

Long-Term Clinical Consequences of Intense, Uninterrupted Endurance Training in Olympic Athletes

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Objectives	The aim of this study was to assess incidence of cardiac events and/or left ventricular (LV) dysfunction in athletes exposed to strenuous and uninterrupted training for extended periods of time.
Background	Whether highly intensive and uninterrupted athletic conditioning over a long period of time might be responsible for cardiac events and/or LV dysfunction is unresolved.
Methods	We assessed clinical profile and cardiac dimensions and function in 114 Olympic athletes (78% male; mean age 22 ± 4 years), free of cardiovascular disease, participating in endurance disciplines, who experienced particularly intensive and uninterrupted training for 2 to 5 consecutive Olympic Games (total, 344 Olympic events), over a 4- to 17-year-period (mean 8.6 ± 3 years).
Results	Over the extended period of training and competition, no cardiac events or new diagnoses of cardiomyopathies occurred in the 114 Olympic athletes. Global LV systolic function was unchanged (ejection fraction: $62 \pm 5\%$ to $63 \pm 5\%$; $p = \text{NS}$), and wall motion abnormalities were absent. In addition, LV volumes (142 ± 26 ml to 144 ± 25 ml; $p = 0.52$) and LV mass index (109 ± 21 g/m ² to 110 ± 22 g/m ² ; $p = 0.74$) were unchanged, and LV filling patterns remained within normal limits, although left atrial dimension showed a mild increase (37.8 ± 3.7 mm to 38.9 ± 3.2 mm; $p < 0.001$).
Conclusions	In young Olympic athletes, extreme and uninterrupted endurance training over long periods of time (up to 17 years) was not associated with deterioration in LV function, significant changes in LV morphology, or occurrence of cardiovascular symptoms or events. (J Am Coll Cardiol 2010;55:1619–25) © 2010 by the American College of Cardiology Foundation

The long-term clinical consequences of cardiac remodeling in trained athletes and whether chronic exposure to highly intensive athletic conditioning might ultimately be responsible for abnormal cardiac function and/or adverse events are not completely resolved. Occurrence of “cardiac fatigue” with acute and transient left ventricular (LV) systolic dysfunction and segmental wall motion abnormalities have been reported as an effect of prolonged endurance events lasting 3 to 17 h—such as Iron-man triathlon races (1–4)—suggesting that athletic training, when particularly strenuous, might be responsible for

deterioration in LV function. We have previously shown persistent LV cavity enlargement after prolonged deconditioning in former elite athletes (5), and other investigators have reported LV dysfunction in professional bicyclists of middle-age (6). Indeed, more than 10% of elite cyclists participating in serial Tour de France races unexpectedly showed systolic dysfunction with marked

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LV cavity dilation, suggesting a possible diagnosis of dilated cardiomyopathy (7). More recently, ominous ventricular tachyarrhythmias of right ventricular origin—associated with mild reduction in systolic function—have been reported in highly trained cyclists (8), suggesting that excessive physical training might have adverse electrophysiologic consequences.

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