We offer a wide range of postgraduate taught MRes and MSc programmes, and PhD programmes in areas including:

- sport and exercise science
- physiotherapy
- podiatry
- strength and conditioning
- health and wellbeing
- sport and exercise physiology.

Find out more at www.brighton.ac.uk
**MEDICAL PROVISION AT THE BRIGHTON MARATHON**

**ARTICLE BY JONATHAN SHURLOCK, RACHAEL GRIMALDI AND ROB GALLOWAY**

The inaugural year of the Brighton Marathon was 2010, since then the event has grown into the 2nd largest marathon in the United Kingdom and the 12th largest in Europe.

**RAPID SUPPORT**

On Race Day, the Marathon control room situated at the Grounded Events Company HQ manages the event. Embedded within this team is the medical control room. The medical director, Dr Rob Galloway, provides mobile oversight and support across the whole event footprint via bicycle. This mobility enables rapid support at any critical incident and ensures effective coordination of care provision.

The medical director is supported by 3 Deputy Medical Directors – Rachael Grimaldi, Rob Greenhalgh and David Bowen. Medical logistics is lead by Carrie Weller in partnership with the St John Ambulance team led by Darren Owen, Hannah Pool and Trevor Moss.

There are two main medical tents, an advanced first aid tent and 13 other smaller first aid tents. There are walking teams based at each first aid post as well as cycle response teams, each carrying defibrillators.

The two primary medical tents contain a broad range of healthcare professionals including St John Ambulance volunteers, paramedics, physiotherapists, nurses and doctors. The tents are arranged similarly to a standard emergency department (Figure 2) with separate areas for triage, physiotherapy, podiatry, minors, majors and resus. These areas are equipped to manage a broad range of medical presentations from soft tissue injuries to cardiac arrest.

Over the marathon weekend, the medical team is responsible for all individuals within the marathon event footprint. Therefore the tents are equipped to provide lifesaving care that would otherwise be delayed while awaiting transfer to hospital. Each medical tent is led by experienced senior healthcare workers; thus allowing a safe learning environment for trainee volunteers working outside of their usual roles.

These two areas manage the majority of clinical presentations, and in 2019 assessed and treated 350 individuals, including 50 collapsed runners, 7 of whom required onward transfer to hospital. Each collapsed runner will then be either transported to a first aid room or taken to hospital directly if required.

In 2016 the concept of an Advanced Cardiac Arrest Team (ACAT) was introduced, led by a highly experienced pre-hospital consultant.

**ADVANCED MOBILE MEDICAL UNIT**

There is a large fleet of ambulances including an Advanced Mobile Medical Unit carrying a doctor and the capability of performing a roadside rapid sequence induction if required. At the Finish Line there are Forward Incident Teams and spotters looking for collapsed runners. A collapsed runner will then be either transported to a first aid room or taken to hospital directly if required.

In 2016 the concept of an Advanced Cardiac Arrest Team (ACAT) was introduced, led by a highly experienced pre-hospital consultant. The ACAT have a dedicated vehicle with a specialised team and equipment, including carbon dioxide monitoring and a LUCAS (automatic chest compression device). If, after 20 minutes of cardiopulmonary resuscitation (CPR) there is no Return of Spontaneous Circulation (ROSC), out of hospital ECMO is started by a team from Barts Health NHS Trust who are embedded within the ACAT. Dr Rachael Grimaldi, Associate Medical Director of the marathon, led the integration of the ECMO team into the ACAT, underpinned by a series of roadside to critical care simulations (Figure 1).

**THE BRIGHTON MARATHON HANDBOOK**

In an effort to ensure consistency of care an event handbook has been developed which is updated annually. The handbook provides essential information for volunteers including a summary of individual roles and responsibilities. An integral component of the handbook is prompt cards and treatment algorithms for medical emergencies including Exertional Heatstroke (EHS), with reference to the Faculty of Sport and Exercise Medicine (FSEM) EHS guidelines which were co-authored by members of the Brighton Marathon medical team. These guidelines have been used to support the International Olympic...
Committee (IOC) decision making processes with particular focus on managing the high temperatures expected during the 2021 summer in Tokyo.

This is especially pertinent to the postponed 2020 Tokyo Olympics due to the concerns regarding the risk of EHS and plans for mitigation of such risk. The handbook provides an evidence based, easy to access resource for the assessment and treatment of commonly seen medical emergencies at endurance events, ensuring safe and effective healthcare provision. As part of this IOC expert working group, research that can help protect the health of athletes competing in the heat in Tokyo is ongoing (with a research grant of $50,000.00 awarded to the IOC entitled “Protecting athletes’ health through the prevention of heat illness during the 2020 Tokyo summer Olympics”). The Brighton marathon was used as one of the test events prior to the Tokyo Games (albeit the 2020 edition was cancelled due to Covid-19).

• See the article by Borja Muniz and Konstantinos Angeloudis for further details on the research being done in the build-up to the Tokyo Olympics in this special edition.

The Biomarkers After Sporting Inability Study (BASIS) was a prospective case-controlled study carried out at the 2019 event, which attempted to answer whether a group of novel biomarkers could be used for the prediction of severity of Exertional Heat Injury (EHI) and subsequent risk of multiorgan dysfunction. One hundred healthy participants were recruited for blood testing and measures of cardiovascular function before the run and on the finish line. A further eight cases of heat-related collapse had similar measurements in the medical tent and both groups went on to provide later blood tests.

On the event day, the researchers were able to demonstrate the role of assessment of cardiac function using echocardiography to guide treatment strategies for heat-related collapse and assess for other pathologies, including myocardial infarction. Healthy runners were found to have an increase in a novel echocardiographic index, which is thought to help minimise the impact of dehydration and heat-related changes during endurance events. This novel work was published in the Journal of Emergency Medicine.

The Gut Permeability study aimed to assess the role of increased gut permeability during exercise, in the context of evidence suggesting passage of gut pathogens into the circulation and brain as a cause of morbidity in EHI. The study recruited healthy race finishers and collapsed runners, and measured Intestinal-Fatty Acid Binding Protein (I-FABP) and Lipopolysaccharide (LPS) as markers of intestinal permeability. The results and subsequent write up of this study are currently under peer review.

Other areas of interest and publication include the impact and mechanism of troponin release during endurance exercise, and the use of alternative out of hospital cooling techniques.

References:

Jonathan Sharlock
Somerest NHS Foundation Trust

Rachael Grimaldi
Brighton and Sussex University Hospitals NHS Trust

Rob Galloway
Brighton and Sussex University Hospitals NHS Trust

Note: All potential causes of collapse are shown in the flowchart. Further information is available in the Brighton Marathon Medical Team Protocol Management of a collapsed runner.
Paralympic Medicine Research in the University of Brighton

ARTICLE BY DR NICK WEBBORN

The University of Brighton has been integrally involved with Paralympic Sports Medicine research since 2002 and provides the ethical approval for all the illness and injury surveillance research at winter and Summer Paralympic Games. It also has a Clinical Professor of Sport and Exercise Medicine in a UK system that has few academic positions.

Did you think you would make plans and life would follow you obediently?

Ludwig Gutmann, 1948

The university of Brighton has been integrally involved with Paralympic Sports Medicine research since 2002 and provides the ethical approval for all the illness and injury surveillance research at winter and Summer Paralympic Games. It also has a Clinical Professor of Sport and Exercise Medicine in a UK system that has few academic positions.

How did you come about to see yourself as a clinician? It has been nagged at me for years.

Dr Anthony Clare

The University of Brighton has been integrally involved with Paralympic Sports Medicine research since 2002 and provides the ethical approval for all the illness and injury surveillance research at winter and Summer Paralympic Games. It also has a Clinical Professor of Sport and Exercise Medicine in a UK system that has few academic positions.

How did you come about to see yourself as a clinician? It has been nagged at me for years.

Dr Anthony Clare

The University of Brighton has been integrally involved with Paralympic Sports Medicine research since 2002 and provides the ethical approval for all the illness and injury surveillance research at winter and Summer Paralympic Games. It also has a Clinical Professor of Sport and Exercise Medicine in a UK system that has few academic positions.

How did you come about to see yourself as a clinician? It has been nagged at me for years.

Dr Anthony Clare
THE TAVISTOCK TRANSGENDER ATHLETE STUDY (TTAS)

Integrating transwomen and differences of sex development (DSD) athletes into elite women's sport

ARTICLE BY BLAIR HAMILTON (10), FERGUS GUPPY (10) AND YANNIS P. PITSILADIS (11,12)


The question of the eligibility of athletes to participate in the elite female category of sports has been thrust into the public spotlight for both transwomen and differences of sex development (DSD) female athletes. Here we attempt to clarify some of the difficult issues and offer a roadmap to an evidence-based solution.

TRANSWOMEN ATHLETES

World Rugby recently proposed a blanket ban on the participation of transgender athletes in the female elite category based on player welfare (available at https://playerwellfare.worldrugby.org/FullDocument227) and a number of high profile Olympic athletes have applauded World Rugby’s decision, while some leading scientists have criticised the “hypothetical” nature of the biological male vs biological female evidence cited for the unions, while Unions such as England, Canada and USA Rugby have refused to implement the new guidelines due to a “lack of evidence” and its “discriminatory nature.”

To support exclusion, there has to be clear scientific evidence that there is a real safety threat, and both World Rugby’s policy focuses primarily on the physiological differences between male and female elite athletes to create hypothetical modelling to showcase the safety risk to cisgender female rugby players from transwomen rugby players, which represents an overly simplified extrapolation.

World Rugby also draws on numerous longitudinal research studies that have tracked the physiological changes in untrained transwomen, such as reductions in muscle mass and strength, while the real physiological changes in trained transgender athletes remains unknown. Therefore, the paucity of direct evidence to support exclusion, questions the fairness of the policy of World Rugby to exclude transwomen athletes. World Rugby has elected to adopt a cautious approach and while

the safety concern for cisgender female players may indeed turn out to be true, these safety concerns need to be scientifically justified. At the same time, the decision by World Rugby to exclude transgender athletes is also discriminatory to transgender athletes and in conflict with the fundamental aspects of the Olympic Charter. (https://staging.olympic.org/legacy/library/olympicCharters/EnGLISH-Charters.pdf)

SAFE INTEGRATION

As nicely described by Professor Ross Tucker (one of the experts utilised by World Rugby who explains the process used by World Rugby to create their policy [https://vimeo.com/475035370]), the three main arguments needing to be considered when formulating the guidelines and/or rules for the fair and safe integration of transgender athletes in world sport are fairness, safety, and inclusion but also essentially, their respective weightings of importance – akin to a triangular argument depicted in Figure 1. One gets a sense of the IOC’s weighting of these arguments by examining the 2015 IOC Consensus on Sex Reassignment and Hyperandrogenism. In this document it states “it is necessary to ensure insofar as possible that trans athletes are not excluded from the opportunity to participate in sporting competition” and “The overruling sporting objective is and remains the guarantee of fair competition.” The IOC Consensus document as written conveys the message that the IOC prioritises athletic fairness over safety (as does World Rowing), whereas World Rugby professes to put safety at the top of their triangle of priorities (see Figure 1), therefore reaching the conclusion to exclude transwomen athletes from elite level competition. While it makes intuitive sense that the safety of athletes, especially in a contact sport like rugby has to be the overriding concern and priority, there remains very little direct evidence to support the safety argument to exclude transgender athletes.

This scientific reality also prevails in terms of the view that transwomen have a sporting advantage which has now been strongly re-enforced by the recent World Rugby policy. However, performance data in transgender athletes is urgently needed to inform policy, especially transwomen’s but not neglecting transmen because of the reliance on non-sports performance data. The current consensus in the literature is that transwomen, during their gender-affirming treatment for gender dysphoria and subsequent cross-sex hormone therapy, have reductions in performance-related physiological parameters such as haemoglobin concentration, muscle mass, cross-sectional area and strength, coupled with an increase in fat mass. A recent study by Wili et al. (which incidentally is the first study to compare outcome measures in transwomen) that 12 months of treatment versus control, found that in transwomen, thigh muscle volume decreased by 8% (muscle volume) and quadriceps cross-sectional area (CSA) by 4%, while strength was generally maintained over the assessment period. The limitation, however, of such evidence and most of the literature pertaining to transwomen is the reliance on physiological measures obtained in untrained transgender individuals, and without any focus on measures of sports performance. The only study to investigate transwomen’s sporting performance was an observational study by Harper (11) who in a pioneering way investigated the self-reported running times of transwomen masters runners before and after their respective transitions. Harper found, using a method called “age grading” which is a method of comparing the performance of athletes of all ages and both sexes, found similar age-graded scores for both genders in the eight runners assessed. As this is the only study, conducted in non-elite athletes as well as relying on self-report, there is an urgent need for replication as well as studies conducted in well-trained transgender athletes involved in numerous sports.

DSD ATHLETES

There is no more prominent public case in DSD athletics than the case of the South African runner Caster Semenya, who recently lost her appeal to the Swiss Federal Tribunal against the restrictions of blood testosterone concentrations in female athletes. The argument put forward by World Athletics is that DSD athletes competing in female sports in events between 400m and 1500m possess unfair advantages created by the effect of high levels of testosterone on physiological function (12). The issue with such a policy is that there is no direct scientific evidence that women athletes with DSD have performance advantages in these specific sporting events. There is, however, observational data that shows a clear difference in performance in DSD athletes depending on whether testosterone concentration was suppressed or not, with an average performance reduction of approximately 6.7% in three athletes who had T concentration suppressed from 21-25 to 2 nmol/l over 2 years (13). A low number granted (n=5) but an indicator of the performance advantage held by DSD athletes. Although conditions such as DSD are rare, hyperandrogenic 46 XY karyotype females in the 2011 World Championships were 140 times more prevalent than in the general population (6), another indicator of an indirect, or adverse effect on athletic advantage. However, it is important to note that testosterone concentrations in DSD athletes will not have the same universal effect on each athlete, due to there being athletes with androgen insensitivity which can be either complete or partial. This complexity needs to be considered if testosterone concentrations, either as a single parameter which is already being used (6), or more likely as one of several parameters, will evolve into a viable solution.

www.basem.co.uk

Above: Figure 1 - weightings for the IOC (left) and World Rugby (right) of the three primary criteria for formulating the guidelines to ensure fair and safe integration of transgender athletes.
During transition (i.e., both in male to female and female to male transitions) are well documented over 12-24 months. It is time for the scientific community to shift the focus of the science to trained transwomen and transmen and to elucidate the changes in physiology and sporting performance of well-trained transgender individuals for at least 48 months to generate the data needed to create a fit for purpose policy to guide international sports federations. In addition to the above, the United Nations Human Rights Council’s (UNHRC) recent recommendations to remove the eligibility rules that amounts to allowing athletes to self-identify into women’s elite sporting category creates a dilemma for the integrity of sporting competition at the elite level. The evidence of testosterone effects in male and female sport is clear. However, the scientific evidence is scarce on the effects of endogenous testosterone concentrations on individual sporting performance of athletes with DSDs. We have recently outlined our grave concerns in a letter accepted to the Editor of Sports Medicine [12] that also outlines an urgent need for continued research to develop new policies that include fair DSD athlete competition. Until such studies are concluded, we must not abandon all eligibility rules for the female classification within sports.

**The TAVISTOCK TRANSGENDER ATHLETE STUDY**

How does science solve the question of integrating transwomen and DSD athletes into the elite female category? The use of science alone is destined to fail if sports performance is so multifaceted (not to mention the political dimension) that science will never be able to explain or indeed eliminate all differences between one athlete and another. Scientific approaches also continuously evolve, where many of the techniques we use today in science are destined to be obsolete in less than 10 years from now. It is vitally important, therefore, that science continues to provide the evidence to support and update sports policies, only as the scientific evidence develops and not via common sense intuition, however, prophetic common sense may prove in the future.

With this objective in mind, the Collaborating Centre of Sports Medicine and Science at the University of Brighton have proposed the largest study of this kind, the Tavistock Transgender Athlete Study (TTAS) [13], which is a unique collaboration with the Tavistock and Portman NHS Trust. The TTAS will look at 20 transwomen and 20 athletic transmen throughout their gender-affirming treatment from baseline to 24 months and compare both to a female athletically cohort of 20 university female athletes. Importantly and taking heed of previous gaps in the literature, sports performance indicators such as maximal strength, 100m sprint function tests, and strength and power measurements of transgender athletes [14] will be documented specifically to help inform policy, with scientific evidence at its core. The TTAS also seeks to answer the new science of “muscle memory” in transgender athletes, which proposes that previous exposure to testosterone in transwomen, results in a peak pegging of myonuclei number to allow a quick return to a hypertrophic muscle state after a period of muscle detraining. If a significant “muscle memory” remains in transwomen, as it appears to be in mice [15], this potentially could be an irremovable advantage depending on the length of this advantage which currently remains in human transwomen, that sporting policymakers would have to consider. The Covid-19 pandemic has already led to the suspension of data collection by around 10 months, with preliminary data collection now planned for January 2021 or soon thereafter depending on Covid-19. To date we have recruited 11 transwomen and 6 transmen, all very excited and eager to participate. See TTAS advert above for further details.

Although the TTAS is based solely on transwomen, it may help to inform policies on DSD athletes by showing the effects of testosterone suppression or administration have on sporting performance measures. It is essential, however, that the communication and heat of the subject be replaced with a focus on scientific enquiry and evidence.

**References**

4. Eligibility Regulations for the Female Classification (Athlete with DSD) by World Rugby. [11].
**TECHNOLOGICAL DOPING: How we opened Pandora’s Box...**

**ARTICLE BY BORJA MUÑIZ-PARDOS**, **CONSTANTINOS ANGELOUDIS**, **FERGUS GUPPY**, **SHUAI SUTHEW**, **ANDREW BOSHE** AND YANIS PITTASIDIS

1. GENUD research group, Faculty of Sport and Health Sciences, Department of Physiotherapy and Nursing, University of Zaragoza, Zaragoza, Spain,
2. Collaborating Centre of Sports Medicine, University of Brighton, Eastbourne, UK, 3. Centre for Stress and Age-related Disease, School of Pharmacy and Biomolecular Sciences (PaBS), University of Brighton, Brighton, UK, 4. Division of Exercise Science and Sports Medicine, University of Cape Town, Cape Town, South Africa, 5. International Federation of Sports Medicine (FIMS), Lausanne, Switzerland

**W**e consider "Technological doping" as the performance advantage provided by technology that determines the outcome of the competition. In terms of the recent focus on carbon fiber plates (CFP) running shoes (1), the irony is that we, as the Sub2 marathon project (2,3), conceived of the idea to focus on developing innovations that would allow athletes to utilize and fulfill their full biological potential without the need to resort to doping. This unique and innovative anti-doping project was launched in Newcastle in December 2014 (at the International Sport and Exercise Nutrition Conference (ISENC14) annual event) with the “headline” attracting goal to break the 2hr barrier in the marathon(4). In fact, the project had at its core a holistic anti-doping focus – developed from “out of the box” thinking. Briefly, a solution that encompasses a holistic anti-doping approach comprising of at least three primary anti-doping pillars (see Figure 1) motivated by the need to prevent doping, protect the clean athlete, and promote performance without doping (5). A major research priority in the Eastbourne laboratory is the application of “omics” (i.e., genomics, proteomics, and metabolomic) for the detection of drugs in sport with particular reference to recombinant human erythropoietin (RHuEpo), blood doping and testosterone. Most of our recent research is funded by the World Anti-Doping Agency (WADA) and by the International Olympic Committee (IOC), with the primary focus of these projects being to understand the physical and psychological outcomes beyond the breaking of the 2-h barrier were envisaged including the demonstration of clean high performance marathon running, development of next generation anti-doping tests, personalised medicine/rehabilitation, individualised training, performance nutrition, customized race footwear designs, and expanding the real-time performance management systems with broader telemedicine implications (i.e., ironically, the summary of this special edition in Basem Today). This was the ambitious and altruistic original idea and not the opening of “pandora’s box” as it unfortunately transpired.

**PEAK PERFORMANCE DEVELOPMENT**

The sport of athletics has taught us that this evolution or modernisation of the anti-doping process had to embrace peak performance development of all forms that do not violate anti-doping rules and/or the rules of the sport; the third pillar of the 3Ps - promote performance without doping.

As we have previously argued (5,6), modern day sport is big business, not only for the 3% elite performers, but a vocation for thousands of athletes and their extensive entourage of physiologists, nutritionists, biomechanists, psychologists and support staff.

The original Sub2 marathon project (7) emerged in response to this professionalisation of sport but also threats to sports integrity (8). The Sub2 marathon project was perhaps the first dedicated international research initiative made up of specialist multidisciplinary scientists from academia, elite athletes, and strategic industry partners with the aim to promote high-performance marathon running without doping. In terms of anti-doping, all athletes participating in the Sub2 project needed to undergo regular doping controls (blood and urine) in accordance with WADA’s anti-doping regulations. Additionally, the Sub2 project pioneered a new WADA programme (9) that involved adding extra information/education, extra testing, and extra storage of samples - does this not sound like what is now evolving as a “patient” pathway (10).

The AIU represents one of the most successful anti-doping systems in recent memory run by David Howman (the Former Director General of WADA for 13 years until 2016 and now chair of WADA). In short, the unique experiences gained from this innovative anti-doping programme, were being used to strengthen anti-doping intelligence and ongoing scientific research. While there were no guarantees the Sub2 marathon project would succeed in delivering a sub 2-h marathon, a number of legacy outcomes beyond the breaking of the 2-h barrier were envisaged including the demonstration of clean high performance marathon running, development of next generation anti-doping tests, personalised medicine/rehabilitation, individualised training, performance nutrition, customized race footwear designs, and expanding the real-time performance management systems with broader telemedicine implications (i.e., ironically, the summary of this special edition in Basem Today).

Technology is already having a major impact with 5 world records (8 km, 5 km, 10 km, marathon, Sub2 marathon) set in 2021. In 2020, Nike launched the Alphafly shoe with a 39.5 mm sole, a CFP road shoe, that sole thickness of a marathon shoe must not exceed 40 mm. Around the same time, the World Anti-Doping Agency (WADA) and by the International Olympic Committee (IOC) had stood for 16 years.

The sudden improvements in performance times witnessed since the emergence of CFP shoes in 2016 are technologically driven rather than physiological. The magnitude of race performance improvements by athletes running in CFP shoes are analogous to those expected from various blood doping substances and methods included on the prohibited list of the World Anti-Doping Agency (WADA), such as erythropoietin, which have been shown to improve performance by 4-6% (11,12).

**EXPANDING TECHNOLOGY**

Since summer 2020 CFP technology has been expanded also to track events with the new Nike CFP spikes. Despite no scientific data demonstrating its impact upon performance, this technology is already having a major impact with 5 world records in only 3 months (Table 1). An illustration of the immediate welcome technological advances. Examples of such advances have been witnessed in tracks when they upgraded from cinder to synthetic rubber, in pole vault when poles evolved from bamboo to fiberglass, or in shoes when this began for corruption to incorporate air bladders, gels, and now a CFP in the midsole. Additional technological advancements were triggered by the introduction of a rule (144.4.d) by the IAAF (now World Athletics) allowing athletes to wear different devices during an event without exceeding the 2-kg/4-litre per athlete equipment limit.

**SPORTS INTEGRITY**

Technological advancements to improve athletic performance are historically considered ethical and part of progress, and as such, acclaimed and considered to be part of the lore of Athletics as long as quality between competitors and sports integrity is guaranteed. In stark contrast to this idea, the launch of CFP shoes by Nike in 2016 has resulted in many men’s and women’s world records in running (i.e., from 5 km to marathon) broken by athletes wearing shoes containing CFPs (Table 1). This phenomenon is raising concerns that the introduction of this technology leads to a distinct non-physiological advantage (13). The first event in which the dominance of CFP was noticeable was the IAAF World Championships in Rio de Janeiro (2016), where all medals in both the men and women races were won by athletes wearing CFP shoes.

Although the use of CFP shoes has been restricted to Nike-sponsored athletes during the last four years, the 2020 season has seen a number of further companies (e.g., Asics, Brooks, Adidas and Saucony) have reacted by designing their own CFP shoe aiming to provide their athletes with a competitive advantage. Additionally, there is now a total of nine shoe companies offering their own CFP road shoe, there are still non-sponsored athletes who will not have access to CFP shoes. Additionally, there is the issue that Nike is the only company, for the moment, that has created CFP spikes and even more records are expected in track events in Nike-sponsored athletes.

**TABLE 1. MALE AND FEMALE WORLD RECORDS IN LONG DISTANCE RUNNING (DATED 16/11/20) **

<table>
<thead>
<tr>
<th>Race</th>
<th>Performance</th>
<th>Athlete</th>
<th>Date</th>
<th>Shoe used</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 km</td>
<td>12:51</td>
<td>Joshua Cheptegei</td>
<td>16/02/2020</td>
<td>Nike ZoomX Dragonfly</td>
</tr>
<tr>
<td>5.000m (track)</td>
<td>12:35.36</td>
<td>Joshua Cheptegei</td>
<td>14/08/2020</td>
<td>Nike ZoomX Dragonfly</td>
</tr>
</tbody>
</table>
| 10 km       | 26.24       | Rhonex Kipruto    | 12/01/2020    | Adidas Adi Zero Talari 5
| 5000m (track)| 26:11.00   | Joshua Cheptegei  | 07/10/2020    | Nike ZoomX Dragonfly    |
| 10 km       | 40.05       | Joshua Cheptegei  | 16/11/2018    | Adidas Adi Zero Talari 5 |
| 1/2 marathon | 58:00       | Stefano Kariocca  | 15/09/18      | Nike ZoomX Vaporfly Next |
| Marathon 2 | 2:03:30     | Eluid Kipchoge    | 16/09/2018    | Nike ZoomX Vaporfly 4   |
| 5 km (W)    | 14:44       | Gal Hassan        | 17/02/2019    | Nike ZoomX Dragonfly    |
| 5.000m (track)| 14:06.62    | Letesenbet Gidey  | 07/10/2020    | Adidas Adi Zero Talari 5 |
| 10 km (M)   | 29:43       | Joepine Netto     | 09/09/2017    | Adidas Adi Zero Talari 5 |
| 10 km (W)   | 44:21       | Sifan Hassan      | 17/11/2019    | Nike ZoomX Vaporfly Next |
| 1/2 marathon (M) | 01:04:31   | Abel Kiprop      | 21/02/2020    | Nike ZoomX Vaporfly Next |
| 1/2 marathon (W) | 01:05:16   | Peres Jepchirchir | 17/10/2020    | Adidas Adi Zero Talari 5 |
| Marathon (M) | 2:04:30     | Frank Kosgei     | 10/12/2019    | Adidas Adi Zero Talari 5 |
| Marathon (W) | 2:07:01     | Mary Keitany     | 23/04/2017    | Adidas Adi Zero Talari 5 |

Ah, women only race. Men + men and women mixed race

spread and popularity of CFP spikes was noted during the 2020 Diamond League in Monaco (14th of August 2020). Of the 65 athletes competing in races between 800 and 5,000 m, 50 athletes wore Nike shoes, and 27 of these athletes wore the new CFP spikes. During this event, the 5,000 m World Record was broken by an athlete wearing a CFP shoe, a record that had stood for 16 years. The sudden improvements in performance times witnessed since the emergence of CFP shoes in 2016 are technologically driven rather than physiological. The magnitude of race performance improvements by athletes running in CFP shoes are analogous to those expected from various blood doping substances and methods included on the prohibited list of the World Anti-Doping Agency (WADA), such as erythropoietin, which have been shown to improve performance by 4-6%. On 31st January 2020, World Athletics reacted to this controversy in shoe technology by announcing new rules stating that sole thickness of a marathon must not exceed 40 mm (30 mm for spiked shoes) and must be sole for at least for four months before they can be used in competition 15. Soon after, Nike launched the Alphafly shoes with 19.5 mm sole, a CFP in the midsole, and the addition of air pods in the metatarsal region. The close proximity of the Alphafly launch to the new...
regulation announcement raised concerns that the rules had been drafted to “legalise” Nike’s CFP shoe series in response to accusations of “technological doping”[10], doing little to protect the principle of fairness in sporting competition. These new rules have resulted in a footwear arms race to develop patented CFP inserts by numerous shoe companies. This is contrary to another important principle of fairness in sport – the universality of sport, where technological developments used by athletes need to be reasonably available to all competitors. The cost of these shoes (most of them above £200) would limit its availability only to a minority of athletes, being inaccessible for the largest sections of society especially from underdeveloped countries, ironically alienating many East Africans, who have dominated long-distance running worldwide for more than 50 years.

A POTENTIAL SOLUTION TOWARDS EQUITY AND FAIRNESS IN SPORT

The one-year postponement of the 2020 Tokyo Olympic Games due to the COVID-19 pandemic provides the opportunity for World Athletics to commission an independent review focusing on technological fairness to systematically evaluate the impact of technology on the essence and integrity of sporting competition.

The controversy today surrounding the “legality” and “ethics” of CFP shoes is not unprecedented. In 2009, the International Swimming Federation (FINA) was obliged to modify the rules and ban full-body swimsuits in response to numerous sudden world records broken by swimmers wearing this technology. Similarly, the IAAF (now World Athletics) faced their own technological issue with shoe designs in the 1960s. In the latter case, both the 200 and 400 m world records were broken within the space of two weeks in 1968, with both athletes wearing the newly developed “brush” shoe[17] (i.e., a shoe containing 68 small pins). This led to the banning of this technological advancement by the athletics governing body and all records broken with these shoes erased from the records.

The recent decision by World Athletics to permit the use of CFP shoes throughout the sport of athletics (including track) is contrary to previous decisions regarding the use of technological ergogenic aids; a decision that must be urgently and carefully reconsidered.

A potential solution to solve this issue would include the reduction of the maximal stack height of a shoe to 20 mm, so that the ergogenic effect and performance benefit provided by a shoe would be limited. Companies would be able to innovate within this space, but shoe technology would be stopped from determining current performance improvements.

References: