

Normal Values of MAPSE and TAPSE in the Paediatric Population Established by Cardiovascular Magnetic Resonance

Filippo Puricelli

Royal Brompton Hospital

Sabiha Gati

Royal Brompton Hospital, London

Winston Banya

Royal Brompton Hospital

Piers EF Daubeney

Royal Brompton Hospital

Dudley J Pennell

Royal Brompton Hospital

Inga Voges

University Hospital Schleswig Holstein: Universitätsklinikum Schleswig-Holstein

Sylvia Krupickova (✉ sylviakrupickova@gmail.com)

Royal Brompton and Harefield NHS Foundation Trust <https://orcid.org/0000-0002-6314-9350>

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Abstract

not applicable, this is Letter to Editor

Declarations

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Measurement of mitral and tricuspid annular plane systolic excursion (MAPSE, TAPSE) by echocardiography provides additional information for biventricular functional assessment with high reproducibility. To date, cardiovascular magnetic resonance (CMR) equivalents of MAPSE and TAPSE for paediatric patients are not available. This study aimed to provide a set methodology for the evaluation of longitudinal function and reference values in healthy paediatric patients.

The study population consisted of all children and adolescents retrospectively selected from who underwent a CMR scan between 2016-2020, resulting in normal cardiac findings. Images were obtained with 1.5T scanners (Sonata/Avanto, *Siemens Medical Solutions*, Germany) and were analysed by a single observer using CMR post-processing software (CMRTools; *Cardiovascular Imaging Solutions*, UK).

Lateral and septal MAPSEs (L-MAPSE, S-MAPSE) and TAPSE were measured from 4-chamber bSSFP cines. L-MAPSE and S-MAPSE were measured as the distance between the cutting edge of mitral annulus with left ventricular (LV) lateral wall or septum, respectively, captured at end-diastole and at end-systole. TAPSE was measured as the distance between the cutting edge of the tricuspid annulus with right ventricular (RV) free wall captured at end-diastole and at end-systole (*Figure 1*).

Intraobserver and interobserver variability was determined in 25 patients measured by two independent observers, using Intraclass correlation coefficient (ICC).

Fulfilling the inclusion criteria were 138 paediatric patients [88 males] with a mean age (SD) of 13.3 (2.9) years (range 4.0-17.0). The mean body surface area (BSA) was 1.6 (0.3) m² [range 0.7-2.2].

Table 1 shows normal MAPSE and TAPSE values.

For L-/S-MAPSEs, simple linear regression showed a weak but significant correlation with age² ($r=0.28, p=0.001/r=0.36, p=0.001$), BSA ($r=0.26, p=0.001/r=0.32, p=0.001$) and LV end-diastolic volume index ($r=0.24, p=0.003/r=0.22, p=0.009$; LVEDVi). When tested in a multivariable model, only correlation with age² for both MAPSEs and with LVEDVi for L-MAPSE was maintained.

For TAPSE, simple linear regression showed a weak but significant correlation with age² ($r=0.22, p=0.008$), BSA ($r=0.30, p=0.0001$) and RV end-diastolic volume index ($r=0.33, p=0.0001$; RVEDVi). In a multivariable model, only correlation with RVEDVi was maintained.

The methods for measuring MAPSEs and TAPSE demonstrated excellent intraobserver agreement (L-MAPSE ICC=0.89, $p<0.0001$; S-MAPSE ICC=0.90, $p<0.0001$; TAPSE ICC=0.98, $p<0.0001$) and high interobserver agreement (L-MAPSE ICC=0.70, $p<0.0001$; S-MAPSE ICC=0.81, $p<0.0001$; TAPSE ICC=0.95, $p<0.0001$).

Ejection fraction (EF) is a widely recognised index of global systolic function in guidelines and clinical practice. However, EF alone has low sensitivity in detecting early contractile impairment with limitations in certain conditions[1]. It is widely considered that the more longitudinally oriented subendocardial fibres provide a significant contribution to normal cardiac function. Echocardiographic studies have established the correlation of MAPSE and TAPSE with LVEF and RVEF. Moreover, MAPSE and TAPSE have been shown to be more sensitive than EF in certain settings including heart failure with preserved LVEF. TAPSE shows high negative predictive power in detecting RV dysfunction and has been shown to be an independent predictor of cardiovascular death in the general population, especially in individuals with normal EF[5].

These data provide the imaging community with normal reference values of CMR-derived MAPSE and TAPSE in healthy paediatric cohorts to serve as additional parameters for the evaluation of LV and RV global function.

References

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2. D Modin, R Mogelvang, DM Andersen, T Biering-Sorensen. Right Ventricular Function Evaluated by Tricuspid Annular Plane Systolic Excursion Predicts Cardiovascular Death in the General Population. *J Am Heart Assoc*, 2019 May;8(10):e012197

Table

Table 1. Normal MAPSE, TAPSE values for our study population presented in age groups as mean (SD) and centiles.

	<i>Age group [yrs]</i>	<i>n</i>	<i>Mean (SD) [mm]</i>	<i>Centiles</i>	<i>Actual Value (Z-Score)</i>
L-MAPSE	4-9	15	13.3 (1.3)	2.5 th ; 97.5 th	10.8 (-2.5); 15.5 (+1.6)
	10-14	66	13.6 (1.2)	2.5 th ; 97.5 th	10.0 (-3.2); 15.7 (+1.6)
	15-17	57	14.0 (1.0)	2.5 th ; 97.5 th	11.9 (-1.6); 15.9 (+1.9)
S-MAPSE	4-9	15	11.7 (1.4)	2.5 th ; 97.5 th	9.5 (-2.6); 13.8 (+0.7)
	10-14	66	12.8 (1.2)	2.5 th ; 97.5 th	10.1 (-2.1); 14.9 (+1.6)
	15-17	57	13.2 (1.3)	2.5 th ; 97.5 th	9.7 (-2.4); 15.8 (+2.1)
TAPSE	4-9	15	22.8 (3.8)	2.5 th ; 97.5 th	18.2 (-1.9); 29.5 (+1.6)
	10-14	66	24.3 (2.8)	2.5 th ; 97.5 th	18.6 (-1.8); 29.4 (+1.6)
	15-17	57	24.8 (3.4)	2.5 th ; 97.5 th	18.6 (-1.8); 32.7 (+2.6)

Figures

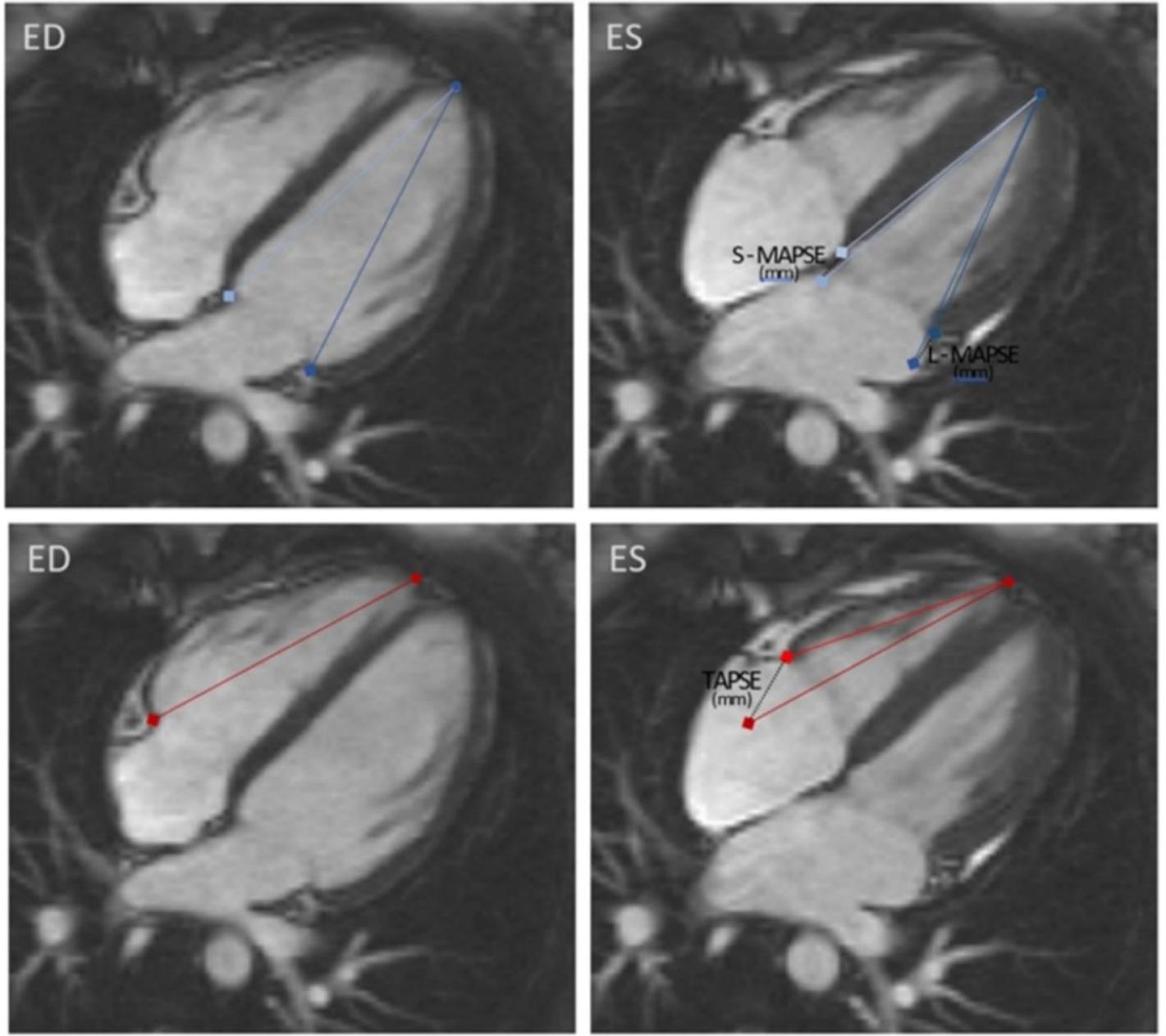


Figure 1

MAPSE and TAPSE measurement using a four-chamber cine image. MAPSE was measured as the distance between the cutting edge of mitral annulus with LV lateral wall (L-MAPSE) or septum (S-MAPSE) captured at end-diastole (ED) and at end-systole (ES). TAPSE as the distance between the cutting edge of tricuspid annulus with RV free wall captured at end-diastole and at end-systole.