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ORIGINAL RESEARCH

# Blood Pressure and LV Remodeling Among American-Style Football Players

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## JACC: CARDIOVASCULAR IMAGING CME

**CME Editor:** Ragavendra R. Baliga, MD.

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**CME Objective for This Article:** After reading this article the reader should be able to: 1) discuss the up-to-date knowledge regarding the long-term cardiovascular health of American style football participants; 2) recognize common changes in blood pressure and myocardial structure in American-style football players after one season of college football participation; and 3) define the association between American-style football field position, resting blood pressure, and changes in left ventricular function.

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## ABSTRACT

**OBJECTIVES** This study sought to determine the relationships among American-style football (ASF) participation, acquired left ventricular (LV) hypertrophy, and LV systolic function as assessed using contemporary echocardiographic parameters.

**BACKGROUND** Participation in ASF has been associated with development of hypertension and LV hypertrophy. To what degree these processes impact LV function is unknown.

**METHODS** This was a prospective, longitudinal cohort study evaluating National Collegiate Athletic Association Division I football athletes stratified by field position (linemen: n = 30; vs. nonlinemen, n = 57) before and after a single competitive season, using transthoracic echocardiography. LV systolic function was measured using complementary parameters of global longitudinal strain (GLS) (using 2-dimensional speckle-tracking) and ejection fraction (EF) (2-dimensional biplane).

**RESULTS** ASF participation was associated with field position-specific increases in systolic blood pressure (SBP) (a Δ SBP of 10 ± 8 mm Hg in linemen vs. a Δ SBP of 3 ± 7 mm Hg in nonlinemen; $p < 0.001$) and an overall increase in incident LV hypertrophy (pre-season = 8% vs. post-season = 25%, $p < 0.05$). Linemen who developed LV hypertrophy had concentric geometry (9 of 11 [82%]) with decreased GLS (Δ = −1.1%; $p < 0.001$), whereas nonlinemen demonstrated eccentric LV hypertrophy (8 of 10 [80%]) with increased GLS (Δ = +1.4%; $p < 0.001$). In contrast, LV ejection fraction in the total cohort, stratified by field position, was not significantly affected by ASF participation. Among the total cohort, lineman field position, post-season weight, SBP, average LV wall thickness, and relative wall thickness were all independent predictors of post-season GLS.

**CONCLUSIONS** ASF participation at a lineman field position may lead to a form of sport-related myocardial remodeling that is pathologic rather than adaptive. Future study will be required to determine if targeted efforts to control blood pressure, minimize weight gain, and to include an element of aerobic conditioning in this subset of athletes may attenuate this process and translate into tangible downstream health benefits.


Hypertension affects approximately 30% of adults in the United States and is associated with premature cardiovascular disease, including myocardial infarction, stroke, arrhythmias, and heart failure (1,2). Recently, it was demonstrated that hypertension in early life is a strong independent predictor of cardiovascular disease in later life and premature mortality (3,4). Additionally, elevated blood pressure in adolescent athletes predicts sustained hypertension 1 year later (5). As such, the identification and management of hypertension in at-risk younger people may improve long-term cardiovascular health.

American-style football (ASF) is a popular sport, with more than 5 million annual participants in the United States (6,7). Prior cross-sectional studies suggest an association between ASF participation and hypertension (8–11). Recent longitudinal work from our group demonstrated that participation in a single season of ASF is associated with increased systolic blood pressure (SBP) among linemen and that increases in blood pressure are associated with the development of concentric left ventricular (LV) hypertrophy (12). These findings are relevant in the context of prior data from the National Institute for Occupational Safety and Health which demonstrated