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A TOTAL BAN ON GENE DOPING: NOT THE MOST GENE-IUS IDEA

I. INTRODUCTION

Advancements in gene therapy have given rise to an ominous opportunity for athletes to engage in gene doping as they continue to find new and innovative ways to maximise their performance.¹ The practice of abusing the nascent field of gene therapy will not only have a detrimental impact on the health of athletes, but also compromise the spirit of sport and idea of fair play.² Although gene doping is dubbed the next frontier in doping in sport,³ there is widespread concern that it has already become a reality.⁴ In this paper, I argue that the current regulations set by the World Anti-Doping Agency ('WADA') which govern gene doping are ineffective due to the inherent difficulties found within detecting gene modifications. I explore various obstacles which current anti-doping practices cannot overcome by implementing a total ban on gene doping. Finally, I advance several recommendations that uphold the health and wellbeing of athletes, retain the spirit of sport and more readily reprimand those who attempt to cheat the system.

II. CONTEXT

Gene doping developed as an extension of gene therapy,⁵ which succeeded in treating several diseases such as blindness, paediatric immune deficiency and neurodegeneration.⁶ Gene therapy involves transferring genetic material in the form of a vector to the cells of a human body⁷ for the purpose of treating or preventing a disease or disorder rather than boosting the athlete's performance.⁸

Gene doping was first defined in 2003 by the List of Prohibited Substances and Methods published by the International Olympic Committee⁹ and later broadly defined by WADA as the 'non-therapeutic

¹ Theodore Friedmann, 'How Close are We to Gene Doping?' *Hastings Centre Report* 40(2) 20 – 22; Filomena Mazzeo et al, 'Development of Doping in sports: overview and analysis' (2018) 18(3) *Journal of Physical Education and Sport* 1669 – 1677;

Angela J. Schneider and Jim L. Rupert, 'Constructing Winners: The Science and Ethics of Genetically Manipulated Athletes' (2009) 36(2) *Journal of the Philosophy of Sport* 182 – 206, 182 John Ehrbar, 'Ethical Considerations in the Genetic Modification of Sport' (2015) *The Sport Journal* 2 < <https://thesportjournal.org/article/ethical-considerations-of-genetic-manipulation-in-sport/>>

² Stefania Santamaria et al, 'Gene Doping: Biomedical and Laws Aspects of Genetic Modifications of Athletes' (2013) 17(4) *Medicina Sportiva* 193 – 199, 193.

³ Filomena Mazzeo et al, above n 1; Shayna M. Sigman, 'Are We All Dopes? A Behavioral Law and Economics Approach to Legal Regulation of Doping in Sports' 19(1) *Marquette Sports Law Review* p. 125 – 208, 128; Kate Kelland, 'Genetically Modified Olympians: Could Future Athletes Cheat Without Being Detected?' *Huffington Post* (online) 7 October 2012, < https://www.huffingtonpost.com/2012/08/07/genetically-modified-athletes-olympians_n_1751952.html>.

⁴ Dominic Wells, 'Gene doping: the hype and the harm' (2008) 154 *British Journal of Pharmacology* 623 – 631.

⁵ Santamaria et al, above n 2, 193.

⁶ Friedmann, above n 1, 20.

⁷ Jack Anderson, 'Doping, sport and the law: time for repeal of prohibition?' (2013) 9(2) *International Journal of Law in Context* 135 – 149, 143.

⁸ Mazzeo et al, above n 1, 1671.

⁹ Santamaria et al, above n 4, 195.

use of cells, genes, genetic elements or modulation of gene expression, having the capacity to enhance performance'.¹⁰ As at 2019, the WADA Prohibited List defines gene doping as 'the transfer of polymers or nucleic acid analogues' and 'the use of normal or genetically modified cells'.¹¹

There are two common ways to achieve genetic modification: somatic therapy, and germline therapy.¹² The first, being somatic therapy, is incapable of being inherited by offspring,¹³ and involves cell-based treatment to alter the genetic structure of a person.¹⁴ The second, being germline therapy, is more controversial and can be hereditary,¹⁵ as it is performed on an embryo to elevate certain features, such as metabolism or physical capabilities.¹⁶

Several candidates for gene doping can be readily identified. Erythropoietin (EPO)¹⁷ can increase red blood cell production and oxygen intake, insulin-like growth factor 1 (IGF-1) can grow and repair muscles¹⁸, and peroxisome proliferator-activated receptors alpha (PPRA-alpha)¹⁹ can reduce body mass and elevate the skeletal muscle metabolic rate.²⁰

The potential to enhance an athlete's performance using genetic engineering has been demonstrated after injecting IGF-1²¹ into mice and increasing the haematocrit levels in monkeys.²² While the results

¹⁰ *Prohibited List* (20 September 2008) World Anti-Doping Agency, <<https://www.wada-ama.org/en/resources/science-medicine/prohibited-list-documents>>; Gary R. Gaffney and Robin Parisotto, 'Gene Doping: A Review of Performance-Enhancing Genetics' (2007) 54 *Pediatric Clinics of North America* 807 - 822; Mazzeo et al, above n 1, 1671.

¹¹ *Prohibited List* (1 January 2019) World Anti-Doping Agency, <<https://www.wada-ama.org/en/resources/science-medicine/prohibited-list-documents>>.

¹² Ehrbar, above n 1.

¹³ Ehrbar, above n 1.

¹⁴ Jose Trivino, 'Technologically Modified Athletes and the Challenges to Sport' in Jose Trivino, *The Challenges of Modern Sport to Ethics. From Doping to Cyborgs* (Lexington Books) 1, 103.

¹⁵ Ehrbar, above n 1; Patrick Tucker, 'Genetic ethics and "superbabies"' (2008) 42(1) *The Futurist* 18 – 19.

¹⁶ Trivino, above n 14, 103.

¹⁷ Robert Knabben, *Genetic Modification in Sports* (LLM Thesis, Tilburg University, 2013) 23 <<http://arno.uvt.nl/show.cgi?fid=128714>>; Angela J. Schneider and Thomas Friedmann, *Gene doping in sports: the science and ethics of genetically modified athletes* (Academic Press, 1st ed, 2006) 1, 38; R. S. Oliveria et al, 'The use of genes for performance enhancement: doping or therapy?' (2011) 44(12) *Brazilian Journal of Medical and Biological Research*, 1194 – 1201, 1195.

¹⁸ Kristin Jo Custer, 'From Mice to Men: Genetic Doping in International Sports' (2007) 30 *Hastings International & Comparative Law Review* 181 – 210, 186; Kevin Van Valkenburg, 'Gene Doping Looms as Next Sports Edge: Boost at Cellular Level is All but Undetectable' *The Sun* (Baltimore), 16 January 2015.

¹⁹ Trivino, above n 14, 104.

²⁰ Ewa Brzezianska et al, 'Gene Doping in Sport – Perspectives and Risks' (2014) 31(4) *Biology of Sport* 251 – 259, 256

²¹ Lara Wynn, 'The Non-Fiction of Captain America: A Legal Analysis of the Potential and Perils of Genetic Engineering in Modern Warfare' (2014) 5(1) *Journal of Biosecurity, Biosafety and Biodefense Law* 109 – 127, 119; Wells, above n 4, 63; Fabian Phillip, 'Is science killing sport? Gene therapy and its possible abuse in doping' (2007) 8(5) *EMBO Reports* 433 – 435, 433; Brzezianska et al, above n 20, 253; Lee Sweeney, 'Gene Doping' (2004) *Scientific American*, 63 – 69, 66.

²² Edward H. Jurith, 'The United States' and International Response to the Problem of Doping in Sports' (2002) 12(2) *Fordham Intellectual Property, Media and Entertainment Law Journal* p.461 – 488, 487; Gaffney, above n 10, 816.

of the animal trials may have been fruitful, it is unclear if this success will translate to humans. This is primarily because there are clear differences between the immune responses of humans and mice,²³ and the amount of vector dose required for the size of a human.²⁴

Nevertheless, the temptation to resort to gene doping spans across a wide range of sports: marathon runners can use it to boost their oxygen supply,²⁵ weight lifters can increase their muscle mass²⁶ and boxers can improve their pain tolerance.²⁷

It is therefore not surprising that unprecedented advances in gene-editing technology provide the method, opportunity and justification for athletes to resort to genetic modification.²⁸ In particular, the use of Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR), which is relatively cheap and accessible,²⁹ has already succeeded in changing a person's gene activity by editing the epigenome without altering the DNA sequence.³⁰

A. Health Risks

Several health risks may arise as a result of gene doping.³¹ For instance, an overexpression of EPO may give rise to uncontrollable haematocrit and haemoglobin levels³², which can result in excess thickening of the blood³³ and may cause strokes or heart failure.³⁴ High levels of IGF-1 can induce

²³ Dominic Wells, above n 4, 64.

²⁴ Trudy A McKanna and Helga V Toriello, 'Gene Doping: The Hype and the Harm' (2010) 57(3) *Pediatric Clinics of North America* 719 – 727, 722.

²⁵ Phillip, above n 21, 433.

²⁶ Blair Moses, 'Eligibility of Athletes Receiving Necessary Gene Therapy' (2009) 49(3) *Jurimetrics* 343 – 373, 349; H. J. Haisma and O. de Hon, 'Gene Doping' (2006) 27 *International Journal of Sports Medicine* 257 – 266, 261 – 262; Sweeney, above n 21, 69.

²⁷ Phillip, above n 21, 433; Mai M.H. Mansour and Hassan M.E. Azzazy, 'The hunt for gene dopers' (2009) 1 *Drug Test Analysis* 311- 322, 312; McKanna and Toriello, above n 24, 719–27; Sweeney, above n 21, 69; Toon van der Gronde et al, 'Gene doping: an overview and current implications for athletes' (2013) 47 *British Journal of Sports Medicine* 670 – 678, 673 – 674.

²⁸ Thomas Friedmann et al, 'Gene Doping in Sport' (2010) 327(5966) *Science* 647 – 648, 648.

²⁹ Emily Ducker, *Gene-editing technology has major implications on the future of sport* (23 April 2018) GlobalSport Matters; < <https://globalsportmatters.com/science/2018/04/23/gene-editing-implications-sports/>>.

³⁰ Michael Le Page, 'Gene doping in sport could make the Olympics fairer and safer', *New Scientist* (online), 5 August 2016 < <https://www.newscientist.com/article/2100181-gene-doping-in-sport-could-make-the-olympics-fairer-and-safer/>>; Ducker, above n 29; Sean Hall, *Olympic gene doping: How WADA is managing new performance-enhancing technologies* (13 February 2018) Genetic Literacy Project < <https://geneticliteracyproject.org/2018/02/13/olympic-gene-doping-how-wada-managing-new-performance-enhancing-technologies/>>.

³¹ Giuseppe Fischetto and Stephane Bermon, 'From Gene Engineering to Gene Modulation and Manipulation: Can We Prevent or Detect Gene Doping in Sports?' (2013) 43 *Sports Medicine* 965 – 977, 972

³² Filomena Mazzeo and Rosa Ada Volpe, 'From gene doping to athlete biological passport' (2016) 9(2) *Medicina Sportiva* 1 – 11, 4 - 5

³³ Edward H. Jurith, 'The United States' and International Response to the Problem of Doping in Sports' (2002) 12(2) *Fordham Intellectual Property, Media and Entertainment Law Journal* p.461 – 488, 487

³⁴ Wells, above n 4, 64.

muscular hypertrophy,³⁵ and hypoxia-inducible factor-1 (HIF-1) can affect iron metabolism and make the body more susceptible to cancer.³⁶

One example of an unanticipated response to gene therapy occurred when an 18 year old boy died from a severe immune reaction to the adenoviral vector used in the process of gene therapy.³⁷ In a French clinical trial, whereby gene therapy was used in an attempt to restore the immune systems of eleven boys, three contracted leukaemia and one died.³⁸

Given the illicit nature of gene doping, any methods that are currently undertaken by athletes certainly lack appropriate oversight and regulation over the procedure and production of gene doping products,³⁹ the informed consent of the athlete and the full disclosure of associated health risks.⁴⁰

B. *Ethical Issues*

Most opponents of gene doping believe that the practice is morally objectionable and provides natural athletes an unhealthy incentive to resort to genetic modification.⁴¹ Other sports ethicists argue that gene doping is contrary to the values of open and fair competition and the traditional image of ‘sport’ as a pure game for athletes.⁴²

Another ancillary concern relates to the possible use of an athlete’s genetic profile.⁴³ Comprehensive data would be collected to track the processes occurring in the body and predict the probability of an athlete contracting a disease.⁴⁴ Life or health insurance companies may use any information of possible flaws inherent in the genetic analysis of an athlete’s intrinsic genome to craft unfavourable

³⁵ Ibid; Brzezińska et al, above n 20, 257.

³⁶ Lippi, ‘Gene manipulation and improvement of athletic performances: new strategies in blood doping’ (2004) 38 *British Journal of Sports Medicine* 641.

³⁷ Gorgi Popstefanov, ‘Gene Doping: The Game Changing Technological Advancement of the Next Generation’ (2013) *Law School Student Scholarship*, 1 – 31, 11; McKanna and Toriello, above n 24, 724

³⁸ Custer, above n 17, 186.

³⁹ McKanna and Toriello, above n 24, 724.

⁴⁰ Schneider & Rupert, above n 1, 189.

⁴¹ Le Page, above n 30.

⁴² Andy Miah, ‘Genetic Modification (GM) in Sport: Legal Implications’ (2003) 6(3) *Contemporary Issues in Law* 207 – 226, 213 – 214; Ivo van Hilvoorde et al, ‘Flopping, Klapping and Gene Doping: Dichotomies between ‘Natural’ and ‘Artificial’ in Elite Sport’ (2007) 37(2) *Social Studies of Science* 173 – 200, 177; Santamaria et al, above n 1, 197; Mazzeo et al, above n 1, 1; Toon van der Gronde, Olivier de Hon, Hidde J Haisma and Toine Peiters, ‘Gene doping: an overview and current implications for athletes’ (2013) 47 *British Journal of Sports Medicine* 670 – 678, 673.

⁴³ Schneider & Rupert, above n 1, 196 – 197.

⁴⁴ Pawel Cieszczyk, Agnieszka Maciejewska and Marek Sawczuk, ‘New threats of genetic research’ 5(3) *Journal of Human Sport & Exercise* 322 – 327, 324.

policies.⁴⁵ Stringent privacy regulations would be necessary to prevent any infringement of an athlete's privacy and misuse of genetic data by insurance companies.⁴⁶

C. Justification

The idea that athletes have resorted to such drastic methods such as gene doping to enhance their performance has sparked outrage and concern. However, proponents rely on several grounds to justify this practice.⁴⁷

Some proponents of gene doping point to the key difference between gene doping and traditional pharmaceutical doping to argue that gene dopers may not necessarily be guilty of a clear-cut ethical violation.⁴⁸ Pharmaceutical doping introduces *foreign* material that overrides the person's DNA and temporarily develops new cells without a biological response.⁴⁹ Juxtaposed to this, gene doping introduces *genetic* material which is assimilated into the cells before it is expressed as a gene product.⁵⁰ The genetic material therefore only becomes operational when it is expressed by the athlete's own cells.⁵¹

A compelling analogy can be made with WADA's decision not to ban "altitude stimulators", otherwise known as altitude chambers.⁵² In the altitude chambers, the body is forced to produce more red blood cells to adapt to the lack of oxygen in high altitude conditions.⁵³ The resulting increase in haematocrit levels yields a *biological* response in the same way as gene doping, rather than a pharmaceutical reaction in the form of a chemical stimulus.⁵⁴ As a consequence, genetic material itself cannot make the body perform beyond what its genes would otherwise allow.⁵⁵

Other academics such as Loland believe that the role of genetic technology merely results in a quantifiable difference in the performance of athletes,⁵⁶ which can make sport more enticing overall.⁵⁷

⁴⁵ Ibid.

⁴⁶ Ehrbar, above n 1, 4; Andy Miah, 'The engineered athlete: Human rights in the genetic revolution' (200) 3(3) *Culture, Sport, Society* 25 – 40, 36; Cieszczyk et al, above n 44, 324.

⁴⁷ Miah, above n 42, 207.

⁴⁸ Joe Fore, 'Moving Beyond Gene Doping' (2010) 15 *Virginia Journal of Law & Technology* 76 – 100, 88.

⁴⁹ Popstefanov, above n #, 21 – 22.

⁵⁰ Fore, above n 40, 88

⁵¹ Fore, above n 40, 88

⁵² Fore, above n 40, 88; Miah, above n 46, 36

⁵³ Miah, above n 40, 36; Popstefanov, above n 37, 22; Fore, above n 40, 88; Doriane Coleman and James Coleman, 'The Problem of Doping' 58(1743) *Duke Law Journal* 1744, 1756.

⁵⁴ Popstefanov, above n 37, 21; Ibid, 1771.

⁵⁵ Popstefanov, above n 37, 22; Coleman and Coleman, above n 53, 1772.

⁵⁶ Andy Miah, 'From anti-doping to a 'performance policy' sport technology, being human, and doing ethics' (2005) 5(1) *European Journal of Sport Science* 51 – 57, 54

⁵⁷ Ehrbar, above n 1, 5; Sigmund Loland, 'The ethics of performance-enhancing technology in sport' (2012) 36(2) *Journal of the Philosophy of Sport*, 152 – 161; Colin Moran, 'Explainer: what is gene doping- and will any athletes at Rio 2016 have tried it?' *The Conversation* (online), 8 August 2016

According to Miah, gene doping could be used as a mechanism to achieve a true level playing field by counterbalancing the genetic advantages and disadvantages of all athletes.⁵⁸ Moreover, as the origin of gene doping stems from gene therapy, it may nevertheless seek to improve the physical wellbeing of athletes,⁵⁹ for instance by repairing damaged tissues.⁶⁰

D. Liability under WADA

The World Anti-Doping Code ('WADC') was created by WADA as a standard for doping rules and regulations.⁶¹ Article 2 of the WADC lists the circumstances in which an athlete may be found to have violated an anti-doping rule.⁶² Under this provision, the onus lies on the athlete to be aware of what will amount to an anti-doping rule violation and what substances and methods are on the Prohibited List.⁶³

The key regulations address the presence of a prohibited substance in an athlete's sample,⁶⁴ and the use or attempted use of a prohibited substance.⁶⁵ Other circumstances include the evading, refusing or failing to submit a sample,⁶⁶ the possession⁶⁷ and the trafficking or attempted trafficking of a prohibited substance.⁶⁸

E. Sanctions

As strict liability is applied to all doping violations,⁶⁹ the intention, fault or negligence of the doper is irrelevant.⁷⁰ Article 10 prescribes the sanctions that may be imposed on athletes upon a breach of an anti-doping violation: disqualification,⁷¹ which is imposed if the violation takes place during an event,

<<https://theconversation.com/explainer-what-is-gene-doping-and-will-any-athletes-at-rio-2016-have-tried-it-63230>>.

⁵⁸ Miah, 'above n 42, 213 – 214.

⁵⁹ Ehrbar, above n 1, 5; W. Miller Brown, 'The case for perfection' (2009) 36(2) *Journal of the Philosophy of Sport*, 127 – 139.

⁶⁰ Wells, above n 4, 624; Miah, above n 42, 229

⁶¹ K Vieweg, 'The definition of doping and the proof of doping offence (an anti-doping rule violation) under special consideration of the German legal position' (2004) *Marquette Sports Law Review* 37 – 48, 38; Knabben, above n 17, 27

⁶² WADC art 2.

⁶³ WADC art 2.

⁶⁴ WADC art 2.1.

⁶⁵ WADC art 2.2.

⁶⁶ WADC art 2.3.

⁶⁷ WADC art 2.6.

⁶⁸ WADC art 2.7.

⁶⁹ WADC art 10.7.3; *USA Shooting and Quigley v International Shooting Union* (Arbitral Award, Court of Arbitration of Sport, CAS 94/129, 23 May 1995); *Foschi v Fédération internationale de natation* (Unreported, Court of Arbitration of Sport, CAS 97/156, 1997).

Jessica Foschi, 'A Constant Battle: The Evolving Challenges in the International Fight against Doping in Sport' (2006) 16 *Duke Journal of Comparative & International Law* 457 – 486, 474 – 475.

⁷⁰ *C v Fina*, (Award, Court of Arbitration of Sport, CAS 95/141, 22 April 1996); Knabben, above n 17, 32

⁷¹ WADC art 10.1.

or ineligibility,⁷² which can be imposed after the event. The usual sanction for first-time offenders committing a breach of certain anti-doping violations⁷³ is an ineligibility to compete for two years⁷⁴. In all other cases, an athlete is ineligible to compete for four years.⁷⁵ Articles 10.4 and 10.5 provide for opportunities to eliminate or reduce the period of ineligibility, although it is unclear if these provisions work in practice,⁷⁶ while Article 10.6 sets out aggravating circumstances that may lead to the increase of this period.

III. ISSUES

A. *Issues with Sanctions*

WADA's sanctions do not take into account the permanency of gene manipulation.⁷⁷ Once it is introduced into the body, it cannot be removed or disabled.⁷⁸ If strict liability applied to doping violations,⁷⁹ a genetically modified athlete would be banned for life, but a first-time pharmaceutical doper would be able to compete after a two-year suspension.⁸⁰ However, it would be contrary to the principles of fair play⁸¹ if natural athletes were to compete against genetically modified athletes after their suspension was lifted.

B. *Issues of Detection*

The anti-doping regulations under WADA are considered incompatible and ineffective with the practice of gene doping⁸² mainly because gene doping remains undetectable.⁸³ Unlike the insertion of prohibited substances or hormones, it is difficult to differentiate naturally occurring genes from artificial genes introduced to the body to naturally produce desired substances.⁸⁴ Moreover, gene doping methods targeting a specific part of the body, such as muscle tissue, will not circulate in the bloodstream and remain undetectable in blood and urine tests.⁸⁵

Current testing methods are also ill equipped to detect gene doping. Any comprehensive method to test each individual cell or tissue for any modification of genetic modification is logically and financially unfeasible.⁸⁶ It may be possible to detect gene doping with a biopsy,⁸⁷ which

⁷² WADC art 10.2.

⁷³ These provisions include WADC art 2.1, 2.2 and 2.6.

⁷⁴ WADC art 10.2.1, 10.2.2.

⁷⁵ WADC art 10.2.1.

⁷⁶ Foschi, above n 69, 478.

⁷⁷ Fore, above n 40, 89; Custer, above n 17, 208.

⁷⁸ Popstefanov, above n 37, 22

⁷⁹ WADA art 2.1.1.

⁸⁰ Popstefanov, above n 37, 22 - 23; Custer, above n 17, 208

⁸¹ Popstefanov, above n 37, 22 - 23.

⁸² Fore, above n 48, 89.

⁸³ Custer, above n 17, 203; Knabben, above n 17, 48; Popstefanov, above n 37, 22

⁸⁴ Custer, above n 17, 188

⁸⁵ Hall, above n 30; Mazzeo et al, above n 1, 4.

⁸⁶ Hall, above n 30.

extracts a slice of the muscle at the site of the DNA injection.⁸⁸ Given the intrusive nature of this method, athletes are likely to have a ‘compelling justification’ to refuse testing pursuant to Article 2.3,⁸⁹ and are unlikely to be forced to consent to this procedure.⁹⁰ Additionally, it would be difficult to pinpoint an appropriate time to collect the athlete’s sample: if conducted too far in advance, athletes may still have a chance to resort to genetic modification prior to competing, but if conducted too late, athletes may not have adequate time to recover.⁹¹

Of course, there is ongoing research to discover and formulate less intrusive procedures. Gaffney suggests several alternatives to biopsies, including inserting a microchip in athletes or labelling transgene products with genetic bar codes to track and assess any alterations to DNA sequences.⁹² Research into other procedures have also received WADA’s financial support, such as the use of real-time polymerase chain reaction (‘PCR’) techniques in fine needle aspiration biopsy⁹³ to detect transgenic DNA:

C. *Issues of Distinction*

1. *Gene Doping vs. Gene Therapy*

As established above, since gene doping is an outgrowth of gene therapy, it utilises identical methods and genes, and yields the same outcomes.⁹⁴ The distinction appears to be merely purposive: gene therapy is used to rectify a medical problem or restore a bodily function to its normal state, whereas gene doping is used merely to enhance athletic performance.⁹⁵ Proving lack of intent will be difficult, if not possible, for regulators.⁹⁶

Athletes may be more reluctant to engage in gene therapy if it would unduly expose athletes to unfair sanctions in the event of a positive test result.⁹⁷ This would be counter-intuitive to the option of

⁸⁷ Custer, above n 17, 203.

⁸⁸ Moses, above n 26, 8; Haisma, above n 26, 263.

⁸⁹ WADC art 2.3.

⁹⁰ Moses, above n 26, 8; Custer, above n 17, 203; Haisma, above n 26, 263; Santamaria et al, above n 1,197.

⁹¹ Custer, above n 17, 203; Moses, above n 26, 8.

⁹² Gaffney and Parisotto, above n 10,818; Brzieszanaska, above n 20, 10.

⁹³ Lucy Battery, Andrew Solomon, David Gould, ‘Gene doping: Olympic genes for Olympic dreams’ (2011) 104 *Journal of the Royal Society of Medicine* 494 – 500, 498; T Beiter et al, ‘Direct and long term detection of gene doping in conventional blood samples’ (2011) 18 *Gene Therapy*, 225 – 231.

⁹⁴ Moses, above n 26, 6.

⁹⁵ Maxwell J. Mehlman, ‘The Law of Above Averages: Leveling the New Genetic Enhancement Playing Field’ (2000) 85(2) *Iowa Law Review*, 517 – 593, 523; Miah, above n 42, 221; Moses, above n 26, 6; Mansour, above n #, 311

⁹⁶ Moses, above n 26, 8.

⁹⁷ Moses, above n 26, 8.

receiving medical treatment from prohibited substances or methods⁹⁸ under the WADA's Therapeutic Use Exemption ('TUE').⁹⁹

2. *Gene Doping vs. Gene Mutation*

Another obstacle to implementing sanctions on gene doping is the uncertainty on regulating athletes who are born with a natural genetic mutation.¹⁰⁰ One infamous example is the Finnish cross-country skier Eero Manta¹⁰¹ who exhibited unusually high haematocrit levels from a natural occurring mutation,¹⁰² which increased his oxygen intake.¹⁰³ In another case, a former professional sprinter¹⁰⁴ gave birth to a child who, as a result of a dysfunctional myostatin gene, was born with the physique of a bodybuilder.¹⁰⁵ If genetically modified athletes continue to be banned from competing, athletes of future generations who have inherited genetic modifications may be deprived of the right to be free from genetic discrimination.¹⁰⁶

IV. REFORM

Since anti-doping sanctions remain ineffective, the following sanctions are offered mostly as a means of accommodating the existence of gene doping.

A. *Legalising Doping*

One oft-cited recommendation is to legalise gene doping and place it under medical control.¹⁰⁷ This would modify the way sport operates to make it scientifically safe, and establish a clearer boundary between the unacceptable use of drugs and the acceptable method of gene manipulation.¹⁰⁸ While this may increase regulation over the use of drugs, and mitigate side effects,¹⁰⁹ this may simply lead to an

⁹⁸ Anderson, above n 17, 143.

⁹⁹ WADC art 4.4; Fore, above n 48, 90; Schneider and Freidmann, above n 17, 49.

¹⁰⁰ Custer, above n 17, 207.

¹⁰¹ McKanna and Toriello, above n 24, 723

¹⁰² Popstefanov, above n 37,10; David Martin et al, 'Blood Testing for Professional Cyclists: What's a Fair Hematocrit Limit?' *Sportscience News* (online) April 1997 <<http://www.sportsci.org/news/news9703/AISblood.html>>.

¹⁰³ Schneider and Rupert, above n 1,185.

¹⁰⁴ Chris Cooper, *Run, Swim, Throw, Cheat: The Science Behind Drugs in Sport*, (Oxford Academic Press, 1st ed, 2013) 213.

¹⁰⁵ Bennett Foddy and Juliet Savulescu, 'Ethics of Performance Enhancement in Sport: Drugs and Gene Doping' in Richard E. Ashcroft et al (eds), *Principles of Health Care Ethics* (John Wiley & Sons, Ltd, 2007) 513.

¹⁰⁶ *Universal Declaration on the Human Genome and Human Rights*, UN GAOR, 53rd sess, UN A/RES/53/152 (9 December 1998), art 2 and 6.

¹⁰⁷ Julian Savulescu, 'Doping scandals, Rio and the future of human enhancement' (2016) 30(5) *Bioethics* 300 – 303.

¹⁰⁸ Miah, above n 42, 222.

¹⁰⁹ Silvia Camporesi, 'An Alternative Solution to Lifting the Ban on Doping: Breaking the Payoff Matrix of Professional Sport by Shifting Liability Away from Athletes' (2017) 11(1) *Sports, Ethics and Philosophy* 109 – 118, 113.

arms race.¹¹⁰ In fact, Bowman believes that governments may play a large role in facilitating the role of gene-editing technology to gain a competitive advantage for its athletes.¹¹¹ However, putting aside the moral or ethical arguments against this proposal, this would nevertheless result in a fundamental shift to the ‘meaning’ of sport. A level playing field would no longer depend on athletic ability or the efforts taken to physically train for a competition, but the level of sophistication involved in the gene editing technology the athlete used to exploit.¹¹²

B. *Separate Categories*

Athletes could compete in separate categories of ‘Normal’, ‘Enhanced’ and ‘Super-Enhanced’ divisions, and be allocated based on the amount of genetic product in their body.¹¹³ Others liken this division to the participation of boxers, wrestlers and rowers in different weight categories.¹¹⁴ However, logistically, the creation of separate categories may only be achievable in sports that concern a single gene product, such as detecting EPO in cyclists.¹¹⁵ Regardless, sporting competitions might inevitably resort to invasive detection methods,¹¹⁶ or have difficulty in establishing the “normal” biological level against which all athletes are to be measured.¹¹⁷

C. *Separate Competitions*

If athletes were required to disclose their genetic information, one option would be to entirely restructure the sporting competitions to create a “Bio Olympics”,¹¹⁸ whereby genetically modified athletes would compete separately from the genetically unmodified athletes against a new criterion.¹¹⁹ This division could operate similarly to the treatment of disabled athletes in the Paralympic Games.¹²⁰ Of course, the glaring difference is that athletes do not choose to be disabled.

The outcome of this option is twofold. On one hand, a separate competition would retain the integrity and equality of the competition by providing a more accurate comparison amongst competitors and

¹¹⁰ Sy Mukherjee, ‘Goldman Sachs: China is Beating the US in Gene Editing Arms Race’ *Fortune* (online) 13 April 2018 <<http://fortune.com/2018/04/13/goldman-sachs-china-gene-editing-race/>>.

¹¹¹ Stefanie Menezes, *Gene editing could create super athletes by 2036, says UNSW guest lecturer* (23 July 2018) University of New South Wales <<https://newsroom.unsw.edu.au/news/science-tech/gene-editing-could-create-super-athletes-2036-says-unsw-guest-lecturer>>.

¹¹² Fore, above n 48, 435.

¹¹³ Fore, above n 48, 93.

¹¹⁴ Popstefanov, above n 37, 28

¹¹⁵ Fore, above n 48, 93

¹¹⁶ Fore, above n 48, 94

¹¹⁷ Ibid; Luca Malvovati et al, ‘Hematologic Passport for Athletes Competing in Endurance Sports’ (2003) 88(5) *Haematologica* 570 – 581, 578.

¹¹⁸ Fore, above n 48, 96; Thomas Friedmann, ‘Potential for Genetic Enhancement in Sports’ (Speech delivered at the President’s Council on Bioethics, Georgetown, 11 July 2002).

¹¹⁹ Miah, above n 42, 224; Andy Miah, *Genetically Modified Athletes: Biomedical Ethics, Gene Doping and Sport* (Taylor & Francis Books Ltd, 1st ed, 2004) 93.

¹²⁰ Miah, above n 42, 218.

give spectators the chance to explore the boundaries of achievement of the human body.¹²¹ On the other, interest in the less-impressive performance of “natural” athletes would inevitably wane¹²² and public sentiment against and resentment towards genetic modification would grow.¹²³

D. *Handicap*

Another temporary recommendation made to retain a ‘level playing field’ is to enforce a ‘measurable handicap’ tailored for the sport. For instance, WADA could mandate that enhanced sprinters run an extra number of kilometres, or give cyclists an extra number of seconds to start the race.¹²⁴ The difficulty, of course, lies in calculating a precise quantification on the ‘handicap’ to counterbalance the athlete’s genetic advantage.¹²⁵

E. *Extending Liability*

The final recommendation upholds a framework which widens the scope of liability for stakeholders that may have contributed to the athlete engaging in gene doping.¹²⁶ Building on a model premised on the concept of agency,¹²⁷ liability is imputed to those who possess or exercise a degree of control over the athlete.

Proponents of this framework refer to a “payoff matrix” that considers the risks and rewards of doping, whereby the reward of gaining a competitive advantage far outweighs the risk to an athlete’s health or reputation. Several factors may explain this imbalance: the tendency for athletes to focus on short-term outcomes,¹²⁸ the relatively short length of the athletes’ careers,¹²⁹ and their “professional” rather than “playful” orientation towards involvement in sports.¹³⁰

While the incentive to ‘die to win’¹³¹ can often be self-driven, there is no doubt that athletes receive pressure from others, such as coaches, sponsors, medical teams and even countries.¹³² For example,

¹²¹ Miah, above n 123, 178; Fore, above n 48, 96

¹²² Ibid.

¹²³ Fore, above n 48, 98.

¹²⁴ Popstefanov, above n 37, 25.

¹²⁵ Ibid.

¹²⁶ Silvia Camporesi, ‘The Solution To Doping Is To Extend The Blame Beyond Athletes’ *Huffington Post* (online), 25 July 2017 < https://www.huffingtonpost.com/silvia-camporesi/the-solution-to-doping-is_b_11132900.html>.

¹²⁷ Camporesi, above n 113, 115.

¹²⁸ Alex Krumer et al, ‘Why do professional athletes have different time differences than non-athletes?’ (2011) 6(6) *Judgment and Decision Making* 542 – 551.

¹²⁹ B. C. Ogilvie & M. Howe ‘The trauma of termination from athletics’ in J. M. Williams (ed) *Applies sport psychology: Personal growth to peak performance* (Mayfield Publishing Company) 365 – 382.

¹³⁰ M McCann, ‘It’s not about the money: The role of preferences, cognitive biases, and heuristics among professional athletes’ (2006) 71 *Brooklyn Law Review* 1459 – 1528.

¹³¹ Anderson, above n 7, 13.

¹³² M. Guivernau and J.L Duda, ‘Moral atmosphere and athletic aggressive tendencies in young soccer players’ (2002) 31 *Journal of Moral Education* 67 – 85; D. E. Stephens and B. J. Bredemeier, ‘Moral atmosphere and

German running coach Thomas Springstein was convicted of doping charges and sentenced to jail for 16 months for giving teenagers performance-enhancing drugs¹³³ Springstein was later suspected of being involved in gene doping after emails were discovered in which the coach expressed his concern over the difficulty of obtaining Repoxygen, an EPO gene-based therapy.¹³⁴

Of course, this does not mean athletes are necessarily absolved of *all* liability; methods to sanction gene doping must still mandate exclusion from the competition for a period of time.¹³⁵ However, it is unclear how this recommendation is any different to Article 2.9 of the WADC, whereby anyone who is complicit in the violation of an anti-doping rule will also incur liability.¹³⁶ Several parties have been found in violation of this provision for other forms of doping.¹³⁷ This is because the standard of proof is considered quite low, in light of the phrase ‘*any type of complicity*’,¹³⁸ and its operation has a broad scope,¹³⁹ which “covers numerous acts which are intended to assist another or a third party’s anti-doping rule violation”.¹⁴⁰ In particular, a violation of Article 2.8 encompasses any psychological assistance used in encouraging an athlete to engage in anti-doping practices.¹⁴¹

Notwithstanding, the issue of detecting gene doping appears to be unavoidable in all three recommendations. After all, gene dopers must be willing to come forward in order for separate categories, separate competitions or further accountability to be effective.

V. CONCLUSION

Gene doping gives rise to a plethora of social, ethical and moral concerns and remains a controversial issue in the sporting field. The current framework under WADA must find new ways to prevail over the unprecedented ability for athletes to re-engineer their body for the pursuit of optimal performance without being at risk of detection. Absent any proper safeguards against gene doping, the temptation for athletes to cheat the system and place their health at risk only becomes greater. As the movement to legalise gene doping is one the rise, and gene-editing technology continues to reach new heights, it is high time for WADA to re-evaluate its strict ban on gene doping.

judgments about aggression in girls’ soccer; relationships among moral and motivational variables’, (1996) 18 *Journal of Sport & Exercise Psychology*, 158- 173; Camporesi, above n 113, 110.

¹³³ Custer, above n 17, 187.

¹³⁴ Schneider and Rupert, above n 1, 190.

¹³⁵ Camporesi, above n 131.

¹³⁶ WADC art 2.9.

¹³⁷ *Alexander Legkov v. International Olympic Committee* (Arbitral Award, Court of Arbitration of Sport, CAS 2017/A/5379, 23 April 2018).

¹³⁸ *Emil Hoch v FIS & IOC* (Arbitral Award, Court of Arbitration of Sport, CAS 2008/A/153), [216] – [220].

¹³⁹ *Johannes Eder v. International Olympic Committee* (Arbitral Award, Court of Arbitration of Sport, CAS 2007/A/1286, 4 January 2008) & *Martin Tauber v. International Olympic Committee* (Arbitral Award, Court of Arbitration of Sport, CAS 2007/A/1288, 4 January 2008) & *Jurgen Pinter v. International Olympic Committee* (Arbitral Award, Court of Arbitration of Sport, CAS 2007/A/1289, 4 January 2008).

¹⁴⁰ *Ibid.*

¹⁴¹ Above n 137, [68].

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