

Supplementary Material

Supplementary Table 1: Conventional 2D echocardiographic parameters of male and female athletes

	Male (n=168)	Female (n=46)	P
LVIDd (mm)	49.9±4.2	47.3±2.9	<0.001
IVSd (mm)	9.6±1.5	9.0±1.2	0.006
PWd (mm)	8.7±1.2	8.1±1.1	0.002
RWT	0.35±0.05	0.34±0.05	0.412
LVMi (g/m ²)	88.3±15.4	79.0±13.5	<0.001
E (cm/s)	92.2±16.6	87.9±18.3	0.131
A (cm/s)	57.1±13.9	61.3±20.3	0.105
E/A	1.70±0.48	1.54±0.45	0.049
DT (ms)	168.2±30.9	171.7±40.8	0.526
Mitral lateral s' (cm/s)	11.8±2.4	11.6±2.4	0.681
Mitral lateral e' (cm/s)	18.1±2.9	18.7±3.4	0.201
Mitral lateral a' (cm/s)	6.0±1.8	6.9±1.8	0.005
Mitral medial s' (cm/s)	9.0±1.3	9.8±1.5	<0.001
Mitral medial e' (cm/s)	13.4±2.1	14.5±2.4	0.002
Mitral medial a' (cm/s)	6.5±1.4	7.5±2.0	<0.001
E/e' average	6.12±1.01	5.43±1.10	<0.001
LAVi (mL/m ²)	24.3±7.8	25.7±7.8	0.256
RVd (mm)	33.6±4.1	30.7±3.7	<0.001
RVSP (mmHg)	24.1±4.2	22.7±3.8	0.082
TAPSE (mm)	23.6±3.7	22.4±3.4	0.067
FAC (%)	47.2±6.2	49.3±5.3	0.040
RVSLs (%)	-23.3±4.9	-23.5±4.0	0.846
RVFWLS (%)	-29.6±4.4	-29.6±3.7	0.996
RAVi (mL/m ²)	26.7±6.6	24.1±6.1	0.019

Continuous variables are presented as means ± SD, categorical variables are reported as frequencies (%). A: mitral inflow velocity during atrial contraction, a': peak late (atrial) diastolic annular velocity, DT: deceleration time, E: early diastolic mitral inflow velocity, e': early diastolic annular velocity, FAC: fractional area change, IVSd: interventricular septal thickness at end-diastole, LAVi: left atrial volume index, LV: left ventricle, LVIDd: LV internal diameter at end-diastole, Mi: mass index, PWd: posterior wall thickness at end-diastole, RAVi: right atrial volume index, RV: right ventricle, RVd: RV basal diameter, RVFWLS: RV free wall longitudinal strain, RVSLs: RV septal longitudinal strain, RVSP: right ventricular systolic pressure, RWT: relative wall thickness, s': systolic annular velocity, TAPSE: tricuspid annular plane systolic excursion

Supplementary Table 2: Comparison of conventional echocardiographic parameters in mixed and endurance athletes

	Mixed (n=180)	Endurance (n=26)	P
Age (years)	15.7±1.4	15.8±1.3	0.977
Since (years)	8.4±3.0	8.9±2.8	0.453
Training time (h/week)	11.1±5.1	21.8±4.7	<0.001
VO ₂ /kg (mL/kg/min)	54.6±6.8	55.0±6.0	0.747
LVIDd (mm)	49.5±4.0	48.5±4.7	0.214
IVSd (mm)	9.5±1.5	9.7±1.3	0.559
PWd (mm)	8.5±1.2	8.7±1.1	0.640
RWT	0.35±0.05	0.36±0.05	0.238
LVMi (g/m ²)	86.2±15.0	90.4±19.5	0.196
E (cm/s)	91.8±16.0	87.8±22.6	0.265
A (cm/s)	57.2±13.9	59.9±18.2	0.379
E/A	1.68±0.45	1.58±0.58	0.326
DT (ms)	168.9±32.0	168.2±36.6	0.925
Mitral lateral s' (cm/s)	11.8±2.4	11.4±2.5	0.480
Mitral lateral e' (cm/s)	18.3±2.9	18.0±3.8	0.673
Mitral lateral a' (cm/s)	6.1±1.8	6.7±2.3	0.129
Mitral medial s' (cm/s)	9.0±1.4	9.6±1.3	0.033
Mitral medial e' (cm/s)	13.5±2.1	13.6±2.2	0.775
Mitral medial a' (cm/s)	6.6±1.5	7.0±1.4	0.243
E/e' average	6.03±1.04	5.73±1.31	0.329
LAVi (mL/m ²)	24.2±7.6	27.5±9.4	0.049
RVd (mm)	33.1±4.1	32.7±4.4	0.660
RVSP (mmHg)	23.8±4.2	24.1±3.3	0.763
TAPSE (mm)	23.5±3.6	22.3±3.9	0.120
FAC (%)	47.8±6.0	46.7±6.9	0.391
RVSLs (%)	-23.8±4.8	-21.1±3.8	0.007
RVFWLS (%)	-30.0±4.3	-27.6±4.0	0.008
RAVi (mL/m ²)	26.1±6.7	26.9±6.7	0.561

Continuous variables are presented as means ± SD, categorical variables are reported as frequencies (%).

A: mitral inflow velocity during atrial contraction, a': peak late (atrial) diastolic annular velocity, DT: deceleration time, E: early diastolic mitral inflow velocity, e': early diastolic annular velocity, FAC: fractional area change, IVSd: interventricular septal thickness at end-diastole, LAVi: left atrial volume index, LV: left ventricle, LVIDd: LV internal diameter at end-diastole, Mi: mass index, PWd: posterior wall thickness at end-diastole, RAVi: right atrial volume index, RV: right ventricle, RVd: RV basal diameter, RVFWLS: RV free wall longitudinal strain, RVSLs: RV septal longitudinal strain, RVSP: right ventricular systolic pressure, RWT: relative wall thickness, s': systolic annular velocity, TAPSE: tricuspid annular plane systolic excursion

Supplementary Table 3: Comparison of 3D echocardiographic data in mixed and endurance athletes

	Mixed (n=180)	Endurance (n=26)	P
LEFT VENTRICLE			
LV EDVi (mL/m ²)	81.3±12.3	76.6±15.4	0.084
LV ESVi (mL/m ²)	34.9±6.8	32.8±8.8	0.159
LV SVi (mL/m ²)	46.3±7.1	43.9±8.1	0.112
LV Mi (g/m ²)	84.8±13.1	81.8±13.7	0.283
LV EF (%)	57.2±3.8	57.6±4.8	0.604
RIGHT VENTRICLE			
RV EDVi (mL/m ²)	81.4±13.4	80.4±19.0	0.736
RV ESVi (mL/m ²)	36.4±8.0	37.7±11.0	0.487
RV SVi (mL/m ²)	45.0±6.9	42.8±9.2	0.140
RV EF (%)	55.5±4.5	53.6±4.7	0.042
RV LEF (%)	25.8±5.3	22.0±3.6	0.001
RV REF (%)	22.1±6.1	23.5±5.6	0.255
RV AEF (%)	26.1±5.2	25.0±6.2	0.321
LEF/RVEF	0.46±0.09	0.41±0.07	0.003
REF/RVEF	0.40±0.10	0.44±0.08	0.054
AEF/RVEF	0.47±0.08	0.46±0.09	0.769
LEF' (%)	19.4±4.0	16.8±2.8	0.001
REF' (%)	16.5±4.2	17.9±4.0	0.117
AEF' (%)	19.6±3.5	19.0±4.1	0.380

Continuous variables are presented as means ± SD, categorical variables are reported as frequencies (%). AEF: anteroposterior ejection fraction, EDVi: end-diastolic volume index, EF: ejection fraction, ESVi: end-systolic volume index, LEF: longitudinal ejection fraction, LV: left ventricle, Mi: mass index, REF: radial ejection fraction, RV: right ventricle, SVi: stroke volume index

Supplementary Table 4: Correlations between 3D echocardiographic parameters and VO₂/kg

	r	P
LEFT VENTRICLE		
LV EDVi	0.377	<0.001
LV ESVi	0.340	<0.001
LV SVi	0.344	<0.001
LV Mi	0.369	<0.001
LV EF	-0.272	<0.001
RIGHT VENTRICLE		
RV EDVi	0.377	<0.001
RV ESVi	0.340	<0.001
RV SVi	0.344	<0.001
RV EF	-0.131	0.056
RV LEF	0.068	0.321
RV REF	-0.100	0.145
RV AEF	-0.189	0.006
LEF/RVEF	0.138	0.044
REF/RVEF	-0.073	0.290
AEF/RVEF	-0.155	0.023
LEF'	0.097	0.155
REF'	-0.088	0.199
AEF'	-0.172	0.011

Pearson or Spearman correlation tests.