Anti-Doping Policy: The Emperor's New Clothes

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Abstract

A sport or game is defined as a "voluntary attempt to overcome unnecessary obstacles [1]" with rules developed to define and shape the goal of the game, control the means of obtaining the goal, and ensure or restore fairness. Anti-doping policy establishes the rules surrounding the testing and sanction of athletes and others for actions related to a Prohibited List of substances and methods. Substances appear on the Prohibited List if they meet two of three criteria: (1) harmful or potentially harmful to an athlete's health; (2) performance-enhancing or potentially performance-enhancing; and (3) in violation of the 'Spirit of Sport.' In this thesis I examine the philosophical justifications for anti-doping policy that are connected to these three criteria. While there is a lack of empirical evidence that appropriately used performance-enhancing substances are harmful, there is evidence that the lack of medical supervision and access to safe medications is causing and allowing harm. There is also a lack of evidence that the substances on the Prohibited List enhance performance, yet they are imbued with this property by their presence on the list. Concerns that performance-enhancing substance use by successful athletes is coercive misplace the coercive influence. It may be that the strongest coercive influence comes from the labeling of a substance as performance-enhancing regardless of its biological effects. Modern, elite sport is a massive commercial enterprise that may itself violate the best intentions of an ill-defined 'Spirit of Sport.' Anti-doping policy has evolved and narrowed to serve an ideological purpose and in doing so has become a threat to the health and wellbeing of all individuals involved in fitness and sport.

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Glossary of Terms

AAF	Adverse Analytical Finding
AAS	Anabolic androgenic steroid
ADAMS	Anti-Doping Administration & Management System
ADRV	Anti-Doping Rule Violation
CAS	Court of Arbitration for Sport
The Code	World Anti-Doping Code
EPO	Erythropoietin
FIG	Fédération Internationale de Gymnastique
FINA	Fédération Internationale de Natation
IAAF	International Association of Athletics Federations
ICC	International Cricket Council
IOC	International Olympic Committee
MMA	Mixed Martial Arts
UCI	Union Cycliste Internationale
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USADA	United States Anti-Doping Agency
VO_{2max}	Maximal oxygen uptake
WA	World Athletics (formerly IAAF)
WADA	World Anti-Doping Agency

Chapter 1

Introduction

Introduction

In the Hans Christian Andersen fairy tale "The Emperor's New Clothes" two vagabonds portrayed themselves as weavers of a cloth so special that it was invisible to "…every one that was not fit for his office, or was hopelessly stupid." The emperor had to have clothes fashioned from this most wonderous of fabrics and proceeded to send gold and the finest silk to the two con men. His courtiers, sent to report on the progress, could of course see nothing, but not wanting to be revealed as not fit for office or hopelessly stupid, reported that the cloth was indeed wondrous. When the time came for the emperor to see the cloth his courtiers pointed out how magnificent the fabric was, and the emperor who could see nothing, agreed enthusiastically while frantically thinking that he could not reveal that he could see nothing because then it would be apparent that he was not fit for his office. And so, the emperor donned his splendid attire ready to parade through the town. All the townspeople who had heard of the properties of this wondrous fabric exclaimed at the magnificence of the robes held aloft by courtiers until a child cried "[b]ut he hasn't got anything on!" Then the rumblings began, and the emperor knew the people were right, but he stayed the course and continued the charade thinking "I must keep it up through the procession anyhow" [2].

Just as the swindling vagabonds defrauded the emperor into thinking he was wearing clothes when he was not, the World Anti-Doping Agency (WADA) tells us that anti-doping policy protects athletes from harm and protects the integrity of sport, when it is anti-doping policy that may be one of the greatest threats to the health of athletes and

the integrity of sport. The Prohibited List (perhaps falsely) bestows the aura and allure of performance enhancement on a list of substances without identifying which substances have been approved for use in humans, then the policy prohibits athletes and medical personnel from seeking or providing qualified, knowledgeable healthcare. The fraud is cloaked in the moral superiority of a 'spirit of sport' that is conveniently used to prop up an outdated ideology that has little foundation in fact and even less relevance to a modern sports institution that has evolved to occupy a different role in society. Understanding the changing nature and role of elite sport is an important basis for examining an anti-doping policy that should serve to protect athletes from a myriad of potential abuses but often does not.

The purpose of this thesis is not to address the ethical problems associated with carrying out anti-doping operations (from intrusive whereabouts reporting and sample collection, to the adjudication of sanctions) or to argue that performance-enhancing substances are no different to other performance-enhancing techniques, but to examine the three possible rationales for banning substances, for without a prohibited list, anti-doping operations would be unnecessary. While the Code lists 11 violations that could result in an anti-doping rule violation (only one of these violations is consumption of a prohibited substance), the core of anti-doping policy rests on *why* particular substances or methods are forbidden in sport. The criteria for inclusion of a substance or method on the Prohibited List are presented in Article 4.3 of the Code [3]:

> **4.3** Criteria for Including Substances and Methods on the Prohibited List WADA shall consider the following criteria in deciding whether to include a substance or method on the Prohibited List:

> **4.3.1** A substance or method shall be considered for inclusion on the Prohibited List if WADA, in its sole discretion, determines that the substance or method meets any two of the following three criteria:
>
> > **4.3.1.1** Medical or other scientific evidence, pharmacological effect or experience that the substance or method, alone or in combination with other substances or methods, has the potential to enhance or enhances sport performance;
> >
> > **4.3.1.2** Medical or other scientific evidence, pharmacological effect or experience that the Use of the substance or method represents an actual or potential health risk to the Athlete;
> >
> > **4.3.1.3** WADA's determination that the Use of the substance or method violates the spirit of sport described in the introduction to the Code.

For inclusion on the Prohibited List a substance or method must satisfy at least two of these criteria and WADA, a private foundation, is the sole arbiter of this decision, with no transparency or accountability [4]. Since the substances on the Prohibited List are the reason athletes are being tested and the provisions and sanctions outlined in the Code rely on there being something prohibited, it makes sense to examine these three criteria in detail. Since performance enhancement and health are quantifiable measures, these claims can be assessed using empirical data. If both the performance enhancement and health justifications are not supported by quantitative, peer-reviewed evidence, then anti-doping policy rests on an ideological claim of spirit of sport that also needs delimiting.

Sport is a philosophically interesting activity. The rules and obligations provide the macro- and microscopic structures, and the voluntary acceptance of these structures is somewhat necessary for the sport to be. However, the rapid increase in knowledge over the last ~120 years can be used to reevaluate and refine rules that may not be keeping pace with the evolution of the practice of elite sport. In this thesis I examine sport

through the criteria for Prohibited List substances. Chapter 2 presents a general overview of the structure of sport. Because two of the criteria for anti-doping policy can be examined using objective data, the empirical evidence for claims of health harm and performance enhancement are examined in Chapter 3 and Chapter 4 with particular emphasis on the evolution and limits of human athletic performance over the last ~120 years. An understanding of health and performance is necessary to begin to examine the role of anti-doping policy in health and harm (Chapter 5), and if the policy itself contributes to or mitigates the use of performance-enhancing substances. Claims of coercion are examined in Chapter 6. With the dismissal of health and performance enhancement as valid justifications for anti-doping policy, the final justification is the spirit of sport. This ideology is examined in the context of the experiences of Olympic and elite athletes (Chapter 7). In the final chapter I propose a new way forward that prioritizes the health and wellbeing of athletes.

The Changing Role of Sport and Doping in Society

The role of sport in society has changed dramatically over the last 120 years [5] with an increasing dominance of the Olympic movement in elite sport. Pierre de Coubertin envisioned the Olympic Games as a beacon of pure gentlemanly amateurism. Sport was an arena to cultivate virtues of hard work, excellence, health, joy, and moral character [6]. The Olympic movement positions itself as a virtuous and chivalrous expression of modern sport even as the eligibility requirements were adjusted to allow professional athletes. Commercialism and overtly competitive attitudes were antithetical to the vision of de Coubertin [7]. The reality is that the event rapidly transformed into a political tool for nations to advance propaganda, showcase superiority, and achieve political, economic, or social goals [8]. Many factors contributed to a rapid progression of athletic performance in

the post-war years and, combined with the politics of the time, winning and athletic superiority became a primary motivating force [7]. Technological innovations in entertainment allowed the television rights for the Olympic Games to be purchased in 1960. Commercialism was slow to take root in the Olympics. Olympic sport was restricted to amateur athletes until the 1974 revision of the Olympic charter. In the late 20th century, the increasing cost of hosting the games forced a shift to commercialization of the event. The 1996 Atlanta games were also known as the 'Coca Cola Games' due to the dominant presence of advertising and commercial interests [8]. The income from broadcasting rights is such a substantial part of the International Olympic Committee (IOC) budget [9] that the 2020 Olympics will be held during a global viral pandemic that is exacerbated by large gatherings and travel. The IOC openly, and misleadingly claims that IOC funding "enables the staging of the Olympic Games" but is less enthusiastically open about the reliance of the IOC on income generated by the broadcast rights of these events [9]. In reality, the IOC provides a small portion of the cost of hosting an Olympic Games, with the vast burden falling on the host nation [10]. Yet despite the heavy influence of professionalism and commercialism in Olympic (and any) sport, athletes are still expected to personify the virtuous Olympic ideology [7].

Performance-enhancing substance use is an integral part of sport history. Attitudes towards performance-enhancing substances have evolved from an accepted part of gentlemanly competition to a moral failing on the part of deviant athletes [11,12]. Until the 1970s there was little moralizing around doping. Amateur athletes were pure and honorable, part of a noble knighthood and therefore would not dope, whereas professionals were part of the crass, materialistic, lower classes and so doping was an inevitable and acceptable part of professional sport [5]. Stimulant use was at one time

accepted and expected in endurance sports. Thomas Hicks, the 1904 Olympic marathon winner famously used a combination of alcohol and strychnine throughout his winning performance [13]. Cyclists in the early 20th century would use a range of stimulants from cocaine to alcohol to strychnine.

The Olympic movement began to conflict with the reality of the training and performance demands of modern sport and the amateur ideal was abandoned in 1974 [7]. Attention shifted to drug use in sport. The death of 23-year-old cyclist Knud Jensen on the opening day of the 1960 Rome Olympics is widely viewed as the event that marks the beginning of public awareness of drug use in modern sport. Knud Jensen fell off his bike towards the end of a 100 km team time trial on a 40°C day. He was moved to a medical tent in temperatures approaching 50°C where he remained for ~2 hours until he died. His Dutch trainer admitted that he gave him the drug Roniacol prior to the race. Roniacol is a nicotinyl alcohol (not an amphetamine) that primarily causes peripheral vasodilation and has been misidentified as an amphetamine in historical accounts of Jensen's death [13]. Roniacol would likely impair endurance performance and given the environmental conditions, the fact that the cyclists did not carry fluids on their bikes, and subsequent treatment, it is more likely that Jensen died of heat stroke (31 other cyclists suffered heat stroke during the time trial). Autopsy reports for Jensen were unavailable and there is no official available documentation that definitively states that Jensen died from the use of amphetamines yet his death is still widely used as an anti-doping call to arms [14,15].

Anti-doping statements were developed, and the focus shifted from the health of the athlete to the deficits in moral character of drug users [6]. Anti-doping policy began to be formalized in the early 1980s after the revelations of the East German state sponsored doping [16,17] but it was policy that had little legal heft. The involvement of the United

Nations Educational, Scientific, and Cultural Organization (UNESCO) throughout the 80s and 90s legitimized the fledgling anti-doping movement and promoted international cooperation. However, UNESCO's preference for educational approaches to anti-doping was dismissed in favor of prohibitive 'catch and punish' policies of the IOC and then the World Anti-Doping Agency (WADA) [18]. Language became increasingly emotive and judgmental with a December 1999 UNESCO meeting of government officials and representatives from national and international sports organizations opening with the words "if the world of sport suffers from doping, it is because society suffers from drug addiction [18]. David Howman, WADA Director General in speaking to athletes at the 2012 Winter Youth Olympic Games stated "I do not think we will ever get rid of doping. I do not suggest for one second that it is an evil that will ever be expunged" [18].

The emotive language used when referring to performance enhancing substances (both legal and illegal) has hijacked the very concept of performance enhancement. Extraordinary performance is questioned and covertly, and sometimes overtly, associated with doping. Ketones, for example, are a natural energy substrate utilized during periods of starvation or reduced carbohydrate availability (such as during an endurance event). Recent research has demonstrated that ketone supplementation may improve endurance exercise performance [19]. Ketones are categorized as a food supplement not a drug, yet because of the association with performance enhancement, use of ketones has been regarded with suspicion and confusion [20,21]. The estimated 1.5% improvement in laboratory cycling performance is enticing but should be interpreted with caution. It is difficult to blind subjects to a ketone supplement because of the distinctive taste which raises the possibility of a placebo effect [22]. Further, Heuberger *et al.* [23] demonstrated that cycling performance is far more complicated than can be replicated in a laboratory time

trial. A true performance enhancement of 1.5% is likely to be engulfed by the variability in day-to-day performance and strategies on the road. As a comparison, carbohydrates are also an energy substrate during performance and carbohydrate replacement beverages enhance performance during periods of reduced carbohydrate availability such as during an endurance event. Unfortunately, the mere hint of an association with performance enhancement for a product that has a scientific name (for example, a 'ketone' supplement) is enough to raise suspicions of doping, cheating, and illegality. When commenting on the use of ketones by professional cycling teams, Union Cycliste Internationale (UCI) President David Lappartient specifically referred to ketones as drugs: "I am confident that WADA will monitor all performance-enhancing drugs. Ketones aren't on the list of banned drugs, but we must monitor usage" [20]. Ketones are not medications intended to diagnose, mitigate, treat, cure, or prevent disease [24]. Ketones are classified as dietary supplements and are not subject to regulatory oversight beyond that required in the food industry.

The narrative surrounding the use of performance-enhancing substances has also undergone considerable evolution. The term 'doping' has now been co-opted to include anything that may enhance performance from financial doping [25], to manager doping [26], to temperature doping [27]. The underlying implication is that of an unfair and unnatural advantage. The historical acceptance of stimulant use in the early 20th century began to shift with increasing prominence of the Olympic Games in sport. Harm attributed (often without evidence) to use of performance enhancing substances [15,28,29] provided a politically safe rationale for a paternalistic anti-doping policy: saving athletes from the hazards of products that would, unequivocally, harm them. The establishment of the WADA following the Festina affair at the 1998 Tour de France created an environment

where use of performance enhancing substances was spoken about in increasingly morally judgmental terms [18]. Athletes who return an adverse analytical finding are deviant and cheaters [30] and prohibited association with the sporting community is enshrined in the World Anti-Doping Code (the Code) under Article 2.10 [3].

Misinformation and Anti-Doping Policy

The Olympic movement has transitioned and rather than professionalism being the enemy of Olympism, performance-enhancement is the villain and professionals are embraced. This transition influenced the development of formal anti-doping policy. The change in narrative regarding doping from athletes protesting drug testing at the Tour de France in the 1960s [30,31] to Howman's description of doping as an "evil" to be "expunged" in 2012 [18] is eerily evocative of Orwell's Two Minutes Hate [32] where:

> "The horrible thing about the Two Minutes Hate was not that one was obliged to act a part, but, on the contrary, that it was impossible to avoid joining in."

The descent into dystopia in Orwell's 1984 started with morally laden messaging, mass surveillance, and condemnation of those who did not conform to the noble ideal. Elite athletes have overwhelming pressures that have little to do with execution of their sport to vigorously deny and decry doping [33,34]. In this thesis I will examine the three prongs that form the justification for the substances on the Prohibited List and show how misinformed arguments have fueled an anti-doping policy that may be causing more harm than good to both athletes and the institution of sport itself [35].

Simon [36] presented five broad arguments against doping in sport, using steroids as the example drug of choice. These arguments are:

> "(1) use of steroids to enhance performance is harmful to athletes, who need to be protected; (2) use of steroids to enhance performance by some athletes

> coerces others into using steroids; (3) use of steroids to enhance performance is unfair or a form of cheating; (4) use of steroids to enhance performance violates justifiable norms or ideals that ought to govern athletic competition; and (5) use of steroids demeans or cheapens achievement in sport, for example, by making home runs too common and too easy to hit in baseball."

I will note first that the use of "steroid" as a surrogate for any performance enhancing substance is a rather clumsy shorthand for a wide range of prohibited substances, and appears to be an emotively loaded word choice, in keeping with the trend in anti-doping information outlined in the previous section. While Simon presents five reasons to ban performance-enhancing substances [36], these justifications (referred to as 'Simon justifications') are interrelated and reduce to the three WADA criteria for banning a substance (i.e. harmful to health, performance enhancing, violating the spirit of sport). These five justifications for drug-free sport can be examined in the light of available empirical evidence. Simon justification (1) is the health justification (Article 4.3.1.2) and states that performance-enhancing substances are harmful to athletes, so a ban is justified to protect the health of the athlete. This claim that performance-enhancing substances should be banned because they are harmful can be examined by determining if performance-enhancing substances *are*, in fact, harmful, where the harm is coming from, and if anti-doping policy enhances or mitigates this harm. Simon justification (5) is the simplest connection to performance-enhancement (Article 4.3.1.2), although this justification can also have deeper philosophical relationships with attribution of effort, and physiological and psychological relationships with effort perception and expectations. If performance-enhancing substances really do enhance physical abilities of elite athletes, then the challenges of sport become too easy. The allocation, perception, and expectation of effort is also tangentially related to Simon justifications (3) and (4), although these justifications have stronger connections to the

'spirit of sport' ideology that will be examined in Chapter 7. The third justification for anti-doping policy related to fairness and cheating also relies on performance enhancement, and again, it is a complex task to unwind a performance enhancing effect from all the influences on performance. The fourth justification for anti-doping policy has roots in both health and performance, but speaks to a deeper, subjective expectation of the right way to do sport and what we expect from elite performers. Simon justification (2) states that use of performance-enhancing substances coerces other athletes to take these substances in order to stay competitive. This claim relies on a complex interplay between biological effects that *are* performance enhancing and expectation effects that may also be performance enhancing. The allocation of performance enhancement to the drug or some other factor is not a simple task. There is a strong interconnection between the criteria for banning a substance or method and the philosophical justifications for the need for a Code.

The argument that anabolic androgenic steroid (AAS) use is directly harmful to the health of the athlete is supported by reports in the medical literature of injury, illness, and death attributable to AAS use [37-45]. As Simon [36] argued, it is because of these dangers athletes should be prohibited from using these substances for their own protection. However, this is a blunt-force assessment of a more complex problem. A more detailed analysis of the evidence produces the following observations: (1) the athletic subjects of these case reports are frequently recreational athletes, or athletes competing at a high, but not elite level. These athletes were not part of the WADA registered testing pool that is the primary target of anti-doping education and policy. Hence, the athletes were not subject to testing or sanction; (2) when product and dosage details were available it was clear that the patients were stacking and cycling multiple products, only some of which were

approved for human use, without guidance or monitoring from a qualified healthcare professional; (3) because the patients were taking substances that were not prescribed they did not have access to products that are subject to oversight, quality control, and manufacturer withdrawal. It is likely that many products were obtained on the black market. Doping products obtained on the black market are frequently adulterated or do not contain the ingredients listed [46-51]; and (4) the lack of qualified medical guidance and monitoring is a consequence of both drug policy and a morally laden anti-doping policy that has crept beyond the boundaries of elite sport performance into healthcare. The evidence supports a hypothesis that prohibiting access to qualified medical professionals and evidence-based healthcare at a time when such access could make a difference in health outcomes (i.e. when deciding which products to use, interactions, and how to administer the substances to maximize physiological gains while minimizing harm to the individual) may be a greater danger than prescribing the approved substances themselves. For example, AAS have been used in sport for decades, and more importantly, tests to detect AAS use were among the first anti-doping tests developed and deployed in elite competition. Many AAS that have undergone clinical trials and been approved for human use have well developed side effect profiles from decades of prescription and adverse event reporting. These substances are also the AAS that are easily detected as the testing methodology has simultaneously undergone decades of refinement. This simple reality drives the development of new undetectable substances that utilize similar cellular signaling pathways as established and approved medications (tetrahydrogestrinone [THG] is a high-profile example) but have not been through the clinical trial process to determine if they are safe for human use. When access to substances that have been approved for human use is denied, athletes may use

comparable veterinary products that have not been approved for human use but are more readily available.

A further criticism is that the current anti-doping policy is paternalist [52-54]. Paternalism involves a limitation on freedom or autonomy of an agent without their consent in the belief that this limitation is in the best interests of that agent [55]. Paternalism is accepted when there are clear harmful outcomes such as laws requiring seat belts or motorcycle helmets to mitigate risk of serious injury or death in the event of a crash. Anti-doping policy could be seen as paternalist as the freedoms of athletes to use certain performance-enhancing means are limited (or banned) with the justification that these limitations are in the best interests of the athletes. These interests include claims that performance-enhancing substances themselves are harmful to the athlete's health. The criticisms that anti-doping policy is unjustifiably paternalistic have misplaced the harm. Rather than the harm lying in the substances themselves, the harm lies in a poor policy framework that increases rather than reduces the likelihood of athletes making harmful, uninformed choices and reduces opportunities for medical intervention before catastrophic outcomes manifest. Sporting authorities, just like many other authorities, should be paternalistic, to protect athletes from themselves but anti-doping authorities are fulfilling this paternalistic obligation the wrong way. They should carry out their paternalistic duties by ensuring that the real alternatives athletes have are safe, thereby minimizing harm and fulfilling their paternalistic duties. The use of black-market doping products stacked and cycled based on information from dubious sources with limited or no medical training is the end result of choices that are governed and limited by anti-doping policy. Anti-doping policy fails in its paternalistic duty as it both causes and allows more harm than it prevents.

Using AAS as the representative for performance-enhancing substances to examine and justify anti-doping policy is an easy target. Higher doses of AAS are only beneficial in a handful of sports with open-ended morphological demands. For example, in competitive body building bigger is better, although with some limitations for balance and function. In the heavyweight classes of combat sports with no upper weight limit, bigger will be better to a certain extent. If an athlete becomes too large to move quickly that athlete will not be able to respond to quick, forceful movements from a competitor and will likely not be as successful. A rugby player who gains too much muscle mass will not be able to move quickly on the field of play. Yet, many other types of performance may benefit from lower doses of performance-enhancing substances. Other sports that are considered high-risk for doping favor other substances. For example, erythropoietin (EPO) could be considered the drug of choice for road cyclists. Erythropoietin was first marketed in 1989 (Procrit, Epogen) as a treatment for anemia due to chronic kidney disease or myelosuppressive chemotherapy. A spate of deaths of young European cyclists was blamed on EPO with little medical evidence to support the claims [56]. Further work has demonstrated that no elite French Tour de France cyclists who were active during the EPO-era of the 1990s and 2000s had died by 2012 [57]. Erythropoietin is a substance that is far more likely to cause health issues during the time it is effective, i.e., during the ~120-day lifespan of the red cells produced from EPO administration. If EPO is a dangerous drug, then elite cyclists should be dying or experiencing health complications in competition and training, or while sleeping. Inconveniently, cyclists persist in using EPO and staying both healthy and alive in flagrant disregard of WADA's party line. Ironically, it may be the hematocrit limitation of 50% that is acting to prevent harm rather than the prohibition of the use of EPO. It is quick and easy to determine hematocrit and does not require expensive, sensitive lab equipment, enabling athletes to monitor their hematocrit

themselves. Cyclists are not banned for having a hematocrit greater than 50% but are required to remove themselves from competition for a period of time until their hematocrit decreases below 50%. It is not clear that there is a direct relationship between increased hematocrit and endurance performance [58] so EPO use may be limited by the user as the ergolytic effects of higher doses become apparent. Performance would be impaired well before reaching a level of use that would cause health harms. Regardless of whether or not a substantially elevated hematocrit is performance enhancing, the hematocrit limit acts to restrain profligate use of EPO that would likely be harmful to either performance or health. This use of a health marker prioritizes health outcomes rather than substance use.

When considering the claim that performance-enhancing substances are dangerous, it is important to recognize that the substances on the list that are approved for human use are used to treat people with disease. If the drug was dangerous, it would be of far greater risk for patients who are clinically compromised than for athletes who are healthy (or at least healthier) and active. A drug that was unreasonably dangerous for a clinical population would not be approved for human use. Use in the clinical population would remain experimental and limited to patients who had exhausted all other treatment options. Approved treatments that do have significantly severe side effects (for example chemotherapeutics) are unlikely to be performance enhancing therefore of little interest to athletes. While some drugs do have narrow therapeutic windows (range of doses that treat the disease without causing negative side effects), any drug that is approved for human use, regardless of whether it is available over the counter or by prescription only, can be dangerous if taken inappropriately. For example, acetaminophen is available over the counter and by prescription and is a common ingredient in cold and

flu medications. It is also easily overdosed and can cause liver toxicity and death. It is a critical error to assume that performance-enhancing substances exert their effects in a directly proportional way (i.e., greater doses result in greater performance enhancement) if they enhance performance at all. As with everything in sports performance, there is a "Goldilocks zone." More drug does not necessarily improve performance to a greater degree, if at all. If anything, the harmful side effects that may occur with increasing dosages will also impair performance. Since the purpose of taking the substance is to enhance performance this outcome is a built-in limitation to excessive drug use. If performance-enhancing substances are dangerous (regardless of approval status) and given the estimations of prevalence of use ranging from 40-60% [59,60], the morbidity and mortality rate of elite athletes during their competitive years and after retirement should be higher than the general population. It is not [57,61-67]. What is dangerous about current performance-enhancing substance use is the lack of qualified medical oversight that supports appropriate dosages and combinations, and the inability to obtain substances through regulated supply chains.

The claim that performance-enhancing substance use makes elite performance easier to achieve and thus devalues the performance is interesting. The notion that athletes who take performance-enhancing substances are taking a 'short-cut' to elite performance is a common theme through anti-doping rhetoric. However, as Simon [36] points out, performance-enhancing substances are not a magic pill that transform an average recreational athlete into an elite athlete instantly. When physiological mechanisms are considered, most prohibited substances would act as a training aid, allowing an athlete to train harder or recover better. The accrual of a greater volume of high-intensity training contributes to performance enhancement. This is the same

mechanism of performance enhancement for substances like creatine, and methods like carbohydrate loading that are not prohibited. The substances do nothing without the training. Stimulants may enhance performance acutely, but again, without the training base, elite performance is not possible. The athlete is still "…the cause of the performance" [68] and athletes who supplement their training with performance-enhancing substances may work harder (absolutely) than those who do not.

Chapter 2

Rules, Obligations, and Fairness

Introduction

The structure of the activity we call sport is important when considering the rules and policies surrounding it. Participation in sport and games relies on agreement between participants about the acceptable and unacceptable actions that constitute the recognizable sport. On a basic level, these constitutive rules shape some of the most recognizable elements of a sport [1,69], for example, whether or not hands are used in a sport that involves kicking a ball is a major distinction between soccer and the different forms of rugby. Voluntary acceptance of rules is crucial in many definitions of sport and is a concept that is often co-opted when defending rules that seem to have little direct relationship with the activity being performed. If an individual does not like the rules, or want to abide by the rules, then they can simply do something else that is more suited to their desires. However, rules often do not reflect the practice of the sport, and it is in this mismatch that questionable policies and consequences can arise. Elite sport has evolved from a gentlemanly pursuit where participation and inclusion confirmed an individual's acceptance among the ranks of the elite class to an activity that is constantly expanding the boundaries of science and technology [5]. Many constitutive rules and understandings of fairness have evolved to accommodate technological and training advances. This chapter will present the basic structure of sport and interpret this structure in the light of the rapid evolution of sport over the last century to lay a foundation for examining the

basis and direction of a determinedly regressive anti-doping policy that seeks to govern an unstoppably progressive advancement that is fundamentally human.

Rules and Obligations in Sport

Sport is a rule governed activity entered into voluntarily by athletes seeking to play the game. Building on the analysis of Searle [69], Suits [1] summarized games as "…the voluntary attempt to overcome unnecessary obstacles," and described the requirements of prelusory goals, constitutive rules, and a lusory attitude to meeting this definition. Further work by Ryall [70], Simon [36], and Loland [71] has added additional regulatory and auxiliary rule categories that provide structure to a sport outside of the field of play. Constitutive rules describe the means for achieving the prelusory goal and shape the individual nature of the sport. Constitutive rules are fundamental to the existence of the sport as a distinct activity. For example, the ball is advanced in soccer without use of the hands or arms. Regulatory rules provide a mechanism for returning to the constitutive rules of play if these rules are broken. For example, when a soccer player commits a foul, play may be stopped to administer a penalty and restore equal opportunity to the opposing team. Auxiliary rules do not shape the individual sport or alter the way the sport is conducted on the field, but serve to establish expectations for conduct, appearance, or welfare among other considerations. For example, the use of a distinctive uniform for the goalkeeper on a soccer team is an auxiliary rule. According to the simplest interpretation of Suits' definition, in order to fulfill the requirement for the lusory attitude, athletes voluntarily agree to accept all the rules inherent in the sport regardless of utility and applicability of the rule to modern practice [72,73]. Because sport is an organized, rule governed activity with many layers of participation and governance, athletes may also incur obligations to adhere to the rules that are distinct from the voluntary acceptance of

the rules. Rules are important for measuring and ranking absolute performance at the time of the performance and for comparing athletic performance over time [71,74].

Obligations to accept and adhere to rules can arise out of considerations for fair play, gratitude, and membership [75]. More complex are determinations of consent when examining the voluntary nature of rule following in sports participation, especially with rules that are designed to promote welfare rather than shaping the characteristics of the sport. Sport is an activity requiring cooperation for measuring and ranking the performance of participants. This cooperation extends to accepting a share of the restrictions (or rules) in place to ensure equality of opportunity and fair play. The obligation to adhere to the rules is owed to other athletes in order to make the activity possible and to benefit from the activity. If an athlete is benefitting from a sport, that athlete is obligated to follow the rules of the sport out of a position of gratitude. The athlete is obligated to avoid actions, or rule violations that would compromise the interests of the sport because they have benefitted and may continue to benefit from the sports community of which they are members. Membership itself engenders obligation that may or may not be voluntary. Being an athlete of a particular sport obliges the athlete to adhere to the rules. Indeed, the participant could not be an athlete of a particular sport without at least following the constitutive rules that give rise to the existence of the sport [76]. Being a member of a particular sport also entails an obligation to comply with the norms of that sport's culture and practice. It is in this theory of obligation that the greatest mismatch between a sport as it is practiced versus a sport as it is codified in the rules can arise.

Anti-doping rules are auxiliary rules that are not directly connected to the structure of the sport or the constitutive rules that shape the essential characteristics of

the sport [70]. Membership in a sporting community obliges an athlete to obey the written rules and also respect the social and cultural practices of that sport. For example, while not written in the rules, it is considered unacceptable for a cyclist to attack the race if the designated race leader has had a mechanical issue or has crashed. While debated hotly by television pundits as part of the skills and tactics of the sport (some may say that cyclists should be able to maintain their bicycle in functioning mechanical order, should calibrate their approach to technical areas of a course to match their individual skills, and should be able to make rapid adjustments in a fast paced competitive arena), this behavior is negatively viewed by the participants and the violator risks ostracism from, and lack of access to benefits provided by the community. In contrast, anti-doping rules are formalized within almost all sports communities, but evidence suggests that the use of banned substances is part of the social and cultural norms of elite athletes [59,60]. If membership conveys obligation to accept social and cultural norms, then the use of banned substances is an acceptable practice in elite sport. A formalist might say that a runner who knowingly took a banned substance was no longer running because the auxiliary anti-doping rule had been broken. Is a runner who has unknowingly taken a banned substance still running? Is this the sporting form of Schrodinger's cat? Is the athlete running as long as they remain unaware of the presence of the banned substance? Once the presence of the banned substance is known, was the runner no longer running even if this knowledge is gained after the running race is completed? This analysis is, of course, ridiculous. Despite evidence that use of performance enhancing substances (knowingly or otherwise) is prevalent by elite athletes, few rule violations draw as much ire and moral condemnation as anti-doping rule violations [77]. Precise explanations of how the use of a banned substance changes the essential characteristics of a sport have yet to match the sophisticated molecular and mechanical understanding

of the activity or create distinct separation from the molecular and mechanical actions of other performance enhancing activities that are permitted by the rules.

Fair Play and Fairness

While the concept of playing well refers to athletic excellence, fair play involves the adherence to rules and norms that are codified and justified by the institution. However, fair play can occur while rules are broken, and unfair play can occur without breaking any rules. When a soccer player deliberately fouls an opponent to gain a strategic advantage, they are breaking the rules, but this rule-breaking is an accepted part of the game, the soccer player is generally not considered morally deviant. Other rules then guide how the game will be re-established after the foul. In some cases, a referee will allow a game to continue by playing advantage until the next break in play so the flow of play is not disrupted. These situations allow for rule-breaking while still preserving the rules and the goal of the game [78]. It seems that in order to allow the sport or game to progress and to allow the athletes to demonstrate excellence within the confines of that game, some rules are 'softer' than others and can be strategically broken without tipping the overall balance of the game, whereas some rules are 'hard' and cannot be broken without violating a prelusory goal of the sport. When a rule violation changes the fundamental aspects of a game it can be argued that the athlete is no longer playing the original game [1,71]; a soccer player handling the ball is now playing something closer to rugby.

The goal of fairness in sport is based on the concept of 'equality of opportunity' where inequalities that are outside of the control of the athlete are largely eliminated through the use of categories or competitive classifications [71]. While the goal of equality is admirable the reality is that while inequalities are somewhat minimized, they are

impossible to eliminate. For example, weight classifications in combat sport somewhat equalize mechanical and physiological differences between significantly different weight athletes. Access to facilities, training and competition, cultural influences, differences in genetic predisposition for athletic performance, and countless other factors will always result in inequalities that cannot be eliminated. Loland [74], suggests that "[m]oderate cardiovascular or strength talent [genetic differences] can be compensated for by hard efforts". The empirical evidence does not support this assertion. The HERITAGE family study found that up to 50% of maximal oxygen uptake (VO_{2max}) is heritable [79,80]. While physiology does function on a continuum, people generally fall into a low or high sedentary VO_{2max} category and are low or high responders to training. A person with a low sedentary VO_{2max} who is also a low responder can complete as much hard effort as their body can tolerate and still not attain a high VO_{2max}. A person who has a high sedentary VO_{2max} and is a high responder will need very little training (comparably) to attain a high VO_{2max}. Since VO_{2max} is strongly associated with endurance performance it is unlikely that the low responder with a low sedentary VO_{2max} will be an elite endurance athlete and there is no volume, intensity, or type of training that will change that. This is an inequality that is outside of the control of the athlete but that cannot be eliminated without the creation of genetic categories of performance. Given the complexity of genetic and other contributions to elite performance, the creation of these categories would be impractical. But we do not consider these genetic predispositions to be unfair. When one athlete has to train differently from another to achieve a similar outcome, it is accepted as part of being human, contributes to the uncertainty of outcome, and provides for much greater equality of opportunity and uncertainty in outcome than normalizing training would do.

Fairness in competition, outside of the constitutive rules, seems to be a matter of trade-offs. When Oscar Pistorius sought to compete in the Olympic 400 m using carbon fiber prosthetics he was deemed to have an unfair advantage due to energy savings during straight-line running and therefore not eligible to compete against able-bodied athletes. Upon appeal to the Court of Arbitration for Sport (CAS) it was found that while Pistorius did indeed have a lower metabolic cost for straight-line sprinting, the biomechanical adjustments necessitated by use of the prosthetics during starting and acceleration impaired his performance. The advantages gained from the metabolic savings were offset by the disadvantages of the biomechanics resulting in no net advantage [81,82]. The Court of Arbitration for Sport determined that Pistorius did not have an unfair advantage and he was allowed to compete in the Olympics if he met the qualifying times. This pattern of trade-offs is evident throughout sport. A metabolic gain through training, nutrition, or genetics may be offset by a loss due to adaptation, resources, access, or desire. These tradeoffs are continually functioning to preserve the uncertainty of outcome.

Outside of a competition phase, sport can be divided into training/preparatory and equipment phases [83]. While constitutive rules and classifications to eliminate inequality are largely confined to the competitive phase, regulative and auxiliary rules have significant influence on the preparatory and equipment phases. It is in the preparatory and equipment phases that rules, equality of opportunity, and fairness seem most disconnected from the actual performance. Advances in technology and changes in social and political practices consistently test the limits of rules and assessments of fairness and for the most part rules evolve just as the technology, practices, and individuals they govern do. In this way, the historical development of sport could be

compared with biological evolution. A species appears and remains relatively stable (stasis) until a period where, usually due to environmental pressures, the species evolves, and species divergence may occur. Sport is similar, once a sport appears there are periods of stasis with little change in the outward appearance of the sport. Environmental pressures of technological advances and social change force changes where the sport evolves, and divergence (appearance of new sports) may occur. For example, the evolution of both mountain biking and cyclocross from road cycling in the 20th century and the recent emergence of e-cycling as a separate sport show the evolution and divergence of cycling sports. Examples of fairness in sport also seem to undergo a process of evolutionary change. What was once considered unfair in sport, is now fair. Professional athletes now compete in the Olympics, where previously only amateurs were eligible, cyclists use aero bars in road time trials, and training itself is considered not only fair but required for sports performance.

International sporting federations seem to play a significant role in the determination of fairness that may not match what the athlete population (or general public) considers to be fair. Exceptional athletes who are producing outlier performances can be penalized for excellence. Despite having a Code of Points ranging from A to I that scores skills based on difficulty, the International Federation of Gymnastics (FIG) decided to award a triple twisting double backflip floor skill performed by Simone Biles with a level H, despite experts expecting an I or potentially even an unprecedented J rating. The explanation was not related to the complexity of the skill itself but to the inability of other athletes to perform the skill. So, while Biles is capable, to reduce the risk to other athletes who may not have the ability to perform the skill and thus risk injury in any attempt, Biles does not receive the credit she fairly earns and deserves. As Biles states “Am I in a league

of my own? Yes, but that doesn't mean you can't credit me for what I'm doing" [84]. Biles has continued to perform unprecedented skills in competition leading pundits to accuse the FIG of "…punish[ing] her for being better than everyone else…" and "…dumbing down the sport" when deliberately assigning her skills lower start values [85]. In deciding if Oscar Pistorius was running fairly the International Association of Athletics Federations (IAAF), IOC, CAS, and other administrators delivered various decrees but there was a lack of input from other active athletes, coaches, independent scientists, and fans of the sport [82]. If anything, sports federations guard the traditions of a sport at the expense of both sporting and ethical progress. This protection of traditional elements of a sport is not necessarily negative unless it comes at the expense of fairness as it did with Biles.

The overlap of training, competition, and equipment phases is not well defined, and fair play occurs within and around sport. For example, full-body polyurethane swimsuits are banned in any International Swimming Federation (FINA) sanctioned event but are not banned in training. The swimsuits undoubtedly enhance swimming performance. Inequality of access to the fastest swimsuits due to sponsor obligations was a compelling reason to ban the swimsuits [86]. However, an athlete is still able to use the swimsuits in training. Overspeed training is an accepted training methodology and affords specific neuromuscular adaptation that enhance sprint performance [87]. Elite athletes are notoriously private about their training, so it is unknown if this practice occurs in training (and there are other easier and cheaper methods to achieve overspeed training in a pool). World Athletics (WA; formerly IAAF) recently faced the dilemma of whether or not to ban the Nike Vaporfly running shoes that were worn during the INEOS 2-hour marathon breakthrough. According to the previous IAAF rule 143 shoes

> "…must not be constructed so as to give athletes any unfair assistance or advantage. Any type of shoe used must be reasonably available to all in the spirit of the universality of athletics" [88].

While the Vaporfly shoe is reasonably available, Nike claims that the Vaporfly shoe improves running economy by ~4%, later confirmed by lab testing [89]. For a sub-elite or recreational runner, a 4% improvement in economy is possible with changes in training and recovery practices, but for an elite runner, a 4% improvement in economy simply from further training adaptations would likely be near impossible and it should be noted that a 4% improvement in running economy is not equivalent to a 4% improvement in overall performance. Elite athletes are already near the limits of human performance and overall performance enhancements of ~1% are considered valuable at the elite level [90]. Running economy, VO_{2max}, and anaerobic threshold together play a significant role in determining endurance performance and enhancement of any of these will likely contribute to improved endurance performance [91,92]. In 2020 WA released updated technical rules addressing the rapid evolution of shoe technology [93] that restricts sole thickness, number of carbon fiber plates, and availability.

Carr [83] states that "performance enhancers are not performance replacers." This view is better presented as "performance enhancers are not training replacements." When an athlete takes the field of play, regardless of what has occurred pre-competition, that athlete still needs to have trained to perform. Wearing running shoes that improve economy, or a polyurethane swimsuit in training to target certain neuromuscular adaptations does not replace the need for intense running or swimming training and so would not be unfair (provided reasonable access to the technology). The training still needs to be completed to enable the performance.

Sport relies on absolute outcomes. An athlete may be able to produce more power per kilogram of muscle mass but when assessing winning and losing, in strength and power sports the athlete who produces more power absolutely will almost always defeat an opponent who produces less absolute power even if that athlete produces more power relatively (the same relationship does not hold true in endurance sports). Since absolute power production is proportional to muscle mass, to promote a fair and even contest with a reasonable degree of uncertainty of outcome most combat sports have weight classes. There would likely not be any uncertainty of outcome if a 51kg flyweight was fighting a heavyweight (>91 kg) boxer. The heavyweight athlete would win, probably quite quickly and probably with minimal skill. It is advantageous for a heavier athlete to cut weight and compete in a lighter weight class so extreme dehydration and caloric restriction prior to weigh-in are common in combat sports. Some have argued that this is unfair "…because an athlete unwilling to compete having rapidly reduced weight would face unfair contests against opponents who are 'artificially' bigger and stronger" [94] and rapid weight loss may endanger the health of the athlete. Athletes who rapidly cut weight prior to competition rarely regain that weight in the time between weigh-in and competition and in general it seems that absolute performance is not enhanced (and is more likely to be impaired) refuting the inference that 'making weight' is unfair [95]. This situation is another example of trade-offs. An athlete may rapidly reduce weight to make weight for a significantly lower weight class. But in doing so the athlete risks losing so much weight in a manner that can impair performance (dehydration and caloric restriction). Every sport and every athlete have a Goldilocks zone for phenotype, training, recovery, and adaptation. Allowing an athlete to push the boundaries of that Goldilocks zone is not unfair.

Fairness norms in sport and sport itself seem to coevolve in a manner that is similar to biological evolutionary processes. Selective pressures include advances in training, nutrition, technology, and biomechanics, and the influences of changing social, political, and commercial interests. The rules that govern the goals of a sport and the means to achieve these goals are also influenced by advances in the training, competition, and equipment phases. The evaluation of fairness and application of rules seems to be the most challenging in the training and equipment phases and it is in these phases where the most resistance to alternative approaches to achieving the excellence required for performance in the competition phase seems to arise. Sometimes this resistance can promote fairness and equality of opportunity, but sometimes resistance comes at the expense of fairness. There is no easy definition of fairness across the wide spectrum of contributions to sports performance. Our perceptions and evaluations of fairness and development and application of rules to maintain fairness fluctuate and respond to a changing sports and social environment while attempting to maintain equality of opportunity within the competition and uncertainty of outcome. Our evaluation of whether an action, such as the use of performance-enhancements, is morally permissible or not depends on established rules of conduct [96] which themselves may evolve.

Anti-Doping Policy in Sport

The use and condemnation of performance-enhancing substances in sport is as old as sport itself [6]. The development of the modern Olympic movement brought with it an expectation of how sport should be done that has not aged well. Both WADA and the IOC are private, non-governmental organizations. While, ostensibly separate entities, each organization relies on the other for funding and legitimacy. Sports cannot participate in

the Olympics without adhering to the Code and many sports rely on exposure at the Olympic games for survival and growth [97].

Anti-doping policy falls into the category of auxiliary rules [70], not contributing to the recognizability of a sport (constitutive rules) or correcting infractions to return to play (regulative rules), but rather contributing to governance of sport. Anti-doping policy is an integral part of the expectation that elite competitive athletes should develop and execute their physical capabilities in a certain way, that is, without the use of substances that appear on the Prohibited List. Examination of anti-doping policy can be separated into two broad categories: (1) justification of the existence of the Code and the program that supports the Code; and (2) justification for the presence of a substance on the Prohibited List. There is considerable overlap and interdependence of these categories. An anti-doping code needs to delineate the substances and methods that trigger the provisions in the code, i.e., a Prohibited List, and the Prohibited List needs criteria for inclusion of a substance or method on the list, i.e., an ideology to justify the need for the testing program. Since the provisions and sanctions outlined in the Code are based on substances and methods on the Prohibited List, it is reasonable to examine the justifications for including a substance on the Prohibited List to determine if anti-doping policies, including intrusions on privacy and sanctions against athletes, coaches, and medical professionals, are being applied for justifiable, evidence-based reasons.

The purpose of the Code is “to protect the Athletes’ fundamental right to participate in doping-free sport and thus promote health, fairness and equality for Athletes worldwide…” while also providing a framework for how this protection will be delivered. Drug free sport is an admirable, if idealistic and poorly defined goal. Watching elite athletes perform at the limits of human physiology where the uncertainty of outcome is preserved through unfixed competition is thrilling. However, the anti-doping

policy that aims to achieve drug free sport is intrusive and punitive [98,99] and its effects reach beyond elite sport [100-102]. Despite the many papers written across philosophy, medicine, and sport science for or against anti-doping policy, the common theme is a blind acceptance that the justifications for the Prohibited List are true, that is, that performance-enhancing substances are harmful to health, and that so called performance-enhancing substances are actually performance *enhancing*.

Conclusion

Sport is an activity created by humans and governed by rules created by humans. Loose groups of actions coalesce into an activity which is then codified by rules allowing for comparison within and over time. However, these rules that give us sport are not fundamental natural laws that are eternal and unchangeable principles. As society has evolved, so to have the rules and the moral permissibility of various actions that make up the varied cultures around the world. Rules and morally permissible and impermissible actions within sport have also evolved as athletes approach the limits of human physiology. Anti-doping rules seem to be moving backwards, with increased oversight and greater moral judgement for more and more actions. This conflicting evolutionary path is leading to more questionable outcomes for athletes and others suggesting that anti-doping rules that have become increasingly draconian and punitive are unethical.

Chapter 3

Sport, Doping, and Health

Introduction

To reiterate, the first justification for anti-doping policy presented by Simon [36] is that the use of steroids (steroids is used as a surrogate term for all performance-enhancing substances) is harmful to the health of the athlete. For this reason, a ban is justified to protect athletes from the harm that they would do to themselves by using these performance-enhancing substances. This sweeping claim assumes that performance-enhancing substances are specifically harmful to athletes, despite many of these substances being approved for human use in patient populations that are of less robust health than athletes. Protecting the health of the athlete has become part of the fundamental rationale of the Code, WADA "…seek[s] to protect the health of Athletes and to provide the opportunity for Athletes to pursue human excellence without the Use of Prohibited Substances or Methods" [3]. Critics of the health justification for anti-doping policy point out that sport itself can be inherently dangerous [103] and within this acceptance of risk, specific banning of performance-enhancing substances is overly paternalistic [52].

In this chapter I will present some of the empirical background related to the health of elite athletes during training, performance, and retirement, and review the literature of health harms directly related to performance-enhancing substances. The health-based ban is more complicated than first glance. First, it needs to be established

that the immediate and long-term *health* risk of elite sport is acceptable. While injury and sometimes trauma (for example in cycling) are accepted as part of voluntary participation in the sport, the health risks of training for elite performance and competition are less prominently featured in discussions of the risks of sport. Next, the health risk from performance-enhancing substances themselves needs to be established. While anti-doping authorities often rely on the mantra that performance-enhancing substances are dangerous and can harm the user's health, this is a rudimentary assessment of a far more nuanced situation of misuse, absence of qualified medical guidance, black market performance-enhancing substances, and preferential selection of substances that have not been approved for human use but are easier for the user to obtain and may have a better chance of evading anti-doping testing.

Health and Training for Elite Performance

Training for elite competition places the body under stress. Because the performance demands of different sports vary, the types of physiological disruption an athlete experiences will depend on their sport. For example, a marathon runner will complete significantly more mileage at a much lower intensity than a 100 m sprinter even though both are running athletes. Similarly, a throwing athlete has different training demands than a sprint swimmer even though both athletes have a significant upper body contribution to performance. Differences in training and performance demands, combined with variations in morphology and individual tolerance to training and recovery may influence overall health of the athlete during periods of intense training or performance. Performance demands may give rise to negative health behaviors such as disordered eating and addictive exercise patterns [104]. While all physiological systems

contribute to overall health, immune responses and cardiovascular complications are well-documented.

It is accepted that moderate exercise improves immune function. However, elite athletes complete periods of intense, high-volume training interspersed with periods of lower volume or intensity training that would still not be considered 'moderate exercise.' Immune responses to repeated, intense, prolonged exercise are difficult to characterize but the consensus is that heavy exercise is acutely immunosuppressive, although this is a transient effect [105]. Cunniffe *et al.* [106] found a temporary impairment in immune function and elevated tissue inflammatory markers after an international rugby match. During periods of overreaching where athletes may be completing multiple training sessions each day, the cumulative effects of exercise-induced immune suppression may increase the risk of catching a common infection [107,108]. The effect of anaerobic, power, or strength training on immune function has not been characterized [105]. While elite athletes do not reap the immune benefits of moderate exercise, they are not clinically immune deficient but may have reduced resistance to common minor illnesses while training and competing. The plasticity of the immune system suggests that these deficits are likely not permanent.

Moderate exercise is beneficial for cardiovascular health. The cardiovascular adaptations due to prolonged, intense training ('athletes heart') include increased left ventricular chamber diameter and left ventricular hypertrophy [109], increased vagal tone and altered electrophysiology, and functional changes during systole and diastole [110]. Remodeling responses differ depending on the sport, for example left ventricular wall thickness is greater in strength and power athletes compared with endurance athletes. These adaptations contribute to the capacity for elite performance, especially in

endurance sports, and are not considered pathological. Dickerman *et al.* [38]. examined left ventricular wall thickness in elite resistance trained athletes. Ten of the subjects used AAS and seven of the subjects were drug free. Left ventricular wall thickness was ≥ 11mm in all of the steroid users, and three of the seven drug free athletes. Of these subjects, seven steroid users and one of the drug free athletes had a left ventricular wall thickness ≥ 13 mm. Thirteen mm is considered the limit of physiologic left ventricular hypertrophy and a left ventricular wall thickness ≥ 13 mm is considered pathological. However, the difference between pathological left ventricular hypertrophy and physiological left ventricular hypertrophy is diastolic function. None of the elite resistance trained athletes, regardless of steroid use or degree of left ventricular hypertrophy had diastolic dysfunction. It was concluded that the left ventricular hypertrophy was secondary to increases in strength [38]. Athletes will often perform a valsalva maneuver (forced expiration against a closed glottis) during a lift. The resultant increase in intra-thoracic and intra-abdominal pressure mechanically stabilizes the spine and allows the athlete to lift through the non-optimal areas of the length-tension relationship in skeletal muscle. The increase in strength afforded by the training combined with AAS use results in a greater pressor response thus causing physiologic compensatory left ventricular hypertrophy. The mechanism for left ventricular hypertrophy is the same as is seen in patients with hypertension. Importantly, when athletes retire from elite competition and detrain, the heart remodels in response to reduced demands and left ventricular wall thickness and chamber diameter return to normal [109]. There is no evidence that, in the absence of underlying genetic or congenital cardiovascular abnormalities, training at the elite level in any sport is chronically damaging to cardiovascular structure or function.

Acutely, the risk of a sudden cardiac event during exercise is greatly elevated in both trained and untrained subjects [111]. However, sudden cardiac death that is attributable to underlying cardiac abnormality is the leading cause of death in young (< 35 yr) athletes [112]. The population of elite athletes is dominated by athletes under the age of 35 yr (sudden cardiac death in athletes over the age of 35 yr is usually secondary to atherosclerosis [110]). Up to 80% of athletes are asymptomatic before cardiac arrest [112]. Leading causes of sudden cardiac death include hypertrophic cardiomyopathy, coronary artery anomalies, and arrhythmogenic right ventricular cardiomyopathy. Most cases of sudden cardiac death in young athletes are due to underlying congenital or genetic conditions. Critically, these conditions may be undiagnosed and symptomless prior to training or performance, or the condition may arise as a response to training stimuli superimposed on the genetic background of the athlete [110,112,113]. Of note, while intense exercise certainly increases the risk of death from a cardiac event; depending on the sport, it is likely not greater than the risk of death or injury from the other aspects of the sport itself. Use of screening tools more sensitive than symptom-based preparticipation questionnaires, such as 12-Lead ECG and echocardiography, can reduce the rate of sudden cardiac death in young athletes even while missing the 2-10% of athletes who die suddenly but show no evidence of structural abnormalities upon autopsy [110].

The demands of training and performing at an elite level are often not physically or psychologically healthy. Many performance-enhancing substances may exert their performance-enhancing properties by supporting the athlete's health and wellbeing during training for elite performance rather than directly affecting performance. An elite performance is not made more worthy by the amount of suffering the athlete endures.

Long-Term Health of Former Elite Athletes

Participation in some sports comes with risks that are inherent to the sport. For example, participating in sports like cycling, downhill skiing, and boxing can result in death from trauma. Even sports that do not involve speed or contact carry risk. Recent news reports detailed the injuries to a Russian powerlifter as he attempted to squat an 882 lb bar while competing in the 2020 World Raw Powerlifting Federation Championships. The athlete's knees fractured under the weight of the bar and the quadriceps muscle group on both legs ruptured [114]. Elite athletes spend the majority of their time training and preparing for competition, however the intensity and loads of competition are only rarely encountered in training. Chronic, intense training that is designed and periodized to cause a state of overreaching is a physiological stressor that has the potential to cause short-term, or long-term damage to health. However, outside of underlying genetic predispositions to catastrophic outcomes, research shows that elite athletes are living longer, healthier lives than age-matched peers [57,61,64,67,115,116].

While it is encouraging that research seems to show no significant lingering health effects from elite sports participation beyond those expected from the sport itself [117] these studies have limitations. For example, Sanchis-Gomar *et al.* [116] reported that elite French cyclists who completed the Tour de France between 1930 and 1964 lived 17% longer than the general population. During the time period analyzed cyclists routinely used stimulants, with amphetamine use becoming more common towards the end of the study period. However, the authors did not include further variables related to performance-enhancing substance use or health outcomes that would allow for a comparison between athletes who used performance-enhancing substances and those that did not. It is possible that while the French Tour de France cyclists as a group lived

longer than the general population, that longevity or health within the group may have been influenced by performance-enhancing substance use.

Marijon *et al.* [57] extended the work of Sanchis-Gomar *et al.* [116] by obtaining mortality data for all French participants in the Tour de France from 1947 to 2012. Cause of death was available for deaths that occurred after 1968. Similar to other work [67,116], all-cause mortality was lower in the elite athlete cohort. The leading cause of death was cancer and cardiovascular disease. There was a higher rate of death in younger athletes (<30 yr) that was mainly attributed to trauma (accidents) associated with training or racing. Of interest, no cyclists who were active in the 'EPO era' (1991 – 2010) had died at the time of analysis. Despite a more detailed analysis of the health outcomes in this cohort of elite athletes, data relating to performance-enhancing substance use was not collected. It is unknown if athletes who used performance-enhancing substances were more or less susceptible to cancer or cardiovascular disease compared to their elite peers. Without a medical record of performance-enhancing substance use, it is impossible to accurately determine if the use of these substances enhances or impairs long term health outcomes of elite athletes. More research is needed to develop evidence-based policy.

There have been attempts to quantify the long-term health effects of performance-enhancing substance use in elite athletes. Kettunen *et al.* [62] found a higher life expectancy in former Finnish elite athletes active between 1920 and 1965 (the former elite athletes lived 5 – 6 years longer than general population controls). The group of power sport athletes were at greater risk of dementia (especially boxers) than the general population, although their lifespan was still longer than the general population. Lindqvist *et al.* [66,118,119] surveyed morbidity and mortality data over a 30-year period for 1133 male elite Swedish power sport athletes who were active between 1960 and 1979. There was a

slightly higher mortality rate in the 40–50-year age interval but no difference in overall mortality rate. Twenty one percent of respondents admitted to AAS use [119]. The AAS users had higher rates of injury and mental health problems [118,119], and higher suicide rates during a certain age range [66]. While these data make a compelling case in support of banning AAS, there are methodological limitations that need to be considered. The authors were able to identify the athletes from public records. Questionnaires were mailed to the subjects and returned questionnaires appear to have been identifiable since "a reminder to fill in the questionnaire was sent to those athletes who had not answered." The survey instrument was not provided in any of the publications but does not appear to be a randomized response design. It is possible that sensitive questions related to performance-enhancing substance use or health (in particular mental health) were not answered honestly. Those athletes who had sought help for depression or anxiety may also have been more willing to admit to past AAS use.

Lindqvist *et al.* [66] found no difference in mortality rate between this group of former elite power sport athletes and the general male population. The leading cause of death was cardiovascular disease. Fewer former athletes died of cancer compared to the general population. The authors did find an increase in suicide rate for former athletes aged 30-50 yr. Rates of steroid use in the deceased athletes were inferred from data provided by the surviving cohort (21% lifetime prevalence). This paper presents a biased interpretation of the data. The overall mortality rate of the athlete group (181 deaths) was not different from the expected mortality rate for a matched population over the 30-year period examined (197.5 expected deaths) yet the authors focus on an increase in mortality between 20-50 yr that is partially attributable to an increased suicide rate and attribute this increase to steroid use with only tenuous supporting anecdotes. These

authors also speculate that accidental deaths from car crashes and drownings may be "disguised suicides" despite being listed as accidental on the death certificate. Empirical data from the surviving athletes that indicated ~21% of the cohort used AAS [119], however this rate is much lower than current estimates [59,60] for an era when AAS use was not banned and testing was not available suggesting that the survey data and conclusions related to AAS use are flawed.

While it suits the anti-doping narrative to claim that performance-enhancing substance use is rife with risk and that athletes who use performance-enhancing substances are risking both their current and future health, the data simply don't support this hypothesis. In general, former elite athletes live longer and healthier lives than the general population. If performance-enhancing substances were dangerous while being used (i.e. during the sports career when health is often compromised) then there should be evidence of higher morbidity and mortality in elite athletes during their careers, especially when considering the prevalence of performance-enhancing substance use in the elite athlete population that is estimated at 40-60% [59,60]. Even studies that have attempted to compare athletic AAS users with comparable athletes who do not admit to using AAS have not found compelling evidence that athletes who use AAS have greater morbidity and mortality than athletes who do not use AAS [66,118,119]. There is no evidence that active elite athletes have a higher mortality rate than the general population outside of the risks inherent in their sport. For example, deaths in young (< 30 yr) elite cyclists due to traumatic accidents in training and competition are higher than the general population [57]. There is no empirical evidence that elite athletes continue to use performance-enhancing substances after retirement, nor is there evidence that the most commonly used performance-enhancing substances (AAS, diuretics, EPO, human growth hormone)

are addictive (although certain classes of pain killers and stimulants can be addictive). If performance-enhancing substances cause damage that somehow does not impair performance during the athletic career but manifests as increased morbidity and mortality post-retirement, then this pattern should be evident in the data. It is not.

Without reliable, valid data about performance-enhancing substance use, including type of substances used and dosages it is impossible to determine if there are significant effects on the health of elite athletes. Even with this limitation, current data do not support the assertion that performance-enhancing substance use endangers the health of elite athletes. If anything, the lack of medical guidance and monitoring or use of substances that are not approved for human use (to avoid a positive test), are likely the greatest danger to athletes who are using performance-enhancing substances.

Misuse of Performance-Enhancing Substances

There is a substantial body of literature documenting the adverse effects of prohibited substance misuse. These publications are almost exclusively retrospective case studies with the vast majority documenting adverse effects of AAS abuse. A sampling of this literature includes: case reports detailing jaundice in a 24 yr old amateur body builder injecting a veterinary product [120], renal damage from uncontrolled use of multiple AAS in bodybuilders [41], necrotic tissue damage from self-injection of trenbolone in an otherwise healthy 35 yr old man [46], and acute pancreatitis in a 24 yr old police officer who had used a variety of AAS obtained from the internet [121]. The toxic effects of AAS on the liver and kidneys are well documented. A 28 yr old bodybuilder taking four different AAS products in conjunction with other substances and a high protein diet presented with severe jaundice and enlarged kidneys [122], and a 29 yr old professional bodybuilder required a liver transplant after 6 years of self-administering multiple oral and injectable steroids,

diuretics, insulin, estrogen receptor blockers, and growth hormone caused hepatomegaly, hepatocellular carcinoma, and fatty liver disease [123]. It was noted that this patient, and others [124] had significant steroid induced hypogonadism. In addition to hepatic and renal effects, AAS abuse has significant impact on cardiovascular function. A 39 yr old weightlifter presented with dilated cardiomyopathy after 3 months of trenbolone and boldenone (both veterinary products) use [45] and sudden cardiac death in young bodybuilders was attributed to anecdotal AAS use with gross cardiomyopathy observed on autopsy [125].

In addition to the physiological effects of AAS misuse, there is also a potential for health consequences from a lack of knowledge of infection risk when injecting substances. Needle sharing, injecting from a shared container or vial, and reusing equipment increase the risk of infection. Risky injection behaviors have been associated with higher rates of Hepatitis C infections in men using AAS for performance and image enhancing purposes [126]. These subjects were taught how to inject themselves by friends (39%) or a doctor (20%), or reported that they were self-taught (29%) with a substantial proportion of the subjects accessing information about their substance use on the internet (62%) or from friends (55%) and a smaller proportion getting information from a doctor (22%) or a needle and syringe program (7%). Of the 77% of subjects who regularly saw a primary care physician, 21% did not share their AAS use with their healthcare provider (no reasons were provided). Rates of bloodborne viruses (HIV, Hepatitis B and C) have increased among men who use performance and image enhancing drugs, but these data are complicated by other lifestyle factors and the hidden nature of illicit drug use so should be interpreted with care [127-129]. It is noteworthy that these case reports are rarely

elite, high-performance athletes, rarely involve products that are approved for human use, and use is rarely supervised by a physician.

While adverse effects of uncontrolled, multiple AAS use are repeatedly documented in the medical literature, there are fewer case reports related to other substances on the prohibited list. Myocardial hypertrophy was observed in single rat that died suddenly during the experimental use of EPO in a rat model of doping. The other animals in the experimental groups did not suffer any adverse effects [130]. Despite the alarmist title of this paper (*Erythropoietin promotes deleterious cardiovascular effects and mortality risk in a rat model of chronic sports doping*), the data presented show no difference in normalized left ventricular weight between exercise and exercise+EPO groups suggesting that exercise has a greater effect on left ventricular weight than EPO.

The attribution of deaths of young cyclists in the late 1980s to EPO may not be as simple as presented. Lopez [56] suggests that the rate of deaths attributed to EPO use was consistent with the rates of sudden cardiac death normally observed in young athletes and only four of these deaths could be linked to drug use. Sudden cardiac death is one of the most common causes of death in young athletes and most commonly presents with underlying, undiagnosed cardiac abnormalities [112]. Documented side effects of blood doping are rare in the literature, but the general risks of transfusions hold true for this prohibited method. These risks include phlebitis, septicemia, bacterial infection, air or clot embolism, transfusion reactions like fever and anaphylaxis, and the risk that hyperviscosity may reduce peripheral oxygen delivery [131].

Misuse of AAS is well documented in the literature but less well recognized is that this pattern of misuse that results in harm occurs in a setting with no medical supervision and restricted access to substances that are approved for human use. Medical

intervention happens after the harm is initiated, rather than preventing the harm from occurring.

Prevalence of Performance-Enhancing Substance Use

Of the 344,177 samples analyzed in 2018, 4896 (1.42%) returned an adverse analytical finding (AAF). Despite increased surveillance and increasingly punitive punishments this AAF rate has remained stable (1-1.5%) for the last decade [132]. WADA President Witold Banka stated "…that WADA, as the global leader of anti-doping, has significantly matured and is stronger than ever before" [133]. However, recent work [59,60] suggests that the prevalence of performance-enhancing substance use among the ranks of elite athletes is substantially higher than WADA testing statistics indicate. Gaining a true estimation of prevalence of use of performance-enhancing substances is difficult. Researchers are asking about behavior that is stigmatized and considered deviant and is punished severely. Even with assurances of anonymity athletes may be unwilling to honestly answer questions about substance use in case of judgement or sanction. Using a randomized response survey technique (a technique designed to increase responder anonymity when surveying sensitive topics), Ulrich *et al.*[60] found that 43.6% of athletes at one elite competition had knowingly used a prohibited substance in the last 12 months, while 57.1% of athletes surveyed at a second competition admitted to prohibited substance use within the last 12 months. At these competitions 0.5% and 3.6% respectively of athletes returned an AAF upon testing. An online survey of elite Danish athletes (using the randomized response technique) estimated lifetime prevalence of intentional use of "forbidden substances or forbidden methods" to range from 3.1 – 26% however the authors acknowledged problems in survey completion and return and cautioned that the sample may not be representative of the elite athlete population [134].

When reviewing the use of the randomized response survey technique, de Hon *et al.* [59] determined that the overall prevalence of performance-enhancing substance use among elite athletes ranged from 14 – 39%. Despite this estimation being lower than the findings of Ulrich *et al.*[60] this rate is still many orders of magnitude higher than the AAF rate indicating that the testing is failing to deter athletes from using performance-enhancing substances.

Rather than asking athletes to admit to or deny their own use of performance-enhancing substances, some researchers have probed attitudes towards hypothetical substance use situations, often in a variation of the now debunked Goldman dilemma [135,136]. Bloodworth *et al.* [137] surveyed athletes in the UK Talented Athletes Scholarship Scheme. Athletes were given the example of a prohibited substance or method that enhanced performance and was undetectable. Fewer than 10% responded that they would take the substance and this rate decreased to less than 1% when serious health consequences were added to the use of the hypothetical substance. Of interest, when given the same scenario and asked if they believed other athletes would use the substance 72.6% believed their competitors would use the substance, a rate that decreased to 40% when health consequences were included. The discrepancy between these responses may indicate the effect of the social stigma surrounding doping. Athletes may have given socially desirable responses about their own attitudes. As with all surveys there was likely an element of self-selection in survey return. Athletes with attitudes that do not conform to the anti-doping message may be more reluctant to return surveys about doping behavior and attitudes.

Instead of establishing the prevalence of performance-enhancing substance use in elite sport (or even providing a general indication), these data collectively demonstrate

the impracticability of current policy. The WADA testing data objectively show that performance-enhancing substance use does happen. The survey data suggest that patterns of use are high and hidden. Without reliable estimates of prevalence, it is difficult to determine the true effects of anti-doping policy [138]. Evaluations of WADA's performance are rooted in the output measures of number of tests performed and number of sanctions [139] which do not estimate prevalence. Assessing the value and legitimacy of research on attitudes towards doping is challenging and this research should be carefully interpreted. Interviews place subjects in a position where they must choose whether or not to admit support for a behavior that is harshly criticized as a morally deviant character flaw or repeat a socially acceptable and safer opinion that doping in sport is always wrong and they would never engage in such morally impermissible behavior. Similarly, surveys with biased language or that do not have adequate safeguards for anonymity lend themselves to flawed responses. For example, a survey of Dutch elite athletes with an anti-doping whereabouts requirement [140] found that 93% of these athletes agreed with the statement "I think it is important that elite sport in general is free of doping." However, the survey was emailed in two separate mailings timed around the London Olympics and Paralympics differentiating between athletes that did attend the events and athletes that did not attend the events. The response rate was 26% (n=129), and there were enough questions about background and whereabouts requirements that it may have been possible to connect the data and identify an individual respondent even if the survey was anonymous. The backlash for athletes who publicly disagree with anti-doping rules and procedures is severe and serves to dissuade honest responses to questions about attitudes towards doping in elite sport [141].

The use of performance and image enhancing substances is not exclusive to elite sport. Recreational athletes and fitness enthusiasts far outnumber elite athletes in use of performance and image enhancing substances [142]. While WADA policies are beginning to be applied to recreational and amateur athletes these athletes do not systematically receive the same anti-doping education that is expected of elite athletes but are still subject to sanction [100-102]. Recreational athletes may not have the same access to skilled sports medicine providers. The overall prevalence of use of performance-enhancing substances in Dutch fitness facilities was estimated at 8.2% [143]. Approximately 2.2% of U.S. men are reported to have been diagnosed with body dysmorphic disorder with up to a quarter falling into the category of muscle dysmorphia. Almost half of these men reported lifetime use of AAS [144]. Because of the stigma of AAS use it is difficult to accurately predict onset and use of AAS. Pope *et al.*[145] reviewed available published and unpublished data and estimated 2.9 – 4.0 million Americans may have used AAS at some time in their lives. Global lifetime prevalence has been estimated at 6.4% for males and 1.6% for females (overall 3.3%) [146]. The age of onset appeared to be uniform around the world, with AAS use usually starting in the early 20s when drug users were no longer closely monitored by parents or teachers [147]. The vast majority of AAS users are not competitive athletes [146,147]. Over half of AAS users did not disclose their drug use to healthcare providers and were rarely asked about AAS use as a routine part of their health history [145].

The disagreement between testing and survey data and lack of meaningful outcome measures suggest that anti-doping policy is failing at multiple levels from elite athletes to fitness participants and recreational athletes [102], however this failure is not

resulting in the epidemic of drug taking that anti-doping proponents would have us believe [148].

Black Market Products, Drug Safety, and Drug Recalls

The common theme in retrospective case reports of adverse effects of performance-enhancing substance use is the lack of medical supervision of dosage, interactions, and side effects, and the range of substances obtained from non-medical sources. Adolescent athletes who had used a prohibited substance (AAS or other) indicated that they had obtained the substance from various sources including the black market [149]. Analysis of black market doping products has shown additional contents beyond the declared ingredients [49,50], and falsification of ingredients or veterinary products not approved for human use in up to 80% of samples [150]. Common contaminants found in black market medical products include paint thinner, glass particles, and filler substances [47]. Black market pharmaceutical products are easy to obtain online. McBride *et al* [151] used the search term "buy steroids" and found online retailers selling injectable hormone preparations including testosterone, human growth hormone, insulin-like growth factor-1, and thyroid hormone. One of the retailers offered a prescription service for customers to aid with customs compliance. Alarmingly, one group detailed the analysis of several unlabeled injectable black-market products and the discovery of a bioactive peptide that could not be identified by mass spectrometry, liquid chromatography, or gel electrophoresis. The researchers were only able to determine that the peptide had a molecular weight of 6 kDa [152].

These data combine to demonstrate that if an athlete wants to use a performance-enhancing substance they can easily purchase a product that is labeled as the desired substance with no medical guidance or monitoring of outcomes.

Conclusion

Elite athletes are marketed as role models of energetic, strong humans at the peak of physical ability achieved through simple perspiration and trying hard. The reality of training for elite performance is different. Intense training sessions can leave athletes exhausted and susceptible to infection, or the physiological responses to extreme training loads can cause otherwise undetected benign congenital conditions to become pathological or lethal. Intense training and performance increase the risk of chronic or acute injury that can cause lifelong pain or disability [117]. However, as a group, elite athletes live longer, healthier lives than the general population [57,61,64,116] despite evidence that a significant proportion of elite athletes use performance-enhancing substances [59,60]. Elite power sport athletes who have used AAS have increased rates of depression and anxiety although these health effects do not appear to negatively impact longevity [62,63,66,118]. Evidence of harm associated with performance-enhancing substance use is overwhelmingly associated with unsupervised misuse of supraphysiological doses of multiple black-market anabolic steroids (or other performance-enhancing substances) in the non-elite athletic population. The population that does appear to be most at risk of harmful health effects from performance-enhancing substance use is not the population of athletes in the WADA registered testing pool that receives WADA mandated education. This harm may be exacerbated by the trickle-down effects of WADA policies prohibiting medical personnel (athlete support personnel) from providing expert advice and care, and access to human-quality, approved medications. There is a lack of evidence that elite athletes are *mis*using performance-enhancing substances or that performance-enhancing substance use by elite athletes is harmful to the current or future health of the athlete. This differential pattern of harm may be due to differences in access to knowledgeable

healthcare practitioners, monitoring for physiological side effects and interaction effects, access to substances that are approved for human use, or simply the difference in size of the elite athlete population and the recreational athlete and fitness participant populations. Regardless of the reason, there is little evidence to support the rationale that performance-enhancing substance use is harmful to the current or future health of elite athletes. In contrast, there is significant evidence to suggest that performance-enhancing substance use from black market sources and without medical guidance is resulting in harm to recreational athletes and fitness participants. The rules that are supposed to prevent harm, may actually be causing or allowing harm compared to a harm reduction approach that prioritizes health measures over drug testing.

Chapter 4

The Evolution of Sport and Performance

Introduction

Elite athletic performance is complex. Increased global participation and advances in the science of training, recovery, and performance has resulted in the rapid evolution of human athletic performance over the last ~120 years. However, improvement of athletic performance is not unlimited. Human physiology can only do so much, and elite performers are now extremely close to the limits of human physiology. If performance-enhancement is most sensitive to technological and methodological advancements or population growth and is not influenced by prohibited substances, then the rationale for banning substances for 'performance-enhancement' reasons is false. In this chapter I discuss how the evolutionary patterns, well accepted in biology, are also evident in modern sports performance and introduce the idea that performance-enhancing substances may not have had as substantial impact on elite performance since the second world war as is often claimed and it is unlikely that safe, monitored use of these substances now will propel elite performance into an unrecognizable arena.

Evolutionary Patterns in Sport

Games and play are an integral part of human evolution, both biologically and culturally. Play is used to learn important skills and is typically considered separately from games. Games introduce rules and goals to many play activities and contribute to the development of problem-solving, strategic, and physical skills [153]. Rule governed games

can add complexity and challenge to problems found in day-to-day living. Humans are in control of rule development for sports and games. If a rule creates an insurmountable problem or a dangerous situation it can be changed, and these changes influence the development of the game or sport. Sport and games are an “enduring feature” of human social life [154]. Because games are human social institutions, they can be considered part of human culture and are therefore subject to the same cultural evolutionary pressures that influence other cultural institutions, for example, religion [155,156]. Social institutions would not survive and thrive if they had to be invented from nothing in each generation. Each generation builds on the labor and progress of previous generations. The traditions and skills involved in games and play were mechanisms for passing on knowledge for survival and success. The influence of culture and rapid population growth has accelerated human evolution in the last 50,000 years [157] and similar patterns can be observed in modern sport.

Evolutionary patterns of change are evident in the development and progression of modern sport and the athletes who reach elite levels, with each influencing the other. In simple terms, evolutionary adaptation occurs when environmental pressures that impact reproductive fitness change the characteristics of a population. For example, if a trait that was otherwise benign allowed an animal to survive and reproduce after a heat wave, that trait would persist in the population and change the temperature tolerance of the group in the face of repeated heat waves. Conversely, if a trait reduced survival during a heat wave, then the animals that carried this trait would not survive a heatwave to pass on the trait to their offspring. In sport, these patterns can be seen in the use of new technology, equipment, or skills pioneered by one athlete, or a small group of athletes who achieve success. Other athletes adopt these new successful strategies in their own

practice and if success persists then the strategy persists until it is replaced by a new strategy or the governing body that sets rules acts to constrain the use of the technology, equipment, or skill within the sport. The interaction between sports governance and athletes (and others in sport who are acting to innovate) is similar to the Red Queen competition between species that coexist in the same environment [158].

Red Queen dynamics add a layer of complexity to the interactions between sports governance, athletes, and innovation. First described by evolutionary biologist Leigh Van Valen in 1973, the Red Queen hypothesis describes the co-evolution between competing species [159]. The hypothesis is named after the Red Queen in Lewis Carroll's *Through the Looking Glass* who extolls Alice to run faster and faster. Alice comments that her surroundings remain unchanged despite her running. The Red Queen replies "Now, *here*, you see, it takes all the running *you* can do, to keep in the same place" [160]. In evolutionary terms, when one species adapts and achieves success, it is at the expense of coexisting species. But because no species is evolutionarily stationary there is continued adaptation across all species. No single species gains significant fitness advantages at the expense of other species without the other species also adapting (or dying out) in response.

The concepts of evolutionary change and Red Queen dynamics are relevant to sport and athletes. Sport and athletic excellence are not stable or fixed. The constitutive and regulative rules can be changed, adjusted, or refined by governing groups in response to external pressures, and participants work to push the limits of rules and technology to achieve or exceed previously determined levels of excellence. These co-existing groups adapt in response to each other. For example, the speedsuit introduced to swimming that contributed to world record performance in almost all events at the 2009 World Aquatic Championships was subsequently banned by FINA. The participant group (athletes,

swimsuit manufacturers, coaches etc.) sought excellence by using a technological innovation that was not prohibited, and the governing group responded to the action by limiting the technology. Graham Obree achieved success in track cycling with two different techniques, each of which were subsequently banned by the UCI [161,162]. The athlete innovated to achieve excellence and the governing body responded to constrain the innovation. The Fosbury flop technique radically altered high jump performance. When correctly performed, a jumper's center of mass is closer to the bar (within 5 cm at the 2005 World Championships [163]) than other techniques [164]. This technique change contributed to a large, rapid improvement in high jump performance [165,166] but only became a safe alternative to the dominant scissor kick technique with the development of thick, soft, landing pads. In contrast to the UCI rulings on Obree's riding techniques, the IAAF examined the new high jump technique and responded by allowing the technique to persist and it is now the dominant high jumping technique. If the Fosbury flop technique had been banned it is likely that high jump performance would not have advanced as quickly, and that athletes and coaches may have tried other techniques to improve performance. The persistence of the Fosbury flop technique may be due to the substantial mechanical advantages over other techniques that require propelling the center of mass higher to clear the bar.

The rapid dominance of the Fosbury flop technique was likely due to the substantial positive effect on high jump performance. It is unknown whether the Obree Mantis position would have spread with the same persistence and dominance as the Fosbury flop technique, but it is reasonable to assume that the pattern would have been similar given recent UCI rule changes related to less extreme aerodynamic cycling positions [167]. Obree's crouched 'mantis' position is more efficient than other cycling

positions [161] and still uses the legs to generate power by pedaling. If an essential action of cycling is locomotion using the legs to pedal a bicycle, arguably, the prelusory goal of cycling is still met when using the 'mantis' position.

Evolution can be examined at a species level, an inter-individual level (between individuals within a species), and an intra-individual level (within individuals of a species). Evolutionary biologists can use human athletes as subjects to study evolutionary theory from the species level to the individual level [168]. These studies investigate the relationships between environmental selective pressures and the human phenotype. The roles can be adapted. Using evolutionary theory as a conceptual framework to examine patterns of change and selective pressures within a sport and between a sport and its athletes provides an opportunity to identify the impact and magnitude of trade-offs within a sport. Broadly speaking, biological adaptation occurs via two mechanisms: random genetic mutation and selection. Increased survival and reproduction as a result of adaptation to environmental constraints indicates 'fitness' [169]. For a sport this fitness could be the survival, persistence, popularity of, and participation in a sport. For a sport to survive and thrive it must adapt. Adaptations can take the form of rule changes, adoption of new technology, or development of new techniques that allow the sport to find new audiences and sources of engagement. For example, in response to pressure from television broadcasters with advertisers and strict broadcast schedules to satisfy, the IAAF changed the rule governing false starts. Athletes were previously permitted two false starts before disqualification, in 2001 this was changed to allow a single false start with any subsequent false starts resulting in disqualification regardless of who committed the initial false start. False starts delayed the progress of the race, thereby affecting the airing of commercial spots. Athletes reportedly weaponized the new rule by intentionally

false-starting to increase the pressure on their competitors such that the rule was changed again in 2010 and any false start now results in disqualification [170]. Athletics needed exposure and revenue and so needed the broadcasters. The broadcasters needed consistent timing in order to fulfil the obligations to advertisers of the organization. To ensure continued success and exposure in the broadcast market, athletics changed a rule and adapted to the environmental pressures.

For an athlete evolutionary fitness could be interpreted as competitive success, potentially rewarded with other economic or social markers of success. An athlete who is more successful demonstrates more evolutionary fitness in the sports environment. Athletes who cannot perform the sport specific skills at a high level, do not experience success and may drop out of competitive participation in the sport, or continue competing but never reach the highest levels of success. Research has shown a 'relative age effect' in super-elite sportsmen. During developmental years, young athletes born earlier in their selection years were more likely to be selected for additional specialized training, possibly due to being physically more developed compared to athletes born later in the selection year. Greater access to training and resources earlier in an athletic career can influence the overall success and persistence of an athlete. Athletes who are not selected for additional training experience negative selective pressure and are more likely to drop out [171]. The athletes that can adopt and execute the techniques of the sport well reach higher levels of the sport and reap the benefits. In turn these athletes will also have greater access to resources to further shape their success in sport. Competition drives evolution so sport becomes a natural environment for evolutionary processes within individual athletic performances and the sport itself.

Evolutionary processes are not restricted to biology. While the outcome variable of biological natural selection is reproductive success, cultural evolution can be demonstrated by imitation and learning [172]. For example, techniques for building or making implements are demonstrated, taught, and passed to subsequent practitioners or information about edible and medicinal plants that is disseminated through oral or written communication. People may learn new methods through observation and copying, essentially a trial-and-error technique. If the technique results in a positive outcome, then it will likely be retained and adjusted to fit unique environmental constraints, and if there are negative outcomes then the technique will be abandoned. The practices of successful groups will be copied by others hoping to achieve similar successes. Differences in the rates of copying would likely depend on the level of success and the visibility of the group. This model translates well into athletic performance. Within sport, elite athletes form a successful group, and depending on the sport this may be a highly visible successful group or athlete. This group or athlete provides a model for those striving for the same outcomes/successes. Less successful athletes will emulate the practices and techniques of the successful group. Opponents will learn from the successful actions of their competitive peers and adopt the techniques or learn methods to counteract the advantages gained. A constant evolutionary process refines and progresses athletic performance.

The two modes of evolution widely acknowledged by biologists, random genetic mutation and selection, can also be applied to sport. Consider the “super tuck” position used by Chris Froome on the descent of the Col de Peyresourde during Stage 8 of the 2016 Tour de France. Froome descended the mountain using a version of an aerodynamic tuck that placed his mass low over the top tube and forward over the handlebars. How

might this technique have emerged and evolved? Using the analogy of random genetic mutation, Froome may have been trying different descending techniques during training, either as deliberate attempts to discover a new descending position, or as an elite athlete version of play. His teammate Geraint Thomas said

> "It's like going back to being a kid again. We always mess around, race each other on descents, it's why you ride a bike, that adrenaline, that rush. We train like that a lot, a group of boys who want to race each other, and it paid off today." [173]

When an athlete with superior skill and technique 'messes around' in training (or even in performance) new techniques can be discovered by random chance. The 'messing around' may also be a deliberate attempt at discovering new techniques. Using the analogy of selection, with knowledge gained from historical events (the two different aerodynamic techniques pioneered by Graham Obree [161] and subsequently banned by the UCI [162]) and a general scientific understanding of aerodynamics Froome may have simply been attempting to mimic an aerodynamic tuck without realizing that his body position was unusually far forward. Froome claimed that his strategic decision to attack on the descent was "spur of the moment" [173]. The effect of Froome's highly visible victory to take the yellow jersey could be considered twofold: first, the tactic of attacking on the descent of a big mountain becomes a viable strategy for success; and second, the aerodynamic tuck position that seemingly contributed to that success may be widely adopted despite safety concerns. Subsequent work has shown that Froome's descending technique is not the most aerodynamic and he would likely have gained more time (and been safer) if he had adopted a technique similar to that used by Peter Sagan with his mass low over the top tube but evenly distributed between the wheels [174]. What is common about practices that spread quickly though, is that they are highly visible (either the practice occurs during the sports performance, or the practice is widely disseminated via other means e.g., social

media, promotional materials, news reports etc.). If the same technique had been used by a cyclist in the grupetto it is likely that it would not be as analyzed as it is. The cyclist in the grupetto would not be featured in television coverage, and with the nature of the grupetto generally being the sprinters who are simply trying to make the time-cut to avoid elimination from the race, that cyclist would not be in the highly visible yellow jersey. Researchers watching the race would likely not be inspired to test the technique in a wind tunnel. Since there would be no obvious successful outcome from the use of the grupetto tuck, there would be little positive selective pressure based on success. If Froome had crashed on the descent of the Peyresourde while in the super-tuck, it is likely that this highly visible example of the failure of an extremely skilled cyclist would have exerted negative pressure on the use of the super-tuck and its use would have faded away.

In early 2021 the UCI responded to the persistent adoption of the super tuck technique across road cycling by reiterating Article 1.3.008 regarding a cyclist's position on the bicycle:

> Article 1.3.008: The rider shall normally assume a sitting position on the bicycle. This position requires that the only points of support are the following: the feet on the pedals, the hands on the handlebars and the seat on the saddle. [175]

The UCI has clarified that the super tuck position violates this rule and cyclists who use the technique will be sanctioned. In addition to the super tuck descent technique, the rule also prohibits the use of a common 'invisible aero' position that is common in cycling. The cyclist leans forward, placing his or her wrists on the handlebars. Because hands are not on the handlebars, this position is in violation of Article 1.3.008. Cyclists often use this technique to vary their position on the bike or to have two hands available to use for another task (unwrapping food, opening a drink). While it is mimicking the aerodynamic

position used in time trials, it is not aerodynamic under these conditions and does not confer an advantage. Within a month of the UCI announcing that hands must remain on handlebars an equipment manufacturer released a new handlebar design that conforms to the new UCI focus on cycling position and allows the cyclist to adopt the 'invisible aero' position while keeping their hands on the handlebars [167]. It is unknown how the UCI will respond to prominent images of cyclists crossing a finish line with both arms raised above their heads (an important image for sponsors), or cycling within the peloton with no handlebar contact since both of these common actions are also violations of Article 1.3.008. It seems clear that the visibility of the Froome Peyresourde descent with the associated wide adoption of the technique in other races prompted the rule clarification and enforcement. It is not clear what prompted the specification that the common 'invisible aero' position also needed sanctioning.

Success is the evolutionary currency of sport just as reproduction is the evolutionary currency of biology. In biology there is no negative selective pressure against harmful effects that occur post-reproductively, for example, symptoms of Huntington's Disease typically manifest in the 30s and 40s, an age where most patients may have already had offspring and so their reproductive fitness is unaffected by the disease. Because reproduction is unaffected there is no negative selective pressure against the trait and Huntington's Disease persists in the population. In the case of Huntington's Disease, the advent of genetic testing and pre-implantation genetic diagnosis technology allows for the Huntington gene to be artificially selected against. Eventually Huntington's Disease could be removed from the human genome and any recurrence would be the result of random genetic mutation. In sport, while there may be some negative selective pressure on use of performance-enhancing substances due to the public shaming and

sanctions that accompany a positive test, a stronger negative selective pressure occurs when there is a clear and direct connection between an action and negative *performance* outcomes:

> "The techniques you see in MMA [mixed martial arts] are not new techniques. They're just a blending of old martial arts techniques. In MMA, we're just taking what works from a lot of different arts, then we make sure it *does* work. How? By experimenting. In MMA competition — outside of biting, eye gouges and groin shots —everything else is pretty much fair game. Once we identify a technique that we think might work, we have the perfect laboratory to do that. It's hard to argue with results that say, 'Here is a move that just failed six times in a row, and here is a move that just worked 20 times in a row.'" [176]

This example of the development of performance-enhancing techniques in MMA demonstrates a simple relationship between an athlete trying a technique and immediately receiving objective feedback related to the success or failure of the technique. The use of performance-enhancing substances either in or out of competition is considerably more complex. There is rarely immediate feedback that the performance-enhancing substance is directly contributing to some kind of enhancement and placebo effects are a significant confounding variable. In the case of performance-enhancing substances, performance may be enhanced simply because the athlete *expects* performance to be enhanced even in the absence of any biological effects of the drug [177-180].

Co-evolution of Rules and Technology

Sports are defined on a macroscopic level by constitutive rules. Over time these rules have arisen to constrain actions into something that can be recognized as a distinctive sport. Adaptations within that sport continue to occur in response to external pressures. Athletes, coaches, scientists, and commercial interests accelerate the evolution

of sport with advances in physiology, mechanics, and equipment. Once these advances appear administrators and politicians and sometimes athletes, scientists, coaches, and commercial entities resist and constrain the adaptation in a reactionary way that takes the sport back to a previous iteration, usually in the name of fairness. Sometimes the constraints spawn a new sport, and sometimes the constraints withhold the progress of sport. Sometimes the technological innovations are external to the sport itself. In the late 1970's One Day International (ODI) cricket evolved out of test match cricket to appeal to a wider audience of people who simply could not spend five days playing or watching a game. Various traditionalists decried the new format but ODI cricket persisted and thrived. More recently T20 cricket was developed to engage the entertainment market. In each format of the game (test, ODI, T20) the players are playing cricket, but the skills and strategies for each format are very different. What has been interesting is the transfer of skills specifically developed in the shorter T20 format, to ODI and test match cricket. The strategic demands of the shorter T20 format require different physiological and biomechanical contributions to athletic excellence necessitating changes in training. Because many players are active in all three formats of the game, these training adaptations have filtered through all formats of the game and are persisting. Not only were the shorter formats of cricket able to engage more players and commercial interests (positive selective pressure), but these formats also pushed the limits of cricket excellence resulting in more athletic and dynamic players and matches.

As a sport develops athletes learn techniques to be successful and if these techniques stray too far from what is considered constitutive to the sport, rules can be created to constrain the activity and keep it recognizably the same sport [181]. The overarm bowling of cricket was first recognized as a legal delivery method in 1864 [182] and has

become the norm in cricket. In response to increasing incidents of 'no ball' deliveries due to a perceived throwing action, the laws of cricket were revised in 2000 and state:

> "A ball is fairly delivered in respect of the arm if, once the bowler's arm has reached the level of the shoulder in the delivery swing, the elbow joint is not straightened partially or completely from that instant until the ball has left the hand." [183]

A strict interpretation of this rule requires a straight elbow (i.e. 0° elbow extension) in the bowling arm once the arm reaches shoulder height. While the MCC Laws of Cricket govern the game in general, the International Cricket Council (ICC) rewrote this particular rule in 2002 to include different thresholds of acceptable elbow extension for different style bowlers (for example a threshold of 5° of elbow extension for spin bowlers and up to 10° of elbow extension in fast bowlers). Subsequent research showed that not only was it impossible to attain a straight elbow through the bowling action for any type of bowler [182,184] but that the tiered thresholds for elbow angle would also result in a significant number of no balls if all illegal deliveries were correctly identified [184]. In 2005 a further ICC rule change imposed a uniform elbow extension threshold of 15° for all types of bowlers. If elbow extension is greater than 15° the bowler is judged to be throwing the ball and at this threshold ball speed was significantly increased [182]. This evolution of rule changes shows a pattern of initially imposing a rule that was too stringent and not based on the mechanics of the human body and the action. If the rule had been strictly applied matches would have descended into a farcical display of no balls. Technological innovation in sport science allowed for the identification of thresholds where the cricket bowling action changes into a throwing action and these thresholds were then adapted into the rules.

The rules of sport co-evolve with technological innovation by participants. These innovations include but are not limited to technique changes, technological advancement in equipment, and biomedical innovations in testing, training, recovery, nutrition, and performance preparation. It may be that a rule change is necessary because performance outpaced traditional limits as was the case in javelin. In less than a century, training refinements had improved javelin performance to such a degree that the javelin itself had to be altered (altered center of mass and changes to increase air resistance) to avoid spectators being impaled during competition within stadiums. Moving the center of mass alone caused a 10.5% reduction in men's javelin performance and a 9.5% reduction in women's javelin performance [166] and allowed javelin competitions to continue taking place within athletics stadiums. In contrast, the use of fiber glass vaulting poles allowed for a 7.9% improvement in men's pole vault performance [166] with overall improvement in pole vault performance post-war to 2008 reaching ~80% as the vaulting pole material changed from ash, to bamboo, to aluminium, then fiber glass [165]. Vaulting pole material is not specified in the rules but selective pressures have resulted in adoption of the most effective material by elite athletes.

An excellent example of the effect of embracing innovation is America's Cup yachting. Under the Deed of Gift for the America's Cup, the defender of the cup specifies the class of boat to be used in the competition for the cup. It is in the last ~40 years, since the Cup first left the New York Yacht Club (won by Australia II) the vessels competing for the America's Cup have transformed from single hull 12-meter class yachts, to catamarans, and most recently foiling multihull and monohull yachts. Following legal challenges in 1988 a new America's Cup class of boats emerged. Boats are built to a standard design that is selected by the defender. Technological advances have been

embraced and giant leaps forward have often resulted in success. Most recently the replacement of traditional soft sails with rigid wing sails, then the innovation of foiling technology has resulted in boats that race above the surface of the water on foil arms, exploiting the physics of wind and lift [185] and the energy generated by grinders isn't used to raise or lower sails but is stored and used to trim the sails and foils [186]. America's Cup racing is barely recognizable as yachting, but it is still a yachting competition. The athleticism of the crew, and the skill and tactics necessary for success are still comparable with traditional yachting, with the added skillset of successfully integrating the demands of the technology with the speed and power that technology can generate. These innovations have kept the competition for the oldest trophy in international sports relevant. The speed and power of the boats under human control, the ever-present threat of capsize if conditions are misjudged, and misread wind shifts that could render a boat stationary preserve a true uncertainty of outcome that is not diluted by the rapid evolution of the sport. Technological change is inherent in sport and has resulted in greater performance-enhancement than is possible physiologically.

Performance Evolution and Physiological Limits

One of the central ideas underlying many justifications for anti-doping policy seems to be the suggestion that human athletic performance is open-ended, that is, human physiological performance has unlimited potential for improvement. However, this idea is incorrect. Analysis of elite performance over the last century suggest that the physiological limits of human performance have either been reached or will be reached in the next few years. The greatest impact on performance is the vastly increased global participation in sport over time but beyond the effect of greater competition there is a definable influence of technological innovation. Balmer *et al.* [165] examined post-war

performance in jumping events and concluded that technological or technical changes would be needed to propel any further improvement in performance. A wider examination of field events identified technique changes (for example, the Fosbury flop technique in high jump) and equipment innovation (changes in vaulting pole material) as main drivers of performance change and concluded that throwing events had reached the limits of performance and jumping events would reach performance limits in the early 2030s [166]. Further improvements in performance would only be possible with development of new technology, rule changes, or significant changes in the athlete population itself. However, the driving force behind the experimentation and adoption of new technology and techniques is athletes seeking an advantage over their competition. The innovations would not persist if they did not confer an advantage or harmed performance.

Running events have also benefited from increased participation and competition that have propelled the anthropometrics of elite runners towards population extremes. Successful distance runners are small and lightweight. Innovation has often come in the form of changes in training, recovery, and nutrition. Prior to the development of the Nike Vaporfly shoe Olympic running events showed a pattern of improvement in middle and distance running attributed to the influx of African runners to elite competition [187]. At the time of publication, Haake *et al.* [187] predicted that all Olympic running events would reach limits by 2031 and this may still be true even with the advent of new shoe technology. Even with the superior shoe technology, the sub-2-hour marathon performance of 1:59:40 was approximately 2 min slower than predictions of the fastest human marathon performance based on physiological limitations [92]. The overall pattern of performance in most Olympic events indicates that the steady improvement over the last few decades

appears to be reaching limits beyond which there will be no further improvement outside of atypical performances without further innovation or rule changes [188].

Outside of Olympic competition, elite road cycling provides an interesting case study for performance improvements and the complexity of elite performance. An examination of results in elite European road cycling in the post-World War II (WWII) period showed a progressive increase in mean speed [189]. Four distinct periods were observable; the first two periods include the world wars; the third period of the years after the conclusion of WWII until 1993 included a long period where mean speed did not change. In the period of 1993-2008 there was a ~6.38% increase in mean speed. This period coincided with the introduction and use of EPO by professional cyclists. After referencing laboratory studies of the effect of EPO on *maximal* cycling performance, the authors concluded that doping with EPO provided a significant performance advantage that was directly reflected in the increased speed of the peloton after 1993. While research has shown that EPO does increase VO_{2max} by 6-7% [190-195] this increase in maximal performance would not be expected to directly translate to a 6-7% improvement in the submaximal cycling speed of a road race [23,193]. It would be simplistic to attribute the increase in cycling speed post-1993 solely to the use of EPO while ignoring the contributions of sweeping changes in training, recovery, nutrition, technology, and analysis to elite performance in conjunction with organizational changes and increased commercial interest and pressures on cycling.

It should be noted that the analysis of mean cycling speed that led to the conclusion that the improvement in performance post-1993 was due to EPO was based on the analysis of mean winners speed alone without accounting for other changes to the races that may impact performance [189]. A more detailed analysis of Grand Tour cycling

performance compared the use of speed with completion time as the dependent variable and included covariates that showed that completion time was a statistically more robust measure of performance [196,197]. The greatest influence on performance was the steady decline in race distance and the increase in the number of stages (thereby making each stage a shorter distance). The more complex statistical model showed that the period with the greatest improvement in performance was 1983-1992, a period that coincided with organizational changes and rapid commercialization of cycling that increased pressure to improve performance across all levels of the professional peloton [198]. When accounting for the covariates of distance, number of stages, and a brutality index that accounted for the difficulty of the stages, the performance improvement in the period 1993-2002 was estimated at 3.18% and was within the range of normal variability [197]. Statistical analysis revealed no outlier performances, including during the 'EPO-era' [196]. Aside from the disconnect between the physiology of cycling performance and the effect of EPO (EPO improves maximal performance but road cycling performance is largely submaximal [23]) and the intricate strategies involved in stage racing, what has actually happened is that races have become easier, with shorter overall distance distributed over more stages. Combined with advances in training and recovery it is not surprising that speeds have increased. What these analyses show is that elite performance is complex, with many contributing factors [199], each of which can be subject to adaptive pressures that influence overall performance. Attributing performance enhancement to a single substance (e.g. EPO) or combined performance-enhancing substances is simplistic and naïve.

Other sports show evolutionary patterns. Norwegian cross-country skiers in the 1960s were predominantly forestry workers. Commuting to remote job sites and

performing manual labor was a large part of the training for the sport. Modern cross-country skiers complete specific, periodized training and performance is planned and finely tuned [200]. The advent and pressures of professionalism in the 1990s triggered a transformation of the morphology of rugby union players which in turn has affected the game. Professional rugby unions players are taller and heavier [201,202] and passes, tackles, and ball-in-play time has increased [201]. Taller rugby players have a performance advantage in lineouts and passing, and heavier players that can move fast have an advantage in tackling. As the availability of player physical abilities changed, the skill and intensity of rugby union games also changed. Athletes who could not meet the skill demands or physicality of the game were simply not successful at the highest levels. In just seven seasons of English Premier League soccer matches high intensity running in possession of the ball increased by up to 50%, sprinting distance and number increased by up to 70% and 107% respectively, and there was an 81% increase in passes made and 113% increase in passes received [203]. As players move through the levels of volleyball the game speed, intensity, and number of jumps increase. Volleyball is a faster and more powerful game at higher levels [204] which will exert a selective pressure on the athletes who are successful. Amateur boxing has seen rule revisions that have improved safety for participants. These rule changes may have had a negative effect on the marketability and audience for the sport and so were reversed in 2013 [205]. These examples demonstrate that sports performance is continuing to evolve in response to a range of pressures.

Elite athletes tend to be morphologically homogenous within their sports (for example, high jumpers tend to be tall and lean), but over time the ideal body type for elite performance has become further and further removed from population means. In sports where athlete morphology is relatively open ended (for example, rugby union),

successful athletes have become taller and heavier at a faster rate than the general population. In sports where size has a negative impact on performance (for example, figure skating and women's artistic gymnastics) successful athletes are becoming smaller than population norms [206]. These changes in physical characteristics influence performance and the demand for athletes who have the body type to satisfy those performance requirements acts as a selective pressure on the body type required for success in a particular sport. As a result, sport and games are becoming faster, more powerful, and more skillful which feeds back to the selective pressure on morphology. But these changes are not endless. Human physiology has limits and analyses of historical and current trends in performance suggest that elite performance and the morphology of elite athletes is approaching limits. When combined with data suggesting that rates of use of banned substances in elite populations is high [59,60] despite testing figures [132] it seems that elite performance, even with a background of performance-enhancing substance use that may or may not have a biological effect, is reaching the limits of human physiological performance.

Conclusion

The commercialization of elite sport, including the Olympic Games, as an entertainment product is fast approaching a barrier where records will fall infrequently, and events will no longer compare favorably with record-breaking events of the past. The Olympic motto '*citius, altius, fortius*' (faster, higher, stronger) will soon be unattainable, and it is reasonable to ask what will happen to elite and professional sport if the entertainment product that is so critical for the survival of sport no longer generates ratings and profit? Could sport survive without the media? The empirical data suggest that extraordinary record-breaking performances will rarely happen unless sport

continues to co-evolve with technological and biomedical innovations. Enhancements that alter the identifiability of a sport and change constitutive, recognizable characteristics, for example, a motor in a bicycle or the Fosbury Flop technique, can and have been dealt with by acceptance, rule changes, or development of new sports. Performance-enhancing substances are already a part of elite performance that is nearing the limits of human physiology and allowing safe, monitored use of these substances is unlikely to propel elite performance into an unrecognizable arena. Allowing performance-enhancement that explores the limits of human physiological performance but does not harm the health, safety, and wellbeing of athletes is a fundamentally human activity that balances the paternalistic duties of sports governance with an innately human drive to compete and push boundaries.

Chapter 5

Health and Harm

Introduction

The right to health has long been recognized as "… a fundamental part of our human rights and understanding of a life in dignity" [207]. Anti-doping policy is a policy that impacts the provision of healthcare and potential for harm of not only elite athletes, but athletes and fitness participants of all levels. The supposed central role of health in the Code connects anti-doping policy to human rights and so a critical examination of the policy in the context of health and harm is warranted. This chapter examines anti-doping policy through the lens of health, safety, and knowledge and questions the causal events in health harms related to anti-doping policy.

Understanding Drug Safety and Prescription Practices

Medicine and healthcare are evidence-based. Healthcare providers and professionals in the biomedical sciences rely on high-quality, placebo-controlled research to be able to provide informed and up-to-date advice and care. A drug prescribed for a pathological condition has been tested in preclinical studies, usually in animal and cell models for efficacy, and mechanism of action. Once a substance moves into clinical trial phases, dose-response trials are conducted in healthy humans (Phase 1), therapeutic doses are given to patients to determine if a therapeutic effect exists and to begin to develop a side effect profile (Phase 2), and finally the trials are expanded to a greater number of patients to gain a more complete picture of effectiveness, side effects, and

interactions (Phase 3). Once approved and on the market, monitoring of safety, effectiveness, and manufacturing quality continues [208]. Often called Phase 4, this continued monitoring and study of the drug allows for dose optimization, applications in different patient populations, and use of the drug for additional indications. Manufacturers are required to report adverse events that may be used to initiate a recall. Off-label use of prescription drugs can be studied and recommended in Phase 4 [209].

The notion that drug development and approval is solely based around treatment of clinical conditions that can be deadly if untreated is naïve and disingenuous. For example, sildenafil is a phosphodiesterase-5 (PDE-5) inhibitor that allows for greater nitric oxide signaling with the end result of vasodilation. The drug and the enzyme it inhibits are not tissue specific but PDE-5 has been shown to be upregulated in patients with pulmonary artery hypertension [210]. Sildenafil entered clinical trials with the goal of treating pulmonary artery hypertension, a condition that can lead to congestive heart failure and death if untreated. So the story goes, during clinical trials a nurse happened to note that male subjects were experiencing vessel dilation in the penis [211]. Pulmonary artery hypertension is a condition that directly leads to heart failure and death. Erectile dysfunction does not tend to lead to death. While Sildenafil was in clinical trials for treatment of pulmonary hypertension, it was initially approved to treat erectile dysfunction in 1998 and was prescribed, off-label, to treat pulmonary artery hypertension until eventual approval for this use in 2005 [212]. Off-label prescription is an accepted part of continued drug discovery. If initial drug approval can be directed towards conditions that are not life-threatening but do impact quality of life at the expense of prioritizing treatment of pathology, then it seems reasonable to investigate the use of other drugs

that have approval for life-threatening conditions but could enhance quality of life, including the quality of life of an athlete.

Once approved, a drug can be prescribed off-label or without supporting diagnostic criteria. For example, testosterone prescriptions for the treatment of hypogonadism increased 170% between 1999 and 2002 [213]. Global sales of prescription testosterone increased from ~$150 million in 2000 to $1.8 billion in 2011. Prescription guidelines indicate that testosterone should only be prescribed with documented low serum testosterone levels, confirmed by two laboratory tests within a 6-month period. Analysis of insurance and other medical records showed that in the US between 2007 and 2011, 90% of men prescribed testosterone did not have two lab measurements prior to prescription, and 40% of men had no measures of serum testosterone prior to receiving the prescription. In the UK these proportions were 87% with only one measure and 54% with no measures. In men with measurements of serum testosterone, 20% had levels of testosterone in the normal range. Men who seek testosterone therapy often have comorbid conditions such as obesity, diabetes, and hypertension [214] so are not healthy to begin with and are receiving prescriptions without meeting diagnostic criteria. These data clearly indicate that prescription guidelines are already blurred in the general population.

Implying that all substances on the Prohibited List are dangerous naively ignores the decades of research and many layers of regulatory processes required to bring a drug to market. Many, but not all, of the entries on the Prohibited List are for substances or methods that have been approved for human use via the clinical trial process. Diuretics and β-antagonists are frequently prescribed for cardiovascular disease and hypertension, β-agonists are used to treat asthma, anabolic agents can be used in aging and cancer treatment, growth factors and hormones and metabolic modulators can treat many

conditions. Artificial enhancement of oxygen delivery has applications in kidney disease and trauma and battlefield scenarios. A notable exception is gene therapy which is beginning clinical trials for very limited diseases. What is important to note is that while the classes of substances and methods on the Prohibited List have clinical relevance, many substances and some methods (gene therapy) on the list have not been approved for human use. Some products are veterinary products while some substances and methods are gleaned from basic science research and have not been used outside of an animal model. Other products did not complete clinical trials because of lack of evidence of clinical effectiveness or safety concerns. For example, WADA took the step of warning athletes of the toxicity of GW501516 after clinical trials in animals were terminated following reports of adverse effects. This substance is available from online sources as Endurobol or Cardarine [215]. The Prohibited List does contain a blanket ban on any substance that is not approved for human use, but experimental substances obtained from black market sources are particularly attractive to athletes due to limitations in current testing methods.

Recent large-scale prescription drug recalls in the US serve to highlight the absence of oversight of black-market pharmaceuticals. Various formulations of losartan, irbesartan, valsartan, ranitidine, and metformin from different manufacturers have all been recalled for containing carcinogenic impurities [216-220]. What these recalls have demonstrated is that, while there have been problems with the dissemination of information to patients and healthcare providers, the mechanisms are in place to monitor the quality of active pharmaceutical ingredients in a complex, global supply chain. Experimental substances that are not approved for human use, and black-market doping

products are not part of the normal quality control process of government regulators and present a significant health risk to athletes.

Dietary supplements do not undergo the same process of clinical testing for safety and effectiveness prior to marketing and can be adulterated with clinically active pharmaceutical ingredients that can cause harm [221,222] or lead to sanction but these products can be subject to voluntary recall by the manufacturer on the recommendation of the FDA. Black-market enhancement products do not undergo any regulation or oversight and the contents frequently do not match the ingredient lists [151]. This lack of regulation and oversight is significant when considering the potential for harm to an athlete who has decided to take a banned substance. Outside of the morality of the decision to use a banned substance, the inability to access qualified medical advice for the use of performance-enhancing substances or human-quality products may create a more dangerous combination of factors that result in harm. Removing the healthcare provider from the decisions about complex pharmaceutical and physiological interactions by prohibiting this practice also removes an additional pathway to harm prevention

Health and Healthcare

The moral status of denial of healthcare depends on whether it is the right of a patient to receive healthcare, and more specifically, healthcare that is tailored to the individual patient with their specific mental and physical needs. Health behaviors and decisions are complex [223,224]. As non-communicable lifestyle diseases such as obesity and diabetes become more prevalent health promotion is trending towards responsibility in healthcare. Should an obese patient be denied weight loss treatment simply because they are choosing to eat too many calories? It is generally agreed that this would be morally impermissible because it is an unreasonable restraint on personal autonomy. It is less well

recognized that health behaviors are far more complex than simply choosing a salad over a burger.

The use of performance-enhancing substances is as complex as health-related behaviors. A patient with a desire for a physiological outcome (for example, increased muscle mass, improved health or quality of life after intense training) seeks the use of medical technology (pharmaceutical or technological) to achieve that outcome. Just as with treatment of traditional pathology, there are many ways to achieve the physiological outcome. The influences leading to the decision to use a performance-enhancing substance are broad, complex, and likely pervasive in the athlete's life and lifestyle. Social and environmental pressures will be influential as well as underlying, pre-existing differences in psychological approaches to the decision that may be shaped by past experiences and interactions. Healthcare providers are subject to sanctions under the Code as athlete support personnel and are prohibited from administering any prohibited substance or being complicit in any anti-doping rule violation (including providing advice or prescriptions for prohibited list substances that are approved for human use). Anti-doping policies of the World Medical Association [225] are based on the 1999 Lausanne Declaration on Doping in Sport [226]. By implementing policies that prohibit the provision of knowledge and care related to complex and evolving aspects of science and medicine, by qualified practitioners, WADA policies shift all responsibility for health outcomes while using performance-enhancing substances from trained healthcare providers to untrained patients. Any consequences of misuse (incorrect dosing, polypharmacy, lack of knowledge of side effects, poor quality products) then become the responsibility of the patient. Negative health outcomes will be treated, as evidenced by many case reports in the

literature, but at present the responsibility for prevention of negative health outcomes lies with the uninformed patient, with a complex behavior simplified to “just say no.”

Many behaviors are the results of many different actions by many different agents over time. For an athlete to be considered morally responsible for taking performance-enhancing substances they need to possess knowledge of the consequences of their actions (epistemic condition), and enough control of the decision to be able to make a reasonable alternative choice [227]. The epistemic condition is complicated in the case of performance-enhancing substances. What knowledge fulfils the condition? With the swath of media portrayals of elite athletes who test positive and suffer public shaming it is likely that most athletes would know that taking the performance-enhancing substance was against a rule and of moral significance. But where does the attribution of performance enhancement to a substance come from? There is very little peer-reviewed, double-blind, placebo controlled, sport-specific evidence for performance enhancement for most performance-enhancing substances [228]. The inclusion of a substance on the Prohibited List of performance-enhancing substances implies that the substance is performance enhancing even if evidence is absent or contrary. Since there is very little high-quality research to support the assertion of performance enhancement in elite or highly trained athletes it is likely that athletes do not have this knowledge beyond anecdote or placebo effect from previous use or expectation from the inclusion of the performance-enhancing substance on the Prohibited List. Here, the allocation of effort becomes complicated. If an athlete has taken a substance with no biological effect with the belief that it will be performance enhancing, and performance is enhanced this is because the athlete has accessed physiological reserves that were present regardless of substance use. Athletes who have not received training in physiology, pharmacology, and

drug interactions will also likely not have knowledge of the health consequences of performance-enhancing substance use or the ability to detect side effects before they become severe. Which of these aspects of knowledge is the most important? Is it the morality (spirit of sport), the performance enhancement, or the health knowledge? The control condition is also complicated when assigning absolute responsibility for the use of performance-enhancing substance. Athletes face a range of pressures and influences and may believe that there is no reasonable alternative course of action open to them [227] raising concerns about coercive influences. Anti-doping authorities suggest that the alternative course of action is to simply refuse to use performance-enhancing substances. For some athletes this choice may result in losses (real or perceived) that outweigh the risks. It is not clear whether athletes fulfill the epistemic and control conditions required to clearly assign moral responsibility for performance-enhancing substance use.

Harm

The concept of harm is often separated into categories of doing or allowing harm. In both conditions an agent is involved in a bad outcome. When doing harm, the agent causes the harm to occur; when allowing harm, the agent fails to prevent the harm from occurring [229,230]. The agent's relationship with the harmful sequence is critical to the analysis of harm. If an agent initiates or sustains a harmful sequence, that agent is doing harm. If an agent enables the harmful sequence by removing a barrier or failing to take an action that would have stopped the harmful sequence that agent is allowing harm [230]. Removing the safety net of healthcare could also be considered neither doing nor allowing harm, but a third distinct category. McMahan [231] describes three key factors that determine whether removing a safety net falls into doing or allowing harm. These factors are: 1) whether the agent who removes the protection is the agent who provides it; 2)

whether the protection is self-sustaining or requires more of the agent; and 3) whether the protection is functioning and ongoing or has yet to be initiated. The removal of a safety net is considered to be allowing harm if the agent provides the protection, the protection is not self-sustaining and requires further input from the agent or is not yet functioning. Healthcare is a safety net that when used appropriately can steer a patient away from a potentially harmful sequence of events, provide safer alternatives to harmful choices, or treat and prevent further harm from occurring. This is true for diabetes and obesity, and it can also be true for use of performance-enhancing substances.

In the case of the WADA restrictions on healthcare providers as athlete support personnel 1) WADA does not directly provide healthcare; 2) healthcare may not necessarily be considered self-sustaining since healthcare providers are required to stay up to date with current knowledge and best practices, but this requirement for continuing education is not required by WADA but rather the medical community; and 3) providing advice and healthcare to a patient in the matter of performance-enhancing substances could be considered ongoing if the patient approaches their healthcare provider after they have already begun to take performance-enhancing substances, or not yet initiated if the patient approaches their healthcare provider with the intention of taking performance-enhancing substances and is seeking medical advice for the most appropriate substances, dosages, and prescriptions for safe medications that are approved for human use. WADA policies that restrict the activities of healthcare providers remove the safety net of healthcare. Depending on when in the causal sequence the patient approaches their healthcare provider, these policies can fall into doing harm or allowing harm. A healthcare provider has a duty to avoid unreasonable harm to their patients [232] and humans have a right to benefit from scientific progress [233]. The

professional guidelines surrounding sports medicine and performance-enhancing substances are strongly value-based at the expense of evidence-based healthcare presenting a conundrum for the healthcare provider. Prescription guidelines for performance-enhancing substances for the clinical conditions they were developed for are well defined with known safety profiles. However, the abundance of evidence shows that patients can and do purchase and use performance-enhancing substances without medical guidance or care, often from dubious sources, sometimes with disastrous outcomes. Research and Phase 4 monitoring are needed to translate these guidelines into an exercising highly trained or elite athlete model so that clinicians have the knowledge to make an informed assessment of risk. Anti-doping authorities may be focusing on the harm of doping to society or to the spirit of sport, but this focus neglects the health and well-being of athletes of all levels.

Central to the Code is the claim that use of prohibited performance-enhancing substances is harmful to health. Certainly *misuse* of any performance-enhancing substances, particularly AAS, may cause pathological myocardial remodeling and affect other organ systems in certain individuals but it is not true that AAS use automatically results in lifelong morbidity directly attributable to former drug use. High-quality, peer-reviewed studies on the prevalence of performance-enhancing substance use by elite athletes provide a rate of use of approximately 40-60% [59,60]. When combined with the message from WADA that performance-enhancing substances are harmful to health we should see an impact on the health and longevity of former elite athletes, especially in sports with a well-documented history of doping such as cycling [31,196,234-236]. Studies of morbidity and mortality in cohorts of former elite athletes generally show that former elite athletes live longer and are healthier than controls. An analysis of French cyclists

who completed the Tour de France between 1947 and 2012 showed 41% lower all-cause mortality in the cyclists compared to controls and a 61% lower risk of cancer and cardiovascular disease [57]. Participation in the Tour de France improves longevity. Cyclists from France, Belgium, and Italy who completed the Tour de France between 1930 and 1964 lived 17% longer than the general population [116]. A systematic review of research encompassing almost 500,000 elite athletes showed that elite athletes from all sports live longer than the general population with the greatest gains in longevity in European cyclists and the lowest gains in longevity in Finnish power-lifters [64]. When these longevity reports are considered in the light of estimates of the prevalence of performance-enhancing substance use, there is little support for the contention that performance-enhancing substance use has negative impacts on long term health or longevity compared to the general population. If performance-enhancing substances were as dangerous as WADA would have us believe, elite athletes and former elite athletes would be dying at a higher rate than the general population.

Others have proposed that performance-enhancing substances are a gateway to illicit drugs. This hypothesis is often bandied about when investigating attitudes to supplement use, performance, and performance-enhancing substance use [237]. The basic premise of the gateway hypothesis is that use of a 'softer' drug like alcohol, can lead to using 'harder' drugs like heroin. It is a slippery slope argument. Applied to sport using alarmist anti-doping rhetoric this hypothesis becomes: supplement use leads to steroids, which leads to a crack cocaine habit. Again, when this hypothesis is combined with prevalence data and historic accounts of performance-enhancing substance use in elite sport, it would be expected that there would be high rates of substance abuse or addiction in former elite athletes. The occurrence of alcohol-related disease or death in

Finnish male former elite athletes active between 1920 and 1965 was not different from the general population. Alcohol consumption was higher in former elite athletes compared to controls, but this did not result in increased morbidity or mortality. Alcohol consumption in the group of former elite athletes was higher if the athlete was not participating in leisure-time sports [238]. The many studies of health and longevity [62,63,66,116,117,238] in former elite athletes simply do not support the contention that elite athletes have higher rates of substance abuse or dependence as would be expected if the gateway hypothesis held true. There is no empirical evidence that links the use of performance-enhancing substances in elite sport to substance abuse and addiction. Using EPO is not likely to turn into a heroin habit.

Harm reduction strategies that emphasize public health outcomes and de-emphasize punishment, social exclusion, and marginalization of illicit drug users were adopted by Portugal in 2000. It should be emphasized that decriminalization of illicit drugs in Portugal does not mean that these drugs are now freely available in the supplement aisles in stores. The drugs are still illegal, but the treatment of the end-users has shifted to one centered on public health goals, rather than punishment. Since the adoption of Decree 30/2000 in July 2001, instead of increased rates of drug use with the reduction in punishment, Portugal experienced a reduction in drug use, especially in adolescents [239,240]. Drug-related deaths decreased ~30% between 2000 and 2006, and drug-related HIV, tuberculosis, and hepatitis B and C infections decreased [241]. New drug-related HIV diagnoses decreased from 1430 in 2000 to 352 in 2008 [242]. Even a conservative analysis of the Portuguese drug policy accepts that decriminalization has not worsened drug-related problems in Portugal [240]. Decriminalization has provided protections for the people who use and become addicted to these drugs, changed the

view of drug use from a moral failing to treatable health problem, and focused resources on illegal trafficking and exploitation. Strategies targeting harm, demand, and supply reduction that ultimately allowed the use of performance-enhancing substances in sport could have similar outcomes. Athletes could access qualified medical help to ensure they are safely using substances that are approved for human use, and resources could be focused on black-market doping products, trafficking, and exploitation of vulnerable athletes. If anything can be learned from the 'war on drugs' it is that criminalizing drug use and increasingly punitive systems exacerbate the problem and punish the most vulnerable [241].

Red Queen Dynamics in Doping and Anti-Doping

The pattern of Red Queen dynamics in doping and anti-doping is often colloquially referred to as an 'arms race' [243]. This term is commonly used to refer to the relationship between drug developers and testers. Chemists and drug developers work to develop substances that existing testing methods cannot detect. Testing technology is then developed to detect these substances [244], and so the Red Queen dynamics between drug development and testing technology continues. At times, the testing technology is ahead in the race, and at times the drug developers are ahead in the race. The lead swaps continually. Red Queen dynamics could be applied to the increasingly restrictive policies of WADA. The introduction of out of competition testing, the whereabouts system, and the athlete biological passport are all methods that have been developed in response to increasingly finely tuned use of performance-enhancing substances by elite athletes who have benefited from (illicit) skilled medical advice. When a new detection method is introduced, there is an increase in the number of athletes who are 'caught', then, as athletes and their support structures learn how to evade that method, the positive tests

decline. For example, the development of a test for EPO led to a new strategy of microdosing (frequent, small doses that may only be detectable for an extremely short period of time but with a similar cumulative effect as larger, less frequent doses). The strategy of microdosing in turn led to the development of the Athlete Biological Passport in an effort to detect perturbations in homeostasis that may be the result of performance-enhancing substance use. Evidence suggests that in the EPO microdosing versus Athlete Biological Passport testing race, the EPO microdosing may be winning [245]. Ironically, the strategy of microdosing is often safer than infrequent, larger doses. But what is less widely recognized is how the Red Queen race between the Prohibited List and testing technology may perpetuate and increase risk and harm.

The Prohibited List is a guide to substances that are banned because they meet two of three criteria: performance-enhancing; a danger to the health of the athlete; or in violation of the spirit of sport [3]. Reasons are not provided for the presence of a substance on the list [4,11,246] so a substance may impair performance yet still be on the list. The lack of transparency leads to a situation where it can be assumed that the Prohibited List is a list of *performance-enhancing* substances. Not all of the substances on the list are approved for human use (for example, trenbolone) and some substances are legal in some countries and illegal in others (for example, clenbuterol). What is often lost in the discourse surrounding performance-enhancing substances is that the athlete taking the substance is seeking a physiological outcome, not a psychoactive response. For example, an athlete taking trenbolone likely wants an increase in muscle mass and strength, and an athlete taking clenbuterol is seeking an increase in lean mass and decrease in fat mass [247]. These outcomes are also achievable using anabolic steroids that have been approved for human use in clinical settings and have substantial, well-known safety and side effect

profiles [248]. Dosages and interaction effects are documented and anabolic steroids that have been produced to meet quality control standards can be obtained with a prescription (typically for treatment of a clinical condition). These are also the substances that have well characterized testing methodologies that have also been refined over many years which makes them an undesirable choice for an athlete subject to sanction. The response to this pattern (a Red Queen response) is to seek substances that are undetectable. However, the substances that are undetectable are also more likely to be experimental, not approved for human use, and have unknown side effects. In some cases, modification of existing substances may confer additional risk, for example, 17α-alkylation of anabolic steroids are orally active. The added methyl or ethyl group allows the molecule to survive first pass liver metabolism with significant bioavailability intact. Unfortunately, this modification also results in a drug with significant hepatotoxicity and so prescription and use are carefully monitored. Stanozolol is a 17α-alkylated steroid approved for human use and with known side effects whereas tetrahydrogestrinone (THG) is a 17α-alkylated steroid specifically developed to evade known testing methods, has unknown side effects, and is not approved for human use.

Just as constitutive and regulative rules provide constraints around skill development in a sport and thereby foster the evolution of improved or altered skills that result in performance success within the constitutive rules, the rules surrounding use of performance-enhancing substances provide constraints around the use of these substances. A goal of elite athletes is athletic excellence and success in their sport. While success may come in many different guises, it is underpinned by performance. For athletes who are subject to sanction, one of the goals when using performance-enhancing substances is likely the avoidance of detection so they develop new and innovative ways

of avoiding detection, not all safe. As the rules and methods for detecting drug use in sport (constraints) become tighter, more extreme methods for avoiding detection become the norm. The tightening of anti-doping rules is following Red Queen dynamics and functioning to push sport into more and more risky areas.

The Role of Research

While some substances on the Prohibited List have been approved for human use in treatment of disease and have a foundation of research and ongoing monitoring to establish efficacy and safety in patients, there is a substantial lack of research on the use of these substances for performance enhancement in healthy athletes. As sport science has grown as an academic discipline, the physiological and psychological contributions to elite performance are becoming better understood. A recent review evaluated the scientific literature providing Level 1 evidence of performance enhancement for the classes of substance on the prohibited list [228]. For the level of evidence to be considered "high" the evidence needed to come from double-blind, randomized, placebo-controlled trials, using subjects that could be considered representative of the elite athlete population being studied, and with performance relevant measures. For example, VO_{2max} is often used as a surrogate of endurance performance, however, endurance performance is reliant on a combination of factors of which VO_{2max} is only one. Of the 23 specific substance classes contained on the prohibited list, only five classes had scientific evidence of performance enhancement. There was no Level 1 evidence available for enhancement of endurance performance for any class of substance, including EPO. A total of 11 studies (266 subjects) met the criteria for Level 1 evidence of performance enhancement after use of a prohibited substance in highly trained or elite subjects. There

is little empirical evidence that performance-enhancing substances enhance sport-specific performance in highly trained or elite athletes.

The lack of evidence of effectiveness of performance-enhancing substances is not acknowledged by anti-doping authorities resulting in a situation where the Prohibited List serves as a guide to athletes where every substance that is listed is assumed to be performance-enhancing [249]. Athletes take performance-enhancing substances to achieve a specific physiological outcome. The physiological outcome can often be achieved with a substance that has completed clinical testing, is approved for human use, and in many cases has been used for many years so has a well-developed safety profile. For example, testosterone enanthate has been used since the mid 1950's to treat low testosterone in men (among other conditions). Testosterone enanthate has also been safely used in randomized, placebo-controlled studies of strength and mass gains in response to strength training in healthy young men [248]. Notably, supraphysiological doses of testosterone enanthate administered in a controlled and monitored environment did not increase angry behavior in this subject group [250]. However, testosterone enanthate is easily detectable thus it is unattractive to athletes subject to testing and sanctions. Testosterone enanthate is also a prescription only medication. Athletes who desire greater strength and mass gains from training may not be able to access the prescription drug that is approved for human use but may be able to access drugs that act through similar mechanisms (androgen receptor agonists) through veterinary sources or online sources. The Prohibited List provides a useful list of comparable products but with no indication that the substance is for veterinary use or is experimental and has not been approved for either human or animal use.

When a drug is approved for human use, it is approved for use in a specific pathological condition. However, drugs are often prescribed off-label for other uses. It is widely acknowledged that elite athletes have a unique genetic profile that differs from the general population [251]. Elite athletes also experience extreme and intense disruptions to homeostasis during and after training. These periods of intense exercise have the potential to affect both the pharmacokinetics and pharmacodynamics of a drug yet there is very little research on these effects, even less so in the highly trained or elite genetic background. It is likely that there would be considerable public outcry if federal funds were used to support research using performance-enhancing substances in highly trained and elite athletes if this research could be interpreted as supporting efforts to evade doping authorities. This lack of research has many implications one of which is that the Prohibited List is based on extremely limited evidence of performance enhancement [228]. Similarly, because research and monitoring are prohibited, there is no evidence of harm beyond retrospective studies of mainly recreational athletes taking multiple substances of dubious quality, in unknown dosages. WADA policies are built around the Prohibited List for which there is little to no scientific justification. By severely constraining research WADA has created a vacuum of knowledge. Based on the few high quality research studies that have been published, it is entirely possible that athletes are unnecessarily taking substances that do not enhance performance and/or do not harm health when taken according to prescription and with appropriate monitoring for health. Athletes may be taking prohibited substances not to improve performance, but to improve quality of life during heavy training and competition cycles [252]. Research is necessary to establish guidelines for the safe prescription of performance-enhancing substances in an athletic population. This research could include off-label prescription and post-market

surveillance that is the norm for prescription medications and prescription drug monitoring programs similar to those used for opioid prescriptions.

It is clear that research using untrained or recreational athletes is not generalizable to highly trained and elite athletes and that study outcome measures need to be directly relevant to the specific performance. Safe, well-controlled research using the appropriate highly trained subject population with relevant performance outcomes is possible. With the support of Dutch Anti-Doping authorities, Heuberger *et al* [23] conducted a double blind, placebo-controlled study using highly trained cyclists who were given EPO to maintain hematocrit at 50% then completed relevant endurance performance measurements. While the expected increase in VO_{2max} was observed in the EPO group this improvement in VO_{2max} did not translate to improved road cycling performance. There was no difference between the control and experimental groups in a 45 min lab time trial or race performance up Mont Ventoux. There were also no clinically relevant differences between the groups during or after treatment suggesting that EPO is safe to use in highly trained athletes [253]. Other work suggests that the optimal hematocrit for endurance performance may be well below the 50% UCI threshold for removal from competition [58]. Road cycling is a complex performance that is rarely performed at maximal intensity. While training and physiology are important, strategy and teamwork play a significant role in the outcome.

Research is needed to determine the efficacy and safety of performance-enhancing substances in exercising highly-trained and elite athletes however WADA policy prohibits researchers from using performance-enhancing substances in research and highly-trained and elite subjects may risk sanction by participating in research

studies. Article 19 of the Code relates specifically to research. In one fell swoop (less than one page in a 96-page document) WADA encourages research:

> Article 19.2 Types of Research: Relevant anti-doping research may include, for example, sociological, behavioral, juridical and ethical studies in addition to scientific, medical, analytical, statistical and physiological investigation. Without limiting the foregoing, studies on devising and evaluating the efficacy of scientifically-based physiological and psychological training programs that are consistent with the principles of the *Code* and respectful of the integrity of the human subjects, as well as studies on the *Use* of emerging substances or methods resulting from scientific developments should be conducted.

Requires research to be submitted to WADA:

> Article 19.3 Coordination of Research and Sharing of Results: Coordination of anti-doping research through *WADA* is essential. Subject to intellectual property rights, the results of such anti-doping research shall be provided to *WADA* and, where appropriate, shared with relevant *Signatories* and *Athletes* and other stakeholders.

Then prohibits the use of performance- enhancing substances and methods in research:

> Article 19.5 Research Using Prohibited Substances and Prohibited Methods: Research efforts should avoid the Administration of Prohibited Substances or Prohibited Methods to Athletes. [3]

It is not clear if these policies apply only to WADA-funded research or are expected of all researchers regardless of funding source. A crude analysis of the almost 500 research projects funded by WADA since 2001 shows that ~80% of these projects are solely for detection rather than the physiology or performance enhancing effects of performance-enhancing substances.

While Article 19 of the WADC may be intended to the harmonize anti-doping research efforts in the academic community, WADA has consistently demonstrated

significant conflicts of interest and a willingness to quash results that do not support ideology. The Ulrich *et al.* [60] study demonstrating (and probably statistically underestimating) the prevalence of doping at two elite athletics events was commissioned and funded by WADA. Data were collected in 2011 but the study was not published until 2017 after WADA and the IAAF refused to allow publication of the manuscript and impugned the scientific integrity of the methods and the authors [254]. The data were eventually leaked to the New York Times [254] and reported to a British Parliamentary inquiry [255] in 2016 before eventual publication in a peer-reviewed academic journal. The requirement to coordinate anti-doping research with WADA presents significant conflicts of interest. At present Article 19.3 refers to [all] research, not specifically WADA funded research. This language suggests that WADA wishes to monitor and approve all performance-enhancing substance research regardless of the research relationship with anti-doping authorities. Access to highly trained and elite athletes for research is very limited even under the best circumstances and placing constraints on researchers creates further barriers towards conducting high-quality research to inform the sporting and medical community. Article 19.3 has the potential to suppress independent research that does not support the WADA message and leaves independent researchers at risk of sanction under the label of "other persons" or "athlete support personnel."

Conclusion

Blanket claims that performance-enhancing substances are harmful to health and restricting healthcare providers from harm reduction activities is misguided at best and could be considered causal in a sequence of harmful events at worst. Assigning responsibility for the harms caused by misuse of substances that are given performance

enhancing status by their presence on the Prohibited List to athletes who may not have appropriate knowledge or agency to make safe decisions is morally questionable. While the Prohibited List serves as a list of substances that must not be present in an athletes' body, it also serves as a guide to substances that are considered performance-enhancing. The lack of transparency surrounding the reasons substances are added to the Prohibited List perpetuates the notion that substances listed may enhance athletic performance which may encourage athletes to seek out these substances from any source. In combination with the prohibition on healthcare providers as athlete support personnel providing qualified guidance and access to safe products, and health monitoring, the Code creates an environment where health risks are exacerbated rather than minimized.

Chapter 6

Oh, that way coercion lies

Introduction

Sport is a voluntary activity. We accept the rules of the game so that we may participate in the sport. Sports organizations also accept the rules of WADA so that they may participate in the Olympic Games. Elite sport is not the fun, wholesome activity projected by the Olympic movement and television pundits. It is an activity of intense physical and mental work, deprivation, and sacrifice. As such, elite sport is an endeavor of making hard choices that are unwanted but necessary to edge towards competitive success. These hard choices are not only related to performance-enhancing substances but can be anything from moving away from family to access better training resources, to whether or not to have a second slice of the only pizza the athlete has had in a year.

Coercion is about choices and whether the choices are voluntary or involuntary and permissible or impermissible. Context is important [256]. Often the choices an athlete must make are unattractive, but this does not mean that an athlete has no choice, just that the choices available are unappealing. Many choices make an athlete worse off but still do not meet the criteria of coercion. A superficial consideration of coercion may result in the following analysis: Athlete A is taking Substance X and is achieving success in their sport. Because Athlete A is taking Substance X, Athlete B feels they do not have a choice and must take Substance X in order to be competitive in the sport (or achieve success) even though Athlete B does not wish to take Substance X. Athlete B feels they

have no reasonable choice but to take Substance X to achieve success in the sport. To begin to be coercive Athlete A's actions must be wrong. Superficially, if Substance X is on the Prohibited List, then Athlete A's action are wrong because taking prohibited substances breaks a rule, however this is a circular argument: If taking a prohibited substance is wrong then their use should be banned, and since the use of substances on the Prohibited List is banned, then taking prohibited substances is wrong. Since the prohibition of a substance relies on fulfilling two of three criteria (health harm, performance-enhancement, violation of the spirit of sport) a deeper examination of coercive influences within the context of the complexity of performance and the nature of modern elite sport is needed.

Coercion

An often-cited justification for banning the use of performance-enhancing substances in sport is the notion that the "…use of [performance-enhancing substances] to enhance performance by some athletes coerces others into using [performance-enhancing substances]" [36]. Traditional approaches to coercion in legal and social settings often describe power differentials, ranges of coercive methods (for example, threats, violence, unreasonable proposals), and restrictions of freedom [257]. Wertheimer [256] delineated a two-pronged approach to duress (or coercion):

> "B acts under duress if, under the choice prong, A creates a choice situation for B in which B has no choice but to accept A's proposal and if, under the proposal prong, A acts wrongly in creating B's choice situation." [256] p 53

Simple analyses of coercion involve a powerful agent (Agent A) communicating with another agent (Agent B) and causing a change in B's behavior with the use or threat of force. B's behavior or response aims to avoid the negative outcome threatened by A

and so B's behavior is not voluntary and is considered coerced [256,258]. When A stands before B with a gun and proposes "your money or your life" B has the choice to hand over his money or lose his life and so B hands over his money in order to avoid the negative outcome of losing his life. This choice is often described as 'involuntary' as no rational person would choose to lose their life rather than hand over money to a mugger. The moral impermissibility of the proposal comes from the moral obligation to not kill (and also to not steal). This simple example places obvious agents in the roles of A (coercer) and B (coercee) with an overt threat coming from A who is acting wrongly. However, in real world scenarios it can be more difficult to identify an Agent A, or conclusively determine that Agent B truly had no choice. Choices are often present but lack appeal. If a choice is morally permissible, then it may be viewed as an offer rather than a threat. The offers may be unappealing, but they do not restrict an individual's freedom or coerce. Agent B may agree to a proposal as the best offer available under the circumstances and is acting both voluntarily and involuntarily in a condition of constrained volition.

The distinction between an offer and a threat may rest on whether Agent A is acting wrongly. In this way, paternalistic laws that constrain freedoms in a certain way (for example, seat belt wearing) for the good of the community, while technically meeting the superficial criteria for coercion, are not considered morally impermissible threats. There are many situations where an Agent B will be given choices that result in their situation worsening. The choices may come from an individual fulfilling the role of Agent A, or wider pressures that collectively fulfil the role of Agent A (the coercer). In sport the threat of force or negative outcome for an athlete (Agent B) may manifest as a threat of removal from a team or restricting opportunity for training and competition. The credibility of the threat lends weight to its influence. If a coach threatens an athlete with

removal from a team but does not have selection powers, the threat is less credible. Conversely, a coach or administrator may have the power to alter the trajectory of an athlete's career by restricting resources and opportunity and so any morally impermissible threats gain weight but may not meet the conditions of coercion.

Coercion may not rely on the communication of an explicit threat but rather on power differentials and relationships between the coercer and coercee. Anderson [258] outlined four questions that can guide the assessment of coercion when there are no overt threats of force or violence:

> (1) What need the coercer do in an episode of coercion?
>
> (2) What are the conditions on the relationship between coercer and coercee that make it possible for one to coerce the other?
>
> (3) How is the coercee's situation affected by the coercer's activities?
>
> (4) How are the instances of coercion individuated, ontologically?

In sport, the coercer may be an individual, but it is also reasonable to consider that coercive influences may arise from conditions that have no direct connection with the coercee, coaches, administrators, sponsors, or the conventions of the sport or level of sport. It may be difficult to identify individual coercive events, offers, or threats. Outside of direct control over an athlete's contract or opportunities, the relationship between the coercer and coercee is most likely to involve differences in performance and success. An athlete that is successful may (wittingly or unwittingly) create the conditions where less successful athletes believe they must do an action that they do not want to do in order to also be successful (or avoid failure). Coaches, administrators, or sponsors may have performance expectations that an athlete is trying to meet. Indeed, even Olympic qualifying times can create pressure on an individual athlete that contributes to actions the athlete does not want to do but this is not thought of as coercion. It is actions of the

coercer and the nature of the unwanted action is that are of ethical significance. An athlete may not want to reduce their caloric intake prior to a competition and weight loss can be uncomplicated and harmless, or ethically problematic. For example, when an athlete is so focused on weight before a competition that he develops an eating disorder, or when the athlete is subjected to public or private shaming about body weight [259] and undertakes weight loss activities in response. But these different examples of success or expectation do not place the successful individual in the role of coercer (Agent A) simply because others (Agent B) feel they must perform an unwanted action to attain the same success.

The wrongness of the action of performance-enhancing substance use is codified by the presence or absence of the substance on the Prohibited List. Caffeine has been shown to be performance-enhancing in many peer-reviewed, double-blind, placebo-controlled studies and is not on the Prohibited List [260-274]. Erythropoietin has limited evidence for performance enhancement with few peer-reviewed, double-blind, placebo-controlled studies and is on the Prohibited List. Both substances can, theoretically, enhance performance within dose ranges that are not harmful to health. Both substances can endanger the health of the athlete if used improperly, yet EPO is morally impermissible, while caffeine is morally permissible. There is little empirical logic to the presence of substances on the Prohibited List which contributes to confusion about enhancement potential.

The moral impermissibility of performance-enhancing substance use in sport may be difficult to separate from other means of performance enhancement. Athletic performance, by its very nature, is an endeavor in performance enhancement where performance outcomes are rewarded rather than the process to achieve the outcome.

Athletes will seek to achieve their desired performance outcome (winning, performing a certain role on a team, achieving a standard) through means they have seen are successful in others even if these means are risky. Many risky practices spread in sport before they are either accepted as part of the risk of participation at a certain level in the sport or removed from the sport by rule changes. Athletes are often in a position where they must adopt innovative training and performance techniques to keep up with the evolution of the sport. They often do not have reasonable alternatives, and if they do not adopt the new technique, they will likely lose their status and the rewards of being an elite athlete. Yet these evolutionary patterns in sport are not described as coercive. Performance enhancement in sport is not coercive, it is evolutionary.

Athletes Coercing Athletes

In complicated, multi-agent practical settings like sport it is difficult to find widespread supporting examples of explicit threats that fit this simple example of coercion. Simon [36] examined coercion within the general culture of sport and considers some of the unusual characteristics of elite sport. The very nature of innovation and evolution of sport could be considered coercive; if an athlete doesn't adopt a new technology or training technique, they are unlikely to be successful. Their choice is constrained. An athlete may have an "internal desire for success" [36] that is influenced by external pressure generated by other athletes, coaches, administrators, or sponsors and so the athlete's choices are constrained. But, as Simon acknowledges, this broad use of 'coercion' renders all competitive pressure, in and out of sport, coercive. Any actions taken as a result of this competitive pressure, from training to taking performance-enhancing substances could be considered coercive and so the term is depleted of any moral force. According to Simon: "[w]eight training should make athletes stronger and

more resistant to injury … [b]ut steroid use, even if it enhances athletic performance, also presents serious risk of harm to the user" and later "…we might distinguish between steroid use, which can be harmful, and training, which, if done properly, promotes conditioning and reduces the chances of injury" [36]. When considering the coercion argument for anti-doping policy, it seems that most of the moral objection to use of performance-enhancing substances is in the potential for harm while also attributing the coercive power to performance-enhancement, either directly or indirectly. An athlete would likely not take a substance if it was not performance-enhancing (or thought to be performance-enhancing). It is within these two prongs of the coercion justification for anti-doping that many assumptions and many problems with anti-doping policy lie.

Claiming that athletes have no choice but to use performance-enhancing substances if other athletes are using these drugs relies on a complex interplay between knowledge or belief of use patterns, knowledge or belief of performance-enhancing effects, demonstrable performance-enhancement attributable to the performance-enhancing substance, and the presence or absence of reasonable alternatives to using performance-enhancing substances to achieve a desired or required outcome. The discrepancy between official adverse analytical findings (~2% per year), estimations of use from controlled survey techniques (40-60% of elite athletes admit to using a banned substance [59,60]), and athletes' perceptions of their competitors use (~73% [137]) is wide, making it difficult to discern if there is a clear coercive influence of performance-enhancing substance use in sport or if performance-enhancing substance use is simply an accepted, if now hidden, part of elite sport. Clear demonstrations of threats against athletes from coaches, managers, or other personnel are difficult to find, although this may be because of the self-incrimination required to expose this behavior.

The U.S. Postal Service (USPS) Pro Cycling Team Investigation [275] that resulted in the lifetime ban of Lance Armstrong, Johan Bruyneel, Pedro Celaya Lezama, and Joséí Martí included thousands of pages of supporting documentation, including 12 English language testimonies from cyclists given in exchange for reduced sanctions. Arguably, this case provides evidence beyond anecdote and is of greater veracity than published autobiographies (although both may be considered self-serving). Of all the rider testimonies, only Christian Vande Velde details an explicit threat:

> "Armstrong told me that if I wanted to continue to ride for the Postal Service team I would have to use what Dr. Ferrari had been telling me to use and I would have to follow Dr. Ferrari's program to the letter." Vande Velde Statement [275]

Since Vande Velde did begin a program with Dr. Ferrari after this threat, he was coerced, likely due to a combination of factors rather than this one event. Vande Velde then stated "Floyd Landis confided in me that he had been told that I was left off the Tour de France team in 2002 because I was not on a blood doping program" [275] demonstrating that his beliefs that the threat could be carried out were likely justified. Less clear is the coercion of the other riders. No other riders testified to an explicit threat that connected their undertaking a doping program to their status on the team. In fact, Levi Leipheimer stated:

> "In April of 2007 at the Tour of Georgia I asked Johan Bruyneel whether the team was going to organize a blood doping program for the 2007 Tour de France. Johan responded, 'you're a pro, you should do it on your own.' I told Johan, however, that it was too stressful and that without team assistance I would not be using blood at the 2007 Tour. Johan seemed upset.
>
> More than once thereafter Johan brought up whether I was going to organize my own blood program for the 2007 Tour, and I told him that I was not going to do it.
>
> During the 2007 Dauphiné Libéré, which took place from June 10 to June 17, 2007, Johan again brought up the topic of organizing a blood program for the

> 2007 Tour, and this time he said, 'I think we can make it work.'" Leipheimer statement [275]

Leipheimer placed third at the 2007 Tour de France riding for the Discovery Channel cycling team. USADA has claimed "the evidence shows beyond any doubt that the US Postal Service Pro Cycling Team ran the most sophisticated, professionalized and successful doping program that sport has ever seen" [276] which was true until the Russian Sochi scandal. What is also true is that the US-Postal Service Pro Cycling Team ran a safe, medically supervised (to an extent) doping program and while relevant physiological variables like hematocrit were monitored closely, so was the health of the athletes especially in response to the doping interventions and training loads. USADA stated:

> The USPS Team doping conspiracy was professionally designed to groom and pressure athletes to use dangerous drugs, to evade detection, to ensure its secrecy and ultimately gain an unfair competitive advantage through superior doping practices. [276]

However, the "dangerous drugs" were medications approved for human use in patients with disease (EPO and testosterone), the team was careful to ensure the drugs were pharmaceutical grade and provided instruction on how to use the drugs safely (Michael Barry statement; athletes were not instructed to dope [Tom Danielson statement] and often asked for assistance in developing a safe and effective doping program). The team would not help an athlete with doping practices unless they signed a contract and encouraged athletes to sign because they had a good doping program. Leipheimer described how Johan Bruyneel was not happy that he had taken EPO without the team's knowledge:

> A few minutes later Dr. del Moral called back and gave me specific instructions on how to use EPO to prepare for an event. He told me when to use it, how much to use and when to stop before the competition. He also instructed me to inject EPO

> intravenously rather than subcutaneously so that it would clear my body faster, and I would test positive for a shorter period of time. I realized that Johan's concern and Dr. del Moral's concern was not necessarily that I had used EPO but that because they had not been told of my use, and I might not be using it safely, that I could have had a positive test which could have led to problems for the team. Leipheimer statement [275]

While the 'safety' that Leipheimer refers to no doubt means 'safe from testing positive' the unacknowledged benefit of ensuring athletes are using correct dosages is physiological safety, or prevention of health harms. Jonathan Vaughters used EPO to prevent anemia and maintain his health during intense training and was largely shielded from EPO use as a new professional rider. Tyler Hamilton described how a physician was present for blood transfusions [275]. While all the riders acknowledged that there was an acceptance that doping was necessary to endure the rigors of the European professional peloton, let alone perform well, it is apparent that the pressure to perform was what drove the doping. Placing the moral burden of doping on the shoulders of the athletes ignores the contributions of sponsor and spectator expectations.

Is Coercion Present and Where Might the Coercive Power Lie?

Establishing causal relationships between a substance or technique and performance-enhancement is difficult and extremely complex. There is little empirical evidence that the substances on the Prohibited List provide a demonstrable enhancement of sport-specific performance [228]. However, emerging data suggest that a biological effect due to the substance itself may not be necessary for performance enhancement and has highlighted the complexity of the placebo effect [178,277] and the significant contributions of expectation [179,180], and subject-researcher interactions [177] to the outcome of performance tests. The suggestion that a substance is performance-enhancing will likely render it performance-enhancing. This suggestion does not even have to be overt. Brown *et al*. [278]

found that mouth rinsing with a non-caloric pink colored (pink is associated with sweetness and carbohydrates) drink improved self-selected running speed and distance in recreational runners when compared to the same drink without the coloring. The coercive power of a substance lies in its ability to enhance performance [279], however what is critical to realize is that the performance-enhancement outcomes may not be directly attributable to the biological actions of the substance [180] but more to the expectation of enhancement [179,260]. A substance that is known to be ergogenic can lose this effect if the subject believes they have not consumed the substance [267]. Because of this expectation effect, it is possible that the appearance of a substance on a list of substances that are prohibited for their performance-enhancing actions, regardless of whether or not that substance is performance-enhancing, imbues the substance with a performance-enhancing power. Whether this power is coercive, regardless of the mechanism of performance-enhancement (placebo or biological), is difficult to determine. The athlete does have a choice about whether or not to take the substance. Even if the choice is difficult, it is present. This distinction is critical. Coercion is tightly linked to the choice situation and not state of mind. Just because an athlete feels as if they do not have a choice does not automatically infer coercion [256]. There is no empirical evidence that performance-enhancing substances are necessary for success in elite sport. The argument that prohibiting performance-enhancing substance use 'levels the playing field' is incorrect. Many inequalities exist in sport that are not corrected. Athletes train to create an uneven playing field and strive for success and it is popularly claimed that athletes strive for success above all else [148].

The Goldman Dilemma, so called for its appearance in the book "*Death in the Locker Room*" [280] is often cited as evidence that elite athletes value winning (success) over all else. Goldman writes that he asked 198 top world-class athletes

> If I had a magic drug that was so fantastic that if you took it once you would win every competition you would enter, from the Olympic decathlon to Mr. Universe, for the next five years, but it had one minor drawback – it would kill you five years after you took it – would you still take the drug?

According to Goldman, ~50% of athletes would accept this bargain. Scholarly work has dissected the path this story took from mention in a book about drugs in sport, to the subject of serious scholarly debate and contribution to anti-doping policy [135]. The initial claim did not have any methodological detail and reads more like a chat in a locker room leading to a tally kept on a piece of paper. Peer review and academic scrutiny did not occur, yet the Goldman Dilemma began to be reported as scientific work [148].

More recent work has subjected the core idea of the Goldman Dilemma – that athletes would sacrifice their health or lives for an Olympic gold medal – to rigorous academic scrutiny and the Goldman Dilemma has been thoroughly debunked [136,137,281,282]. Elite and sub-elite athletes demonstrate very low tolerance for ill-effects of substances that are guaranteed to enhance performance. Bloodworth *et al.* [137] found that males in the UK Talented Athlete Scholarship Scheme were more willing to use undetectable prohibited substances than females, and most would not use the substance (<1%) if it shortened their lifespan. No females were willing to take an undetectable performance-enhancing substance if it shortened their lifespan. While only 10% of the sample reported a willingness to take an undetectable prohibited performance enhancing substance, 72.6% believed that their competition would take the substance if it did not shorten lifespan, and 40% believed their competition would take the substance even if it did

shorten lifespan. The authors speculated that the discrepancy between attitudes towards performance-enhancing substance use and belief that competitors were using substances was likely due to social desirability in responses and self-selection in questionnaire return (25% overall return rate).

Connor *et al.* [281] attempted to replicate the results described in "*Death in the Locker Room*" by directly asking elite athletes at an international track and field meet Goldman Dilemma questions with the additional element of legality of substance. Only two of 212 (0.9%) athletes indicated they would take an illegal substance that guaranteed an Olympic gold medal but would kill them in five years. If the consequence of death was removed from the question, 11.8% of the athletes would take an illegal substance that guaranteed an Olympic gold medal. Legality of a substance appears to be important to athletes. Detailed interviews of athletes [136] revealed that athletes conflated performance-enhancement with illegal substances or drugs, and illegal substances with health risks or risks to the sport. Legal substances were considered safe and socially acceptable. Athletes also found the absolute assumption of winning to be unrealistic. The notion that a substance could overcome the uncertainty of outcome of sport was rejected by the subjects.

Placing the health risk of a performance-enhancing substance in either life or death categories is unrealistic. Gonzalez *et al.* [282] estimated the maximum acceptable five-year mortality risk (MAMR) for an Olympic gold medal amongst 2888 elite athletes who completed an online survey in a study funded by USADA. Sports were categorized as high, medium, or low risk of doping based on confidential internal USADA criteria and athletes at regional, national, and elite level were surveyed. Athletes were asked:

> Suppose there was a drug that would guarantee your winning an Olympic gold medal in your sport. Suppose also that using this drug would result in a [variable percentage of risk] chance that you would die of a heart attack 5 years later. Would you use it?

Subsequent questions with different levels of risk established upper and lower boundaries of risk tolerance. The MAMR for all the subjects ranged from 7-14%, was greatest in sports considered to be at medium risk of doping, and was greatest in elite competitors. It was speculated that elite competitors with years of training and experience were more tolerant of the risk of a potentially (not absolutely) fatal cardiovascular event with use of a drug that guaranteed Olympic gold because they saw less chance for further performance improvements with training, making substance use more attractive. Oddly, athletes in sports characterized as high risk for doping had the lowest risk tolerance across all levels of experience.

Dilemma style questions are typically considered to have three elements: performance-enhancing substance (legal or illegal), certainty of winning an Olympic gold medal; and a health/harm element (originally death in five years but other, shorter time frames have been used). In reality Dilemma questions have four elements: the legal or illegal performance enhancing substance should be split into performance-enhancing and no effect on performance categories. It seems ludicrous to ask whether an athlete would take a substance that could result in sanction, stripping of results, and public shame if that substance did not enhance their performance. If there was no performance benefit, but still risk the athlete would likely not take the substance. Yet this leverage remains largely ignored when considering claims of coercion. Further, guaranteeing winning is unrealistic. Even if a substance did substantially enhance physiological or psychological performance there is no guarantee of winning since the substance is only acting on the

athlete that took it, and not the competition. Even in the presence of prohibited substances, uncertainty of outcome is preserved. The only way to guarantee an outcome is match-fixing or deliberate underperforming.

If the goal of anti-doping is to eliminate drug use in sport, then it makes sense to find the correct leverage for the elite athlete population. The data clearly show that elite athletes have some tolerance for health risks when using a performance enhancing substance [282]. This tolerance is still higher than the proportion of athletes who return a positive test. Health risks have limited use as a tool for reducing performance-enhancing substance use in this population. However obvious the answer may be, what is absent from the literature are any questions that ask if an athlete would take a 'performance-enhancing substance' that doesn't actually enhance performance and studies that determine whether performance-enhancing substances actually enhance performance.

Turning the Tables: WADA Coercing Athletes

While Simon [36] and others [279] have suggested that athletes who use performance-enhancing substances coerce other athletes into also using these substances if they wish to be successful thereby justifying a ban, there is little examination of the idea of coercion from the other side. Does WADA (or the IOC) coerce athletes? In this case athletes continue to fulfill the role of the coercee, Agent B. WADA or the IOC occupies the role of Agent A, the entity that is making the proposal and proffering the threats or offers. WADA relies on voluntary acceptance of the Code by athletes, sports federations, and national bodies. Athletes must accept anti-doping procedures or they cannot participate in their sport at the elite level (and in some cases at the recreational level [100-102]); sports federations must accept anti-doping procedures if they wish to be eligible for Olympic competition; and national bodies must accept anti-doping procedures to be eligible to

send a national team to the Olympic Games to represent the nation [11]. In all of these settings, the other choice is non-participation either in the sport (for the individual) or the Olympic Games. Since there is no fundamental right to participate in organized sport or the Olympics, while each group may be made worse off by non-participation (not every sport is an Olympic sport), the choices are not morally impermissible and so these are offers, not threats. The situation is one of constrained volition rather than coercion.

Setting aside the constrained voluntary adoption of the Code by both Olympic and Olympic-hopeful sports, examining anti-doping practices at an individual athlete level provides more interesting moral fodder. The setting becomes: Agent A (WADA via requirements of sports federations and national bodies) proposes that Agent B (the athlete) complete the requirements of anti-doping protocols or be unable to participate. The actions Agent A is requiring for participation include notification of location for an hour every day of the year. If not at the location at the specified time sanctions may be levied. This amounts to just over two weeks where the athlete's movements are restricted. The athlete must avoid association with anyone who is sanctioned by WADA. The athlete must expose their genitals and urinate in front of a witness. Once the witness appears at the athlete's location the athlete has no right to privacy until the biospecimen is provided. Any activities that would normally be considered private or intimate will be surveyed by this witness, for example defecation [98] or the birth of a child [283] until the sample is provided.

If Agent B refuses any anti-doping procedures, then Agent A can carry out the threat of sanctions. The threat is credible since many athletes have been sanctioned under these conditions. Agent B has choices, submit or do not do sport either voluntarily or through imposed sanction. While both choices are unpleasant, they are present

suggesting that these may be offers rather than threats. But a difference between offers and threats is the moral permissibility of the proposal. Agent A (WADA) proposes to intrude on the private lives and bodies of athletes without probable cause based on health, fairness (performance-enhancement), and spirit of sport. There is little empirical evidence of enhancement for many of the substances on the Prohibited List; health harms are perpetuated and exacerbated by the Code itself; and as I will show in Chapter 7, the spirit of sport is an ideological myth that does not hold up to scrutiny. WADA is creating the conditions it uses for its moral entitlement. Athletes do not have a fundamental right to participate in sport, 'clean' sport, or elite sport. However, athletes as humans have a right to privacy, a right to bodily autonomy, and a right to freedom of movement and association if they are not, or have not been, imprisoned. The proposal by Agent A is morally impermissible since it violates these rights.

The challenging aspect of this view is the fact that both WADA and the IOC are private, non-governmental entities and so athletes and sports federations are seeking membership of a private organization. While governments and democratic societies may have to justify laws to citizens and citizens exercise their choice when voting, private organizations are not held to these same standards. Further confusion is added when considering the sanctions. There are ten actions that can result in an anti-doping rule violation. Only one of these actions is the documented presence of a prohibited substance in an athlete's body. The remaining actions include (briefly): use or attempted use of a prohibited substance or method; evading, refusing, or failing to provide a sample; being unavailable if a doping control officer appears to obtain a sample (whereabouts failure); tampering with sample collection; possession; trafficking; administration of a prohibited substance to another athlete; complicity; associating with someone who has

been banned from sport; and retaliation [3]. If Agent B is found guilty of any of these actions not only will they be labeled a 'cheater', but they will be procedurally isolated and formally prohibited from having any contact with, for many in elite sport, a majority of social and vocational relationships in a form of solitary confinement without physical walls.

WADA is issuing credible threats related to anti-doping protocols. WADA does not coerce athletes into not taking performance-enhancing substances, WADA coerces athletes to effectively waive certain basic rights. Athletes would be considerably worse off if they did not agree to anti-doping procedures. It is my contention that the reach of these sanctions is unjust and morally impermissible however, because this is the price of joining the private organization of the Olympic movement, these normally morally impermissible intrusions into the lives of athletes, athlete support personnel, and persons subtly shift into the realm of hard choices cloaked in the morality of an imaginary spirit of sport.

Perhaps participation in the Olympic movement could be seen as an unreasonable incentive that excuses the actions of the IOC and WADA? Many sports rely on exposure at the Olympic Games to draw in participants and sponsors and are willing to sacrifice essential characteristics of the sport for Olympic recognition [97]. But there are many sports that survive and thrive outside of the Olympic movement, for example: cricket, rugby, golf, tennis, cycling, surfing, and American professional leagues and so this theory holds little weight. The Olympic movement does exploit the vulnerable position of many smaller sports, but this is not morally wrong.

Sport is a rule-governed activity that relies on equality of opportunity. Athletes have a moral obligation not to cheat to distort the equality of opportunity. Perhaps the unreasonable incentives function at the level of the athlete and athletes are worse off if

they do not use performance-enhancing substances? Given that there is little evidence at present to support a biological mechanism for sport specific performance enhancement for most substances on the Prohibited List [228] any coercive influence of performance-enhancement at the level of the individual athlete comes from the labeling of a substance as 'performance-enhancing' i.e. placing it on the Prohibited List. In its simplest form, the cheating comes from breaking the rule against using Prohibited Substances (or committing one of the other 10 violations), but breaking this rule does not substantially improve chances of success or remove the uncertainty of outcome. Essential elements of sport are preserved which depletes the rule of moral force.

Conclusion

Evolution happens. It is the nature of systems that have a capacity to change (from biological systems to social institutions) in response to environmental pressures. Successful performance in elite sport is reinforced and rewarded handsomely by strong external selective pressures. There are many practices throughout sport that could be described as fulfilling the choice prong in the coercion description. For example, requiring an athlete to complete a training schedule to remain part of a team. If the athlete is a professional and relies on being a member of the team to make a living, the choice to lose one's job could be seen as an unreasonable option. It is the proposal prong that establishes the wrongness of the action. Often in sport (not always) wrongness is determined by reference to the rules. Rules can and have been changed to accommodate the evolutionary change in sport such that actions that were acceptable previously, are now impermissible and vice versa. For example, a urinary caffeine concentration > 12 μg/dL was banned until 2004 when caffeine was removed from the prohibited list. It is now permissible to have any level of caffeine in the urine even if caffeine is openly being

used for performance enhancement purposes. Given the moral significance of the use of substances on the Prohibited List, caffeine was transformed from being morally impermissible, to morally permissible overnight. The super-tuck aero position and the invisible aero position in cycling were acceptable in 2020 and became unacceptable and subject to sanction in 2021. These rule changes usually tighten the constraints on the sport and are often in reaction to successful performance. Anti-doping rules differ from this general pattern as there is little evidence that performance-enhancing substance use results in successful performance and the use is not usually visible unless the anti-doping authorities themselves publicize it.

Examining anti-doping policy from the opposite perspective and putting WADA and the IOC into the role of Agent A, the coercer, raises interesting and troubling ideas about the voluntariness of adherence to anti-doping policy. The choices available to those who do not wish to sign on to the Code are extremely limited to non-Olympic (and probably financially unsustainable) arenas. Despite claims that anti-doping rules are based on health of the athletes, unfair performance enhancement, or the spirit of sport, the health and performance enhancement conditions cannot be reliably fulfilled and so these rules are based solely on an ideology of the right way to do sport that is in conflict with the practice of modern elite sport [11]. Anti-doping policy is trying to swim against the current of established evolutionary patterns throughout society and biology which may account for its lack of effectiveness [60,284] but this lack of effectiveness is not due to a coercive environment surrounding performance-enhancing substance use and sports performance.

Chapter 7

The Spirit of Sport: Elite Sport Eats Its Young

Introduction

The five justifications for anti-doping policy proposed by Simon [36] can be reduced down to the three distinct reasons for placing a substance on the Prohibited List: health harms; performance-enhancement; and spirit of sport. I have reviewed the empirical evidence for health harms and shown that anti-doping policy may be causing or allowing harm more than the substances themselves. The evidence for performance-enhancement is poor and attributions of performance-enhancement may be more closely associated with the presence of a substance on the Prohibited List rather than any biological effects. What remains is to examine the elite sport infrastructure developed around the ideology of the spirit of sport as a defensible rationale for anti-doping policy.

Anti-doping policy purportedly exists to protect athletes. It protects athletes from themselves, from the coercive pressure to perform at all costs, and from the unscrupulous ambitions of evil, exploitative influences. After all, a former WADA Director General stated "I do not suggest for one second that [doping] is an evil that will ever be expunged."[18] WADA adopts a default position of strict liability where all athletes are guilty until presumed innocent and that their voluntary participation in sport gives WADA consent to control and surveille their lives in and out of sport. Never mind that this consent bears no resemblance to the voluntary, informed consent required of ethical human subjects' research [11]. Intervention in a person's body and private sphere in the

absence of informed and voluntary consent is considered morally impermissible [285]. In order to participate in sport, athletes in the registered testing pool sign a consent form for testing that also obligates them to allow sample storage and testing for up to 10 years [286]. This 'consent' cannot be withdrawn without repercussion.

WADA demands unfettered access to private, intimate details of athletes lives [287-289] under a moral cloak of integrity, honesty, and protection. I take the position that it is morally impermissible to deliver sanctions that have such far-reaching repercussions based on an instrument that has little to no empirical support for two out of three fundamental elements (health and performance enhancement), and a third fundamental element that is arbitrary and vague (spirit of sport) and unsupported by the experiences of elite athletes. WADA has skillfully circumvented the accepted standards of evidence in most democratic societies by creating a policy that allows the governing agency carte blanche to declare anything and everything a "potential" threat, then creating a Prohibited List with no limits (substances are listed as "Including but not limited to") that places athletes, athlete support personnel, and 'other persons' (defined by WADA as "a natural person or an organization or other entity" essentially the rest of the world) in a situation where WADA can ban anything, for any reason, for everyone, at any time and they do not need to justify themselves [290,291]. Even in the face of evidence, WADA have codified that they will not accept challenges to their 'sole determination' of the classification of substances and methods as prohibited:

> *WADA's* determination of the *Prohibited Substances* and *Prohibited Methods* that will be included on the *Prohibited List*, the classification of substances into categories on the *Prohibited List*, the classification of a substance as prohibited at all times or *In-Competition* only, the classification of a substance or method as a *Specified Substance*, *Specified Method* or *Substance of Abuse* is final and shall not be subject to any challenge by an *Athlete* or other *Person* including, but not

> limited to, any challenge based on an argument that the substance or method was not a masking agent or did not have the potential to enhance performance, represent a health risk or violate the spirit of sport. Article 4.3.3 [3]

With little to no empirical evidence to support a Prohibited List of substances and methods based on risks to health, or real, perceived, or even possible performance enhancement, the Prohibited List, and therefore the Code rests on the spirit of sport criterion. For without the Prohibited List, we would not need an anti-doping code. This chapter will review some of the academic work related to the spirit of sport but focus more on recent reports in the popular media of elite athletes' experience to examine the practical manifestation of the spirit of sport within the elite sport experience.

The Spirit of Sport

The Code defines the spirit of sport as a value that is intrinsic to sport, and as such it is the "fundamental rationale for the world anti-doping code." In developing this fundamental criterion for determining guilt or innocence WADA have tied themselves to Olympism. This fundamental rationale reads:

> Anti-doping programs are founded on the intrinsic value of sport. This intrinsic value is often referred to as "the spirit of sport": the ethical pursuit of human excellence through the dedicated perfection of each *Athlete's* natural talents.
>
> Anti-doping programs seek to protect the health of *Athletes* and to provide the opportunity for *Athletes* to pursue human excellence without the *Use* of *Prohibited Substances* and *Methods*.
>
> Anti-doping programs seek to maintain the integrity of sport in terms of respect for rules, other competitors, fair competition, a level playing field, and the value of clean sport to the world.
>
> The spirit of sport is the celebration of the human spirit, body and mind. It is the essence of Olympism and is reflected in the values we find in and through sport, including:

- Health
- Ethics, fair play and honesty
- *Athletes'* rights as set forth in the *Code*
- Excellence in performance
- Character and *Education*
- Fun and joy
- Teamwork
- Dedication and commitment
- Respect for rules and laws
- Respect for self and other *Participant*s
- Courage
- Community and solidarity

The spirit of sport is expressed in how we play true.

Doping is fundamentally contrary to the spirit of sport. [3]

While WADA use terms like "intrinsic" and "fundamental" to imply that this amorphous spirit of sport has always imbued sport since the dawn of time, the construction of the spirit of sport is the creation of a very young WADA [292,293]. While health and performance enhancement can be objectively measured (although these data seem to be ignored), the spirit of sport criterion serves as a catch-all for substances that simply offend the sensibilities of WADA and the IOC [292,293] enabling the 'mission creep' of WADA into social policy [139,294] and a moral emphasis on the character of an athlete [6]. The Olympism that the spirit of sport is based on is also a recent concept originally developed by an aristocrat to define his particular brand of elitism that sought to exclude the working class masses so that "athleticism … remained pure and magnificent" [6]. It is rather paradoxical that substance use was rife, expected, and accepted throughout the early history of the Olympic movement yet Olympism is now central in the justification for

banning substance use. At the same time, the concept of amateurism that was central to the introduction of the modern Olympic movement has been discarded as an outdated and unsustainable ideal.

In academic circles the spirit of sport has been criticized as vague [295] and ideological [11], and also lauded as an ideal that all involved in sport should strive for, regardless of the level [296]. The vagueness of the concept is treated as both useful [296] and unethical [297] since any action can be deemed a violation of the spirit of sport if there are no objective, measurable delimiters creating a situation where athletes are playing by unknown rules (itself contrary to the very concept of games). Sanctions are severe and can end a competitive or a professional career. The collateral damage of the 'war on doping' is antithetical to the warm and fuzzy ideals of the spirit of sport [101]. Athletes are swept into the morally deviant category of cheater even if they used a substance that is legally available and demonstrably ergolytic [298,299].

Under the Code, athletes do not have the right to privacy when it is balanced against the interests of sport and the declared right of other athletes to 'clean' sport. The invasiveness of the whereabouts rules and the sample collection process itself place athletes in a unique class of individuals who are assumed to be guilty by default and must prove their innocence, often by revealing intimate details of their private lives [288,289]. The right to privacy is extensively protected by different laws at many different levels including personal, medical, financial, information, and consumer privacy. Respect for dignity, individual autonomy, and independence is essential to being human and central to concepts of privacy [300]. While some aspects of privacy are given up to serve social or legal demands, for example, providing personal or contact information prior to air travel for security purposes or targeted online advertising based on browser history there is

often a degree of choice involved in these activities. A traveler may choose a different method of travel, or a different airline and internet users have the ability to use software to eliminate online tracking. Requiring pilots to provide routine drug and alcohol tests prior to flying is in the interests of public safety [300]. In elite sport the requirement to give up the right to privacy, however it is defined, is absolute and non-negotiable. This requirement is said to be in the interests of sport, 'clean' sport, or 'clean' athletes. It might be argued that athletes consent to this intrusion into their private sphere but with no other choices this consent veers into coercion and so might be considered void [301].

While the right to privacy is a more expansive issue than can be dealt with here, a cursory assessment of the practical execution of the Code and spirit of sport language suggests conflict. The required intrusions into athletes' private spheres, especially their bodily sphere, and disregard for their right to privacy needed to execute the Code are contradictory to the twice stated ideal of "respect" (for rules, laws, self, and others). Anti-doping authorities have little to no respect for the fundamental human right to privacy. "Athletes rights as set forth in the Code" are procedural rights. Elite sport demands access to athletes' private spheres in a way that has become normalized and expected. While urine drug screens are common in employment and military settings, rarely is sample provision required to be witnessed and rarely are individuals required to provide extensive whereabouts information so that these samples may be obtained without notice in the individual's private spaces. Giving up the right to privacy is the cost of elite sport however, when athletes and governing bodies state that giving up the right to privacy is worth it for 'clean sport' it ignores the data that show that doping in elite sport is more common than not [59,60]. This raises the question of whether the loss of privacy is morally permissible if the outcomes are already not being achieved despite intrusions?

The challenge for anti-doping authorities is to balance the morally significant right to privacy, dignity, and individual autonomy with the excesses of elite sport and potential for abuse of vulnerable athletes. At present anti-doping authorities are failing athletes with their disregard for privacy and dignity.

The vague description of the spirit of sport circles back on the other criteria used to justify banning a substance - health, and performance enhancement. There is a tension between health, the limits of human physiology and athletic performance, and the 'natural talents' called for by the spirit of sport that do not coexist well [302]. As Savulescu *et al.* [52] succinctly state, "[p]erformance enhancement is not against the spirit of sport; it is the spirit of sport. To choose to be better is to be human." Character, fun, joy, courage, and other abstract qualifiers of the spirit of sport are admirable values for sport and life in general, but they are not required to produce an elite athletic performance. They are not fundamental or intrinsic to elite performance. An athlete can be an elite performer and take no pleasure in his sport [303]. Does this mean he is halfway to an anti-doping violation? The circular connections of the policy and the spirit of sport are further demonstrated when testing and sanctions are considered. The Prohibited List itself imbues substances with the label of performance enhancer and provides a guide to athletes of which substance to take; the intrusive testing and surveillance encourages more deceptive (and potentially more dangerous) behaviors; and the severity of the sanctions encourages athletes to lie about their use [34,249,304,305]. Paradoxically, anti-doping policy instigates the very immoral behavior it claims to prevent, then harshly sanctions individuals for these behaviors.

Anti-doping rules and rhetoric that hyperbolize cheating and moral deviance have turned elite sport into a farce. Is it the doping itself that is leaving a sour taste in our

mouths or is it the profoundly negative, destructive excesses of the anti-doping machinery that is destroying the integrity of sport [306]? Extraordinary performances are questioned [307] and the pall of illegitimate means hangs over all wins [308]. An undercurrent of accusation runs through elite sport, sometimes resulting in police action spurred by an 'informant' [309]. Fans are unable to invest in a winner because that athlete may not be the winner in subsequent months or years despite being the fastest or strongest on the day. Despite recommendations to discard the spirit of sport criterion from revisions to the Code, it has persisted. Loland and McNamee [310] argue that the spirit of sport should be the only criterion for anti-doping policy because harm to health and performance enhancement are too crude measures to adequately interpret the multitude of situations in sport. Indeed, they claim that "a reliance on medical or scientifically based criteria is fundamentally flawed" because the Prohibited List committee does not publish the reasons for placing a substance or method on the list [310]. This distorted view of data serves a useful purpose of justifying the continued existence and centrality of a spirit of sport ideology that is pervasive and destructive [11]. In describing one of their objections to doping in sport, Loland and McNamee [310] state "pharmacologically enhanced performance is not a genuine expression of the performer, but of an expert system beyond" and fail to recognize that this is a description of the complex nature of delivering elite performance. Elite performance *is* the expression of the expert system beyond.

Elite Sport Eats Its Young

Modern, elite sport, good or bad, eats its young. Abusive and coercive practices are common and accepted. The athletes themselves are unimportant players in a vast commercial enterprise; afterthoughts that are used and abused to fuel the juggernaut of

international sports spectatorship. Elite sport is dependent on money, not the spirit of sport. Athletes are commodified and coerced to support the industry of elite sport:

> You are in the business of... finding the latest and the greatest athletes, extracting the best performance out of them, and then going back to the trough to look for the latest and greatest athletes and doing it over again, time and time again. Apolo Ohno, short track skater
>
> [I] think the system is set up for high turnover, one, and two, the manner in which the funds and services are distributed are incentivized. So if you're a federation that can win medals, you get funding; if you're not, you get cut, not just the federation's funding but also the salaries and the coaching, so it's hard, I think, for those people, then, to see the athletes as individuals. Katie Uhlaender, skeleton, both from *The Weight of Gold* [311]

Despite this seedy underbelly, there is no doubt that the values identified as contributing to a "spirit of sport" (for example, teamwork, fair play, dedication, commitment) are worthy ideals for youth and recreational sports participants. Olympic and other elite athletes almost always begin in youth sports with a love of the sport and a reverence for the Olympic story:

> I'd always watch the Olympics with my parents, like, "Wow, this is the highest level there is." That's how my mom explained it to me. My parents, my mom and my dad, had sat me down. They're like, "This is...It doesn't get "any higher than this. "This is the Olympics. That's it. "These athletes have worked their entire lives "for this moment, "and that's why they go to the greatest lengths to try and win." I just remember being awestruck by that. Shaun White, snowboarder in *The Weight of Gold* [311]

As an athlete improves and moves up the rankings, the treatment of an athlete begins to evolve. The love of sport, always in the background, begins to be supplanted by external pressures that force intolerable choices that drift closer and closer to morally impermissible coercion with clear threats and restrictions of freedoms:

> 2008, when my father was diagnosed with cancer and I went on tour... Which for skeleton, when we go on tour, it's six months. You are on the road from October until April. My dad understood, and he told me to go compete while he was sick. But I got these emails from my mom saying he was not doing well; like, I needed to come home. I, like, turned to my coach every time, and I said, "I think I might need to go home," and he said, "We can't." And I said, "Why?" And he goes, "'Cause you're the only one we have. We need you to make... To get medals." So the first time, I kind of, like, didn't respond, but then when I got the second email from my mom saying he wasn't gonna make it... [sniffles] I asked again. [breathing raggedly] And he gave me the same answer. And... it's really difficult in that situation, 'cause I love the sport, my father understood, but I wanted to go home, and it was just becoming so difficult to try to convince myself and them that I wanted to go, but... when he... he did pass away while I was competing, and... I don't think that I ever got over that. Katie Uhlender, skeleton, in *The Weight of Gold* [311]

Many point to the financial rewards of being an elite athlete or Olympian. Gracie Gold, a U.S. Olympic figure skater summed up the falsity of this notion quite succinctly "[t]he whole thought that going to the Olympics, and especially if you win a medal, sets you up for life is such horseshit" [311]. There is substantial pressure for excellence in performance with respect to allocation of rewards and resources to athletes who outperform their competition and withholding or withdrawal of support for subpar performance. Only the top performance is rewarded and as soon as performance slips, there are others to take the athlete's place. The glory of gold does not translate into financial security for many athletes and the warm attention during the games quickly fades away:

> "In that 2002 Olympic 500-meter final in men's long track, the difference between gold medal, recognized, celebrated, and fourth place is this difference. [claps twice rapidly] Four guys just went by in that time frame, and you worked an entire lifetime for that. The difference is, the guy who won, we celebrate; we look to; we love. The guy in fourth, you never hear from that person. He disappears.

> He dissipates. He becomes a civilian. It's gold and then what? … You are in the business of... finding the latest and the greatest athletes, extracting the best performance out of them, and then going back to the trough to look for the latest and greatest athletes and doing it over again, time and time again. … Let's only talk about Olympic athletes from the United States. How many golds do you have? Because if you're silver, you're not making money. You're bronze, you're not making money. You didn't medal? I don't even know your name, pal. Go back to the end of the line, okay? Out of the gold medals, how many of those are actually being concentrated on by corporate America to be hired by speaking engagements or sponsorships? You got such a small amount of people who are actually making money, and that moneymaking opportunity has a life cycle... I would say on average, unless your family is funding you throughout this process, which many do, you are in debt every single year you compete, even with the amount that you make. Apolo Ohno, short track skating in *The Weight of Gold* [311]

If Olympism is the essence of sport the movement cannot only claim the positive outcomes from participation in sport and the Olympic Games. It must also own the side effects of the pressure and scrutiny on young adults who have focused on the one event to the exclusion of everything else:

> You think and you operate as if everything revolves around this sole focus, and that sole focus is the Olympics. Everything else is secondary, so your relationships, your school, your family, your other friends, everything that's not catered to you performing at the highest level in sport, it's a nonstarter conversation. Apolo Ohno, short track skating in *The Weight of Gold* [311]

Once at the Olympic Games the unrelenting pressure faced by athletes in service of the Olympic ideal metastasizes into abuse and shame if the performances expected are not delivered:

> I was running the best races of my life, the best times of my life. And I hit one hurdle, and it cost me the Olympic gold medal. In my life, I've probably hit a hurdle three times. I'm talking about training, races, practices. And now I'm known as a girl who hits hurdles. I got ripped across the media, like, "Oh, she had all these sponsors. How could she not medal?" Like, "She's such a freaking flop." It

> was so overwhelming, and I had no one to talk to. I would be washing dishes, like, months later, and I'd think about it, and I'd literally be frozen, like, "What could I have done differently?" I'd be walking in the grocery store, day's going fine, and then someone would come up to me: "Oh, I feel so bad for what happened." Could you imagine? Like, let's say you get a divorce and then everywhere you go in public, someone's like, "Oh, I feel so bad for you. I heard you got that divorce." Happened so many times, and I had no one to help me through that. Lolo Jones, 100 m hurdles, in *The Weight of Gold* [311]

Elite performance, particularly at the Olympic Games, creates a pressure that seems to be in direct contradiction to the values so cherished by Olympism or indeed the spirit of sport. There is a vast gulf between what the IOC and WADA think sport is or should be, and the reality of elite sport. Arguably, the life of an elite athlete is not one of fun or joy. The lack of fun and joy is even embedded in the language and strategy surrounding sport. We talk of “grinding the opponent down,” “turning the screw,” and “putting down the hammer” as athletes and coaching staff deliberately use differences in physiology to remove the competition from contention. In elite men’s road cycling Team Sky, the US Postal Service Team, and Team Lotto Jumbo were well known for deliberately setting a pace at certain points of the race with the deliberate intent of creating physiologically unsustainable requirements for teams with less powerful cyclists. This strategy is often used on steep climbs, towards the end of a stage when the group is fatigued and would reduce the size of the group that would compete for the stage wins. Creating persistent physiological extremes, which are also extremely unpleasant, is strategically advantageous, not fun or joyful. In these scenarios, athletes become tools within an overall strategy for improving the odds of returning a win (whether that win is a competitive win, increased sponsor exposure, or strategic maneuvering within a larger competitive context). The athletes’ have a specific function to fulfil, their enjoyment of the process is unimportant.

Athletes who dare to stray from the story they have been allocated are excoriated and their downfall becomes the sport. Elite downhill skier Bode Miller described how the media originally created a narrative of success and quirky youthful rebellion when he was achieving success, then rapidly turned on him in a subsequent Olympic cycle when the only difference in circumstances was poor performances on the ski slopes:

> Mainstream media, especially in America but really everywhere, they love that feeling of building somebody up because that gives them control over the situation. You know, they pump them up, pump up expectations, and then it's good news, it's good content if they can chop their legs out from under them and see a hero come crashing down. It's good for everybody's ego. Everybody likes to read about that stuff. And then to build them back up, then you have this underdog, the hero reborn. There's just a lot of natural flow to that pattern. I've gone through it enough times to know what it looks like from the inside. In '05 when I won the overall, I was the golden boy, and even though I was rebellious and they knew my patterns, they knew all my stuff... Wasn't like I wasn't having fun or partying or going out... They sort of covered it up and made it so they could refine the picture of the hero on the top, and then they were setting it up so that if I did well, they'd have something else in the Olympics, and instead, I didn't do as well as I could've, and they cut the legs out. Failing to do well in races always sucks. I mean, it was my life, and I had a huge opportunity there, and, you know, that just is annoying from a personal standpoint. I think every athlete would relate to that.
>
> It was painful to see my family's reaction to it, what they had to go through. I think that's what hurt the most was seeing my image tarnished in their eyes, that I shouldn't be allowed back in the country, that I was, you know, the most disgraceful Olympic athlete ever in the history of the world. [laughs] Your Q rating is where they tell 1,000 people your name. Do they recognize the name? Do they have a favorable or an unfavorable opinion of your brand or your name? My Q rating was lower than Mike Tyson, who had... Bit off Holyfield's ear or O.J. Simpson, who at the time had a double murder and ran. Bode Miller, skier, in *The Weight of Gold* [311]

The limelight of elite sport is sweet and harsh at the same time. It is also extremely short-lived. Actions that would normally be considered abusive are widespread and accepted simply for the chance to be an elite athlete. Athletes describe the production of elite sportspeople as factory-like operation with a constant need for new faces and stories:

> When you're a younger athlete, they love you. You're the new, fresh face. They want to promote you. They want to put you out there. They want everybody to fall in love with you. But after you've been to a few Olympics, you know, you'll see, it kind of weans out. It's so funny, because... [laughs] The longer you're here, you just... you're like, "Oh, that's my replacement." "We got Sydney McLaughlin: "19 years old, marketable. "Social media's on fire. "And, Lolo, that's your exit. Please go right." Motherfucker. [laughter] Lolo Jones, 100 m hurdles and bobsled, in *The Weight of Gold* [311]

While new faces and stories feed the media's need for fresh content, performance outcomes are the currency of elite sport. If an athlete is performing well, the support structures remain in place, but as soon as performance starts to decline the support is withdrawn, often to the detriment of the athlete:

> It's almost like a conveyor belt of athletes, that, like, you're doing really well, you're doing really well, they keep you healthy, but, like, when you're done, you're off the conveyor belt. Like, that's... they just have new athletes from every sport coming in all the time. Gracie Gold, figure skater, in *The Weight of Gold* [311]

Elite athletes in smaller sports may face the pressure of producing performances to not only support their own status as an elite athlete but the livelihoods of an ever-widening pool of support staff and development athletes:

> USA bobsled and the U.S. Olympic Committee came to me, and it was like, "Hey, look, you've never actually won "any sort of medal in bobsledding yet. "You're USA-1; you're our top driver "going into this next season. "We really need you to do well. If not, like, we just can't support you." All of a sudden now the entire

> weight of... the program is on my shoulders. I'd better do well. Steven Holcomb, bobsled, in *The Weight of Gold* [311]

Outside of the Olympic sphere, elite athletes are becoming increasingly open about the reasons for taking a break [312,313] or retiring permanently from elite sport [314]. Marcel Kittel retired from elite men's road cycling while still at the height of his career, choosing to terminate a lucrative contract early rather than continue. He stated, "I have lost all motivation to continue to torture myself on the bike." While this may be a tongue in cheek description, Kittel further referenced "permanent fatigue" and questioned his quality of life as an elite athlete:

> The biggest question of the last few months was: Can I and do I want to continue to make the sacrifices needed to be a world-class athlete? And my answer is: No, I do not want that any more, because I have always found the limitations on a top athlete as an increasing loss of quality of life [314].

Kittel's decision to withdraw from two races before terminating his professional contract early points to a desperation to be done with the "permanent fatigue" of a professional rider and seek out other life experiences that he missed due to the demands of his sport. Grand tour winner Tom Dumoulin left a training camp in January 2021 to take an indefinite leave of absence from cycling citing the pressure of cycling and expectations of different parties. Of note, this announcement came only one week after Dumoulin gave interviews where he spoke of his "excitement" about the upcoming cobbled classics season "We're going to ride the cobbles, which will be fun" [313]. Similar to Kittel, the sequence of events and timing suggests these athletes were at breaking point when they chose to break professional contracts to step away from their sport.

In the world of professional tennis, the number one ranked female tennis player, Naomi Osaka, drew headlines when she announced that she would be eschewing her

contractually obligated post-match press conferences at the 2021 French Open. True to her word Osaka did not appear at the press conference after her first-round win. The tournament responded with a fine and threat of further fines and sanctions from the other grand slam tournaments. News outlets criticized the athlete as a "snowflake" asking "how could an athlete be tough enough to win major championships and yet be intimidated by a roomful of reporters [315]?" Of course, the answer to that question is simple, Osaka is skilled at the game of tennis, not the game of press conferences. Osaka responded by withdrawing from the tournament. She later wrote a piece for Time Magazine addressing the stress and anxiety she experienced while speaking to the press, a consequence of her shy and "introverted" nature. Osaka raised the excellent point of workplace leave policies (which seem to be absent in tennis) and the pressure she felt to disclose personal medical information (something that would not be required in most workplaces) to the world in order to justify her need for leave:

> In any other line of work, you would be forgiven for taking a personal day here and there, so long as it's not habitual. You wouldn't have to divulge your most personal symptoms to your employer; there would likely be HR measures protecting at least some level of privacy.
>
> In my case, I felt under a great amount of pressure to disclose my symptoms—frankly because the press and the tournament did not believe me. I do not wish that on anyone and hope that we can enact measures to protect athletes, especially the fragile ones. I also do not want to have to engage in a scrutiny of my personal medical history ever again." [312]

It is the characterization of her sport as a workplace that is a critical point here. Elite athletes, especially professional elite athletes, are performing their activities in a workplace. Elite sport is an industry [316] that carries the external presumption that intrusion into personal and professional spaces is an expected, and noble sacrifice for the spirit of the industry.

The industry of elite sport has long protected sexual predators in both elite women's cycling [317] [317,318] [318] and artistic gymnastics [319]. Elite women's gymnastics has been a breeding ground of physical and emotional abuse of children and adolescents around the world [319-322] with that abuse causing lasting damage and affecting performance [323] yet these abusive practices were legitimized and accepted as the cost of being an elite gymnast. The pressures on elite gymnasts are extraordinary. Simone Biles, widely acknowledged as the greatest gymnast ever, was asked shortly before the Tokyo Olympic Games, to name the happiest moment of her career. Her response was "[h]onestly, probably my time off" [324]. She then withdrew from the Olympic team all-around competition citing her mental state from pressure to win leading to a fear she might injure herself performing some of the extraordinarily difficult and risky skills she is known for [325]. Elite cyclists are lauded for competing with broken bones and race on increasingly dangerous courses [326]. A young British wild-card entry to the Wimbledon tennis championship, Emma Raducanu, withdrew from her fourth-round match after the pressure to perform in a prime-time match on a show court filled with thousands of fans elicited physical symptoms and she was unable to continue safely. Raducanu commented that "[b]efore Wimbledon, … the biggest crowd she had played before was 'maybe a hundred' people" [327]. Prior to the match the British media predicted the 18-year-old, who had never played in front of more than a hundred fans, would be a top earner in women's tennis somewhat placing the cart before the horse and adding to the pressure:

> To heap that on an 18-year-old girl's shoulders is entirely unhelpful to her development as a human being. Because basically what you're doing is setting the bar so high that anything other than being a multiple Grand Slam champion is constituted as a failure" Mark Petchey, coach and former British tennis player, quoted in The New York Times [327]

The ideals of the spirit of sport are indeed noble. They are also childish and unrealistic when applied to a high-pressure commercial enterprise. Holding elite athletes to the expectations we have for a five-year-old playing a game of soccer does a disservice to the experience of these athletes, is disrespectful of their place within the industry, and provides shelter for abusive and coercive practices. For our five-year-old soccer player we simply hope they dribble the soccer ball towards the correct goal, for an elite athlete the stakes are much higher. Protecting a system that places the athletes whose efforts ensure the existence of the sports industry last is morally questionable.

Elite sport is sport on steroids and the spirit of sport is caught up in an irrational "'roid rage". Sport itself is not good or evil, sport itself does not create the significant pressures just discussed, pressures which gain in intensity the higher an athlete rises in level from recreational to elite performance. It is the systems and structures around sport that survive and thrive on the performances and stories of the athletes that create what has been described as "a petri dish for abuse" [321]. Anti-doping itself is a system that needs athletes for its very existence. If the Prohibited List did not exist, athletes would not be doping and then WADA would be unnecessary. Athletes are expendable and guilty until proven innocent while it seems that there have been too many instances where coaches and administrators who perpetuate abuse are protected at the expense of the athletes.

Conclusion

At the end of the day anti-doping policy in elite sport is here to stay. There is too much money tied up in the movement and too much moral panic and indignation for it to go away despite ethical concerns related to abuse, privacy, consent, and autonomy. Without a fundamental repositioning of the view of elite sport in society, athletes will continue to reap the harms of anti-doping policy. Trying to mold elite sport into the

model of youth sport is causing significant harm to athletes and sport itself. The spirit of sport has been deified and weaponized to the extent that this artificially constructed ideology is more important than the health and wellbeing of human beings. Livelihoods, reputations, and mental, physical, and emotional health are all sacrificed on the altar of the spirit of sport and real people are dying or being irreparably harmed. Anti-doping ideology is the greatest threat to the health of athletes, the integrity of sport, and any semblance of a real spirit of sport.

Chapter 8

Clothing the Emperor: An Evidence-Based Policy for Safe Sport

Introduction

The World Anti-Doping Agency and the Olympic movement are both private, non-governmental organizations that have extraordinary reach into the private spheres of a vast swathe of individuals. Few have had input into the sweeping rules that have the potential to define lives and livelihoods. The Prohibited List is at the heart of the Code. Without a Prohibited List, the Code and WADA as it currently exists would be unnecessary. The invasiveness of actions and severity of sanctions taken in the name of the Code (and thus the Prohibited List) heighten the need for critical examination of the evidence for items on the Prohibited List. Further, the Prohibited List is not a finite document. The language "including, but not limited to" allows WADA to sanction an individual for using a substance that is not on the list. Sport is a rule-governed activity. Athletes accept the rules to play the sport. But how can athletes be expected to play the 'anti-doping sport' if the rules are hidden, ever changing, and whimsical? It seems unethical to engage in a high-profile game of 'gotcha' when the balance of power is so unbalanced. T.J. Dillashaw upon his return to MMA fighting after a two-year suspension for EPO use [328] commented that the US Anti-Doping Agency (USADA) had retested every sample he had ever provided in the wake of his positive EPO test: "That's like USADA's weapon to use against you, to really slander you so no one else wants to do this shit" [329]. Another MMA fighter described the impact a positive test and subsequent sanction for a substance that is a known contaminant in supplements [330] "[f]uck man. This hurt me, my

family, my career. It was a life changing event and it means jack shit to the assholes running things" [331]. Regardless of balances of power, the policy and much of the philosophical literature relating to the policy make the critical error of blindly accepting the claims of both performance enhancement and health harms without critically examining the evidence to determine if these assumptions are true. In doing this, judgements and sanctions with very real impacts are delivered based on anecdote, disparate experiences, and hearsay, all of which are considered the poorest quality of evidence. Unquestioning acceptance of assumptions to support a policy that imposes harsh, life-changing sanctions is lazy and unethical. While it is not the job of philosophers and policy makers to perform the empirical work, it *is* their job to know the evidence that underlies the philosophy and policy, and it is here where the failures lie.

What is curious about the use of performance-enhancing substances in elite sport is that while the issue is highly visible due to widely reported anti-doping infractions, the use itself has been driven underground by the emphasis on the moral impermissibility of using performance-enhancing substances. A subtext to the coercion argument is the idea that were doping to be legalized athletes would be open and flagrant in their drug use, much like Chris Froome using an asthma inhaler during the 2015 Dauphine, and that performance-enhancing substance use would happen in the absence of medical guidance and would promote the use of substances that are not approved for human use. Research shows that elite athletes are accepting of the use of performance enhancing substances in light of the commercial pressures to perform and sacrifices already made. They understand the reality and demands of their profession more so than sub-elite athletes [332]. However, in contrast to popular lore [148,280], elite athletes do not have a significant tolerance for adverse health effects [282] in exchange for glory.

Legalizing the use of currently banned performance-enhancing substances would likely increase the use of medical guidance and reduce the reliance on substances that are not approved for human use, and may reduce the use of masking substances, substances that treat the misuse of performance-enhancing substances, and substances that are not performance-enhancing. While there are always outliers it is likely that market forces and social mores would shape the openness of performance-enhancing substance use. These conditions would expand the safe choices available to athletes rather than restricting them. Sports governance has the infrastructure and reach to transform the practice of sport at all levels into a safe and ethical activity where athlete health and wellbeing is at the forefront of policy and practice.

Health, Performance, and the Spirit of Sport

Training for elite performance is not a healthy activity. The volume and intensity of training required to reach the limits of an individuals' physiological and psychological capabilities is often grueling and torturous. Outside of sport-related injuries that are part of the voluntary acceptance of risks in sport, elite athletes often walk a fine line between health and wellbeing and ill-health and ill-being. The negative effects of elite training and performance on health and wellbeing are transient and former elite athletes are healthier and longer lived than their peers. Overall, sport at all levels is beneficial to health, with some health benefits only being realized after retirement from high-level competition.

Athletic performance has improved dramatically over the last century. Increased scientific knowledge related to training and recovery methods, greater understanding of human physiology, and technological advancements have combined to bring humans to the brink of physiological limitations in human performance. Many advancements in performance have been in response to rule changes and many rule changes have

occurred in response to advancements in performance; physiology has not changed in the short time that modern elite performance has been evolving. The dynamic interaction between rules and constraints and innovations in training, technology, and performance are inextricable. Performance is incredibly complex. The use of performance-enhancing substances (either allowed or prohibited) has potentially contributed to some advancements in performance, although the there is little support for this hypothesis in the data. However, it is largely unknown whether performance enhancement arises due to a biological (peripheral) action of a substance, or if performance enhancement arises due to central mechanisms that are not directly related to the biological actions of the substance. The understanding of mechanisms of action and efficacy of supposed performance-enhancing substances is profoundly lacking. This lack of knowledge may contribute to profligate use of substances that do not contribute directly to performance.

The spirit of sport ideology serves as a convenient catch-all basis for anti-doping policy that has a weak foundation in evidence. While noble and idealistic, the spirit of sport ideology captures elite athletes between an outdated notion of what sport should be and how sport should be done, and the current practice of elite sport as a high-pressure, commercialized industry. Holding elite practitioners to a standard more suited to corralling a gaggle of five-year-olds into a human pyramid places elite athletes in an untenable position. These athletes have been youth participants themselves; the values of youth sport have already been absorbed by these athletes. Elite athletes do not suddenly become devoid of respect for others and dedication simply because they are elite performers. Sport itself is not morally deviant, it is the structures and pressures surrounding elite sport that propagate morally impermissible acts. There are enough bad

experiences and abusive practices reported by elite (and non-elite) athletes to support the contention that the spirit of sport and elite sport are diametrically opposed.

A New Way Forward: Evidence-Based Policy for Safe Sport

There are several potential agents involved in the dissemination of knowledge and care to an athletic patient: the healthcare provider that works directly with the patient; medical regulatory bodies that adjudicate malpractice and negligence; international federations that adhere to the Code; and WADA itself. Policy development related to health and medicine should be evidence based but is often complicated by political goals that may have little relationship to science and evidence [333]. The lack of knowledge of real health or performance effects of substances on the Prohibited List in a highly trained or elite athlete model suggests that WADA policy is not evidence based but is anchored in political and ideological goals [11]. With this ideology comes intrusions into private spheres, judgment and exclusion without reasonable cause, and a progressive chipping away at the rights of athletes as humans first and athletes second. WADA claims that athlete health is a priority, however this has only been achieved superficially by changing the order of items in the spirit of sport definition to place 'health' at the top, and by adding 'health' to the preamble to the list. There are no practical changes to the revised 2021 Code that prioritize athlete health.

As recent events in elite sport have demonstrated [312-314,320-322], athlete health encompasses more than doping. Athletes who are training for elite competition, whether they are at the elite level yet or not, are particularly vulnerable to abuse and exploitation. Athletes who are not in the elite ranks (fitness enthusiasts, recreational athletes) are also denied access to harm reduction healthcare related to performance-enhancing substances even though they do not receive the education required of the registered

testing pool elite athletes and may be more apt to turn to black market products because the threat of testing and sanction is minimal. While anti-doping policy purportedly protects the tiny population of 'clean' elite athletes (who are a minority even within elite sport), it disproportionately effects health harms in a wider public health context. There is evidence that elite athletes have little tolerance for health harms [282], but are realistic about the demands for performance within the sphere of commercialized, professional sport [332]. These data suggest that the most effective way to deter use of a substance is to demonstrate that it has no effect or a negative effect on performance. Here WADA fails on two counts: insisting that medical personnel play no role in the provision and supervision of use of pharmaceutical products listed on the Prohibited List; and actively discouraging objective research into whether Prohibited List substances have any performance-enhancing effects. A revised approach to athlete health and wellbeing, and knowledge acquisition could reduce harms, protect athletes across the participation spectrum, and contribute to scientific and medical advancement for the benefit of all humans. To begin to achieve these goals, I propose the following:

(1) Regulations for pharmaceutical aids for training and performance should be developed by the individual sports in consultation with athletes, medical professionals, and exercise physiologists. These regulations should be developed to consider the physiological and psychological health and wellbeing of the athlete and should evolve as sport, technology, and knowledge evolves.

(2) The medical and allied health community should actively engage in developing educational material and continuing medical education related to the effects of performance-enhancing substances on the physiology of exercise,

performance, and recovery, and the interactions of intense exercise with the pharmacokinetics and pharmacodynamics of the product. Evidence-based guidelines for prescription and monitoring should be developed by scientific and medical bodies independent of sports governance. More peer-reviewed, placebo-controlled research studies, free from the negative stereotyping of performance-enhancing substance use in training and performance are needed to support these aims. Unfortunately, the present WADA regulations preclude the inclusion of athletes subject to testing (these may not be elite athletes [100-102]) in subject cohorts limiting the scope and applicability of current research.

(3) Physicians who have completed specialist training should be free to prescribe the appropriate federally regulated pharmaceutical product for the desired physiological outcome of the patient in conjunction with education about adverse effects of overuse or abuse. Prescription guidelines already in place govern the appropriateness of the individual drug prescribed and the type of monitoring the physician requires for continued prescription of the drug. For example, a physician may prescribe an AAS for a month but require the patient to return to the physician for hemodynamic, renal, and liver function tests, a psychological inventory, and assessment of dosage each month for continued prescription (i.e., the prescription won't be renewed without a repeat physician visit). The educated physician is best placed to determine which tests to perform to ensure the health of the individual patient, and the length of prescription they are prepared to prescribe. At the very least, health problems arising from polypharmacy, black-market products, or abusive practices may be detected earlier. The same holds true for substances that are injected. The

patient visits the lab to receive their injection from a qualified healthcare provider who also has the opportunity to monitor injection site reactions.

(4) Pharmacy databases can be used to track usage and determine if abuse and 'physician shopping' is occurring similar to the monitoring already in place for opioid painkillers and sales of ephedrine containing products. While imperfect, these databases at least provide information about prescription and use trends and abuse.

(5) Robust adverse event reporting mechanisms for prescription medicines and dietary supplements are already in use. These databases also assist in the quality control monitoring of the global supply chain. Additional categories specifically related to athletic participation could be added to these databases. While not high quality, placebo-controlled data, these types of data can add to the knowledge base of performance effects of substances.

(6) The Anti-Doping Administration and Management Software (ADAMS) currently used by WADA could be redirected to manage health certifications. This same system could be co-opted so that physicians could log in and clear their patient for competition with the appropriate expiration on that clearance. For example, if a physician required a patient to return monthly for monitoring and a repeat prescription, the clearance to compete would be valid for a month. If the monitoring requirement is quarterly, then the expiration for clearance to compete would similarly be quarterly. Sanctioned events can require physician sign off for competitors in compliance with risk management advice received from legal counsel. Each event may choose whether or not to allow participants to compete without medical clearance with extensive

waivers of liability in place above and beyond those typically signed by entrants. There is no need for sports governance to know the details of an athlete's medical history, only whether the athlete is 'safe for sport.' This type of database may also allow detection of physicians with poor outcomes and circumvent 'doctor shopping' and aid in the identification of abusive practices in sport.

(7) Just as a physician is able to refuse specific medical services in order to comply with their own personal interpretation of ethics (for example, abortions), the physician would also be able to refuse these prescription and monitoring services if their own personal ethics did not agree and the patient could seek this treatment from a different medical provider.

(8) Medical professionals who cause harm to their patient through negligence or corruption would be subject to the established procedures and sanctions by the medical community.

(9) Just as medical records related to illness and disabilities are confidential, the medical records related to prescriptions and monitoring of pharmaceuticals related to training and performance would also be confidential. There is no need for sporting authorities to know these details, and indeed the sporting authority does not have the expertise to assess this information. The only requirement would be the clearance from the physician who has the education and expertise, and the one-on-one physician-patient relationship to assess the available information and provide or withhold clearance.

(10) Limited in-competition testing should continue, however, the drugs that are banned in competition should be determined by the individual sporting organizations in consultation with the major stakeholders (i.e. athletes) and

the focus should shift towards banning drugs that can compromise the safety of the athlete and others during competition, and testing technology that provides immediate results with a low rate of false positives so that impaired athletes can be removed from the competition. The UCI has recently taken this step by banning tramadol in-competition after WADA refused to move this drug from the monitoring list to the banned list (WADA has since announced that tramadol will be added to the Prohibited List in 2024 [334]). Tramadol is an opioid pain reliever. A side effect of tramadol is a slowing of reaction time, and the drug has been implicated in crashes. Banning tramadol use in the peloton is sensible and protects the safety of all the athletes in the peloton, particularly those who have not chosen to take the drug, but this outcome relies on preventing the cyclist from joining the peloton while impaired. While detection of tramadol can be done from a fingerprick blood sample, the test results are returned days or weeks after sample collection which erases any immediate health or safety benefits.

(11) Substances that are not approved for human use will remain prohibited by law (a Code is unnecessary here). Substances that are only available by prescription should remain behind the prescription barriers with the physician prescribing refills according to prescription guidelines and their own medical judgement of the patient. While there will always be athletes who will choose to use products on the cutting edge of biomedical innovation that are not approved for human use or have failed clinical trials, having safe, effective, approved alternatives at least gives athletes a safe choice. If athletes are able to develop a relationship with a trusted healthcare provider they may disclose

use and physicians will be better positioned to counsel and advise their patient on the dangers of non-approved products and monitor for adverse effects.

(12) Resources previously used for testing and sanction can be diverted to 'Safe Sport' programs that protect vulnerable athletes of all levels from predatory and abusive practices that can also include pressure to take substances outside of medical guidance. These resources can also be used to combat trafficking in black-market doping products and supplement adulteration and safety.

(13) Objective, unbiased, and carefully monitored investigation into the role of testosterone in athletic performance in females and the effects of AAS use in female athletes is important and warrants special attention especially when considering the historic and current vulnerability and abuse of female athletes. Females are systemically underrepresented in scientific, medical, and sport science research and female athletes are among the most vulnerable populations in sport and society. Anabolic androgenic steroids are approved for use in humans. As with any drug that is approved for human use, misuse of the drug may result in harm and females will have different dosages and monitoring requirements than males. Females can take high doses of androgens to stimulate the development of secondary sex characteristics so the health and safety of these drugs is established, but the characterization of toxic side effects will differ depending on the individual. For example, thickening of the vocal cords resulting in a deeper voice or the development of facial hair may be welcomed by one individual but considered a toxic side effect by another individual. The tolerance of side effects will determine dosages and monitoring requirements. More research is needed to determine the effects of AAS use within the female athlete physiology with attention to

reproductive and sexual health. Female athletes are uniquely vulnerable and warrant special protections. If AAS use was legalized for female athletes (with specific guidelines) rigorous systems should be established to prevent abuse, identify misconduct, and sanction individuals and institutions that exploit and harm female athletes.

Substance use for athletic performance should be allowed regardless of whether the intent is to enhance performance or to maintain quality of life. Bans serve only to drive the practice underground and create a breeding ground for unsafe and abusive practices. Appropriate evidence-based prescription and monitoring by a knowledgeable healthcare professional based on an individual's health and sport, and access to substances approved for human use and regulated supply chains can protect athletes from misuse and unsafe black-market substances. Importantly, scientists must do the work to determine whether these substances have any performance-enhancing effects beyond placebo effects. This work is only possible if governing authorities support the participation of highly trained and elite athletes in carefully controlled, double-blinded, sport-specific research studies without risk of sanction or stigma.

Conclusion

Seeking enhancement is fundamentally human and should be embraced by social institutions, with appropriate evidence-based constraints that protect health and safety while preserving dignity and quality of life. Identifying then banning an activity that is so innate to being human is bound to backfire as it has with anti-doping policy. All categories of sanctions in the Code relate back to the Prohibited List. There is little or no empirical support for the contention that substances on the Prohibited List harm health or enhance performance. Further, the lack of transparency of the process for a substance to appear

on the list [4] has the effect of endowing every substance on the list, regardless of actual biological activity, with performance enhancing qualities. There is substantial work that shows that a performance enhancing effect can be obtained from a substance that has no biological effect simply by informing the athlete that the substance will enhance their performance. The policy also prohibits the prevention of harm by medical personnel by prohibiting athlete support personnel (in this example medical professionals) from prescribing safe substances that are approved for human use in dosages and combinations that will not harm health. In this way, WADA has created and inflamed the very circumstance that they claim they are preventing. Any doping sanctions could be considered fruit of the poisonous tree although WADA rests easily on the vague language of potential harms, potential enhancement, and the wide ranging 'including but not limited to' criteria on the Prohibited List. Anti-doping policy is unethical and is the greatest threat to the health and wellbeing of elite athletes, recreational athletes, and fitness participants. A policy that accepts enhancement as fundamentally human and prioritizes the health, safety, and wellbeing of athletes is possible if the egos that have shaped anti-doping rhetoric can get out of their own way.

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