Abstract: Cardiac remodeling in junior endurance athletes.


On behalf: ProAtHeart

Topic(s): Sports Cardiology

Citation: Background: The long-term cardiovascular repercussions of high level, high volume sports practice are well established. However, despite the fact that most athletes start training and competing at a junior level, few studies have evaluated and integrated the effects of cardiovascular remodeling at a young age.

Purpose: To phenotype the structural and functional cardiovascular adaptations associated with high volume exercise in junior elite endurance athletes in a multicenter longitudinal cohort study, the ProAtHeart study.

Methods: We evaluated and compared cardiac remodeling of elite junior endurance athletes at baseline and after 2 years. Exercise performance, cardiac remodeling and electrophysiological characteristics were assessed with cardiopulmonary testing for maximal oxygen consumption (VO2max), cardiac magnetic resonance imaging (CMR) and 24-hour Holter monitoring, respectively. Wilcoxon signed-rank tests and General Linear Models with gender and evaluation time as fixed effects were used to evaluate the evolution of the different study parameters over time.

Results: Sixty-one junior athletes [43 male, 17 (16 – 18) years of age] were included in this analysis. Male athletes had a higher VO2max (65.9±5.2 vs 57.2±4.6, p<0.001) and a higher exercise training load (14±6 hours vs. 9±4 hours, p=0.001) compared to female athletes. At baseline, mean ventricular volumes of junior athletes already approached the upper limits of normal of healthy non-athletic adults. Compared to female athletes, male athletes had higher ventricular volumes (LVEDV: 214±42 vs. 158±22 and RVEDV: 240±57 vs. 175±27, p<0.001 for both) and a lower ejection fraction (LVEF 56.7±5.9 vs. 59.8±4.9, p=0.01 and RVEF: 51.1±5.5 vs. 54.5±6.6, p=0.026). At follow-up, ventricular volumes, function and volume-to-mass ratio remained stable (see figure) and sex-related differences persisted. Interestingly, a significant proportion of junior athletes had an ejection fraction below the lower limits of normal (LVEF<50%, RVEF<45%) both at baseline and at follow-up (7% for LVEF and 13-15% for RVEF respectively). Bradycardia burden (heart rate <50 b.p.m.) was high, especially in male athletes. Ventricular premature beats were noted in up to 70% of athletes, but mostly (98% at baseline and 94% at follow up) only in small numbers (<100/24-hour).

Conclusion: Even at young age, pronounced cardiac remodeling can be observed in endurance athletes. This remains relatively stable during follow-up, indicating that the bulk of remodeling has already occurred in adolescence. A significant proportion of young athletes, however, presents with low LVEF and RVEF, the long-term significance of which requires further follow-up.
Cardiac remodeling in junior endurance athletes.

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