Personal Foul: How Head Trauma and the Insurance Industry Are Threatening Sports

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Abstract

This thesis will investigate the growing problem of head trauma in contact sports like football, hockey, and soccer through medical studies, implications to the insurance industry, and ongoing litigation. The thesis will investigate medical studies that are finding more evidence to support the claim that contact sports players are more likely to receive head trauma symptoms such as memory loss, mood swings, and even Lou Gehrig's disease in extreme cases. The thesis will also demonstrate that these medical symptoms and monetary losses from medical claims are convincing insurance companies to withdraw insurance coverage for sports leagues, which they are justifying through mathematics. Finally, the thesis will explore the ongoing litigation against sports leagues for alleged negligence against their players and their failure to communicate the sports' dangers to their players.

Personal Foul: How Head Trauma and the Insurance Industry Are Threatening Sports

Introduction

For several decades, sports have been an integral part of American culture. Through their rules and incentives of winning and competing, they teach people – especially youth sports players – valuable life lessons that will propel them to success when they reach adulthood. On the professional level, sports are one of the most popular forms of entertainment, collecting billions of dollars in revenue every year. Considering these reasons for sports' prominence, it is difficult to imagine American culture without them. However, contact sports leagues are in danger of shutting down operations, specifically the three main contact sports: football, soccer, and hockey. These sports are not in danger because of the financial failure of professional leagues, nor because of concerning drops in youth sports participation rates. The danger stems from the concept that sets these three main sports apart: contact, specifically as it relates to head trauma. The number of insurance companies willing to provide even partial head trauma coverage for youth and professional sports leagues has dropped significantly in the last few years. Coverage rates have been raised to the point that many youth, semi-pro, and college leagues are shutting down. The operators of these same leagues are now warning other leagues that they must find a solution to this problem before contact sports are erased from American culture. The factors of this concerning trend must be investigated thoroughly before a solution is proposed. Head trauma studies of youth and professional athletes, together with the mathematics of risk leading to an increased likelihood of litigation liability, have driven many insurance companies away from providing complete head trauma coverage to the aforementioned leagues.

Head Trauma Studies in Contact Sports

It is well known to athletes and contact sports fans that the possibility of head trauma, memory loss, mood swings, anger management issues, or other side effects of head trauma is high and becomes more likely the longer an athlete participates in these sports. However, in recent decades an abundance of medical evidence has emerged suggesting that these injury risks have become a critical factor in league organization and participation.

Head Trauma and Football

Death: football's original medical crisis. The most well-known and documented sport associated with head trauma is football. When the first organized football leagues were created around the beginning of the twentieth century, head injuries became an immediate concern. The first football games did not require players to wear helmets, and even when helmets became mandatory, multiple players were dying annually due to head, neck, and other injuries (Feuerherd, 2016). The number of deaths alarmed the general public enough for it to demand that football be outlawed. It could have succeeded had it not been for President Teddy Roosevelt's meeting with Harvard, Yale, and other football coaches to remove some of football's more violent strategies such as the flying wedge. In this move, the ballcarrier runs behind a link of four or more players with a goal of crushing anyone who gets in their way. But even with the ban of these formations and the introduction of the forward pass to reduce the number of violent scrums caused by running plays, players continued to die on the football field at rates consistent with those before Roosevelt's intervention (Feuerherd, 2016). Eventually, President Woodrow Wilson pushed for a standardized and less violent game of football (Feuerherd, 2016). With the advancement of helmet protection and the introduction of a more pass-oriented game of football

that reduced the number of violent scuffles, football saw the number of on-field deaths reduced to almost zero. But football was still, and continues to be, characterized by its violent nature. A careful observer could easily conclude that players who play the game for multiple years suffer many medical consequences after they retire, and they would be correct. It was not until the early 21st century that damning studies were published to show that football players were suffering from head trauma in disturbing numbers, and to make matters worse, the NFL knew about these medical consequences all along and vehemently tried to cover their tracks (Ezell, 2013).

Chronic traumatic encephalopathy (CTE): football's current medical crisis. As explained by Tharmaratnam, et al. (2018), a study conducted by the *Journal of the American Medical Association* (JAMA) in 2017 set out to discover if Chronic Traumatic Encephalopathy (CTE) is a reoccurring consequence of playing football. CTE is a neurodegenerative disease that results from repeated and excessive head trauma, which can often be found in former soldiers who have dealt with multiple concussive explosives and former participants of violent sports. CTE can only be diagnosed by investigating the patient's brain postmortem for the presence of tau protein aggregation. Tau proteins in healthy brains help transport essential nutrients within nerve cells by passages called microtubules. However, with brains afflicted with CTE, Alzheimer's, or dementia, these tau proteins can clump together to block nutrients from being transported to other nerve cells, eventually leading to cell death. Consequences of cell death include memory malfunction and motor skill difficulties, among others (Tharmaratnam et al., 2018).

The first whispers of an ongoing major concussion crisis turned into public outcries in the early 1990s when NFL stars Troy Aikman and Merril Hoge suffered major concussions and retired from the NFL due to post-concussion syndrome (Farber, 1994). In response to the

spotlight on concussions, the NFL, under commissioner Paul Tagliabue in 1994, formed the Mild Traumatic Brain Injury committee, headed by Dr. Elliot Pellman, a rheumatologist who had no previous experience in head trauma treatment or prevention. Pellman, did not even see concussions and head injuries as the NFL's main problem. He said during the committee's inception that he and the rest of the NFL "think the issue of knees, of drugs and steroids and drinking is a far greater problem, according to the number of incidents" (Ezell, 2013b, para. 2). Even more concerning, Tagliabue said later in 1994 that he thought the concussion problem was more concerning to the journalists: "On concussions, I think [it] is one of these pack journalism issues, frankly … There is no increase in concussions, the number is relatively small … The problem is a journalist issue" (Ezell, 2013a, para. 3).

Soon, medical data and former players' testimonies began to contradict the claims of Pellman and Tagliabue. In the early 2010s former NFL players Junior Seau, Jovan Belcher, and Aaron Hernandez all committed suicide and were found to have CTE when their brains were analyzed postmortem. Hernandez's case is particularly troubling: Hernandez hanged himself in April 2017, two years into his life sentence for murdering Odin Lloyd, a friend of Hernandez. When Boston University examined his brain, they discovered that Hernandez had stage 3 CTE, a stage of CTE never seen in anyone younger than 46 years old even though Hernandez was only 27 at the time of his death (Kilgore, 2017). But the most shocking piece of evidence that undermined the NFL's claim that CTE is not directly linked to playing in the league came from the JAMA study published in 2017. JAMA analyzed 202 brains of recently deceased football players who played in high school, college and/or the NFL. The study found that 177 of the 202 brains were confirmed to have CTE, and of the 111 analyzed brains of former NFL players, 110 of them tested positive for CTE, which calculates to a 99.1% correlation between having an NFL

career and becoming diagnosed with CTE. The medical researchers involved in this study also found that of the brains diagnosed with CTE, there was strong evidence of a direct relationship between the level of play and the severity of CTE. In other words, high school players had lower levels of CTE, and college players had higher CTE levels than high school players but lower CTE levels than of NFL players. The medical researchers believe that this progression is due to the longer exposure for potential sub concussive and concussive hits players continue to suffer for the duration of their football careers. To conclude the study, Dr. Ann McKee, a neuropathologist and the head of the study, noted that there probably is a link between CTE and football when she said that from the sample of brains analyzed for the study, "a high proportion had neuropathological evidence of CTE" (Mez et al., 2017, p. 369).

Head Trauma and Hockey

NHL and head safety: behind the times. The next sport that has recently garnered attention for a possible link with CTE is ice hockey. Since the early 1900s, the National Hockey League (NHL) has captivated the attention of millions of fans in the USA and Canada, where both countries have professional teams. When it comes to in-play violence, hockey is similar to football: football has tackles, blindside and chop blocks, wrestling-like takedowns, and gang tackles, whereas hockey has checking—or slamming other players into the high grade plastic walls that surround the arena—the occasional flips, and players decking other players onto the ice. But hockey is different from the NFL in that fights can take place outside of play if two or more players get enraged about something while the game was in play. These players will take off their helmets and gloves, punch and tussle with each other until the referees break up the fight then send the players into the penalty box or even disqualify them for the rest of the game. These fights bring entertainment value to the paying fans who attend the game or watch from

home, which drives up revenue for the NHL, thus, leading the NHL to make few changes to fighting rules in order to increase profits. It also serves as a valuable team strategy for some defensemen to take on the enforcer role, one who has the responsibility to make life miserable, by any means necessary, for any opposing player who attempts to take the puck to score, including fighting. The enforcers were some of the most valuable and popular players in the NHL for a long time, especially in the 1980s and 1990s. But while the enforcers were gaining notoriety with their teams' fan bases and enemies on the ice, they were also damaging their brains with devastating checks and numerous fights.

NHL and CTE: a persistent denial. Hockey's entertaining yet violent nature has been a fixture since its inception, but hockey helmets, a seemingly logical piece of equipment, only became mandatory in the NHL before the 1979-1980 season. Moreover, for any player who had more than 2 years of NHL experience, helmet usage was optional under a grandfather clause, with the last helmetless player retiring only in 1997 ("Only a Few NHLers…", 2017). As a result of delivering big hits to opposing players, it seemed plausible that enforcers would become susceptible to brain damage after suffering significant amounts of punishment throughout their careers. This premise became credible when Reggie Fleming, an enforcer that played for six teams over nearly two decades in the NHL, was diagnosed with CTE shortly after his death in 2009, the first confirmed case of CTE in a former hockey player. In 2011 Bob Probert, an enforcer for the Detroit Red Wings in the 1980s, was diagnosed with CTE, becoming the second hockey player with confirmation of the disease ("CTE found in Probert's…", 2011). But these two initial diagnoses were just the beginning. By 2016 all six brains of former NHL players tested for CTE came back positive, which escalated the pressure for NHL commissioner Gary Bettman, to respond to an increasingly concerning trend. "[A] causal link between concussions

and CTE has not been demonstrated" he said, and that "the relationship between concussion and the asserted clinical symptoms of CTE remains unknown" ("Gary Bettman Denies Link…", 2016). By early 2019, eight brains of former NHL players had tested positive for CTE, suggesting a possible link between hockey's multiple violent hits and the neurodegenerative disease. Since there are not enough brains to conduct a full study on this possible link, no reasonable quantitative conclusion can yet be reached on the possibility of a correlation between violent hits and CTE. Bettman's 2016 claims are still plausible if only because more evidence is needed in order to refute his past statements. The NHL has made minor changes to protect players from head trauma, though these have only increased the criticism from the families of former players posthumously diagnosed with CTE. As concerning as potential CTE could be in the NHL, there is a similar trend of a rising number of concussions in youth hockey.

Youth hockey and concussion prevention: is it working? Where the NHL have made few changes to improve its safety, youth hockey in the U.S. and Canada have started to reform hockey to make it safer for players. In 2012 USA Hockey delayed the introduction of body checking until players reached 13 or 14 years old. Hockey Canada made a similar decision in 2013 to ban body checking in peewee leagues of 11 and 12 year old players while introducing the move when players reach 13 and 14. These changes have paid dividends in the new rules' first years, particularly in Canada, where concussions were reduced by almost two-thirds and all other injuries were reduced by nearly half (Black et al., 2017). These are very good improvements, but there is a long way to go before youth ice hockey becomes safe for kids and teenagers. In 2016 approximately 400 U. S. hockey players aged twelve to eighteen years old still had their incidents of possible concussions documented, along with their side effects and durations. The study concluded that youth hockey has concussion rates "comparable to those

reported in other youth collision sports" (Kontos et al., 2016, p. 5). Similar concussion/head trauma studies have led to many hockey leagues prohibiting body checking until players are 12 or 13 years old, which could explain the higher risk of concussions for players age 12 and over found in the previously mentioned study (Kontos et al., 2016).

Head Trauma and Soccer

Heading and potential head trauma. Even the world's most popular sport is not immune to the head trauma issue. Soccer is now dealing with head trauma ramifications from one of its most spectacular and crucial of plays: heading. Soccer players are not allowed to use their hands or arms to advance the soccer ball down the field, which limits the players' primary advancement methods to dribbling and passing the ball with their feet, or hitting the soccer ball forward with their heads, known as heading. Heading is used most often when the advancing team kicks the ball from one of the soccer field's designated corner spots closest to the opposing team's goal. One of the advancing team's players uses his or her head to hit the ball towards the goal. While strategically efficient, heading leads to some medical problems for the players. The kicks from the corner spots, or corners, are, in some ways, delayed plays. This means that players from both teams have time to gather around the goal to head the ball towards or away from the goal, depending on which team the players represent. Unfortunately, when players from both teams leap for the ball, there is an increased risk for the players' heads to hit together, which can lead to excruciating pain, headaches, or worse – concussions.

Heading concussion data and possible remedies. While football gets most of the attention for head trauma, and justifiably so, concussion rates among soccer players are almost as high as that of football players. In the most comprehensive study of high school soccer injuries, the results showed that around 18% of injuries were concussions, reported as a total percentage

among total injuries to male and female soccer players. Another interesting trend is that the concussion rates for girls' soccer rival that of football and exceed boys' soccer concussion rates, which might be explained by smaller statures and less developed neck muscles for females compared to males (Khodaee et al., 2016). Soccer players have also seen their concussion rates rise over the last three decades, primarily because of heading. Given that the players are bigger, faster, and more physical, the game has become more concussion-prone from player-to-player contact in addition to the head trauma from repeated headings in games. To reduce potential head trauma, most youth soccer leagues have banned heading until the high school level. But when headers are introduced, the concussion numbers are high. On the professional side, some proposals have been made to increase player safety, but none have taken effect. Some of these proposals have included a temporary substitute player for a player suspected to have suffered a concussion, having the temporary substitute become a permanent substitute if the concussion is confirmed, and adding a fourth substitute for each team. Currently teams are allowed three substitutes per game (Brar, 2018). There have been no brains donated to Dr. McKee for CTE testing, so there have been no further investigations into whether soccer players have suffered from CTE or other forms of head trauma. However, soccer is another sport that must pay attention to growing concerns from neurologists and players who believe that more should be done to protect the players from head trauma.

Implications for the Insurance Industries

Research into CTE and other forms of head trauma shows that head trauma is, or will continue to be, a problem in football, hockey and soccer. What does this information mean for insurance companies? The growing number of studies finding a correlation between head trauma and contact sports gives the insurance companies evidence that there is a higher risk or

likelihood of monetary claims from their customers, the sports leagues. This implication means that companies should expect to lose money if they decide to insure against head trauma. Therefore, insurance companies are stepping aside from insuring contact sports leagues. But insurance companies cannot plan their net gains and losses with this reasoning without further validation from risk management mathematics. When the analytic and mathematical techniques used in risk management are examined, one concerning, overarching conclusion can be reached: it would be a bad decision for any insurance company to invest in almost any sports league, whether the league is on an amateur or professional level.

The Mathematics of Risk Management

Based on the available medical evidence for contact sport head trauma concerns, insurance companies have good reason to be cautious about agreeing to insure these sports leagues. But for actuaries, the people who calculate the amount of risk involved for such insurance coverage, the medical research is not enough. The actuaries also need the mathematics of risk management to suggest to them, and their employers, whether providing head trauma coverage would be a profitable or unprofitable investment. To get the data, there are a few major calculations to consider. These calculations can be time consuming and include many mathematical variables. Mathematical models are used extensively to calculate the results of potential sports league investments for the insurance companies, and the actuaries then articulate the quantitative results into a summary that informs the insurance company's executives of their returns on an investment. What do these calculations look like, and what models do actuaries use to formulate their analysis? Two main statistical calculations have important roles in risk analysis, which are the expected value and variance calculations.

Expected Value and its Risk Management Applications

Definition of expected value. First, an actuary calculates the expected value, or the expected shortfall/average value of risk as referenced in risk management. The expected value calculation, from a mathematical standpoint, begins by assigning a value to each possible event multiplying that value by the probability of each event occurring. Each of these multiplied values are added to get a final value, or the expected value. In the area of risk management, the event values represent how much money an insurance company would gain or lose on an investment, and the probabilities represent the likelihood of a profit or loss of an investment (Kenton, 2019). Given the probability of loss data from similar previous investments and normal assumptions about risks in investments, actuaries are confident that they receive accurate estimates of an investment's value to a company. The description outlined above is in the context of a single variable distribution, which means that the only factor, or variable, responsible for an investment's profit or loss is the probability of an investment resulting in various profit or loss values. In the context of an insurance company however, the results of investments depend on many variables, which occur in a multivariable context. These calculations are difficult to compute efficiently, so it is part of an actuary's responsibilities to create models that will calculate the expected value of investments by making assumptions about the many variables that play a role in an investment's expected value. The models may include the market interest rate, inflation, risk of default or bankruptcy in the invested company or organization, and others. In the case of sports leagues and organizations, there are even more variables that can drive down the value of an insurance company's investment to protect them from any liabilities, which serves as a red flag to the entire insurance industry.

Sports league investments: their expected values to the insurance industry. The insurance industry should see sports leagues as a profitable customer. Sports leagues must pay hundreds of thousands, perhaps millions, of dollars to ensure that any sports organization is covered in the case of traumatic medical accidents, embezzlement, general liabilities, crime insurance, and any economic damages suffered at the cause of the sports organization. In the case of the National Alliance for Youth Sports (NAYS), there is a medical limit of $25,000 per accident, a $500 deductible, which means that the organization is responsible for up to $500 of the cost, for general liabilities, a general aggregate limit of $2 million, and a $5,000 medical expense limit ("Youth Sports Insurance", n.d.). The costs of running a sports organization show that insurance companies demand most of the protection cost up front to counter the risk of multiple medical accidents and other liabilities. Oftentimes insurance companies make a profit due to an expected or less than expected number of accidents and liabilities in an organization. But now insurance companies are running away from insuring any sports organization, especially youth sports organizations. If there is potential for a huge profit from sports organizations, why are these organizations being dropped from insurance carriers? The answer lies in the definition of variance.

Variance and its Risk Management Applications

Another critical calculation for actuaries is the variance, which is the simplest mathematical explanation of risk to the actuaries of the insurance industry. In short, variance measures the spread of values in data sets. Going back to the single variable expected value scenario above, we would find the variance of the data set by taking the difference of the expected value from an actual value in the data set, squaring the difference, adding all of the squared differences for all values in the set, then dividing this total by the (possibly adjusted)

number of observations in the data set. Actuaries involved in the risk management of investments see variance as a tool to analyze the potential monetary loss, which computes how much payments to customers can differ from the expected shortfall as described above (Eberlein, Frey, Kalkbrener & Overbeck, 2007). In the case of youth sports leagues/organizations, insurance companies expect to receive millions of dollars from the organizations in exchange for protection from a list of liabilities. But with the potential of violent head trauma in contact sports, especially football, hospital bills for the injured players can quickly add up for any sports organization. If a sports league is negligent in their medical treatment, insurance companies can lose money protecting these leagues. Insurance companies prefer investments with little variance, and sports leagues have very high variance; therefore, insurance companies will generally not want to invest in these organizations. As a result, many youth leagues would have no choice but to shut down, which is happening across the country at an increasing rate (Fainaru & Fainaru-Wada, 2019).

Possible Distributions Used in Risk Management Calculations

When making investment calculations for insurance companies, actuaries must build a foundation to set up their calculations. This foundation is made up of assumptions, or observations that the actuary will assume to be true before making their calculations. These assumptions are formulated by either past data or from preliminary observations of the data set that is currently being evaluated. Using these assumptions and the expected value and variance calculations, actuaries run models that produce estimates of the insurance companies' investments and how much profit or loss they should expect to receive. But what kind of mathematical assumptions do actuaries use to develop their models? The most critical

assumption involved in these calculations is the selection of a probability distribution, which is a broad generalization about the data sets that actuaries work with to run their calculations.

Normalcy in risk management. One of the most widely used distributions used by actuaries to develop their models is the Normal distribution. The Normal distribution is a bell-shaped probability distribution, where the center of the bell curve represents the expected value of a data set, and the width or fatness of the curve is related to the variance of the data set. Therefore, a wider variance in a data set means that the bell curve representing the data set is wider. For a given value in a data set, the farther the value is from the center of the bell curve, the less likely it is that that value will appear in a sample or model simulations. The Normal distribution is often used by insurance actuaries because it accurately approximates any distribution with many values in a data set. This is true because of the Central Limit Theorem (CLT), which states that if there is a random variable *X* that is represented by the sum of other, smaller random variables, regardless of how the other, smaller variables are distributed, then *X* can be well represented or approximated, by a Normal distribution (Lyon, 2013). There are some conditions to the CLT, however. The CLT holds if the size of the sample data set taken to represent the population is large enough to assume the sample can be approximated with the Normal distribution, which is often agreed by statisticians to be around 30 values. The insurance industry actuaries favor the Normal distribution because it is an easy tool to help with investigating the probability of the riskiest scenarios in their investments, thereby giving the possibility of conclusive evidence that the insurance industry should not make a particular investment.

Poisson distribution and risk management. The Normal distribution plays an important role for actuaries in the insurance industry, but complex models sometimes show that other

distributions better approximate the results and trends of an insurance company's investments. One of these distributions is the Poisson distribution. The Poisson distribution serves insurance actuaries well because when the claims data approximates a Poisson distribution, actuaries can analyze valuable statistics about the most likely number of claims on investments. This helps companies narrow down how much money they should set aside in reserves to pay out claims, which have escalated due to the increased awareness of head trauma and other serious injuries (Stat Trek Staff, n.d.).

Exponential distribution and risk management. The Poisson distribution determines the number of insurance claims within a specific timeframe, usually a year. But suppose insurance company *Y* has another question: How much time should they expect to pass in between claims? This question can be answered using the exponential distribution. As the Poisson distribution details the probability of the number of claims, the exponential distribution details the time between claims, which aids the insurance actuaries to report to the insurance companies when they should expect to pay more in claims.

Monte Carlo Simulation Modeling: The House Always Wins… or Does it?

There has been mention of complex models that actuaries use to project the profit or loss of an insurance company's investments, many of which are beyond the scope of this paper. However, one model does deserve some explanation, as it serves as the foundation for most other probabilistic models used by actuaries. This model is the Monte Carlo simulation model, named after the world-famous casino in Monaco. The Monte Carlo simulation models started to develop as a central part of physics, engineering, financial calculations, and mathematics because the model involves a user-created algorithm that runs calculations multiple times, giving the most probable values for critical calculations. Some of these include expected value, variance,

standard deviation, and others for insurance companies to understand the most likely results for their investments. The basis for running Monte Carlo simulations is to input a probability density function (pdf), which gives a relative probability calculation for continuous random variables (Harrison, 2010).

The classic example that demonstrates the power of Monte Carlo simulations would be a gambler's expected winnings against the casino, otherwise known as the house. Every casino game has a probability, say x, that the house will win in a round against a player. Thus, since all probabilities add up to one, the probability that the player wins is $(1- x)$. The house's win probability x is always greater than the player's win probability, $(1- x)$. Of course, if the player only plays a few rounds with his or her funds, there is a realistic chance that the player will walk away with more money than his or her initial betting funds. If the player continues to play, the odds of the player winning decrease dramatically until the house ends up earning large profits off the player (Joseph, 2018). Insurance companies use this philosophy when setting prices for their coverages and when considering how many claims they can expect to pay out on a yearly basis. Likewise, insurance companies make substantial profits more times than not by insuring their customers, especially sports leagues that require the best insurance protection against serious medical injuries. As the saying goes, "The house always wins." However, with the increasing awareness of head trauma and other major injuries in contact sports, there are also a rising number of cash payouts that the insurance industry never expected: class-action litigation, which will be explained further in the next section. When considering the money that has already been paid out in claims and the potential money that could be lost in lawsuits, there is now reason to change the notion of "The house always wins" to "The house always wins, barring unforeseen circumstances."

Mathematical Implications for the Insurance Industries

Other in-depth calculations involve distributions which assume conditions like the increased chance for net loss with a higher documented level of risk, including the Pareto and Weibull distributions. Citing these distributions, there is now tangible evidence that the insurance industry underwriting of contact sports leagues is a bad investment. Equipped with this mathematical knowledge and the ever-growing medical studies, insurance companies are finding themselves on the losing end of the gamble by becoming the participant that is more likely to lose money on insurance claims, which has placed the insurance industry into uncharted territory.

Litigations and Insurance

The medical data and the mathematics behind the probability of monetary loss are enough to deter insurance companies from covering head trauma losses via contact sports leagues. What may frighten these companies the most is the litigation brought against the sports leagues and their administrations. Contact sports have been around for a long time, with their players using their bodies to help their teams win at great personal expense. Most players did not think twice about sacrificing themselves for the betterment of their teams, but that was decades ago. Then, players only knew their bodies would be wrecked from interacting with veteran players. Now, as medical technology has improved and risk mathematics has developed, the players' fears of broken bodies and painful retirements are not only realized, but well known. The medical data pointing towards the brutality of contact sports is inevitable, and litigation is on-going. There are credible reasons to believe that these contact sports leagues: the NFL, NHL, and the numerous professional soccer leagues, knew their sports were potentially dangerous, even mortal, and they did not inform their players of the risks. Almost all litigation on head

trauma and willful negligence is focused on the NFL, with some lawsuits brewing in the NHL. Nevertheless, the insurance industry knows they could soon be paying out millions, if not billions, in settlements.

The NFL and Head Trauma Litigation: A Potentially Horrifying Trend

As mentioned previously, the Mild Traumatic Brain Injury (MTBI) Committee under Dr. Elliot Pellman was formed in 1994 to determine if there was a possible link between traumatic injuries and playing in the NFL. They participated in a 13-part study that interviewed NFL team doctors, medical specialists, and gathered player concussion data from previous seasons. Curiously, the study mentioned that the head blows NFL players receive ultimately result in brain damage greater than or equal to the brain damage suffered by boxers, a group of athletes who already had a well-established connection between head injuries and CTE diagnoses. However, this same study also noted that NFL players diagnosed with concussions recovered and lost all concussion symptoms abnormally quickly, noting that NFL players "are a highly conditioned, physically fit population accustomed to playing with pain and highly motivated to return to play as soon as possible" (Weinmeyer, 2014, p. 553). Finally, the committee also concluded that there were no cases of CTE in active NFL players (Weinmeyer, 2014). As previously mentioned, Dr. Pellman had no previous experience in neurology or analyzing head trauma, which made the study suspicious and controversial from the outset. But until players were diagnosed with CTE as a result of many concussions and extensive head trauma, the study's results could not be investigated any further. Nearly a decade later, one doctor started to stack evidence against the NFL.

Dr. Bennet Omalu is a Nigerian-American neuropathologist, examining brain tissue for forensic or diagnostic reasons. Omalu was a junior neuropathologist at the Allegheny County

medical examiner's office in Pittsburgh, Pennsylvania in September 2002 when he was presented with the brain of former Pittsburgh Steelers center Mike Webster. Webster was only 50 years old when he died from a heart attack, but what had confused Dr. Omalu was that Webster was already suffering from depression and confusions of memory and judgment. When Omalu cut slices into Webster's brain, everything appeared normal from the outside tissue. But when Omalu investigated the interior of Webster's brain, he found what we know now to be clumps of tau protein, the telltale sign for CTE (Laliberte, 2018). Dr. Omalu then found CTE in the brains of former NFL players Terry Long and Andre Waters in 2005 and 2006 respectively, which went against the MTBI committee's claim that there was no significant risk of having another concussion in the same game or season that a player suffered an initial concussion. The CTE discoveries mentioned above and mounting pressure from the press forced Dr. Pellman to step down as chairman of the MTBI committee, of which he remained a member until 2010 when the NFL renamed the MTBI committee to the Head, Neck, and Spine Committee. It was around 2010 when the NFL began to revamp their concussion guidelines ("NFL Concussion Fast Facts," 2019). The most notable change was a memo that NFL Commissioner Roger Goodell sent to all 32 teams in December 2009, which stated that players who experienced symptoms of concussions such as memory loss, inability to remember plays, persistent dizziness, and constant headaches, were not allowed to return in the same game or practice from which they first started experiencing symptoms ("NFL Changes Return-to-Play Rules," 2009). The NFL was making notable advances towards player safety improvements, but these measures, it could be argued, were likely stemming from the increasing likelihood of lawsuits against the NFL. Even Congress was getting involved into the investigation of head trauma and football, making the damage-control crisis much worse for the NFL.

Head Trauma and the First Litigation

In late 2009 and early 2010, Commissioner Goodell was called to testify before the House of Representatives regarding a possible link between football and head trauma and the NFL's slow pace on adapting improved safety measures for its players. Throughout the testimony, Goodell insisted that no such link existed. DeMaurice Smith, the recently appointed head of the NFL Players Association, was also questioned by Congress. When DeMaurice was asked about the NFL's track record of taking care of retired players and their needs, he admitted that the Players Association had done a poor job of securing medical care and disability benefits. He then stated that would be the Association's primary mission going forward (Goldman, 2009). The Congressional hearings did little to appease retired NFL players, who had noticed that members of the MTBI Committee regularly denounced independent research suggesting that football was to blame for the higher than normal rates of memory related ailments among its former players. With deaths from more prominent former players like Junior Seau in 2012 that confirmed more cases of CTE, many former players decided to act against the NFL. On June 7, 2012, a class-action lawsuit was filed against the NFL on behalf of approximately 2,000 players, accusing the NFL of negligence on player safety and not notifying the players of a link between football and degenerative head trauma. The NFL immediately moved to dismiss the case, but their motion was denied. As the lawsuit went on, the number of plaintiffs increased to about 4,500 retired players along with family representatives of former players who had passed away. After more than a year of negotiating and discussions on both sides, a resolution was proposed on August 29, 2013 for the NFL to pay $765 million to cover legal fees, medical exams, medical research and concussion-related expenses ("NFL Concussion Fast Facts," 2019). Representatives on both sides were ready to make the deal, but the judge presiding over the case, Anita Brody,

refused to agree with the settlement, saying that the $765 million payment was not enough for the damages mentioned in the lawsuit. Furthermore, there were several factors that affected how much money each plaintiff could receive in the settlement, such as the severity of the players' conditions, the players' ages, duration of playing careers, and whether some of the plaintiffs were family members of players found to have CTE posthumously. After another two years, in April 2015, a federal judge gave final approval for a more detailed settlement, but that settlement was only the beginning of the ongoing legal battle between NFL and its former players (Belson, 2016).

After the Settlement: The End of a Legal Crisis, or the Start of Something Worse?

The agreed-upon settlement in April 2015 allowed for every plaintiff to receive up to $5 million for their medical treatments, depending on the severity of their condition. In total, the NFL was tasked to give approximately $1 billion to the plaintiffs. Now that the financial penalties were agreed upon, the question became how the money would be divided between the plaintiffs and their legal representation. In some cases, lawyers were demanding as much as 40% of the reward for their services in addition to a $112.5 million "pot" that would be used to reward all legal representation involved in the lawsuit. Jason Luckasevic, the attorney who filed the first concussion lawsuit against the NFL in 2011, noted that "this case has done nothing but show lawyers at their worst" (Belson, 2016). Christopher Seeger, the founder of Seeger Weiss, the top firm behind the settlement, noticed that he had seen lawyers relentlessly fight for deserved higher legal fees in notorious class-action lawsuits before, but the ruthlessness in acquiring more legal fees is "not even close" in comparison to the lawyers' relatively tame behavior in other cases (Fainaru-Wada, 2017, para. 11). The situation has escalated so much that lawyers are bringing lawsuits against other lawyers to represent players at lower costs (Fainaru-Wada, 2017). Due to

these lawsuits and resistance from the NFL, most plaintiffs still have not been paid, and it could take years longer for the plaintiffs and lawyers to get their share of the settlement. To make matters worse, future lawsuits against the NFL could involve exponentially more money than this first settlement, which has the insurance industry cowering in fear of the incalculable damages that the industry may have to dole out to all sports leagues.

Is the Insurance Industry's Fear of Costlier Settlements Legitimate?

Fair or not, the future of all youth and professional contact sports leagues will be seriously affected by the results of the NFL's settlement with their former players. Veterans of these sports will notice that they can be compensated from any injuries and debilitations they might have suffered from playing contact sports. Most of the plaintiffs in the lawsuits could be seeking two resolutions: monetary settlement for the physical and emotional damage brought upon by head trauma, and/or the acknowledgement of negligence against the defendants, in this case the sports leagues (Reiter & Tanglen, 2017). Negligence can be difficult to prove in court because the prosecution will have to show a pattern of "conduct that falls below the standard regarded as normal or desirable" (Schot, 2005, p. 4). Monetary settlement is the easier resolution because it is difficult for the prosecution and defense alike to pinpoint the exact moment head trauma or CTE started to impact the player's well-being. To close the matter, the leagues will often pay the plaintiffs a portion of the money they requested (Reiter & Tanglen, 2017). In the future, however, obtaining monetary settlements will be more difficult, because the prosecution would have to show that the sports league had an explicitly defined duty to protect their players, the same sports league failed to follow through on their duty, and that playing in that sports league definitively caused the former players in question to suffer mental and/or physical harm (Weinmeyer, 2014). Negligence against these leagues unexpectedly became easier to prove in

2016, when a senior NFL official named Jeff Miller, who was testifying to the House of Representatives, responded to the question of whether a link exists between playing football and CTE with an assertive "certainly," (Belson, 2016, para. 3). If a lawsuit ever finds a major league to be negligent against their players, it would be the insurance companies' worst nightmare: millions of dollars lost, negative publicity, and the inevitable reality that more money will be lost in the future. The potential amount of money that could be lost from the head trauma and negligence issue is even drawing comparisons to the asbestos crisis. In the mid-1960s, it was discovered that asbestos, a high-density fiber prominently used in construction, is linked with the lung disease asbestosis, which still costs the insurance industry around $1.6 billion annually (Fainaru, Finaru-Wada, 2019). With that comparison in mind, the insurance industry is rapidly refusing to insure such leagues, forcing youth sports leagues and community college leagues - specifically football - to shut down due to the league's inability to cover the high protection costs themselves. Even though he was speaking about football, Jon Butler, Pop Warner's executive director, implicitly sent a warning to all contact sports when he said that "people believe that football will never go away, but if we can't get insurance, then it will" (Fainaru, Finaru-Wada, 2019, para. 4).

Conclusion

Insurance companies have drastically reduced the number of sports leagues for which they are willing to provide head trauma coverage. More athletes are aware of the medical issues they could encounter in their playing careers. The mathematics of risk management are telling actuaries that insurance coverage would be a terrible investment. More sports leagues are shutting down every year because less insurance carriers are willing to take on the enormous risk associated with contact sports. Insurance companies are afraid that they will be responsible for

millions in losses if athletes and their families bring lawsuits against the leagues they participate in for physical and emotional damages. The millions will likely turn to billions if more medical data is released that supports the link between contact sports and head trauma, which will bring us closer to facing the harsh reality that we could see contact sport participation reduced to historically low levels, or even abolished in the United States.

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