Left Ventricular Mass in Adolescent Basketball Players

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Previous studies have demonstrated an increased left ventricular mass in professional basketball players. However, no data are available on left ventricular dimensions in adolescent basketball players. We used echocardiography to measure the left ventricular dimensions and left ventricular mass in 10 high-school basketball players aged 14 to 17 years. The left ventricular mass was then indexed and compared to published reference values for young males. The resulting data show that the 95% confidence intervals for left ventricular mass and ratio of left ventricular mass to height in well-trained adolescent basketball players lie above the 90th percentile of established normal values, and that the ratio of left ventricular mass to body surface area approaches the 90th percentile. The results of this study indicate that basketball training in an adolescent population is associated with an increased left ventricular mass and increased ratios of left ventricular mass to height and to body surface area.

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Adult basketball players have been shown to have an increased left ventricular mass as compared to controls.[1,2] However, the effect of basketball training on the adolescent heart has not been examined. We studied a group of competitive adolescent basketball players in order to compare their left ventricular mass and dimensions to established normal values for this age group.[3]

We evaluated 11 male basketball players aged 14 to 17 years who were members of a highly rated high-school basketball team. Two players were eliminated from the study after a complete history and physical examination, one because of hypertension and another because of a combination of hypertension and obesity.

Each player had two-dimensional and M-mode echocardiography performed according to the recommendations of the American Society of Echocardiography, using leading-edge to leading-edge methodology.[4] The left ventricular end-diastolic internal dimension was measured at the tips of the mitral valve leaflets, along a perpendicular line extending from the leading edge of the left septal surface to the leading edge of the left ventricular endocardium. The measurement was made at the time of onset of ventricular depolarization as denoted by a Q or R wave recorded on a simultaneous electrocardiogram. The left ventricular posterior wall thickness was measured as the distance between the anterior surface of the endocardium and the surface of the epicardium of the left ventricular posterior wall. The interventricular septal thickness was measured as the distance between the right ventricular septal surface and the leading edge of the left ventricular surface of the septum. The left ventricular wall and interventricular thicknesses were measured during end-diastole, using the same anatomic position markers at which the left ventricular end-diastolic internal dimension was measured.

The left ventricular mass was calculated using the formula:

$$\text{LV mass} = 0.80[1.04\,(\text{IVSTd} + \text{LVIDd} + \text{PWTd})\,3 - \text{LVIDd}3] + 0.6\text{ g}$$

This formula was used because of an excellent correlation ($r = 0.90$) to left ventricular mass in necropsy studies,[5] and because it was the formula that Daniels et al[3] used in

TABLE I: BASELINE CHARACTERISTICS OF THE STUDY AND REFERENCE POPULATIONS

FEATURE	STUDY	REFERENCE
Age	16.2 ± 0.36	12.6 ± 0.30
Height	1.83 ± 0.03	1.54 ± 0.02
Weight	76.1 ± 3.44	47.3 ± 1.45
Body surface area	1.97 ± 0.06	1.38 ± 0.03

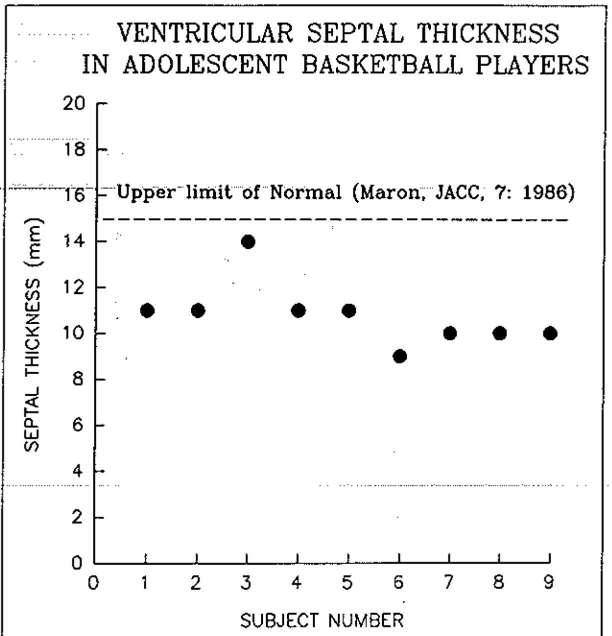

Figure 1. Ventricular septal thickness in adolescent basketball players.

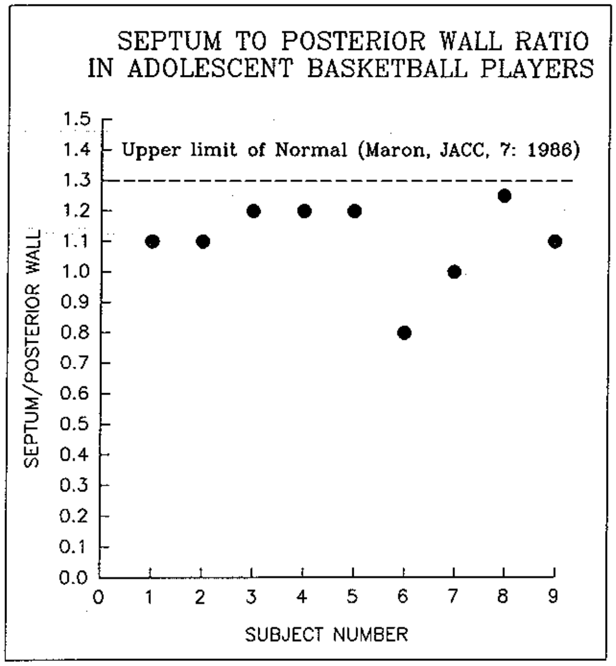

Figure 2. Ratio of interventricular septal to posterior free wall thickness in adolescent basketball players.

et al[3] (Table II), and remained so ($P < .001$) even after indexing for height and body-surface area (Table II).

This study demonstrates that basketball training in an adolescent population is associated with an increased left ventricular mass and a left ventricular mass index that is well above the 90th percentile of established normal values. Although our study population included subjects that were on the average older, taller, weighed more, and had a greater body surface area than the group examined by Daniels et al, all of our echocardiographic data were indexed to account for differences in height and weight.

Cardiac changes that result from athletic training have been described as part of the "athletic heart syndrome." One of the problems with this syndrome is differentiating the presence of a normal physiologic, morphologic change in the heart from a disease such as hypertrophic cardiomyopathy. Yet this differential diagnosis is especially relevant for young athletes because hypertrophic cardiomyopathy accounts for 48% of sudden deaths related to exertion in athletes under 35 years old.[7]

Maron et al[6] found that certain echocardiographic features, such as a posterior wall thickness exceeding 15 mm, or a septal-to-posterior wall thickness ratio above 1.3, could help differentiate an athletic heart from hypertrophic cardiomyopathy. The increase in left ventricular mass seen in our subjects is most likely a physiologic hypertrophy, as demonstrated by a normal interventricular wall thickness and a normal wall-thickness ratio. The clinician may use these results as an aid in recognizing normal variations due to basketball training in adolescent males, and for distinguishing physiologic hypertrophy from a pathologic state.

TABLE II: LEFT VENTRICULAR DIMENSIONS IN COMPETITIVE HIGH SCHOOL BASKETBALL PLAYERS VERSUS PUBLISHED REFERENCE VALUES

	REFERENCE VALUES (PERCENTILE)		BASKETBALL PLAYERS	
	50TH	90TH	MEAN	95% CONFIDENCE INTERVAL
LVM (g)	99.7	156.2	205.0	174–236
LVM/BSA (g/m²)	70.4	95.1	100.7	88–114
LVM/HT (g/m)	62.6	91.0	110.0	94–126

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