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Echocardiographic Nomograms for Chamber Diameters, Area and Volumes in Children: Preliminary Data

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Background: Despite a quantitative evaluation of cardiac chambers dimension in pediatric echocardiography is often required, nomograms for these structures are very limited or even absent. Aim: to establish reliable pediatric echocardiographic nomograms for cardiac chamber dimensions.
Methods: we performed two-dimensional and M-mode measurements of 23 individual cardiac structures. These included: systolic and diastolic left ventricular (LV) volumes, area and length calculated in 4 and 2-chamber view by Simpson's method, LV diameters evaluated in M-mode and in 4 and 2-chamber views, right ventricular area and diameters and atrial diameters and area evaluated in 4-chamber view.
Statistical analysis: Models using linear, logarithmic, exponential, and square root relationships were tested. Heteroscedasticity was tested by White test and Breusch-Pagan test. Age, weight, height, and body surface area (BSA), calculated by seven different formulas, (i.e. Haycock, DuBois, Mosteller, Dreyer, Meban, Boyd and Gehan) were used as the independent variables in different analysis to predict the mean values of each echocardiographic measurement. Structured Z scores were then computed.
Results: 912 consecutive Caucasian Italian healthy children (age range 0 days-17 years; 44.8% females) with a BSA ranging from 0.12 to 1.8 m2 were prospectively enrolled.
The calculation of BSA using the Haycock formula provided the best results while other formulas either underestimated (DuBois, Mosteller, Dreyer, and Meban) or overestimated (Boyd and Gehan) BSA.
The Haycock formula has been used when presenting data. Data have been presented by the use of tables showing predicted values (mean±2SD) for a given BSA and by percentile charts. Equations relating echocardiographic measurements to BSA for every parameter were also provided. For all the measurements there was no significant intra/inter-observer variability.
Conclusions: We present echocardiographic normal values for chamber volumes, area and diameters derived from a large population of children. Our data partly cover an important gap of knowledge in actual pediatric echocardiographic nomograms and will allow for a more reliable calculation of chamber dimensions. Further studies are required to reinforce these data, as well to evaluate other parameters and ethnicity.
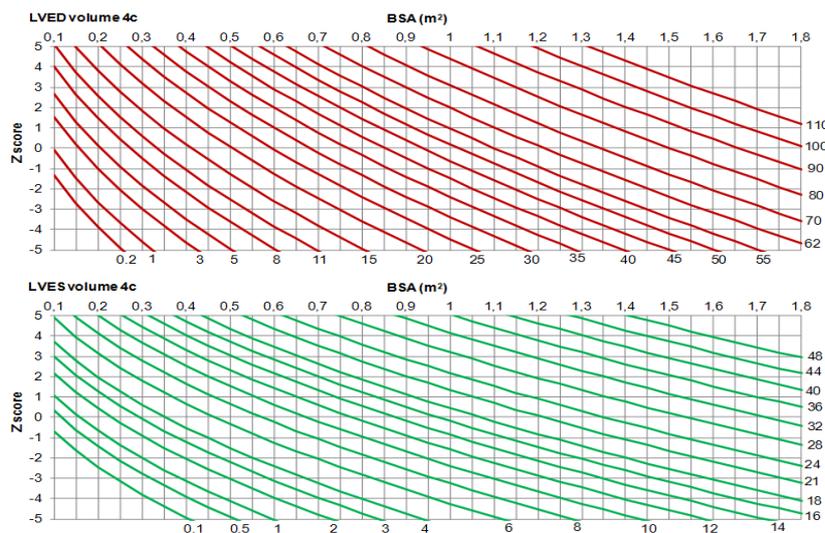
Figure 1: we report, as an example, percentile-charts for LV volumes (by Simpson's method). LVED=left ventricular end diastolic, LVES= left