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Race in association with physical and mental health among former professional American-style football players: Findings from the Football Players Health Study

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Title: Race in association with physical and mental health among former professional American-style football players: Findings from the Football Players Health Study

Running head: Race and health in professional football players

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ABSTRACT

Purpose: Race differences in health are pervasive in the United States. American-style football players are a racially diverse group with social status and other benefits that may reduce health disparities. Whether race disparities in health exist among former professional football players, and whether they differ by era of play, is unknown.

Methods: We examined the association of self-reported race with health outcomes (e.g., physical and cognitive function, pain, depression and anxiety), among 3,747 participants in the

Football Players Health Study, comprised of former National Football League (NFL) players who played since 1960. We conducted analyses stratified by age.

Results: Black players had increased risk of all five adverse health outcomes versus white players (risk ratio (RR) range=1.36 to 1.89). Native Hawaiians and men of other races had greater risk of all health outcomes except impaired physical functioning, compared with white players (RR range=1.25 to 1.64). No clear patterns were observed by era of play. In general, race disparities were not accounted for by health-related exposures during playing years. Adjustment for current BMI somewhat attenuated associations.

Conclusions: Social and economic advantages of playing professional football did not appear to equalized race disparities in health.

Keywords: anxiety, cognitive function, depression, health disparities, pain, physical function, professional football, race

Race differences in health are well-documented in the US, in part driven by conscious and unconscious biases, which have led to inequities in neighborhood environment, medical care, and socioeconomic position[1,2]. Professional American-style football players are a racially diverse group exposed to high levels of physical trauma during their playing years, which may cause lasting pain, physical impairment and neurocognitive dysfunction[3-5]. At the same time, professional football players generally have social status and other benefits not typically available in the general population. Former NFL players are more than twice as likely to be college graduates than US males[5,6] and have higher median income than the US population[5]. Advantages associated with playing professional football may reduce race disparities in health, in particular among more recent players, who played when black coaches and high-salary players (e.g., quarterbacks) were rapidly increasing in the NFL[7,8].

In the present study, we examined five important determinants of health-related quality of life in a cohort of former NFL players, the Football Players Health Study. We investigated whether self-reported physical functioning, pain interference in daily life, cognition-related quality of life, and indicators of depression and anxiety differed by race. We further examined whether exposures during playing years, including seasons of play, playing position, concussion symptoms, surgeries, BMI, use of performance-enhancing drugs, and pain medication accounted for possible differences.

METHODS

Sample

The Football Players Health Study (FPHS) recruited men who were on an NFL team between 1960 and 2015.[9] We sent a questionnaire to 13,200 men for whom we obtained valid

home or email addresses. At the time of this analysis, 3,794 men (28.7%) had responded. Compared with former players in the Pro Football Reference dataset,[10] our sample was somewhat older (FPHS, median birth year=1962, interquartile range (IQR)=1951-1974; PFR, median=1967, IQR=1954-1981) and had slightly longer careers (FPHS, median=6, IQR=4-9; PFR, median=4, IQR=2-8). The Harvard School of Public Health Institutional Review Board approved the study.

Measures

Race. Players were asked "Which category best describes your race?" with response options: Black/African American, White, American Indian/Alaskan Native, Native Hawaiian/Pacific Islander, Asian, and other. Among men who endorsed only one category, few endorsed American Indian/Alaskan Native (n=10), Native Hawaiian/Pacific Islander (n=23), Asian (n=2) or Other (n=43). Therefore, we grouped these for analysis as "Hawaiians and men of other races" to reflect the most prevalent categories. Ninety-six men endorsed more than one race. For main analyses, we first categorized these men as Black if they endorsed Black and any other category, then "Hawaiians and others" if they endorsed American Indian/Alaskan Native, Native Hawaiian/Pacific Islander, Asian, or other.[11-14] We created an additional coding scheme including a "multi-racial" category. Forty-seven men did not select a race and were excluded.

Professional football exposures. Players were asked to indicate the positions and number of seasons they played professionally. We obtained number of games played and started from Pro Football Reference[10]. We queried 10 football-related concussion symptoms during playing years and calculated the mean frequency across items (Supplemental Methods).

The number of types of surgeries occuring during playing years was queried (Supplemental Methods). BMI was calculated from self-reported height and weight during playing years. Prescription pain medication use ≥1/week was yes/no. Use of performance-enhancing drugs during playing years was any/none.

Health outcomes. Physical functioning was measured by the PROMIS Physical Functioning Scale 6b, which queries day-to-day physical functioning (e.g., "Are you able to do chores such as house work or yard work?")[15]. The PROMIS Pain Interference Scale 6b assessed past 7-day pain intereference in daily life[16]. The short form of the Quality of Life in Neurological Disorders, Applied Cognition-General Concerns (Neuro-QOL) assessed cognition-related QOL[17]. Eight items queried past 7-day cognitive difficulties (e.g., "I had to read something several times to understand it"). Both PROMIS scales and the Neuro-QOL were standardized to the US-population and dichotomized at ≥1 SD to indicate moderate or severe impairment based on published guidelines[17,18].

The Patient Health Questionnaire (PHQ)-4 queried two past-2-week depression symptoms and two anxiety symptoms. Responses dichotomized at ≥3 for each[19,20]. Men were considered to have indicators of either disorder if they met the PHQ-4 cutoff or were currently taking medications for that disorder.

Current health-related factors. Current BMI was calculated from self-reported weight and height. Current alcohol use of ≥14 drinks/week was considered higher-risk drinking[21]. Smoking was never, past, or current. Lifetime chewing tobacco was ever/never. Current marital status was: married, divorced/separated/never married, or widowed. Age at return of questionnaire was self-reported.

Analyses

We examined the prevalence of health outcomes, football exposures (e.g., seasons of play, position) and current health-related factors (e.g., BMI, substance use) by race. We calculated associations among the five continuous health outcomes using Spearman's rho.

To ascertain whether health outcomes differed by race, we first estimated risk of each of the health outcomes in association with race in age-adjusted models. To investigate whether race differences in health varied by player's age, we tested race-by-age interaction terms for each outcome and estimated associations stratified at the median of players' ages at questionnaire (younger: <54 years, older: ≥54 years), which operates as a surrogate for era of play. Next, to determine whether football-related exposures during playing years might account for possible race differences in health outcomes, we fit four additional models for each health outcome, sequentially adding the following football-related exposures: 1) seasons of play and playing position; 2) concussion symptoms; 3) number of types of surgeries, regular use of pain medication, playing BMI, and use of performance-enhancing drugs. We additionally examined games played and games started as indicators of football exposure. Finally, for each health outcome we fit models further adjusted for current health-related factors individually and together.

Former quarterbacks, kickers and punters in the NFL are nearly all white, therefore we conducted additional analyses excluding these men. We examined associations of race with health outcomes using the alternative coding including a multi-racial category. To investigate potential participation bias, we compared compared the racial distribution of the FPHS to that

of a prior stratified random sample of pension-eligible NFL retirees[5]. Risk ratios were estimated with PROC GENMOD (SAS 9.4).

RESULTS

Playing position differed strongly by race, with black players more than twice as likely as white players to play running back or defensive back. More white than black players had high or very high BMI during their playing years (55.4 versus 40.1%) and were more likely currently to be heavy drinkers, have used chewing tobacco, and be married. Minority players reported the highest quartile of concussion symptoms more often than white players and had greater prevalence of current obesity. All five adverse health outcomes were more prevalent among minority players than whites (Table 1). Health outcomes were moderately to highly correlated (Spearman's rho range: -0.45 [anxiety and physical functioning] to -0.80 [pain interference and physical functioning], eTable 1).

Table 1: Football exposures and current health-related factors by race, Football Players Health Study, 2015-2018, N=3,747

	Black	Hawaiian and other races	White
	N=1423	**N=109**	**N=2215**
Age, years, mean (SD)	49.0 (12.4)	49.0 (14.7)	55.3 (14.6)
Health outcomes			
Impaired physical function	32.8 (467)	22.9 (25)	19.7 (435)
Pain interference in daily life	42.3 (601)	41.3 (45)	28.7 (636)
Poor cognition-related quality of life	56.1 (796)	51.4 (56)	41.1 (909)
Indicators of depression	31.6 (449)	31.1 (34)	19.0 (420)
Indicators of anxiety	32.7 (466)	34.8 (38)	21.2 (469)
Football exposures			
Age at first organized football, years, mean (SD)	11.5 (3.3)	12.2 (3.4)	11.9 (3.0)
Seasons in the NFL, mean (SD)	6.7 (3.4)	6.9 (3.5)	6.8 (3.9)
Games started, mean (SD)	33.8 (48.9)	25.3 (44.9)	32.0 (47.8)
Games played as non-starter, mean (SD)	27.9 (26.8)	31.9 (44.1)	32.5 (40.3)
Position in NFL			
Kicker/punter, % (N)	0.1 (1)	5.8 (7)	5.1 (112)
Quarterback, % (N)	0.6 (8)	5.5 (6)	6.6 (147)
Wide receiver, % (N)	13.4 (190)	3.7 (4)	7.1 (158)
Tight end, % (N)	5.0 (71)	2.7 (3)	8.8 (194)
Running back, % (N)	16.9 (241)	12.8 (14)	11.0 (244)
Offensive line, % (N)	8.8 (125)	24.8 (27)	29.5 (654)
Linebacker, % (N)	16.0 (228)	18.4 (20)	16.5 (365)
Defensive back, % (N)	25.2 (359)	11.9 (13)	8.1 (179)
Defensive line, % (N)	14.1 (200)	13.8 (15)	11.2 (248)
Special teams			
Did not play often, % (N)	71.0 (1011)	73.3 (80)	76.9 (1703)
Strength, % (N)	3.7 (52)	6.4 (7)	7.5 (167)
Speed, % (N)	25.3 (360)	20.2 (22)	15.6 (345)
Concussion symptoms, highest quartile, % (N)	25.9 (369)	40.4 (44)	23.3 (516)
BMI during NFL playing years			
<30kg/m^2, % (N)	59.9 (852)	35.8 (39)	44.6 (988)
≥30kg/m^2, % (N)	28.3 (403)	45.9 (50)	39.1 (867)
≥35 kg/m^2, % (N)	11.8 (168)	18.4 (20)	16.3 (360)
Number of surgery types during playing years, mean (SD)	1.4 (1.3)	1.3 (1.2)	1.4 (1.2)
Regular use of prescription pain medication during playing years, % (N)	32.8 (466)	30.2 (33)	26.1 (578)
Use of performance-enhancing drugs during playing years, % (N)	14.2 (202)	16.5 (18)	16.9 (375)
Current health-related factors			
Current BMI			
<25kg/m^2, % (N)	4.5 (64)	3.7 (4)	6.0 (132)
≥25 to <30kg/m^2, % (N)	37.0 (527)	36.7 (40)	44.4 (983)
≥30kg/m^2 to <35kg/m^2, % (N)	33.6 (478)	32.1 (35)	36.2 (801)

≥35kg/m^2, % (N)	24.9 (354)	27.5 (30)	13.5 (299)
Smoking			
Never, % (N)	86.7 (1234)	85.3 (93)	81.2 (1798)
Past, % (N)	8.9 (126)	13.8 (15)	16.5 (365)
Current, % (N)	4.4 (63)	0.9 (1)	2.4 (52)
Regular chewing tobacco use, ever, % (N)	12.8 (182)	24.8 (27)	22.6 (182)
Heavy alcohol consumption, % (N)	8.4 (119)	6.4 (7)	16.5 (366)
Married, % (N)	66.4 (945)	82.6 (90)	84.3 (1865)

Table 2. Race and risk of poor health outcomes with further adjustment for football-related exposures and current health-related factors, former NFL players, Football Players Health Study, 2015-2018, N=3,747

	Model 1: Adjusted for age	Model 2: Model 1 further adjusted for NFL seasons, playing position	Model 3: Model 2 further adjusted for football-related concussions†	Model 4: Model 3 further adjusted for PEDs, pain meds, and BMI during playing years	Model 5: Model 4 further adjusted for current health factors (BMI, tobacco and alcohol use, marital status)
	Risk Ratio (95% confidence interval)				
Impaired physical functioning					
White	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Black	1.89 (1.69, 2.12)***	2.03 (1.79, 2.31)***	2.04 (1.81, 2.29)***	1.98 (1.76, 2.23)***	1.63 (1.43, 1.86)***
Hawaiian, other races	1.31 (0.92, 1.85)	1.29 (0.92, 1.81)	1.12 (0.80, 1.56)	1.13 (0.82, 1.55)	0.99 (0.72, 1.37)
Pain interference in daily life					
White	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Black	1.53 (1.40, 1.68)***	1.55 (1.40, 1.71)***	1.57 (1.43, 1.72)***	1.52 (1.39, 1.67)***	1.34 (1.21, 1.47)***
Hawaiian, other races	1.49 (1.18, 1.89)***	1.46 (1.16, 1.84)**	1.30 (1.04, 1.62)*	1.32 (1.05, 1.65)*	1.20 (0.96, 1.51)
Poor cognition-related quality of life					
White	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Black	1.36 (1.27, 1.46)***	1.29 (1.20, 1.39)***	1.32 (1.20, 1.45)***	1.30 (1.19, 1.44)***	1.22 (1.11, 1.35)***
Hawaiian, other races	1.25 (1.03, 1.51)*	1.20 (1.00, 1.46)	1.09 (0.91, 1.31)	1.10 (0.93, 1.31)	1.06 (0.89, 1.27)
Indicators of depression					
White	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Black	1.67 (1.48, 1.87)***	1.62 (1.43, 1.84)***	1.68 (1.44, 1.97)***	1.65 (1.41, 1.93)***	1.47 (1.24, 1.73)***
Hawaiian, other races	1.64 (1.23, 2.20)***	1.58 (1.18, 2.11)**	1.41 (1.08, 1.83)**	1.43 (1.10, 1.86)**	1.36 (1.04, 1.79)*

Indicators of anxiety					
White	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Black	1.47 (1.31, 1.64)***	1.40 (1.24, 1.59)***	1.44 (1.29, 1.62)***	1.41 (1.26, 1.58)***	1.30 (1.15, 1.48)***
Hawaiian, other races	1.56 (1.19, 2.05)**	1.50 (1.14, 1.97)**	1.35 (1.06, 1.73)*	1.36 (1.07, 1.73)*	1.31 (1.03, 1.68)*

*p<0.05, **p<0.01, ***p<0.001

PEDs: performance-enhancing drugs

†Impaired physical functioning, pain interference in daily life, and poor cognition-related quality of life were defined as ≥1 standard deviation worse than the population mean. Men were considered to have indicators of depression if they had a score ≥3 on the PHQ-2 or current antidepressant use. Men were considered to have indicators of anxiety if they had a score ≥3 on the GAD-2 or current anti-anxiety medication use.

For cognition-related quality of life and depression, Models 3, 4, and 5 have a race-by-concussion-quartile interaction term.

In age-adjusted models, black and Hawaiian and other players were at significantly higher risk of all five health outcomes compared with white players, except the association of Hawaiian and other players with high pain interference did not reach statistical significance (black, RR range=1.36-1.89; Hawaiian, RR range=1.25-1.64, Table 2). Age-by-race interaction terms were statistically significant only for cognition-related QOL (older black players had worse QOL that younger black players, compared with white players, p-interaction=0.03) and borderline statistically significant for physical functioning (older versus younger black players had better functioning, compared with white players, p-interaction=0.14). Older versus younger minorities had greater risk of depression and anxiety compared with white players, and lower risk of pain interference, though these differences were not statistically significant and confidence intervals were highly overlapping (eTable 2). In analyses examining football exposures and current health-related factors as possible explanatory variables, associations of race with health outcomes did not substantially differ in models further adjusted for seasons of play and playing position (Table 2, Model 2), nor did models which included games played and games started. Further adjustment for concussion symptoms accounted for part of the increased risk among Hawaiian and other players (RR range=1.09-1.41, Table 2, Model 3). In models fully adjusted for football exposures, black players remained at significantly higher risk than white players for all outcomes ($p<0.001$ for all), and Hawaiians and players of other races remained at significantly higher risk for pain interference ($p<0.05$), depression ($p<0.01$), and anxiety ($p<0.05$, Table 2, Model 4). Further adjustment for current BMI, substance use, and marital status attenuated associations, with current BMI accounting for most of this attenuation (Table 2, Model 5).

In analyses including a multi-racial category, multi-racial players were at elevated risk of impaired physical functioning, pain interference, and depression, compared to white players (RR range=1.40-1.70, eTable 3). Results were very similar in sensitivity analyses excluding kickers, punters and quarterbacks. The racial distribution of the FPHS was similar to that of a prior stratified random sample of pension-eligible NFL retirees (FPHS: 59% white, 38% black, 3% players of other races; random sample, weighted: 57% white, 41% black, 2% players of other races).[5]

DISCUSSION

We found substantial differences by race in the five health outcomes we examined. Black men were approximately 50% more likely than white men to have pain interference in daily life, indicators of depression, and indicators of anxiety, 89% more likely to have impaired physical functioning, and 36% more likely to have poor cognition-related quality of life. Hawaiians and men of other races similarly had higher risk of all adverse health outcomes, except impaired physical functioning. We had mixed findings in age-stratified analyses, with no clear indication that racial disparities were smaller among younger players.

Greater experience of concussion symptoms during playing years accounted for some increased risk for Hawaiians others, but not black men, compared with white men. Other NFL exposures did not substantially account for race differences in health. Black men had higher current BMI than white men, and this difference statistically accounted for a portion of the racial differences in health. Our data are cross-sectional, thus it is possible that high BMI among black men may have led to adverse health outcomes[22]; conversely, poor health may have preceded and led to weight gain[23].

Our data suggest that former NFL players who are black, Hawaiian, or other races experience racial disparities in health that are prevalent in the general US population. Prior studies have similarly found race differences in mortality among high-status persons, including male physicians (black men, mean age at death=68.7 years versus white men=73.0 years), lawyers (black, mean age at death=62.0 years, white=72.3 years), and other professionals[24]. A study of former professional basketball players found a 77% greater risk of death for black versus white players, equal to 18 months of life, though this was narrower than the black-white longevity difference in the general population[25].

Additional potential explanations for the differences in health outcomes by race that we found include experiences of discrimination prior to, during, or following NFL playing years.[26-28] Experience of racism is associated with poorer mental and physical health, increased health risk factors[29,30], and higher mortality[31,32]. Additionally, following their years in the NFL, black men may receive poorer quality health care than white men, as numerous studies have documented disparities in quality of health care[33]. Finally, minorities may have had lower NFL salaries and lower current socioeonomic status than white men. Low socioeconomic status is associated with poorer health independently of race.[34,35]

Our study has important limitations. Our study response rate was moderate. If participation in our study was associated with both current health and race, our findings may be biased. However, the race distribution of our sample was similar to that of a prior study of former NFL players, suggesting there was not differential participation by race[5]. Football exposures were measured retrospectively by self-report. Health outcomes were also by self-report, although we used well-validated measures.

In conclusion, we did not find evidence that socioeconomic benefits of playing in the NFL equalized race-related health disparities. Further understanding of the experiences of minorities before, during, and after their time in the NFL may potentially lead to interventions to protect their physical and neuropsychiatric health.

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Supplemental Methods

Concussion symptoms were measured with the question, "While playing or practicing football, did you experience a blow to the head, neck, or upper body followed by: headaches, nausea, dizziness, loss of consciousness, memory problems, disorientation, confusion, seizure, visual problems, and feeling unsteady on your feet." Response options for each symptom were: no, once, 2-5, 6-10, or 11+ times. We coded these as 0, 1, 3.5, 8 and 13 and calculated the mean across all 10 items.

Experience of 7 types of surgeries during playing were: anterior cruciate ligament (ACL) reconstruction, neck, back, knee, ankle, shoulder, and hand surgery.

eTable 1: Correlations among the five health outcomes, Football Players Health Study, 2015-2018, N=3,747†

	Physical functioning	Pain interference	Cognition QOL	Depressive symptoms	Anxious symptoms
Physical functioning	1.0	-0.80***	0.56***	-0.50***	-0.45***
Pain interference		1.0	-0.64***	0.58***	0.54***
Cognition-related quality of life			1.0	-0.65***	-0.64***
Depressive symptoms				1.0	0.75***
Anxious symptoms					1.0

***p<0.0001

†Physical functioning and cognition-related quality of life are scored so that higher scores indicate better health. Pain interference in daily life, depression, and anxiety are scored so that higher scores indicate poorer health.

eTable 2: Analyses by median age at questionnaire, Football Players Health Study, 2015-2018†

	Analysis 1: Restricted to men age <54 years, N=1925	Analysis 2: Restricted to men age ≥54 years, N=1869
Impaired physical functioning		
White	1.0 [Reference]	1.0 [Reference]
Black	2.04 (1.70, 2.45)***	1.73 (1.49, 2.01)***
Hawaiian, other races	1.11 (0.61, 2.01)	1.52 (1.00, 2.30)
Pain interference in daily life		
White	1.0 [Reference]	1.0 [Reference]
Black	1.57 (1.38, 1.80)***	1.41 (1.24, 1.60)***
Hawaiian, other races	1.59 (1.15, 2.19)**	1.41 (1.00, 2.00)
Poor cognition-related quality of life		
White	1.0 [Reference]	1.0 [Reference]
Black	1.24 (1.13, 1.37)***	1.48 (1.33, 1.63)***
Hawaiian, other races	1.19 (0.93, 1.53)	1.30 (0.96, 1.76)
Indicators of depression		
White	1.0 [Reference]	1.0 [Reference]
Black	1.53 (1.30, 1.79)***	1.83 (1.54, 2.17)***
Hawaiian, other races	1.58 (1.09, 2.31)*	1.69 (1.06, 2.70)*
Indicators of anxiety		
White	1.0 [Reference]	1.0 [Reference]
Black	1.35 (1.17, 1.56)***	1.61 (1.35, 1.93)***
Hawaiian, other races	1.43 (1.02, 2.01)*	1.78 (1.14, 2.79)*

*p<0.05, **p<0.01, ***p<0.001

†All models adjusted for age at questionnaire. Impaired physical functioning, pain interference in daily life, and poor cognition-related quality of life were defined as ≥1 standard deviation worse than the population mean. Men were considered to have indicators of depression if they had a score ≥3 on the PHQ-2 or current antidepressant use. Men were considered to have indicators of anxiety if they had a score ≥3 on the GAD-2 or current anti-anxiety medication use.

eTable 3: Race and risk of poor health outcomes, including a multi-racial category, Football Players Health Study, 2015-2018

		Adjusted for age
	N	RR (95% CI)
Impaired physical functioning		
White	2215	1.0 [Reference]
Black	1358	1.90 (1.70, 2.13)***
Hawaiian, other races	78	1.27 (0.83, 1.93)
Multi-racial	96	1.52 (1.05, 2.19)*
Pain interference in daily life		
White	2215	1.0 [Reference]
Black	1355	1.54 (1.40, 1.69)***
Hawaiian, other races	78	1.49 (1.13, 1.96)**
Multi-racial	96	1.40 (1.07, 1.84)*
Poor cognition-related quality of life		
White	2210	1.0 [Reference]
Black	1354	1.37 (1.28, 1.47)***
Hawaiian, other races	78	1.21 (0.96, 1.52)
Multi-racial	96	1.21 (0.98, 1.49)
Indicators of depression		
White	2215	1.0 [Reference]
Black	1356	1.67 (1.48, 1.88)***
Hawaiian, other races	78	1.49 (1.03, 2.14)*
Multi-racial	96	1.70 (1.25, 2.31)***
Indicators of anxiety		
White	2214	1.0 [Reference]
Black	1357	1.49 (1.33, 1.66)***
Hawaiian, other races	78	1.54 (1.12, 2.11)**
Multi-racial	96	1.29 (0.94, 1.77)

* p<0.05, ** p<0.01, *** p<0.001

†Impaired physical functioning, pain interference in daily life, and poor cognition-related quality of life were defined as ≥1 standard deviation worse than the population mean. Men were considered to have indicators of depression if they had a score ≥3 on the PHQ-2 or current antidepressant use. Men were considered to have indicators of anxiety if they had a score ≥3 on the GAD-2 or current anti-anxiety medication use.