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Normal values for left and right ventricular speckle-tracking systolic strain in healthy Italian children

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Background: There is an increasing interest in echocardiographic strain measurements for the assessment of ventricular myocardial function in children, however pediatric nomograms remain limited. Nomograms for the left ventricle (LV) strain values are all numerically limited (with all the studies inferior to 300 subjects and many less than 80 subjects), while data for the right ventricle (RV) are very limited (all less than to 50 subjects) and heterogenous. Our aim was to establish pediatric nomograms LV and the RV strain measured by two-dimensional speckle tracking echocardiography (2D-STE) in a wide cohort of healthy children prospectively enrolled.

Methods: Echocardiographic measurements included: STE LV longitudinal and circumferential and RV longitudinal global end-systolic strain. Age/weight/height/heart rate (HR), and body surface area (BSA) were used as independent variables in different analyses to predict the mean values of each measurement. Echocardiograms were performed by Philips iE33 systems (Philips, Bothell, USA) and offline measurements on Philips Qlab 9.

Results: In all, 723 subjects (age 31 days-17 years; 47.5% female) were studied. Feasibility varied from 97.0% for LV global longitudinal strain (GLS), to 87.0% for RV GLS, up to 71.6 % for LV global circumferential strain. Low coefficients of determination (R 2) were noted among all of the strain parameters evaluated and adjusted for age/weight/height/BSA/HR (i.e. R 2 all < 0.10, range 0.02-0.086). This hampered the possibility to perform z scores with a sufficient reliability. In fact the z scores by using similar R2, generated a difference of more than 20 points among lower and upper limits of normality. We also evaluated the possibility to perform percentiles, but they suffered for the same limitations. Thus, we limited to present data as mean values (plus or minus SD) stratified for age groups (Figure 1).

Age variation of strain values were limited. LV longitudinal strain values decreased with age (p inferior to 0.001), while no significant age-related variations were noted for RV longitudinal strain. Furthermore, no significant effects were found for most measurements.

Conclusions: We calculated echocardiographic normal values for 2D STE for the LV and RV strain in the greatest cohort of healthy children reported so far, by using vendor specific software. Our results tend to confirm previous observations showing only limited variations of strain parameters with age and gender.

Mean and standard deviation of measurements by age group.

Measurements	31 days-24 months (1)	2-5 years (2)	5-11 years (3)	11-18 years (4)	p	post hoc*
Left ventricle						
Longitudinal Strain 4 c	26.1±2.4	25.7±2.6	25.1±2.6	24.8±2.4	<0.001	1 vs 3,4; 2 vs 4
Longitudinal Strain 2 c	26.7±2.8	25.6±2.7	25.4±2.7	24.3±2.8	<0.001	1 vs 2,3,4; 2,3 vs 4
Longitudinal Strain 3 c	25.4±3.3	24.1±3.1	23.8±2.9	23.2±2.9	<0.001	1 vs 2,3,4
Global Longitudinal Strain	26.0±2.3	25.0±2.2	24.7±2.3	24.0±2.3	<0.001	1 vs 2,3,4; 2,3 vs 4
Circumferential strain basal	22.1±4.8	21.3±4.4	22.0±4.6	22.6±4.2	0.243	---
Circumferential strain medial	23.4±6.3	23.5±4.7	24.8±4.8	25.9±4.8	0.003	2 vs 4
Circumferential strain apical	28.0±8.5	25.7±5.9	26.9±6.7	27.5±5.7	0.238	---
Global Circumferential strain	24.6±4.2	23.3±4.3	24.5±4.5	25.4±4.2	0.020	2 vs 4
Right ventricle						
Global longitudinal strain	25.4±3.9	25.9±4.0	25.8±4.7	25.0±4.1	0.305	---