

# The Price of Playing Through Pain: The Link Between Physical and Behavioral Health in Former NFL Athletes

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Evelyn Bush, PhD<sup>1</sup> , Tim Cupery, PhD<sup>2</sup>, Robert W. Turner II, PhD<sup>3</sup> ,  
Amanda Sonnega, PhD<sup>4</sup>, David Weir, PhD<sup>5</sup>,  
Keith E. Whitfield, PhD<sup>6</sup>, and James S. Jackson, PhD<sup>7\*</sup>

## Abstract

Over the past decade, media outlets have drawn attention to some of the health consequences of playing in the National Football League (NFL), including how wear-and-tear and injuries accumulated during athletes' playing years can affect their physical, emotional, and behavioral health after retirement from professional sports. Through a secondary analysis of a cross-sectional telephone survey of former NFL athletes, this study estimated logistic regression models to assess the relationship between several forms of physical pain and anger attacks, controlling for binge drinking, signs of depression, functional limitations, NFL career duration, religious service attendance, and demographic characteristics (age, marital status, race, education, income, and wealth). The analytic sample included 1030 former NFL players. Neck pain, lower back pain, headaches/migraines, and the number of sites of pain were positively and significantly related to anger attacks. There was no significant association between joint pain and anger attacks. NFL career duration was negatively associated with anger attacks, as was religious service attendance. Future research should focus on factors that protect against affective aggression in former professional athletes and how protective factors can be adapted to the broader population.

## Keywords

aggression, behavioral issues, mental health, pain, athletes, anger

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Football is one of America's most popular sports, with an estimated 1,006,013 high school males and 73,712 college males having participated during the 2018–2019 school year alone (National Collegiate Athletic Association, 2020). Of the top 50 most-watched television programs in 2019, 47 were National Football League (NFL) games, with approximately 16.5 million fans tuning in each week (Young, 2019). Professional athletes are accorded celebrity status in American society, so their lives off the field attract significant media attention, both positive and negative. Among the most concerning reports have been highly publicized physical altercations involving individual professional athletes, which have raised public concerns about the possibility of a link between participation in football and interpersonal aggression. Interestingly, there is little research evidence that NFL athletes are significantly more aggressive than

<sup>1</sup>Department of Sociology and Anthropology, Fordham University, Bronx, NY, USA

<sup>2</sup>Department of Sociology, College of Social Sciences, California State University, Fresno, CA, USA

<sup>3</sup>Department of Clinical Research and Leadership, School of Medicine and Health Sciences, The George Washington University, Washington, DC, USA

<sup>4</sup>Survey Research Center of the Institute for Social Research, University of Michigan, Ann Arbor, MI, USA

<sup>5</sup>Survey Research Center of the Institute for Social Research, University of Michigan, Ann Arbor, MI, USA

<sup>6</sup>Department of Psychology, University of Nevada, Las Vegas, NV

<sup>7</sup>Department of Psychology, College of Literature, Sciences, and the Arts, University of Michigan, Ann Arbor, MI, USA

\*Deceased

## Corresponding Author:

Evelyn Bush, PhD, Department of Sociology and Anthropology, Fordham University, Dealy Hall 406D, 441 East Fordham Road, Bronx, NY 10458, USA.

Email: ebush@fordham.edu



other men, but given the popularity of football, any link between participation in the sport and off-field aggression needs to be understood.

Some scholars have attributed athlete aggression to the features of professional sports culture and institutions. Hattery and Smith (2019), for example, have described college and professional sports as permeated with a hyper masculinist, gender-segregated, internally protected subculture that fosters deviance that carries over into athletes' personal lives (see also Benedict, 2005; Carter, 2009; Smith, 2014). But in recent years, in large part due to an accumulation of evidence of traumatic brain injury (TBI) in former football players (Bailes et al., 2013; Omalu et al., 2005, 2006) and research linking TBI to aggression (Buckley et al., 2017; Farrer et al., 2012; Pouwels et al., 2018), an alternative line of inquiry has developed focusing on player health, and how the physical wear-and-tear, head trauma, and other injuries accrued on the field can affect athletes' emotional and behavioral well-being not only during their playing years but also into retirement (Souter et al., 2018). This study contributes to that literature by examining the relationship between a particular kind of aggression, impulsive, or affective, aggression, and pain (Liu, 2006; McCloskey et al., 2010). The main hypothesis of this study is that high levels of pain may predispose some former NFL athletes to affective aggression, which is characterized by a loss of emotional control and episodic anger attacks.

## Pain and Anger Episodes

Affective aggression is defined by impulsivity and a lack of premeditation, which distinguishes it from instrumental, predatory forms of aggression that are characteristically controlled, goal-oriented, and strategically geared toward dominating others (Allen & Anderson, 2017; Liu, 2006). As the term implies, affective aggression is typically accompanied by strong emotions, particularly anger, which manifest in verbal or physical outbursts, directed at individuals, animals, or property (American Psychiatric Association, 2013). Frequent and recurrent anger outbursts are a defining feature of intermittent explosive disorder (IED), which is a clinically diagnosed impulse-control disorder characterized by recurrent episodes of anger that are out of proportion to situational stressors (American Psychiatric Association, 2013).

The centrality of anger to affective aggression is particularly important to understanding the role played by pain. While the pathways linking pain and anger are complex, anger has been reported in the literature as a core component of pain experience (Fernandez & Wasan, 2009). In clinical settings, pain and anger are related in patients experiencing a broad range of health problems,

with anger being the most prominent negative emotion in chronic pain patients (Cosio, 2019). Pain is also associated with anger in individuals who experience frequent headaches (Hatch et al., 1991). The relationship between headaches and anger is especially important for the purposes of this study because of the link between headaches and TBI (Mayer et al., 2013). Given the prevalence of TBI among former NFL players (Bailes et al., 2013; Omalu et al., 2005, 2006; Weir et al., 2009), a finding that headaches are associated with episodic anger in this population could be relevant to research on the pathways from TBI to aggression.

Researchers have also identified significant relationships between pain and IED (Coccaro et al., 2014; Fishbain et al., 1986; McCloskey et al., 2010). Some evidence has pointed to a neurochemical link between pain and outbursts characteristic of IED. Specifically, Coccaro et al. (2014) examined the roles played by C-reactive protein and interleukin-6, which are elevated in patients experiencing inflammation due to painful conditions such as arthritis, spine injury, neuropathy, and headaches (Davenport, 2016; Svensson, 2010; Zhou et al., 2016). Coccaro et al. (2014) found direct correlations between these inflammatory markers and several measures of aggression, including formally diagnosed IED, a composite measure of aggressive behavior, and history of aggression. Consistent with this, an epidemiological survey conducted by McCloskey et al. (2010) found a relationship between IED and neck pain, back pain, headaches, and other forms of chronic pain.

Theoretically, borrowing from the general model of aggression (Allen & Anderson, 2017; Anderson & Bushman, 2002), pain can be understood as situational input that increases the odds of aggression through its influence on affect or emotion (e.g., anger, hostility, irritability). From this perspective, pain does not directly cause aggression, but produces an internal state that potentially, depending on other factors, predisposes an individual to respond aggressively to a given stimulus or situation (Allen & Anderson, 2017). The following section will propose some of those additional factors, particularly as they might apply to former NFL athletes.

## Pain and Anger Attacks in Former NFL Athletes

A literature review for this study did not yield any research reporting that former NFL athletes were significantly more likely than men in the general population to experience or display anger episodes. In fact, in a study conducted by researchers at the Institute for Social Research (ISR) at the University of Michigan, a sample of former NFL players were actually less likely than men in the general population to respond affirmatively to

screening questions for IED (Weir et al., 2009). However, NFL players are exposed to injury risk at relatively young ages, and as a result experience pain earlier in life compared to other men. In the ISR study, when a sample of former NFL players ages 30–49 were asked if they had “pain in any joint lasting most of the day” at any point over the past 3 months, 80% of the respondents answered affirmatively, compared to only 20.6% of a national sample of men the same age, and 37.1% of men age 50 and over (Weir et al., 2009). Large differences were also found for neck pain, back pain, and migraine headaches, with younger NFL former players being more likely to report pain than both older and younger men in the general population (Weir et al., 2009). Given the heightened tendency of former NFL players to experience pain, and the relationship between pain and episodic anger, the role that pain might play in predisposing some former players to anger attacks needs to be considered.

Aside from research on TBI, the literature review for this study also did not yield health research on former NFL players that focused specifically on anger episodes. However, a study of former NFL athlete mortality showed that 9.7% of former player deaths were due to either self-harm or interpersonal violence, and an additional 13.9% were due to transportation injuries (Venkataramani et al., 2018, Table 3). These findings were consistent with a media outlet report on arrest rates for players during their playing years. Although player arrests were only 13% of those for men in the general population, among the categories with the highest arrest frequencies were driving under the influence (of alcohol or other drugs), domestic violence, and nondomestic assault (Morris, 2014). Car accidents, self-harm, and interpersonal violence are all behaviors in which impulsivity or anger could play a role.

### **Other Relevant Correlates of Anger Attacks**

One factor that has been linked to IED in the general population is depression (Medeiros et al., 2018). For some athletes, the years following the end of professional play have been reported to be emotionally difficult, as athletes are confronted with losses of identity, social relationships, income, and daily routines. Some athletes respond to these losses with maladaptive coping strategies, depression, hostility, or anger (Wolanin et al., 2015). A research review by Souter et al. (2018) showed this was particularly the case for former athletes who suffered from multiple severe injuries or surgeries during their careers, as they were two to seven times more likely than other elite athletes to suffer from symptoms of common mental disorders (p. 2). Researchers have also identified a link between severe musculoskeletal injuries and

increased symptoms of anxiety and depression in elite athletes (Gouttebauge et al., 2016).

Another factor that has been positively associated with aggression is alcohol consumption (Bushman & Cooper, 1990; O’Leary, 1999; Pappas et al., 2004). Weir et al. (2009) reported that former NFL players were more likely to consume alcohol than were men in the general population. Former NFL players were also slightly more likely to report heavy drinking, defined as more than 730 drinks per year, and binge drinking, defined as five or more drinks on 25 or more days in the past year (Weir et al., 2009). The factors that lead to alcohol abuse are many and varied, and in the absence of research on alcohol consumption among professional athletes, attribution of their drinking to any one factor is difficult. Alcohol consumption habits could be established during playing years as part of the celebrity lifestyle that exists within pro sports (Carter, 2009), or in later years as a mechanism for coping with pain, functional limitations, or new life circumstances (Souter et al., 2018; Weir et al., 2009).

It is also important to consider the influence of length of play in the NFL, which could serve as an environmental modifier that socializes individuals in ways that either predispose them toward or protect them from tendencies toward affective aggression (Allen & Anderson, 2017). Because the effects of socialization do not immediately disappear after individuals leave the environments where socialization occurs, factors associated with NFL acculturation could continue to influence athletes beyond their years of play. If so, the longer the exposure, the stronger its expected influence would be.

As stated previously, some authors have attributed norm violations during pro athletes’ playing years to the cultural and institutional features of professional elite sports, such as hypermasculine socialization, celebrity privilege, and institutional protection from consequences (Benedict, 2005; Carter, 2009; Hattery & Smith, 2019). Some scholars have also proposed that repeated play in contact sports such as hockey, boxing, or football could habituate athletes to aggression in their personal lives (Smith, 2014). However, research on contact athletes’ off-field behavior has not supported this hypothesis (Grange & Kerr, 2011; Lemieux et al., 2002; Zillmann et al., 1974). Furthermore, in two experimental studies, athletes were better able than nonathletes to control their pain responses. Thornton et al. (2020) found that athletes in contact sports were better able than athletes in noncontact sports to maintain their performance on a motor task during painful stimulation, a finding the researchers attributed to contact athletes’ perception of pain as a challenge rather than a threat. Manning and Fillingim (2002) also found that athletes had higher pain tolerances than nonathletes, which the athletes themselves attributed to competitive coping strategies.

Some additional factors associated with professional sports participation may also play a role in reducing propensity toward aggression. For example, income has been identified as negatively associated with domestic violence (Pan et al., 1994), as has been education (Harris & Knight-Bohnhoff, 1996), and retired players have higher median incomes (Weir et al., 2009) and much higher college graduation rates (Weir et al., 2009) than men in the general population. The potentially positive role of some masculine norms should also be considered. For example, Gerdes and Levant (2018) found that norms pertaining to emotional control and primacy of work are negatively related to anger and stress. There could likewise be protective masculine norms inculcated during NFL playing years that carry over after the end of professional play. Consider the research on "mental toughness," which Gucciardi et al. (2017, p. 308) define in terms of positive psychological resources that develop through experience with stress and anxiety: mental toughness "foster(s) goal-directed behavior by enabling individuals to strive (i.e., direction and magnitude of effort expended on a task), survive (i.e., manage everyday challenges or overcome major adversities) and thrive (i.e., experience growth through one's experiences)." While the conventional wisdom has been that mental toughness is negatively related to mental health, Gucciardi et al.'s research review showed that mental toughness can actually protect against symptoms of depression and anxiety.

Another set of protective factors could come from religious participation. For example, Ellison and Anderson (2001) identified a negative relationship between religious attendance and domestic violence, and Bremner et al. (2011) found that prayer reduced both anger and aggressive behavior toward others. Contrary to popular stereotypes, many NFL players are religious, and their religiosity is supported in the NFL through formal chaplaincies and sports ministry organizations. Carter and Carter (2014) found that in a sample of 104 NFL players, 66.3% claimed to have personal relationships with God, and that player religiosity had a deterrent effect on deviant behavior by increasing group cohesion and social support, and reducing anomie that the authors describe as a by-product of professional sports culture. In a survey assessing the overall health and well-being of retired NFL players, Weir et al. (2009) found that former players were almost twice as likely as men in the general population to identify as very religious, and were more likely (35% vs. 24%) than men in the general population to report weekly church attendance. Religious beliefs, habits, coping strategies, support networks, or health-supporting norms could have protective effects that shield former athletes from anger attacks.

Any of the factors reviewed above could be associated with affective aggression among former players just as

they are associated with it or related aspects of emotional or behavioral health for other populations. But former NFL players are different from most populations in one key regard: in their professions, former NFL players push their bodies to their maximum capabilities, and subject them to repeated punishment, strain, and overuse, such that injury is their most recognized risk factor for stress (Souter et al., 2018). The effects of physical stress continue to be felt in later years, with not only older, but even younger former players reporting much higher levels of pain than men in the general population (Weir et al., 2009).

The following analysis extends previous research on affective aggression by examining how pain is associated with affective aggression within a particular group of men, former NFL athletes, who tend to report more pain compared to men in the general population, and whose physical and behavioral health have been a source of public concern. We hypothesize that, even when controlling for factors that have been associated with anger and affective aggression in the literature reviewed for this study, pain will be positively and significantly associated with anger attacks.

## Methods

### Participants

The present study consisted of a secondary analysis of data that were originally collected for the NFL Player Care Foundation Study of Retired Players, conducted by the ISR at the University of Michigan (Weir et al., 2009). The data did not contain information (e.g., names, current or former places of residence, positions, or teams for which respondents played while in the NFL) that would allow the authors of the present study to identify individual survey participants. Approval for the analysis was obtained from the Institutional Review Board at George Washington University (IRB #180210). The Player Care Foundation provided ISR with a complete listing of 6983 former NFL players with vested rights (minimum 3–4 years active career) in the NFL's pension system in 2006–2007. A stratified random sample of 1625 players was selected. Strata were based on age and disability pension status, with older men and those with disabilities oversampled. The response rate for the ISR study was 65.4%, resulting in a sample of 1063 participants (Weir et al., 2009). For this secondary analysis, 33 cases were missing data due to lack of response for the following variables: 20 for anger attacks, one for married, and 12 for NFL career length. Because of the incomplete data, these cases were eliminated from the analysis. The remaining analytic sample was 1030 (97%).

The ISR survey provided a wealth of information on a population that presents with a unique health profile. On



the one hand, the respondents were elite athletes whose former occupation required that they maintain optimal health. As such, even after the end of their football careers, NFL athletes had better health on average than did men in general population samples on a variety of indicators (Weir et al., 2009). On the other hand, former NFL players tended to suffer from high levels of pain and functional limitations relatively early in life due to overuse and career-related injury (Weir et al., 2009). The ISR-Player Care Foundation survey allows for much needed assessments of the effects of pain on the behavioral health of men within this population.

## Measures

Affective aggression was measured using responses to questions adapted from the *The Diagnostic and Statistical Manual of Mental Disorders*, 4<sup>th</sup> ed. (DSM IV) screen for IED about lifetime occurrence of “anger attacks” (American Psychiatric Association, 1994; Coccaro et al., 1997). Anger attacks, a binary variable, was coded 1 for affirmative responses to any of three questions: “Thinking now about your life after football only, have you ever had attacks of anger when all of a sudden you lost control and” (a) “broke or smashed something worth more than a few dollars?” (b) “hit or tried to hurt someone?” or (c) “threatened to hit or hurt someone?” Research testing the three-question scale showed that the internal consistency of the three questions was very good ( $\alpha = .87$ ) and that the scale was appropriate for use in nonclinical samples (Coccaro et al., 2017, p. 22). The Cronbach’s  $\alpha$  for the anger attacks variable in the present study was .86.

Five pain measures were used, based on four questions adapted from the National Health Institute Survey (National Center for Health Statistics, 2009). The first three questions asked whether respondents had experienced (a) neck pain, (b) lower back pain, and (c) severe headache or migraine that lasted a whole day or more in the past 3 months. Respondents were asked to “not report aches and pains that are fleeting or minor.” A fourth question asked about (d) pain, aching, or stiffness in or around a joint during the past 30 days. Respondents were explicitly asked to not include back or neck pain in their response to this question. In addition to separate measures for each of the four pain sites, a pain index was created to indicate the number of sites of pain, ranging from 0 to 4, based on responses to these four questions.

Several variables were included as controls based on their relationships to either pain or aggression as identified in previous research (Ellison & Anderson, 2001; Holtzworth-Munroe & Stuart, 1994; Hotelling & Sugarman, 1986; Wilt & Olson, 1996). Binge drinking was a continuous variable, based on how many days in the previous year respondents consumed five or more

alcoholic drinks in one day (0–365). Thirty-six cases were missing for the binge drinking variable; their values were set to the mean to prevent losing the cases. The depression screen variable was coded 1 for affirmative response to any of the four screening questions about the lifetime experience of

a period lasting several days or longer when most of the day (a) you felt sad, empty or depressed; (b) you were very discouraged about how things were going in your life; (c) you lost interest in most things you usually enjoy like work, hobbies, and personal relationships; or (d) you were very irritable, grumpy or in a bad mood. (Jackson et al., 2014)

Functional limitations were measured using an index, with values of 0–12, based on the Nagi scale (Nagi, 1976). The Nagi scale measures the number of routine activities, such as climbing stairs, personal care, and preparing meals, that respondents report as being at least “somewhat difficult.” NFL career length was measured using the first and last season played (range 3–20 years). Weekly or more than weekly attendance at religious services was coded 1; responses indicating less than weekly attendance were coded 0.

Sociodemographic controls included age, college education (1 for bachelor’s degree or higher; 0 otherwise), marital status (1 for married at the time of the survey; 0 otherwise), and continuous measures of total income and net wealth computed from self-reported income (including wages, royalties, dividend income, pension income, etc.) and assets (including home value, vehicles, investments, retirement accounts, etc., minus any debts). The natural log of binge drinking, income, and assets was used to correct for skewed distributions.

Race was a binary variable, coded 1 for white, coded 0 for all other races. Because only 19 respondents in the sample identified as being racially other than white or black, identification of their race could have compromised their anonymity. To protect their privacy, their race, along with the race for respondents who identified as black, was coded as non-white.

## Data Analysis Procedures

The analyses were performed using STATA 16 SE. Descriptive statistics for all study variables were generated. Bivariate and multivariable logistic regression was performed to evaluate the relationship between anger attacks and the independent variables, including controls.

## Results

### Descriptive Statistics

The analysis of demographic controls (Table 1) shows that 817 (79%) respondents were married at the time of

**Table 1.** Descriptive Statistics: Characteristics of Retired NFL Athletes Who Responded to the Retired Player Survey ( $n = 1030$ ).

Characteristic	Mean (SD)	Range
<b>Controls</b>		
Age (years)	54.70 (14.17)	26–91
Married (%)	78.83	0,1
White race (%)	58.83	0,1
Income (US\$)	161,732 (335,180)	0–4,259,887
Assets (US\$)	2,856,089 (10,600,000)	0–202,000,000
College graduate (%)	78.45 (0.41)	0,1
Depression screen (%) <sup>a</sup>	19.61 (0.40)	0,1
Functional limitations (0–11) <sup>b</sup>	3.53 (3.25)	0–11
Binge drinking <sup>c</sup>	13.50 (44.93)	0–365
NFL career length (years) <sup>d</sup>	8.10 (3.15)	3–20
Weekly religious attendance (%) <sup>e</sup>	34.47	0,1
<b>Pain<sup>f</sup></b>		
Any joint (%)	78.54	0,1
Headache/migraine (%)	19.13	0,1
Neck (%)	35.63	0,1
Low back (%)	53.40	0,1
Pain index <sup>g</sup>	1.87 (1.19)	0–4
Anger attacks <sup>h</sup>	30.87	0,1

Note. <sup>a</sup>Four-item set of questions on the lifetime experience of a period lasting several days or longer when most of the day you felt sad, empty, or depressed; you were very discouraged about how things were going on in your life; you lost interest in most things you usually enjoy; you were very irritable, grumpy, or in a bad mood. Coded 1 for reporting at least 1 symptom; 0 otherwise.

<sup>b</sup>12-item set of questions asking how difficult it was to do things like climb several flights of stairs; stoop, bend, or kneel; or pull or push large objects. A count of limitations was created that ranged from 0 to 12 for how many activities respondents reported as at least "somewhat difficult" to perform.

<sup>c</sup>In the past year, on how many days did you consume five or more alcoholic beverages?

<sup>d</sup>Calculated using the first and last season played.

<sup>e</sup>How often do you attend religious services? Coded 1 for weekly or more; 0 otherwise.

<sup>f</sup>Survey asked about pain during the past 30 days that lasted most of the day and was not fleeting or minor.

<sup>g</sup>Number of sites of pain.

<sup>h</sup>Composite variable coded 1 for affirmative responses to at least one of three questions: Since you left football, have you ever had attacks of anger when all of a sudden you lost control and (a) broke or smashed something worth more than a few dollars, (b) threatened to hit or hurt someone, or (c) hit or tried to hurt someone?; 0 otherwise.

the survey (90.8% had been married at some point), 809 (78.5%) were college graduates, 606 (58.8%) were white, the average annual income was \$161,732 (range \$0–\$4,259,887), average assets were \$2,856,089 (range \$0–\$202,000,000), and the mean age was 55 years (range 26–91). The average NFL career length was 8.1 years (range 3–20), and 355 respondents (34.5%) reported attending religious services at least weekly. As for substantive controls, 202 (19.6%) respondents reported at least one symptom from the depression screen. Binge drinking was heavily skewed, with a mean of 13.5 days per year, and a median of 0 days per year of consuming five or more alcoholic beverages (range 0–365). Respondents reported an average of 3.5 functional limitations (range 0–11). Respondents reported an average of 1.9 pain sites, with 809 (79%) reporting joint pain, 550 (53%) reporting back pain, 367 (36%) reporting neck pain, and 197 (19%) reporting headaches or migraines. Three hundred and eighteen (31%)

respondents reported a lifetime occurrence of at least one anger attack.

### Logistic Regression: The Relationship Between Pain and Anger Attacks

The bivariate models (the first column in Table 2) separately regressed anger attacks on each of the controls and on each of the pain variables. Age ( $OR = .98$ , 95% CI [.97, .99],  $p = .001$ ), married ( $OR = .70$ , 95% CI [.51, .95],  $p = .024$ ), and college graduate ( $OR = .62$ , 95% CI [.46, .85],  $p = .003$ ) were each significantly associated with reduced odds of an anger attack, as were weekly religious attendance ( $OR = .56$ , 95% CI [.42, .75],  $p < .000$ ) and NFL career length ( $OR = .94$ , 95% CI [.90, .98],  $p = .005$ ). The depression screen ( $OR = 2.82$ , 95% CI [2.05, 3.86],  $p < .000$ ), functional limitations ( $OR = 1.16$ , 95% CI [1.12, 1.21],  $p < .001$ ), and binge drinking ( $OR = 1.23$ , 95% CI [1.13, 1.34],  $p < .001$ ) were

**Table 2.** Logistic Regression. Factors Associated With Anger Attacks<sup>a</sup> among Former NFL Players (n = 1030).

Parameter	Bivariate OR (.95 CI)	Multivariable <sup>b</sup> OR (.95 CI)				
		Model 1 Any Joint Pain	Model 2 Headache/Migraine	Model 3 Neck Pain	Model 4 Lower Back Pain	Model 5 Pain Index
<b>Controls</b>						
Depression screen <sup>c</sup>	2.82*** (2.05–3.86)	1.99*** (1.39–2.85)	1.84*** (1.28–2.65)	1.87** (1.30–2.69)	1.94*** (1.35–2.77)	1.83** (1.27–2.63)
Functional limitations <sup>d</sup>	1.16*** (1.12–1.21)	1.14*** (1.08–1.19)	1.12*** (1.07–1.18)	1.11*** (1.06–1.17)	1.13*** (1.07–1.18)	1.09** (1.03–1.14)
Binge drinking <sup>e</sup>	1.23*** (1.13–1.34)	1.19** (1.08–1.32)	1.20*** (1.09–1.33)	1.20*** (1.08–1.33)	1.19*** (1.08–1.32)	1.19*** (1.08–1.32)
NFL career length <sup>f</sup>	0.94** (0.90–0.98)	0.93** (0.89–0.99)	0.93** (0.89–0.98)	0.93** (0.89–0.98)	0.93** (0.89–0.98)	0.93** (0.88–0.97)
Religious attendance <sup>g</sup>	0.56*** (0.42–0.75)	0.66* (0.48–0.91)	0.64** (0.46–0.88)	0.65*** (0.47–0.89)	0.68* (0.49–0.93)	0.65*** (0.47–0.90)
<b>Pain<sup>h</sup></b>						
Any joint	2.13*** (1.48–3.07)	1.28 (0.86–1.90)				
Headache/migraine	2.83*** (2.06–3.90)		1.84** (1.26–2.69)			
Neck	2.62*** (1.99–3.44)			1.90*** (1.40–2.58)		
Lower back	2.09*** (1.59–2.74)				1.46* (1.08–1.99)	
Pain index <sup>i</sup>	1.66*** (1.47–1.87)					1.40*** (1.21–1.62)
Constant		0.40 (0.13–1.25)	0.34 (0.11–1.04)	0.35 (0.12–1.06)	0.40 (0.13–1.19)	0.20** (0.06–0.64)
Pseudo R <sup>2</sup>		0.10	0.11	0.11	0.10	0.12

Note. <sup>a</sup>Composite variable coded 1 for affirmative responses to at least one of three questions: Since you left football, have you ever had attacks of anger when all of a sudden you lost control and: (a) broke or smashed something worth more than a few dollars; (b) threatened to hit or hurt someone; or (c) hit or tried to hurt someone? 0 otherwise.

<sup>b</sup>Control variables not included in the table: Age, Married, White Race, Income (natural log), Assets (natural log), and College Graduate.

<sup>c</sup>Four-item set of questions on the lifetime experience of a period lasting several days or longer when most of the day you felt sad, empty or depressed; you were very discouraged about how things were going on in your life; you lost interest in most things you usually enjoy; you were very irritable, grumpy, or in a bad mood. Coded 1 for reporting at least 1 symptom; 0 otherwise.

<sup>d</sup>12-item set of questions asking how difficult it was to do things like climb several flights of stairs; stoop, bend, or kneel; or pull or push large objects. A count of limitations was created that ranged from 0 to 12 for how many activities respondents reported as at least “somewhat difficult” to perform.

<sup>e</sup>In the past year, on how many days did you consume five or more alcoholic beverages? (natural log)

<sup>f</sup>Calculated using the first and last season played.

<sup>g</sup>How often do you attend religious services? Coded 1 for weekly or more; 0 otherwise.

<sup>h</sup>Survey asked about pain during the past 30 days that lasted most of the day and was not fleeting or minor.

<sup>i</sup>Number of sites of pain.

\*p < .05. \*\*p < .01. \*\*\*p < .001 (two-tailed tests).

Source: NFL Player Care Foundation Study of Retired Players.

significantly associated with increased odds of an anger attack. Each of the individual pain variables and the pain index were associated with increased odds of an attack as follows: any joint ( $OR = 2.13$ , 95% CI [1.48, 3.07],  $p < .001$ ), headache/migraine ( $OR = 2.83$ , 95% CI [2.06, 3.90],  $p < .001$ ), neck ( $OR = 2.62$ , 95% CI [1.99, 3.44],  $p < .001$ ), lower back ( $OR = 2.09$ , 95% CI [1.59, 2.74],  $p < .001$ ), and pain index ( $OR = 1.66$ , 95% CI [1.47, 1.87],  $p < .001$ ).

The first four multivariable models (Table 2) regressed anger attacks on the individual sites of pain and controls. Headaches ( $OR = 1.84$ , 95% CI [1.36, 2.69],  $p = .002$ ), neck pain ( $OR = 1.90$ , 95% CI [1.40, 2.58],  $p < .001$ ), and back pain ( $OR = 1.46$ , 95% CI [1.08, 1.99],  $p = .015$ ) were all significantly associated with increased odds of an anger attack. The relationship between joint pain and aggression, though positive, was not statistically significant ( $OR = 1.28$ , 95% CI [0.86, 1.90],  $p = .226$ ). As for control variables, binge drinking ( $p < .01$ ), the depression screen ( $p < .01$ ), and functional limitations ( $p < .001$ ) were statistically significant and positive across all models 1–4. NFL career length ( $p < .01$ ) and weekly religious attendance ( $p < .05$ ) were significant and negative across the four models. The final multivariable model (5) examines the relationship between the pain index and anger attacks. Each additional site of pain was associated with increased odds of an attack ( $OR = 1.41$ , 95% CI [1.21, 1.62],  $p < .001$ ), as were binge drinking ( $OR = 1.19$ , 95% CI [1.21, 1.62],  $p < .001$ ), the depression screen ( $OR = 1.83$ , 95% CI [1.27, 2.63],  $p = .001$ ), and functional limitations ( $OR = 1.09$ , 95% CI [1.03, 1.14],  $p = .002$ ). NFL career length ( $OR = 0.93$ , 95% CI [.88, .97],  $p = .002$ ) and weekly religious attendance ( $OR = 0.65$ , 95% CI [.47, .90],  $p = .009$ ) were both negatively associated with anger attacks.

### Robustness Checks

Several robustness checks were run using alternative constructions of variables. The pain index was the independent variable used to measure pain in each of the robustness check models. First, several alternative measures of alcohol consumption were tested. Thirty-six cases were missing data for binge drinking. In addition to the models reported in Tables 1 and 2, in which the values of the missing cases were set to the mean (13.5), models were run with values for the missing cases set to the median (0), and models were run that excluded the cases with missing data. In all three models, pain increased the odds of an anger attack and the relationships were statistically significant ( $p < .001$ ). Models were also run in which the binge drinking variable was replaced with a variable that measured the number of drinks consumed per week. Here as well, the coefficient for pain was

statistically significant ( $p < .001$ ) and positive. However, the number of drinks per week was not statistically significant ( $p = .053$ ).

Second, for the depression screen, the dichotomous variable was replaced with a scaled variable (0–4) based on the number of depression screening questions to which the respondents answered “yes.” The  $OR$  (1.37) for the scaled depression variable was statistically significant ( $p < .001$ ). The coefficient for pain in this model was also positive and statistically significant ( $p < .001$ ).

Third, models were run in which the weekly religious attendance variable was replaced with multiple variables measuring respondents’ self-identification as either “religious” or “spiritual.” None of the alternative measures was statistically significant, and their inclusion in the models did not change the significance of the coefficients for pain.

Fourth, the dichotomous anger attacks variable was replaced with two alternatives. The first alternative was a scaled dependent variable (0–3), based on the number of IED screening questions to which the respondent answered “yes.” The pain index was statistically significant ( $OR = 0.10$ ,  $p < .001$ ). An additional model used a binary variable measuring the occurrence of an anger attack within the past year instead of a lifetime occurrence. The relationship between the pain index and an attack within the past year was also positive and significant ( $OR = 1.44$ , 95% CI [1.07, 1.95],  $p = .016$ ).

### Discussion

In a representative sample of former NFL players, back pain, neck pain, and headaches were all significantly associated with increased odds of an anger attack, as was a cumulative pain index, meaning that with each additional site of pain, the odds of an affective aggression increased. Binge drinking, depression markers, and functional limitations were also significantly and positively related to anger outbursts; however, when controlling for these factors, the pain variables remained statistically significant, indicating that pain plays a distinct role in anger attacks that is not explained by binge drinking, depression markers, functional limitations, or the other controls. These findings are in accord with literature suggesting that pain is a risk factor for anger and affective aggression (Coccaro et al., 2014; Cosio, 2019; Fernandez & Wasan, 2009; Fishbain et al., 1986; McCloskey et al., 2010).

The finding that NFL career length is significantly and negatively associated with affective aggression suggests that longer duration of professional participation in football actually decreases the odds of affective aggression later in life. While care should be taken not to overstate the significance of this finding, it is consistent with research showing that athletes who engage in contact sports are better than others at controlling their emotions



when subjected to pain (Manning and Fillingim, 2002; Thornton et al., 2020). One interpretation of the present study's finding on NFL career duration could be that professional football trains participants to reign in and productively direct aggressive impulses as governed by the rules of the game, even in emotionally charged, pain-inducing situations. If so, longer exposure to the sport could increase the chances that this sort of conditioning would carry over into men's personal lives, in this case after leaving the NFL. Another explanation could be that injury plays a role in shortening career duration, and the higher odds of episodic anger for those with shorter careers reflect the pain suffered from those injuries.

### *Limitations and Strengths*

Several limitations of this study need to be considered. First, the survey did not include a measure of respondents' histories of head injury; therefore, the observed association between headaches/migraines and anger attacks needs to be interpreted with caution and not be taken as evidence for a link between TBI and episodic aggression. The finding does suggest, however, that research on the behavioral effects of TBI might benefit from efforts to disentangle pain from other factors.

The IED measures also present with limitations. While the IED measures allow this study to be compared to other studies on affective aggression that use them, the measures do not operationalize social context; therefore, they do not provide information as to whether reported anger attacks occurred, for example, in family relationships, intimate partnerships, social settings, or in response to provocation. The IED measures also do not specify what kind of "hurt" or "pain" inflicted on others (economic, physical, emotional) is implied when respondents answer affirmatively to the anger attack questions. Furthermore, while the IED survey questions ask about "lost control," the questions do not capture whether self-reported attacks are out of character for the respondents or are instead related to more ingrained patterns of intentional behavior. Research shows that the distinction between affective and instrumental aggression is not clear cut, that motives are often mixed, and that the two the forms of aggression are correlated (Allen & Anderson, 2017). Future research on IED should distinguish among these different forms of aggression, how they might at times be interrelated, and how they operate across various contexts and targets. Additionally, the anger attacks variable measures presence or absence of attacks, whereas frequency of attacks over the life course would have allowed for more detailed comparisons. Finally, the survey questions from which the anger attacks variable was created were retrospective, potentially compromising reliability. However, the pain coefficient was also positive and significant in the model

using the dependent variable measuring the presence/absence of an anger attack within the past year (Table 2). This outcome offers some assurance as to the robustness of the main findings.

The fact that the data were cross-sectional also limits interpretability. Consider, for example, the positive and significant coefficients for binge drinking. At first glance, one might assume that alcohol consumption would result in a loss of emotional control that would lead to anger attacks. However, a study by Coccaro et al. (2016) of the temporal relationship between substance use disorders and IED found the opposite, that IED increased the severity of substance use disorder. Fernandez and Wasan (2009) also point out that anger can be a factor that predisposes, precipitates, exacerbates, or perpetuates pain.

Finally, without biomarker information, it is only possible to speculate on underlying mechanisms that might link experiences of pain with affective aggression. Inflammatory markers such as C-reactive protein and Interleukin-6 have been investigated as potential biological mechanisms. This remains a fertile area for future investigation.

Despite these limitations, this study contributes to research on both episodic anger and pain in important ways. The study focuses on a unique population, former NFL athletes, whose physical and behavioral health have been a source of public interest, and addresses two prominent issues: athlete involvement in physical altercations off the field, and injuries, physical impairment, and pain that afflict players during and beyond their playing years. This study speaks to both sets of concerns.

The finding that pain is related to anger attacks among former NFL athletes suggests directions for future research and implications for practice. First, to expand the generalizability of this study's findings, health research examining other occupational sectors that expose workers to high levels of injury and ensuing pain could include measures of IED or other forms of affective aggression. For example, a report from the Massachusetts Department of Public Health (2018) showed significantly higher rates of fatal opioid-related overdose among individuals working in such occupations. The addition of IED variables to surveys could provide a more nuanced understanding of the struggles faced by individuals who endure injury and pain in the context of making a living. Screening for IED could also aid in the development of more comprehensive assessment tools for identifying family and intimate partner violence (Allsworth, 2018). In clinical settings, conversations with patients about chronic pain can open opportunities to inquire about its impact on emotions, relationships, and family life and offer information about supportive services.

The link between pain and opioid addiction has also called forth a need for non-pharmaceutical forms of

support for those who suffer from pain (Gross & Gordon, 2019). The significant and negative relationships between NFL career duration and anger attacks and weekly religious attendance and anger attacks potentially speak to this need. Protective effects of participation in these institutions might accrue from any number of factors, such as social support, self-esteem, a disciplining of emotions, or the inculcation of positive health habits, life skills, or spiritual practices that might help with pain or anger management (e.g., Davis et al., 2020; Gucciardi et al., 2017). This might especially be the case for men who hesitate to seek out mental health support due to the associated stigma, which threatens more traditional masculine identities. For example, Nieuwsma et al. (2014) found that military veterans who distrusted mental health professionals were more likely to seek help from pastoral counselors. Gucciardi et al. (2017) similarly suggested that men might be more open to support that is framed in terms of “mental toughness” rather than “mental health,” since the former avoids the stigma associated with seeking help for mental health problems. To the extent that sports and some religious cultures, such as the “muscular Christianity” that developed in tandem with men’s sports in the United States (Ladd & Mathieson, 1999), resonate in positive ways with traditional masculine identities, some of their beliefs or practices might serve as valuable resources for men who need help with affective aggression. More broadly, research clarifying mechanisms through which sports and religious participation produce health benefits could aid in the development of alternative pain and anger management strategies outside of these institutions, for athletes and nonathletes alike.

## Conclusion

Former NFL athletes have significantly greater odds of experiencing physical pain, and earlier in life, when compared to men in the general population. As such, former NFL players are a population that lends itself to the study of the relationship between pain and behavioral health. The present study showed that former NFL players who experienced major headaches, back pain, and neck pain were more likely than former players who were not in significant pain to experience affective aggression, as manifest in episodic anger attacks. More research is needed to establish the generalizability of this finding, and to develop intervention strategies to improve behavioral health among individuals for whom pain is a chronic condition.

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## Authors' Note

Dr. Jackson passed away recently. Robert Turner has offered to receive correspondence intended for Dr. Jackson. Dr. Jackson’s research administrator, Diana Armistead, also responds to correspondence intended for him (darmis@umich.edu).

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## ORCID iDs

Evelyn Bush  <https://orcid.org/0000-0001-9162-2742>

Robert W. Turner  <https://orcid.org/0000-0003-4229-7087>

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