ORIGINAL RESEARCH

Factors Associated With Anthropometric Indicators of Nutritional Status in Children With Chronic Kidney Disease Undergoing Peritoneal Dialysis, Hemodialysis, and After Kidney Transplant

Julieta García De Alba Verduzco, BSc, MSc,[*,†] *Erika Fabiola Hurtado López, MD, DSc,*[*,†] *Consuelo Pontón Vázquez, BSc, MSc,*[†] *Adriana de la Torre Serrano, MD,*[*] *Enrique Romero Velarde, MD, DSc,*[†] *and Edgar Manuel Vásquez Garibay, MD, DSc*[†]

Objective: The objective of the study was to demonstrate that there are differences in the factors associated with anthropometric indicators of nutritional status, with particular emphasis on arm indicators, in children with end-stage kidney disease undergoing peritoneal dialysis (PD), hemodialysis (HD), and after kidney transplant (KT).

Methods: An analytical cross-sectional study of consecutive cases included 130 children and adolescents with end-stage kidney disease undergoing substitutive treatment: 49 patients who underwent KT, 33 undergoing PD, and 47 undergoing HD. Socioeconomic data were obtained from all the 3 groups; anthropometric indicators of nutritional status were calculated. Student's *t*-test and analysis of variance were used for parametric variables. Chi-square test, Mann-Whitney *U* test, Kruskal-Wallis test, and odds ratio (OR) were used for nonparametric variables.

Results: The number of parents living as couples was higher for patients who underwent KT (OR = 3.5 [95% confidence interval {CI} 1.34-9.0]) and undergoing PD (OR = 3.0 [95% CI 1.06-8.8]) than those undergoing HD. The number of mothers who worked outside the home was higher for patients who underwent KT and undergoing PD than the mothers of patients undergoing HD (OR = 13.7 [95% CI: 4.56-41.05]; OR = 15.4 [CI 95% 4.8-49], respectively). Family income was higher for patients who underwent KT and undergoing PD (P = .019, P = .093, respectively). More than 40% of patients in all the 3 groups had growth impairment. Body mass index, mid-upper arm circumference, tricipital and subscapular skinfolds, total arm area, and arm fat area were affected in HD and PD groups (9 to 40%), while of the patients who underwent KT, 36.7% were overweight or obese. More than 50% of patients who underwent KT and undergoing HD and PD had involvement in the arm muscular area.

Conclusions: Socioeconomic conditions are more influential for children in the HD program. The nutritional status of children after KT improves; however, not all anthropometric indicators are fully recovered. Children after KT are up to 9 times more likely to be overweight or obese.

Introduction

CHILDREN WITH END-STAGE kidney disease (ESKD) reach a frequency of protein-energy malnutrition ranging from 20% to 80%.[1–4] This pathological entity that affects children with ESKD causes loss of lean mass, depletion of fat mass, and deceleration of growth with affectation in height. These alterations are a consequence of multiple factors, including hormonal imbalance, low nutrient intake, decreased residual renal function, use of renal replacement programs (hemodialysis [HD] and peritoneal dialysis [PD]), chronic inflammation, and metabolic acidosis.[5–8] It has been observed that children with ESKD who underwent kidney transplantation (KT) are overweight or obese, probably because of inadequate diets, administration of immunomodulating drugs, and psychological and affective alterations.[5,9–11] Overweight and obesity are

[*]*Unidad Médica de Alta Especialidad, Hospital de Pediatría, Centro Médico Nacional de Occidente, Instituto Mexicano del Seguro Social, Guadalajara, Jalisco, México.*

[†]*Instituto de Nutrición Humana, Centro Universitario de Ciencias de la Salud, Departamento de Clínicas de la Reproducción Humana, Crecimiento y Desarrollo Infantil, Universidad de Guadalajara, Guadalajara, Jalisco, México.*

Financial Disclosure: The authors declare that they have no relevant financial interests.

Address correspondence to Edgar Manuel Vásquez Garibay, MD, DSc, Instituto de Nutrición Humana, Hospital Civil de Guadalajara Dr. Juan I. Menchaca, Salvador Quevedo y Zubieta # 350, Col. Independencia, CP 44340, Guadalajara, Jalisco, México. E-mail: vasquez.garibay@gmail.com

1051-2276/$36.00

https://doi.org/10.1053/j.jrn.2018.03.002

considered a significant health problem because they may be associated with graft rejection and increased morbidity and mortality.[10-12] The evaluation of nutritional status in children with ESKD in the different substitution programs is complicated by the fact that we do not have a gold standard of comparison and by variations in body composition, both due to the inherent causes of the disease and the use of the programs of substitution therapy.[2,3,5,9,11]

Anthropometric indicators including weight for age, weight for height, height for age, and body mass index (BMI) may be useful for the evaluation of nutritional status; however, these indicators do not identify alterations in body compartments such as fat mass and muscle mass. Therefore, anthropometric indicators of the arm could be an adequate alternative and relatively easy to obtain.[13-15] Studies conducted to assess nutritional status from anthropometric indicators in children with ESKD and factors that may be involved in variations of these indicators in patients undergoing a substitute program, particularly in children who underwent KT, are scarce.[2,4,7] Therefore, the purpose of the present study is to demonstrate that there are differences in the factors associated with anthropometric indicators of nutritional status, with particular emphasis on arm indicators, in children with ESKD undergoing PD and HD, and after kidney transplant.

Material and Methods

Design

In an analytical cross-sectional study, 130 children and adolescents aged 6-18 years with ESKD undergoing substitutive treatment were consecutively included: 49 children who underwent KT, 33 undergoing PD, and 48 undergoing HD. Patients from the nephrology service of the Pediatric Hospital of the Western National Medical Center of the Mexican Institute of Social Security with a diagnosis of ESKD undergoing renal replacement therapy for a period of more than 3 months and less than 5 years were selected consecutively. Children with ESKD who attend this tertiary-level medical center come from the state of Jalisco and the northwest part of the country; and, for that moment, they already have several months or years of clinical evolution. Those who did not present with genetic diseases or episodes of catheter dysfunction or peritonitis in the previous month and children who did not have acute graft rejection after KT were included. Informed consent was obtained from one of the parents or from a legally responsible person, and an interview was conducted with the mother or guardian of the child to obtain socioeconomic and demographic data and aspects related to the treatment of KT, PD, and HD.

Anthropometric Measurements

Measurements of weight, height, mid-upper arm circumference (MUAC), tricipital skinfold (TSF), and subscapular skinfold (SSF) were performed. With MUAC and TSF, total arm area (TAA), arm muscle area (AMA), and arm fat area (AFA) were calculated.[14] The BMI was also obtained. Weight measurement was performed on a scale with a minimum reading of 100 g Health O Meter® Professional model 450KL (Sunbeam, Inc., USA). To measure height, we used the Stadiometer SECA, model 213 (Hamburg, Germany). The child stood without shoes on the base of the stadiometer with his back straight so that his shoulders and buttocks touched the surface of the device and was positioned in the Frankfort plane.

The MUAC was measured using an ergonomic Fiberglass Circumferential Tape SECA model 201 (Hamburg, Germany). The measurement was performed on the nondominant limb, or, where appropriate, on the side opposite the arteriovenous fistula, at the midpoint between the acromion and the olecranon. Skinfolds were measured using a Harpenden caliper model HSB-BI (Burgess Hill, England). The TSF was measured on the posterointernal side of the middle arm; the SSF was measured at the level of the lower angle of the scapula. The procedure was repeated 3 times by the same observer, and the average of the measurements was obtained. The height/age, MUAC, TSF, SSF, TAA, AMA, AFA, and BMI indicators were estimated according to the World Health Organization reference standards and anthropometric standards by Frisancho.[14] These indices were grouped into different categories according to the standard deviations (SDs) with a normality criterion of ± 1 SD. To have a greater adherence to the definition of dry weight, all measurements were made at the end of the HD session. For children undergoing PD, the program nurse drained the peritoneal cavity before making the anthropometric measurements.

Statistical Analysis

Descriptive statistics of the studied variables were obtained. The normal distribution of the parametric variables was assessed using the Kolmogorov-Smirnov test, and the equality of variances was assessed using Levene's test. The unpaired Student's *t*-test was used for parametric variables for 2 independent samples, and analysis of variance was used for the comparison of more than 2 independent samples. For nonparametric variables, chi-square test and Mann-Whitney *U* test for 2 samples and Kruskal-Wallis test for 3 or more proportions were used. The potential probability of risk or protection was estimated by the odds ratio (OR) with 95% confidence interval (CI). The statistical software IBM SPSS Statistics, version 20, and Epi info 7 were used.

Ethical Considerations

The research protocol adhered to the guidelines of the Declaration of Helsinki (2013, the latest update); informed consent was obtained and signed by one of the parents or the legally responsible person, and the project was carried out once the protocol was approved by the Committee of