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Nutritional Status of Children with Chronic Kidney Disease, Upper Egypt

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Abstract

BACKGROUND: Chronic Kidney Disease (CKD) introduces a unique set of nutritional challenges for the growing and developing child. Maintenance of optimal nutrition plays a key role in the management of children with (CKD) across different stages of CKD, during dialysis and following transplantation.

AIM: To assess the nutritional status of children with CKD.

METHODS: This is a cross-sectional study carried out on 40 children diagnosed with stage 5 CKD of both sex attending Pediatric Nephrology Unite, University Pediatric Hospital, Upper Egypt. Their age ranged from 2-15 years. 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.

RESULTS: Weight was the most affected anthropometric parameter, as 80% of the patients were < 5th percentile. 72.5% of our studied children were stunted, their height was less than 5th percentile. Body mass index (BMI) was normal in only 20% of CKD children, no one was obese and 80% were undernourished. Undernutrition was significantly related to the duration of CKD, male gender, age < 5 years, and low socio-economic state.

CONCLUSION: Undernutrition is widely prevalent among children with CKD. Long duration of hemodialysis, young age at presentation, low socio-economic state, and male gender are the main risk factors that threaten the nutritional status of those children.

Introduction

Pediatric Chronic Kidney Disease (CKD) has systemic implications on all aspects of normal development, including nutrition, growth, bone and mineral metabolism, and neurocognitive function. Maintenance of optimal nutrition plays a key role in the management of children with (CKD) across different stages of CKD, during dialysis and following transplantation [1].

Chronic Kidney Disease (CKD) introduces a unique set of nutritional challenges for the growing and developing child. Maintenance of optimal nutrition plays a key role in the management of children with (CKD) across different stages of CKD, during dialysis and following transplantation [2].

Malnutrition, both under and over-nutrition, is widely prevalent and negatively impacts short-and long-term outcomes. It leads to growth retardation, increased risk of hospitalization and infections, poor cognition, and decreased quality of life [3].

The initial evaluation of a child with renal disease includes height, weight, head circumference (up to 36 months of age), and body mass index. These parameters should be plotted on the appropriate percentile charts [4].

In children, serial measurements are required to properly assess growth. When plot¬ting values, age should be adjusted for prematurity. In the United States, Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines recommend the growth charts of the World Health Organization to monitor children at the age of 0 and 2 years and the growth charts of Centres for Disease Control and Prevention to monitor children at the age of 2 years and older. Disease-specific growth charts (e.g., Trisomy 21, Williams's syndrome) can also be used when appropriate. BMI-for-height age (the age at which the child's current height is the 50th percentile) is recommended to assess children with CKD to provide a more appropriate comparison to children of similar stature and maturation [5].

In children with kidney diseases, an assessment of the child's growth and nutritional status is important to guide the dietary prescription. No single metric can comprehensively describe the nutrition status; therefore, a series of indices and tools are required for evaluation. Clinical practice recommendations (CPRs) for The Pediatric Renal Nutrition Taskforce (PRNT) recommend full nutritional assessment for those children that include measurement of anthropometric and biochemical parameters and evaluation of dietary intake [6]. STAMP [7] (Screening Tool for the Assessment of Malnutrition in Paediatrics) and STRONG kids [8] (Screening Tool for Risk of Impaired Nutritional Status and Growth) are two of the main nutritional risk screening tools for early detection of malnutrition in such cases. The aim of this study is to assess the nutritional status of children with CKD.

Methods

This study is a descriptive cross-sectional study that was conducted at the nephrology unit of a University Children's Hospital. It was approved by the local ethics committee under the number (IRB 17101529), then registered on the clinical trials under the identifier number (NCT04584905). Forty children with chronic kidney disease with renal failure (stage 5), aged from 2 to 15 years, were included in our study. Children with any co-morbid or systemic disease other than CKD, on Irregular dialysis, and those who had Renal transplants were excluded from our study. All patients were subjected to full history taking, detailed physical examination, duration and frequency of dialysis, and anthropometric measures including body weight, height, and body mass index. These parameters were plotted on WHO growth standards. Full laboratory investigations including complete blood picture, kidney functions, and electrolytes.

Statistical analysis: Data was collected and analyzed by using SPSS (version 24). Continuous data were expressed in form of mean ± SD or median (range) while nominal data were expressed as frequency and percentage. The odds ratio (OR) and the 95% confidence interval (CI) for each independent variable were derived through regression analysis. p-value was significant if < 0.05.

Results

Table 1 shows the sociodemographic characteristics of the patients studied. The mean ± SD of the studied patients' age was 11.50 ± 3.26 years ranging from (2 to 15) years. 23 patients (57.5%) were males, and 17 (42.5%) patients were females. The residence of our patients was 28 (70.0%) rural children and 12 (30.0%) urban children. The social classes of the studied children were 18 (45.0%), 20 (50.0%), and 2 (5.0%) for low, medium, and high social classes respectively.

Table 1: Socio-Demographic Characters of Studied Patients

Item	Descriptive "n=40"
1-Age "years"	
Mean ± SD	11.50 ± 3.26
<5yrs.	27 (67.5%)
>5yrs.	13 (32.5%)
2-Sex:	
• Male	23 (57.5%)
• Female	17 (42.5%)
3-Residence:	
• Rural	28 (70.0%)
• Urban	12 (30.0%)
4-Social class:	
• Low	18 (45.0%)
• Medium	20 (50.0%)
• High	2 (5.0%)

Table 2 shows the anthropometric measurements of the patients studied. The Mean + SD of patients' height was (124.52 ± 17.81 cm) range (106.71-142.33 cm), weight was (26.77 ± 11.68 kg) range (15.09-38.45 kg), body mass index was (16.12 ± 4.01) in which 32 (80.0%) of cases found to be underweight and 8 (20.0%) children found to be normal without any overweight children.

Table 2: Anthropometric Measurements of the Studied Patients

Item	Descriptive "n=40"
1-Height (cm)	**124.52 ± 17.81** (106.71-142.33)
2-Weight (Kg)	**26.77 ± 11.68** (15.09-38.45)
3-BMI (Kg/m^2)	**16.12 ± 4.01** (12.11-20.13)
Underweight (<5th centile)	*32 (80.0%)*
Normal (5th-95th centile)	*8 (20.0%)*
Overweight (>95th centile)	--

Data expressed as mean ± SD (range) or numbers (%).

Table 3 shows the nutritional assessment of the Studied Patients expressed as a (percentile) using WHO growth charts. Results showed that the patients with > 5th percentile weight, height, BMI were 32 (80.0%), 29 (72.5%), and 32 (80.0%) respectively. While children with 5th -95th percentile were 8 (20.0%), 11 (27.5%), and 8 (20.0%) children for the same parameters respectively with no patient >95th percentile.

Table 3: Nutritional status of the Studied Patients using WHO growth charts

"n=40" Percentile	Weight	Height	Body mass index
<5th	32 (80.0%)	29 (72.5%)	32 (80.0%)
5th -95th	8 (20.0%)	11 (27.5%)	8 (20.0%)
>95th	-	-	-

Data expressed as mean ± SD (range) or numbers (%).

Table 4 shows the relation between nutritional assessment and duration of dialysis in the studied group expressed as a (percentile). Duration of CKD more than 2 years, 95.45 % falls below the 5th centile on WHO growth charts for weight for age, and 86.36%falls below the 5th centile on WHO growth charts for height for age and that was significantly greater compared to children with the period of dialysis

less than 2 years as 61.11% of them falls below 5th centile on WHO growth charts for weight for age and 55.55% of them falls below 5th centile for height for age (p<0.001).

Table 4: Relation between nutritional assessment and duration of dialysis in the studied group

Item	Duration of CKD		P-value
	<2yrs. "n=18"	>2yrs. "n=22"	
Weight			
<5th	11 (61.11%)	21 (95.45%)	**P<0.001****
5th -95th	7 (38.84%0	1 (4.54%)	
Height			
<5th	10 (55.55%)	19 (86.36%)	**P<0.001****
5th -95th	8 (44.44%)	3 (13.63%)	

Data expressed as numbers (%).

Discussion

In children with CKD, inadequate nutritional intake may be the most important factor leading to poor growth and/or abnormal body composition. Measures of length, weight, and head circumference are relatively easy and inexpensive to obtain and probably represent the most valuable indices of nutritional status in children with CKD [10].

This study revealed that malnutrition among children with CKD was more common in children aged less than 5 years (n = 27) compared to children aged more than 5 years (n = 13) this was in accordance with the repeated WHO reports that state that about 43 percent of children under 5 years of age, living in low – and middle-income countries are at risk of suboptimal development and malnutrition [11]. Growth and neurodevelopment progress very rapidly during the first 3 years of life; therefore, inadequate nutrition during this critical period may result in serious growth restriction and developmental delays [6].

The present study revealed that malnutrition was more prevalent in boys than in girls. This finding may be explained by the higher prevalence of obstructive uropathy which is generally more common in boys than girls. Warady and Chadha (2007) also reported male preponderance in their studies on CKD children, but he stated that the reasons for these gender differences are not clearly understood [12].

As regards patients' social classes, we found that most malnourished patients were of low social class followed by those of medium class and the least percentage within high social class children. Rivenbark et al 2020 stated that childhood development delay is a major public health problem in resource-limited countries and children from lower-income households are at increased risk for poor health, educational failure, and behavioral problems. This social gradient is one of the most reproduced findings in health and social science [13].

As regards BMI of our children studied, 32 children (80%) were underweight. BMI does not allow for the distinction between various body components meanwhile, muscle deficits are common in CKD children and typically persists post-kidney transplant [14]. This suggests that even CKD children with normal BMI may have excess adiposity or fluid retention, and these imbalances may be present even with adequate physical activity and adherence to proper management [15]. BMI may also be misleading because many children with CKD have growth retardation. Consequently, short children with CKD may have a normal weight compared with pediatric norms, but their short stature leads to a raised BMI so adjustment of BMI for height age (age at which an individual's height would be at the 50th centile) have been validated in our study as being more accurate than the unadjusted BMI [16]. Despite the influential factors noted above, BMI for children more than 2 years or weight for children younger than 2 years, remains the best primary measure of malnutrition or adiposity for children with kidney disease. It is easy to calculate and is indicative of being overweight at the upper end or underweight at the lower end.

On evaluating the relation between nutritional status and duration of CKD, our study found that in patients with a duration of CKD of more than 2 years, 95.45 % fall below the 5th centile on WHO growth charts for weight for age and 86.36% fall below 5th centile on WHO growth charts for height for age and that was significantly greater compared to children with periods of dialysis less than 2 years as only 61.11% of them fall below 5th centile on WHO growth charts for weight for age and 55.55% of them falls below 5th centile for height for age (p<0.001). Wong et al have evaluated the association between anthropometric measurements and death among pediatric patients at CKD stage 5 and showed that each decrease by 1SD in height was associated with 14% increase in the risk of death and for each 1SD decrease in growth velocity the risk of death increased by 12% [17]. Poor linear growth in CKD children is the result of several factors, including metabolic acidosis, inadequate nutrition, renal osteodystrophy, sodium depletion, delayed sexual maturation, and abnormality of growth hormone-insulin-like growth factor axis]18[. Many of these factors also affect weight gain. Assessment of weight and linear growth (Length before 2 years of age or height from 2 years of age) should be regularly measured by trained personnel for early detection and management of malnutrition among CKD children [19].

Conclusion

Undernutrition is widely prevalent among children with CKD in Upper Egypt. Long duration of hemodialysis for more than 2 years, young age at presentation less than 5 years of age, low socio-economic state, and male gender are the main risk factors that threaten the nutritional status of those children.

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