

## Letters

### RESEARCH LETTER

## Social Determinants of Health and Cardiovascular Risk in Collegiate American-Style Football Athletes



Black adults are twice as likely to die from cardiovascular disease relative to White adults.<sup>1</sup> Factors underlying these disparate health outcomes include social determinants of health (SDOH) grounded in a legacy of structural racism and discrimination. However, the effects of SDOH on health outcomes in younger individuals are not well-established.

Young Black athletes have increased risk of sudden cardiac death compared to White athletes,<sup>2</sup> but there is no evidence that they have higher prevalence of genetic cardiac conditions. As such, similar to the general population, understanding the impact of social disparities on outcomes in young Black athletes is imperative. As a first step to address this uncertainty, we sought to examine differences in neighborhood deprivation and experiences with discrimination in a multicenter cohort of self-identified Black and White freshman collegiate American-style football (ASF) athletes. We also explored the relationship between neighborhood deprivation and known maladaptive ASF cardiovascular phenotypes hypertension, arterial stiffness, and reduced diastolic function. We hypothesized that Black ASF athletes would report more experiences with discrimination, have higher neighborhood deprivation, and that these factors would be associated with cardiovascular risk.

Incoming Black and White freshman ASF athletes from 2 NCAA Division-I programs had recorded anthropometrics, echocardiography, and vascular function testing using high-fidelity applanation tonometry (SphygmoCor, Atcor).<sup>3</sup> Pulse wave velocity

(PWV) was measured by acquisition of pressure waveforms within the carotid and femoral arteries and calculated using the “foot-to-foot” method as previously described.<sup>3</sup> PWV is the gold standard for the measurement of arterial stiffness and is a key mechanistic precursor to overt hypertension.<sup>3</sup> Area deprivation index (ADI), which consists of 17 census data components including education, employment, housing-quality, and poverty measures, was derived from home addresses.<sup>4</sup> Median household income was retrieved using 2021 U.S. Census Bureau data based on 5-digit zip codes. The Everyday Discrimination Scale<sup>5</sup> was administered to investigate experiences with discrimination. Variables were compared using 2-sample *t*-tests for continuous variables or chi-square for categorical variables. To assess the association between ADI and Everyday Discrimination Scale responses with our primary cardiovascular outcome measures of systolic and diastolic blood pressure (DBP), PWV, and tissue-Doppler E' mitral annular velocity, univariable and multivariable (adjusting for age, race, and weight) linear regression analyses were performed.

A total of 143 incoming freshman ASF athletes (n = 89 [62%] White/n = 54 [38%] Black) were included in the analysis. Black and White ASF athletes were similar in weight and blood pressure. Median household income was lower (\$75,504 vs \$103,012, *P* < 0.001) and ADI higher (47.4 [22] vs 24.5 [21], *P* < 0.001) for Black athletes.

Black ASF athletes reported more experiences with discrimination, particularly receiving unequal service (25% vs 6%, *P* = 0.001), feeling others were afraid of them (38% vs 22%, *P* = 0.05), feeling perceived as dishonest (19% vs 8%, *P* = 0.05), and being insulted (23% vs 6%, *P* = 0.002), compared to White ASF athletes (**Table 1**).

Higher ADI was associated with higher PWV ( $\beta$ : 0.01, 95% CI: 0.003-0.01, *P* = 0.003) and DBP ( $\beta$ : 0.06, 95% CI: 0.01-0.11, *P* = 0.03) (**Table 2**). Adjusting for age, race, and weight, while statistically insignificant, higher ADI approached an independent association with higher PWV ( $\beta$ : 0.006, 95% CI: -0.001 to 0.013, *P* = 0.09) and DBP ( $\beta$ : 0.06, 95% CI: -0.001 to 0.12,

**TABLE 1** Everyday Discrimination Survey Results Stratified by Race

Questions From the Everyday Discrimination Survey <sup>a</sup>	White ASF (n = 89)	Black ASF (n = 54)	P Value
Are you treated with less courtesy than other people?	15 (17)	13 (25)	0.27
Are you treated with less respect than other people?	11 (12)	13 (25)	0.06
Do you receive poorer service than other people at restaurants or stores?	5 (6)	13 (25)	<b>0.001</b>
Do people act as if they think they are smarter than you?	19 (21)	13 (25)	0.66
Do people act as if they are afraid of you?	20 (22)	20 (38)	<b>0.05</b>
Do people act as if they think you are dishonest?	7 (8)	10 (19)	<b>0.05</b>
Do people act as if they think they are better than you?	16 (18)	16 (30)	0.09
Are you called names or insulted?	5 (6)	12 (23)	<b>0.002</b>
Are you ever threatened or harassed?	1 (1)	2 (4)	0.29

<sup>a</sup>Dichotomized responses report n (%) who responded 'Yes' to any prior experience. **Bold** indicates the significance of  $P \leq 0.05$ .

$P = 0.06$ ). No associations were observed between experiences with discrimination and our primary outcome measures.

To our knowledge, this is the first study focused on neighborhood deprivation, experiences with discrimination, and cardiovascular correlates in a young, healthy athletic population. We observed that competitive Black collegiate ASF athletes come from regions of higher social vulnerability and report more

experiences with discrimination. In addition, higher DBP and PWV were associated with neighborhood deprivation. After adjusting for weight, the most potent ASF cardiovascular risk factor, higher ADI approached independent association with both higher DBP and PWV. Taken together, early life social barriers, including experiences with discrimination, are enriched among collegiate Black ASF athletes and may lead to the development of early cardiovascular risk.

While Black athletes are at increased risk of sudden cardiac death relative to White athletes,<sup>2</sup> underlying mechanisms are unknown. In the present study, we found that ADI, a comprehensive surrogate for numerous elements of SDOH, was significantly higher among healthy Black ASF athletes and associated with both higher DBP and arterial stiffening. As such, our data support the consideration of validated measures of SDOH in studies focused on epidemiologic outcomes and early cardiovascular risk in competitive athletes.

Limitations of this study include this was a cross-sectional analysis and generalizability to athletes in other sports and females is not possible. One advantage of the present study design, however, was the ability to capture athletes prior to collegiate ASF training, which is an established time point after which the risk of hypertension and cardiovascular maladaptation increases.<sup>3</sup> Second, while we captured ADI with block level accuracy, we did not have access to individual socioeconomic data. Finally, the sample size was small, thus we were unable to fully explore the association between discrimination and cardiovascular phenotypes and limited in the analysis of our primary outcome measures.

Incoming Black collegiate freshman ASF athletes come from regions with higher levels of neighborhood deprivation and experience more discrimination than White ASF athletes. Inclusion of SDOH in future studies of athletes is warranted and should be considered in the clinical evaluation of the physical and mental health of young, competitive ASF athletes.

**TABLE 2** Association Between ADI and Primary Outcome Measures of Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Wave Velocity, and E' Velocity

	Univariable		Multivariable	
	Estimate (95% CI)	P Value	Estimate (95% CI)	P Value
<b>Systolic blood pressure (mm Hg)</b>				
Age	-0.42 (-2.56 to 1.24)	0.70	-0.64 (-2.73 to 1.45)	0.55
Black race	-4.59 (-7.67 to -1.51)	<b>0.004</b>	-5.05 (-8.44 to -1.66)	<b>0.004</b>
Weight (kg)	1.04 (0.29-1.79)	<b>0.007</b>	1.02 (0.28-1.76)	<b>0.007</b>
ADI	-0.02 (-0.08 to 0.05)	0.59	0.02 (-0.05 to 0.09)	0.58
<b>Diastolic blood pressure (mm Hg)</b>				
Age	-0.63 (-2.49 to 1.24)	0.51	-0.48 (-2.29 to 1.34)	0.61
Black race	0.47 (-2.27 to 3.20)	0.74	-0.86 (-3.81 to 2.09)	0.56
Weight (kg)	1.05 (0.40-1.69)	<b>0.002</b>	1.00 (0.36-1.64)	<b>0.003</b>
ADI	0.06 (0.01-0.11)	<b>0.03</b>	0.06 (-0.001 to 0.12)	0.06
<b>Pulse wave velocity (m/s)</b>				
Age	-0.15 (-0.37 to 0.06)	0.16	-0.15 (-0.36 to 0.05)	0.15
Black race	0.31 (0.02-0.59)	<b>0.04</b>	0.16 (-0.17 to 0.49)	0.35
Weight (kg)	0.11 (0.04-0.18)	<b>0.003</b>	0.11 (0.04-0.18)	<b>0.002</b>
ADI	0.01 (0.003-0.01)	<b>0.003</b>	0.006 (-0.001 to 0.013)	0.09
<b>E' (cm/s)</b>				
Age	-0.45 (-1.27 to 0.37)	0.28	-0.38 (-1.21 to 0.45)	0.37
Black race	-0.67 (-1.64 to 0.30)	0.17	0.96 (-2.09 to 0.17)	0.09
Weight (kg)	-0.23 (-0.48 to 0.02)	0.07	-0.23 (-0.48 to 0.02)	0.08
ADI	-0.002 (-0.02 to 0.02)	0.84	0.009 (-0.01 to 0.03)	0.44

**Bold** indicates the significance of  $P \leq 0.05$ .  
ADI = Area Deprivation Index; E' = tissue-Doppler averaged mitral annular early diastolic velocities.

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