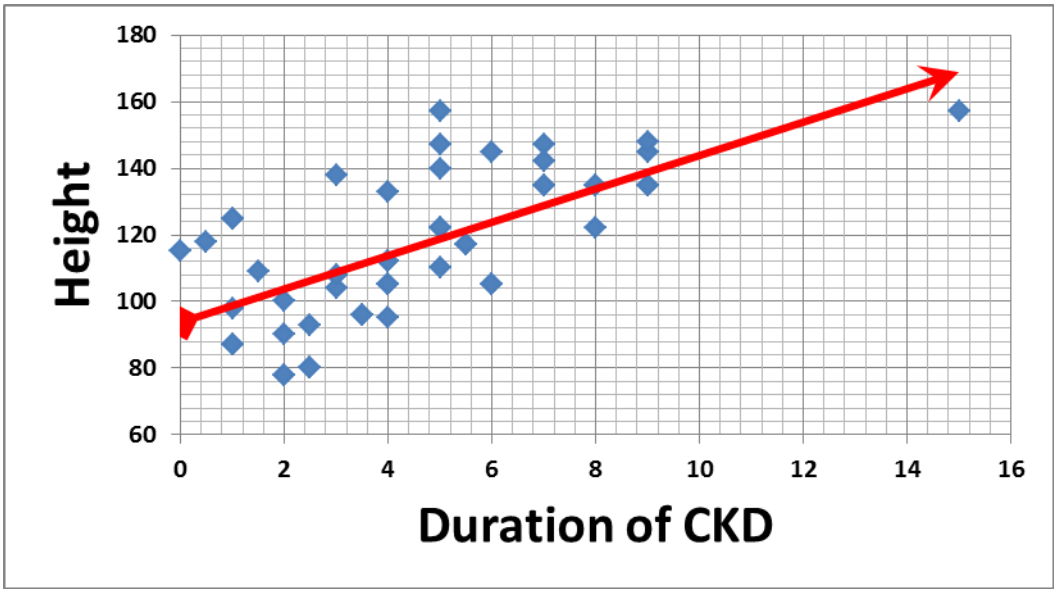

Figure (7): Positive correlation between Duration of CKD and height.

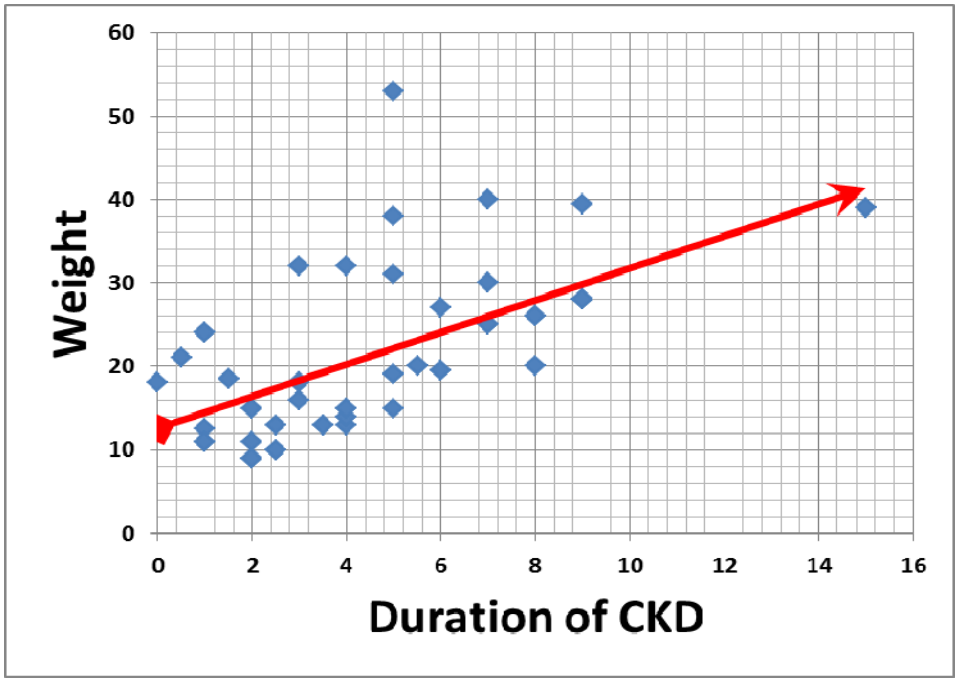

Figure (8): Positive correlation between Duration of CKD and weight.

Table (8): Correlation study between duration of CKD and (ALB, HB, urea and creat. in studied patients group.

Parameters	(r)	p-value
Duration of CKD vs ALB	- 0.8	**< 0.001***
Duration of CKD vs HB	0.09	0.5
Duration of CKD vs urea	- 0.3	0.06
Duration of CKD vs creat.	- 0.1	0.4

(r): Pearson correlation coefficient.
***: p-value < 0.05 is considered highly significant.**

This table shows:

- **Highly** statistical **significant (p-value < 0.001) Negative** correlation between Duration of CKD vs serum ALB in studied patients.
- **No** statistical **significant (p-value > 0.05) Positive** correlation between (Duration of CKD vs HB) in studied patients.

- **No** statistical **significant (p-value > 0.05) Negative** correlation between (Duration of CKD vs urea) and (Duration of CKD vs creat.) in studied patients.

Table (9): Description of laboratory findings among studied cases.

Laboratory parameter	Range	Mean ±SD	IQR
WBCs	(4 – 12.1)	11.3 ± 5.8	(7.7 – 12.5)
HCT	(31.5 – 40.6)	31.8 ± 4.5	(29.8 – 35)
Hb	(10.3 – 14.1)	10.1 ±1.5	(9.1 – 113)
Platelets	(203 – 426)	281.1 ± 64.2	(240 – 331)
Creat. at diagnosis	(0.2 – 0.6)	2.8 ± 1.6	(1.8 – 3.7)
Urea	(14 – 33)	64.4 ± 57.2	(33 – 85)
Total calcium	(8.3 – 9.6)	8.2 ± 0.5	(8 – 8.5)
Phosphorous	(4 – 5)	5.05 ± 0.8	(4.4 – 5.5)
Albumin (g/dl)	(1.6 _ 4.8)	3.5 ± 0.65	(2.9 – 4.1)

Table (10): Caloric intake.

	K cal / day	Kcal/ Kg / day	% of RDA
Range	547 – 2179	22 – 102	19 % - 216 %
Mean ±SD	1305 ± 401	60.3 ± 17	107% ± 36.6%

Table (11): Caloric intake frequency and percentage.

	No. of patients	Percent
energy intake **< 70%** of RDA	**6**	**12%**
energy intake between **70% - 120% (normal)**	**28**	**56%**
energy intake **>120%** of RDA	**16**	**32%**

Table (12): Caloric intake correlations.

		BMI
Caloric intake gm /kg/day	R value	-.377**
	P value	.007

**: Correlation is significant at the 0.01 level (2-tailed).

Table (13): Nutritional status of studied children according to WHO by Z score.

Nutritional status	No. %
Normal	15 30
Wasted	5 10
Severely wasted	3 6
Stunted	14 27
Severely Stunted	10 20
Wasted and Stunted	3 6
Total	50 100

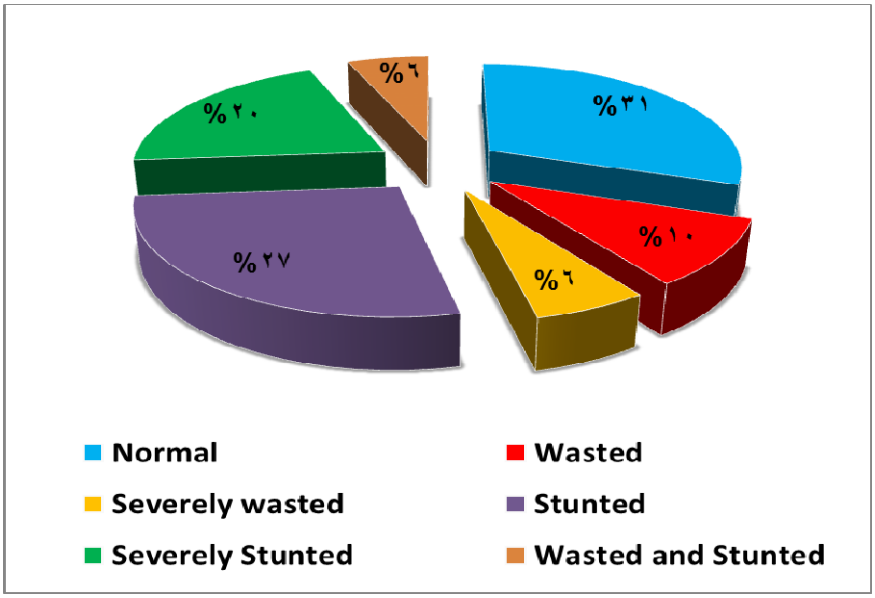

Figure (9): Nutritional status of studied children according to WHO by Z score.

DISCUSSION

Normal growth and development are major goals of pediatric CKD management. Because adequate nutritional status is important in achieving these goals, careful monitoring of nutritional status is essential. Nutritional status is a complex concept that cannot be adequately summarized by a single measurement. Multiple measures, considered collectively, are required to give a complete and accurate picture of nutritional status. Growth parameters are particularly important in children and should be accurately measured using calibrated equipment and standardized techniques***. (KDOQI, 2008)***

This study is a descriptive cross sectional study for children with chronic kidney disease (CKD) who are on regular follow up at pediatric nephrology unit ***at Al-Hussein university Hospitat***.

Fifty cases (50) with chronic renal impairment on conservative treatment were included in this work.

The age of the studied cases ranged from 2-18 years (mean 8.8±4.6) and they were 34 male (68%) and 16 females (32%).

As regard to demographic data, our study revealed that the prevalence of CKD was higher in boys than in girls. Male preponderance may be explained by higher prevalence of obstructive uropathy in our study which is generally common in boys. This agrees with ***Warady and Chadha (2007)*** who reported male preponderance in their studies on CKD children on conservative treatment.

The common presenting symptoms of our cases were recurrent UTI, 13 cases (26%) followed by fever & abdominal pain 10 cases (20%).and failure to thrive 7 cases (14%).The other symptoms represented one to five cases for each category.

Our result correlate with ***Carlstrom (2010),*** who reported that the presenting symptoms depend on the site and type of obstruction, so, frequency of symptoms vary from study to study and from center to center. However, ***Jamro (2003)*** showed that the common clinical presentations were anaemia, growth retardation and urinary complaints like symptoms of UTI or voiding dysfunction. The difference between the present work and the previous study can

be explained by the small sample size, the type of underlying etiology and the younger age in our study. Also anemia is not necessarily a consequence of CKD but might be due to iron deficiency as well.

In the present study patient results of weight &height measurements showed that the majority of cases were below 5th percentile. Also the highest percentage of cases regarding BMI (38%) were below 5th percentile, using ***CDC charts*** specific for weight & height . It has been proved that the majority of children who have CKD suffer from significant growth retardation ***(American Kidney Foundation, 2010).***

In our study, the body weight of 70% of patient were < 5th percentile , while only 4% of the patient were on 50th percentile (mean 21.3 ± 9.6).

This comes in accordance with ***Abitbol et al., 1990 and Foster and Leonard (2004)*** who reported that significant deficit in body weight has been found in studies of children with CKD.

The present work has demonstrated that height was markedly affected in children with CKD, as 50% of the patients were short.

Our results come in accordance with ***Zahran et al., 2002*** who evaluated the growth of 64 Egyptian children with CRF on conservative treatment with an age range of 0.5 – 21 years, and demonstrate that patients with CRF have a mean height SDS of -3.7. On the other hand, data from developed countries generally show less severe height affection, for example, data on growth of 2,329 children in the North American Pediatrics Renal Transplant Cooperative Study ***(NAPRTCS,2006)*** revealed that 36.6%, 47.0% and 43% of children with chronic renal insufficiency (CRI), dialysis, and transplantation, respectively, have short stature, and the mean height SDS was -2.54, -1.95n and -1.67 for children aged 0 to 1 years, 2 to 5 years and 6 to 12 years, respectively ***(NAPRTCS, 2006).***

The more severe affection of height in our country may be due to delayed diagnosis of cases with CKD with consequent delay in interventional measures.

In our study, the body mass index of 38% of the patient were < 5th percentile, while only 2% of the patient were > 50th percentile. The BMI ranged from 8.9 – 23.4 (mean 15.04 ± 1.9).

These results come in accordance with ***Nesrin Beşbaş et al., 1998*** who reported that BMI of 32.6% of the pediatric patients age ranged from 8 – 18 years was decreased, (mean 17.1± 1.6).

Because of the high prevalence of growth retardation in children with CKD, nutrition has always been a primary focus of pediatric CKD care. Early studies emphasized the importance of adequate energy intake in maintaining normal growth in pediatric CKD. However, no study demonstrated a growth advantage to a caloric intake greater than about 75% of the RDA in children older than 3 months. ***(Simmons et al., 1971, Betts and Magrath.1974 and Arnold. 1983)***

In the present study, caloric intake of the patients ranged between 19% - 216% of the RDA of calories with a mean of 107%, and 12% of the patients received < 70% and 32% of the patients received >120% of the RDA of calories. The high caloric intake in our patients is mainly due to consumption of cheap sources of energy like bread.

In our study, caloric intake showed negative correlation with BMI. This disagree with ***Rees and Show (2007)*** who reported that on CRF, restoration of normal energy requirements to 100% of RDA of calories allows for catch-up growth in children under 2 years of age and show some benefit in older children. Both ***Ledermann et al (1999)*** and ***Ellis et al (2001)*** showed no change after increasing caloric supplementation to patients above the age of 3 years.

Serum albumin was recommended in the ***2000 K/DOQI*** Nutrition Guidelines as a marker of nutritional status. Hypoalbuminemia is a common finding in those with CKD and consistently has been associated with increased mortality in both adults and children with CKD***. (Wong et al., 2002)***

The results of our study group revealed that the serum albumin of 20 patients (40%) were < 3.5 gm, while the rest 30 patients (60%) were > 3.5 gm of the serum albumin.

CONCLUSION

- Growth of patients with CKD is markedly affected despite of adequacy of their caloriec intake.
- The longer the duration of CKD, the more severe the affection of growth parameters.

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تقييم الحالة الغذائية للأطفال الذين يعانون من أمراض الكلى المزمنة

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خلفية البحث: يعرف الفشل الكلوي بأنه قصور الكليتين عن أداء وظائفها الحيوية في تنظيم إخراج المواد السامة والحمضية بطريقة منتظمة مما يؤدي إلى اختلاف في نسب الأملاح في الدم . واضطراب في وظائف الهرمونات. ويعتبر الفشل الكلوي لدى الأطفال من الأسباب الرئيسة التي تؤدي إلى تأخر نمو الأطفال، كما يؤدي الى اضطراب إكلينيكي وكيميائي وتغير في نظام التمثيل الغذائي نتيجة تدهور وظائف الكلى، ونقص الهرمونات التي تفرزها الكلى.

الأهداف: الكشف عن تأخر النمو وتقييم الحالة الغذائية للأطفال الذين يعانون من الفشل الكلوي المزمن الذين يترددون على مستشفى الحسين الجامعى.

الأساليب: أجريت هذه الدراسة على خمسون طفلا تتراوح أعمارهم ما بين 2-18سنة من بيئات متنوعة اجتماعيا وجغرافيا وقد تم فحص الأطفال إكلينيكياً مع تسجيل تاريخ الحالة المرضية وقياس الوزن والطول وسمك الجلد ، وتم اختبار وظائف الكلى ، وقياس نسبة الكالسيوم والبوتاسيوم والصوديوم والفسفور ونسبة الهيموجلوبين في الدم.

نتائج البحث: تمت الدراسة على 50 حالة منهم 34 ذكر و 16 أنثى وتتراوح أعمارهم من 2-18 سنة ممن يترددون على عيادة كلى الأطفال بمستشفى الحسين الجامعى وقد أظهرت النتائج أن هؤلاء الأطفال الذين يعانون من الفشل الكلوي المزمن يتعرضون لتأخر شديد وملحوظ في النمو حيث وجدنا أن 70% من وزن الأطفال أقل -3من الانحراف المعياري بينما 50%من طول الأطفال أقل من -3 من الانحراف المعياري و38% من مؤشر كتلة

الجسم أقل من -3 من الانحراف المعيارى. كما وجدت علاقة عكسية بين مدة المرض و مقاييس الجسم المختلفة.

الاستنتاجات: يعزى التأخر في نمو هؤلاء الأطفال إلى سوء الحالة الغذائية التي تصاحب الفشل الكلوي المزمن وكذلك إلى الاضطراب الكيميائي في أملاح الجسم الناتج عن عدم تنظيم إخراجها عن طريق الكلى بطريقة طبيعية، والي فقدان الشهية و فقر الدم.

التوصيات: توصي الدراسة بسرعة تشخيص أمراض الكلى المزمنة وعمل جدول غذائي مناسب لتجنب تأخر النمو. كما توصي ايضا بأن يكون أخصائي التغذية ركن أساسي من فريق علاج الأطفال المرضي بالكلي.

(**الكلمات الدالة** : الأطفال, فشل كلوي مزمن, الحالة الغذائية, تأخر النمو)