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Body composition and hydration factors in infants and young children using multicompartment models

Ms. VILLEGAS-VALLE, Rosa Consuelo [1]; Dr. VALENCIA, Mauro E [1]; Dr. SOTELO-CRUZ, Norberto [1]; Dr. HURTADO-VALENZUELA, Jaime Gabriel [2]; Ms. ANTUNEZ-ROMAN, Lesley Evelyn [1]; Mr. LOPEZ-JIMENEZ, Cesar A [1]; Ms. MONREAL-BARRAZA, Brianda I [1]; Ms. ROBLES-VALENZUELA, Edna L [1]

[1] *Universidad de Sonora, Mexico*

[2] *Hospital Infantil del Estado de Sonora - HIES*

Corresponding Author: che.elito@gmail.com

Background. Until recently deuterium (2H2O) analysis has been performed almost exclusively by isotope ratio mass spectrometry (IRMS). The IAEA has promoted the FTIR methodology to measure deuterium (2H2O) enrichment, but there is limited information in infants and small children, which have different hydration status than adults. Due to the limited information available, the optimum deuterium dose amount to be administered to children in these studies has also been controversial. The aim of this investigation were to measure body composition and determine the hydration factors in infants and young children using multi-compartment models generating algorithms for prediction of body composition. Subjects and Methods. Seventy-eight male and female infants and young children (ages 3-24 months), from the urban and agricultural zones of Hermosillo, Sonora, Mexico participated. We measured weight, length and circumferences to evaluate nutritional status using the WHO Growth Reference 2006. We also measured total body water (TBW) by deuterium oxide dilution, bone mineral content (BMC) through a DXA scan and body density was estimated through published algorithms. Bioimpedance analysis (BIA) was also measured to explore the prediction of body composition using this technique. Results. In general, children from the urban area had better nutritional indicators than children from the agricultural area. Eleven (16.1%) children had some type of malnutrition (any nutritional index below -2 Z cutoff point) and 2 were overweight. Optimal amount of deuterium for dosing in this age range was 0.53 to 0.83 mg/kg body weight, which has implications for future studies of body composition in infants and young children. DXA overestimated body fat percentage compared to other 2, 3 and 4 compartment models ($p<0.0001$). Hydration of fat-free mass was not different between children with normal nutritional indexes and those with some type of malnutrition ($p>0.05$). Resistance or impedance indexes (Height2/R or Z) were not important predictors of FFM or TBW (increase in R2=0.004). Prediction of FFM was then performed by using only anthropometric variables, sex and age. The final model was: FFM (kg) = 0.6462 (Body weight in kg) + 0.0672 (Age in months) + 0.2702 (Sex; 0 for females and 1 for males) + 0.4263 (R2= 0.98, SEE=0.19, n=21) based on the 4C model by Lohman (1993). Final FFM prediction model was accurate, precise and showed no significant bias. Conclusions. Children from the urban area had a better nutritional status than the children from the agricultural zone. Hydration of FFM in malnourished children does not appear to be different to the hydration of FFM in healthy children; however, sample size needs to be increased. In this age group, BIA with current methodology applied to adults was not appropriate for predicting body composition.