

discriminating based on a legally recognized disability. Finally, requests for family medical history both during the Combine and as part of the standard NFL preseason physical violate GINA.

With respect to the biometric screening of professional athletes, our recommendations center around four C's: compliance, clarity, circumvention, and changes to existing statutory schemes. First, we encourage the leagues and their teams to take a closer look at their policies and practices to ensure they are in full compliance. When the applicability of a given law is unclear, we urge them to seek clarification. We also caution against using corporate structuring or other techniques to circumvent these legal protections. And finally, we recognize that Congress may want to revisit how the ADA and GINA apply to professional sports and change the current law.

CONFLICTS OF INTEREST

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Wearable Technologies in Collegiate Sports: The Ethics of Collecting Biometric Data From Student-Athletes

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The wearable technology market is booming and more than 400 million wearable smart devices, worth about \$34 billion, will be sold in 2020 (Lamkin 2016). Fitness, activity,

and sports trackers represent more than 60% of this market. Examples of wearable devices that collect biometric data include heart-rate and sleep monitors, as well as devices

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that can wirelessly collect electroencephalogram (EEG) and electrocardiogram (ECG) data. The wearable technology industry is still in its infancy and future applications of these monitoring devices are broad, though not yet entirely clear. Many universities have used biometric data to help inform their training methods in sports (Tracy 2016; Wilers 2015). The National Collegiate Athletic Association (NCAA) recently approved the use of some wearable technologies in football games, limited to one-way communication and only for health and safety (Dodd 2014).

Biometric data are measurements that permit tracking of physical and physiological information for assessment of performance and recovery in sports (Karkazis and Fishman 2017). Research using biometric information promises modification of training regimens to prevent injuries, but collecting this information raises serious ethical questions. To provide guidance for regulating the use of wearable technologies in professional sports, Karkazis and Fishman (2017) examine five areas of ethical concern that are also applicable to collegiate sports. We contrast the adoption of wearable technologies by student-athletes and by professional athletes, and argue for more empirical research into the use of wearable technologies in sports. We also argue that research institutions are better equipped than professional sports teams to handle this research and provide guidance on best practices for proper collection, storage, and sharing of health information.

ETHICAL ISSUES

The first area of ethical concern Karkazis and Fishman (2017) discuss is the validity and interpretation of the collected data. They analyze heart-rate variability monitoring in professional and recreational sports and persuasively argue for more empirical research to determine whether new biometric technology and the procedures used by the operators of such equipment improve currently available methods. Such research is desperately needed for both amateur and professional sports, and it will be expensive. Funding will probably come from professional sports and private industry, but professional sports teams focus on winning and corporations focus on immediate return on investment, so they are not well positioned to conduct long-term research studies or to share what they may view as proprietary information. Professional sports also have a history of trying to suppress research findings: For many years the National Football League (NFL) harassed university-affiliated scientists who suggested a link between concussions and chronic traumatic encephalopathy, and a recent congressional investigation claims that NFL officials improperly attempted to influence the National Institutes of Health (NIH) grant selection process for concussion research (Goldman 2016; Perez 2016). In contrast, research universities incorporate elements of peer review, disclosure of conflicts of interest, freedom to publish, and public disclosure of research findings (Goldman 2016). Because of

potential contributions by each, however, partnerships between universities and private industry should be encouraged and not viewed as adversarial. Regardless of funding source, all aspects of study design and execution should be publicly available, and research protocols should be registered in a public database at the outset to ensure conformity with the best research practices (Drazen 2012). Investigators conducting research on the validity of biometric data should disclose all study results, whether positive or negative.

The next two areas of ethical concern involve the issue of increased surveillance of players, and the associated risks regarding data security (Karkazis and Fishman 2017). To address these concerns, Karkazis and Fishman suggest creating a governing body that would be responsible for creating a protocol for data governance. We build on this idea by suggesting that this council should develop standards on how best to collect, store, and use biometric data to optimize its usefulness while also respecting privacy rights of athletes. It is important for the council to build a coalition of amateur sports, professional sports, the military, consumers, and manufacturing providers. This coalition should create practical resources for information governance, including data privacy and protection standards for all segments of the wearable technology market. Some legal scholars have called for creating a consortium in which teams and players can share biometric data across organizations to help identify behavioral patterns that may lead to better safety protocols (Roberts 2016). The council can help here, for example, by creating a data safety and monitoring board to assist with research protocols and to disseminate study results.

Karkazis and Fishman (2017) also discuss potential conflicts of interest when personnel within sports organizations have access to player data or when teams enter into contractual agreements with technology companies in which they have an ownership stake. Similarly, in collegiate sports, university activities, income, or other interests may create conflicts of interest. For example, the University of Michigan recently signed a \$170 million contract that allows Nike to harvest Michigan student-athletes' personal data collected from its wearable technology (Tracy 2016). Not only did the contract lack protection for the student-athletes, but questions arose about how university officials selected these particular wearable technologies and whether they fully understood the terms of the contract (Tracy 2016). Also troubling was the fact that the contract negotiations were conducted in secret; the details became available only after several news organizations obtained relevant information through the Freedom of Information Act. Transparency is needed in these situations. It would be prudent for university personnel who are engaged in relationships with private industry to ensure that all financial conflicts or institutional conflicts of interest are appropriately identified and managed. This should not be difficult because many universities already have conflict-of-interest policies that address these issues and ensure ethical conduct in research.

The final area Karkazis and Fishman discuss is coercion: People in authority (e.g., coaches, team doctors) may demand collection of biometrics or fellow players may apply peer pressure to reveal personal data. Professional players' associations and unions actively negotiate collective bargaining agreements with team owners, and they have recently discussed issues related to the use of wearable technology (Karkazis and Fishman 2017; Tracy 2016). At the collegiate level, however, the amateur status of student-athletes limits their leverage to influence negotiations with technology companies. This power imbalance has led to disputes in the past. For example, in 2009 former student-athletes sued the NCAA in an antitrust class action lawsuit (*O'Bannon v. NCAA* 2009) based on the organization's unauthorized use of players' images for commercial purposes. In 2016, a videogame company settled its portion of the lawsuit for \$60 million after the players demanded payment for use of their name, images, and likenesses (Rovell 2016). Space prevents full analysis of the case, but the U.S. Supreme Court recently denied certiorari in *O'Bannon*, meaning the NCAA must comply with federal antitrust laws, and legal analysts are predicting more challenges to NCAA rules that disallow college athletes from obtaining compensation (i.e., product endorsements) from third parties (Edelman 2016).

BIOMETRIC TECHNOLOGIES AND CONCUSSIONS

Concussions are increasingly considered a public health priority, and head trauma and concussion research using the biometrics of wearable technology offers great promise for protecting players' health and safety. Sports-related concussions are often difficult to diagnose and few objective diagnostic measures are available, forcing reliance on players' self-reported symptoms. The timeline guiding a player's return to full activity is also poorly understood, and players may underreport symptoms or inflate their level of recovery in hopes of being cleared to return to competition (Torres et al. 2013). Because biometric devices potentially offer more objective measures than self-reporting, investigators are designing studies that include wearable devices that track the frequency and magnitude of head impacts. One biometrics manufacturer, for example, recently developed a mouth guard that measures each head impact's force level and location on the field (Wiers 2015). To date, the majority of head-impact research on football players has involved high school or collegiate student-athletes (Torres et al. 2013).

More research is urgently needed to study the long-term effects of repetitive head trauma and concussions in sports. Wearable devices that collect biometric data on head trauma may be able to provide objective measures for investigations into the efficacy of self-reporting and for drafting concussion guidelines. Progress on this topic has been slow, however, and research requests have been met with resistance. For example, the NCAA

recently denied a request to experiment with helmet cameras that may be able to record data on head impact and trauma (Dodd 2014). This decision is troubling because sports organizations usually talk about players' health and safety and the need to act in their best interests, but actions of sports organizations sometimes contradict this rhetoric.

CONCLUSION

Federal regulations do not address the use of biometric technologies in sports. Professional athletes are considered employees, but student-athletes in collegiate sports have no protection from federal and state employment regulations. Representatives from amateur and professional sports should work together to promote sound ethical policies through the formation of a data governance council, whose goal would be to adopt best practices for the collection, use, and storage of biometric data, including those generated by wearable technologies. Until privacy safeguards are established by such a council, universities and the NCAA should discourage the sharing of biometric data among teams and conferences without the explicit consent of the player. Commercial use of individually identifiable biometric data collected from student-athletes should be permitted only with the athlete's permission. Further research on the validity and interpretation of biometric data in amateur and professional sports is urgently needed and should include a more systematic approach to gathering information on the prevalence of biometric technologies and on existing privacy protections.

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Collegiate Sports: Professionals All But in Name Raise Unique Bioethics Concerns in the Collection of Biometric Data

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Karkazis and Fishman (2017) present an interesting analysis of the bioethical dilemmas facing professional sports organizations seeking to incorporate biometric data in the analysis and optimization of their players and teams. The use of biometric data in sports can be useful; genetic information in particular may provide relevant and actionable information with regard to predispositions to injury (Greenbaum 2013). The authors failed, however, to present appropriate guidance for a large and special subset of athletes: the nearly half a million collegiate athletes (Potuto and Mitten 2016). The ethical and legal issues introduced by the use of genomic analyses in college sports are non-trivial and substantially different from the concerns raised

by their use in professional sports. They should be assessed independently.

Perhaps most problematic is the murky and long-standing (Epstein and Anderson 2016) issue regarding the employee status of athletes who are academic scholarship recipients. As described herein, various recent and ongoing legal disputes have raised significant questions as to the exact nature of the student/athlete/university relationship, and as such, this case law has created substantial uncertainty as to whether athletes can be statutorily protected by genetic discrimination laws designed specifically to protect employees. For example, Title II of the Genetic Information Non-discrimination Act (GINA) (Genetic

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