A pragmatic approach to genetic testing in elite sport – are we there yet? – Comment on McAuley et al.

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COMMENT

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ABSTRACT

The use of genetic testing within sport is a hotly debated topic, with concerns around utility, validity, and the ethical use of any collected data. Whilst the general scientific consensus is that genetic testing has no utility within sport, research suggests around 10% of athletes have undertaken a genetic test—and more would be willing to do so. This highlights the need for a pragmatic approach to the use—or otherwise—of genetic testing in sport, with a recent article seeking to develop a framework for its use. However, there are still many unanswered and unexplored aspects around the use of genetic information in elite sport, including whether it is truly necessary and whether athletes can be adequately protected from misuse of their genetic data.

Keywords

athlete development, genomic, high performance, polymorphism, talent identification

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Introduction

A long time ago, I was quite a good athlete, being selected to compete for Great Britain and Northern Ireland at both a Summer and Winter Olympic Games. My sporting career began with promise; within a year of starting in track and field, and with limited training, I ran the second fastest 100 m time by an Under-15 athlete in British history. A couple of years later, I came 3rd at the World Under-18 Championships, before winning the European Under-20 Championships. After that, my career was blighted by issues; I experienced multiple hamstring injuries, Unexplained Underperformance Syndrome (UUPS), and a back injury that required surgery (causing me to miss the 2012 Olympic Games)

and leading to my eventual retirement in 2014. I also felt that the typical training program of an elite sprinter didn't quite suit me.

Post-retirement, I took a direct-to-consumer (DTC) genetic test aimed at sportspeople, which highlighted:

- I possess genetic polymorphisms associated with increased risk of sports injury (McCabe & Collins, 2018; e.g., COL1A1, COL5A1, & GDF5; Posthumus et al., 2009). Did this explain my extensive injury history?
- I possess genetic polymorphisms associated with increased post-exercise recovery requirements (e.g., SOD2, IL6, IL6R; Ahmetov et al., 2014; Yamin et al., 2008). Did this explain my UUPS experience?
- I have the *ACTN3* RX genotype, commonly associated with elite speed-power athlete status (Yang et al., 2003). Is this why I was a high-level sprinter?
- I am classed as a slow metaboliser of caffeine, based on my *CYP1A2* genotype (Pickering & Kiely, 2018a). Is this why I could only tolerate lower doses of caffeine—a highly effective ergogenic aid (Grgic et al., 2020)—during my career?

I found the results compelling, believing they explained many of my experiences (*horoscope bias* notwithstanding). Soon after, I began working for a DTC genetic testing company in the role of Head of Sports Science. Over the following years, my roles included delivering genetic testing to sports teams and individuals, as well as heading up the organisation's research program. Through these experiences, I came to the belief that:

- Genetic testing in sport is not useful for talent identification (Pickering et al., 2019). If you compare the genetic profiles of a group of elite athletes—including an Olympic Champion—and compare them to a sample population, the elite athletes do not possess a superior genetic profile (Pickering & Kiely, 2021a).
- Genetic variation likely explains some of the variation in response to a training program, and this response may be somewhat predicted by genetic testing prior (Jones et al., 2016; Pickering et al., 2018).
- Genetic variation in genes like *CYP1A2* and *ADORA2A* influence the ergogenic response to caffeine (Pickering & Kiely, 2018a), and this information may be used to manipulate caffeine use (Pickering, 2019).

These findings were often criticised by academics, both in academic journals (Jones et al., 2017; Karanikolou et al., 2017) and on social media. The general academic consensus is that genetic testing in sport has no scientific basis (Tanisawa et al., 2020; Vlahovich et al., 2017; Webborn et al., 2015); however, around 10% of athletes and sports teams, when surveyed, report using genetic testing to assist performance decisions (Pickering & Kiely, 2021b; Varley et al., 2018). Accordingly, I came to the final pragmatic conclusion that, whilst genetic testing had a limited evidence base, those involved in elite sport were likely to use it anyway, and so we needed to ensure it provided sufficient utility—with this level of utility clearly communicated—whilst sufficiently protecting athletes.

Similar conclusions are reached by McAuley et al. (2023) in their target article, "Talent inclusion and genetic testing in sport: A practitioners guide". This article, and the evidence presented within it, provides a useful and pragmatic first step for practitioners considering the use of genetic testing within their sporting team or organisation.

How is genetic testing undertaken in sports teams now?

McAuley et al. (2023) highlight examples of how genetic testing has been utilised within sport previously. This relies on published accounts, either academic (e.g., Dennis, 2005), or lay (e.g., Williamson, 2014), which can be short on information. I was personally involved in some of these referenced projects (Holmes, 2018; Williamson, 2014), as well as with a number of other sporting teams, organisations, and individuals. Typically, the organisations would make contact with my employers, and I would spend some time with the key performance staff outlining the potential use of the information received, as well as the limitations. Once the performance staff were comfortable, players provided samples to the performance staff, who then provided us with blind samples (i.e., we were unable to identify the player's genetic profiles). I would then spend at least a day, debriefing the results with the performance staff to ensure the results could be placed in context to the best of my knowledge and ability.

Interestingly, and in addition to the explanation regarding the allure of genetic testing by McAuley et al. (2023), some practitioners commented that the results of the test were secondary to instilling the belief in players that no stone was left unturned in their quest for success. Another practitioner commented their belief that players would utilise genetic tests anyway, so at least this way they could control it.

What are the outstanding issues in utilising genetic testing in sport?

Even with the pragmatic approach advocated by McAuley et al. (2023), there are various remaining—and unresolved—ethical and practical barriers facing the utilisation of genetic testing in elite sport.

Genetic testing is primarily available via DTC companies, who have the ability to rapidly collect, test, and report on genetic profiles. There are no regulations governing what genetic data can, and cannot, be reported, and no minimum threshold level of evidence for any particular genetic variant. Accordingly, if an athlete were to take two tests from two different companies, they may get different recommendations, due to the DTC providers reporting on different genetic variants. Making informed decisions on the results provided is, therefore, difficult, especially for non-specialists (athletes) or the time poor (performance support staff).

Other ethical issues have been explored elsewhere (Pickering et al., 2019; Webborn et al., 2015), but include; can athletes under-18 provide informed consent? Where is the data stored? Who can access it? How is anonymity maintained? Who owns the data? Some are partially resolved by McAuley et al. (2023), but some remain. A point highlighted is the minimum necessary principle, with only genetic markers fully relevant to sporting traits explored. The challenge here is knowledge of genetic variants associated with sporting traits is ever increasing (Ahmetov et al., 2016)—if an athlete were to undertake a genetic test now, they may need another one in a few years' time to receive updated recommendations. One potential solution involves collecting whole genome data from the athlete at the initial test, and updating the reporting mechanisms as new evidence comes to light. But what is the burden on the testing organisation that utilises this approach? If an athlete can access their genetic data, what happens if they use third party applications to assess their disease risk in an uncontrolled manner? If an organisation utilises whole genome testing, is there any expectation that they should provide athletes with information of their disease risk, especially if this is performance-relevant? An example of this is variation in *APOE4*, which may influence the risk of neurodegeneration following low-intensity head trauma (Vasilevskaya et al., 2020) as seen in contact sports.

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A final challenge

One potential use of genetic testing promoted by McAuley et al. (2023) is talent inclusion; whilst genetic testing is ineffective at predicting talent, an athlete with a positive polygenic profile, who is otherwise not of the required performance standard, may still be retained. I personally struggle with this rationale; for genetic information to be used in this way, we would require a polygenic profile that is somewhat predictive of talent (we don't have this), and, for it to be useful, we would have to utilise it whilst aspects such as Relative Age Effect, maturation, and training age are exerting a large influence. Typically, this would be before the age of 18, which, given the ethical difficulties around testing under-18s, is challenging. I don't think we need a genetic test for this—instead, we require more wholesale changes in the talent ID process to account for these various biases (accepting that this is difficult), and allowing for delayed talent identification and selection decisions (Baker et al., 2018). This is also in tension with the principle of autonomy; if an athlete is at risk of being deselected, *unless* a genetic test can be performed, are there really no negative consequences for non-participation in the testing procedure?

Conclusion

Coming back to my experiences, I often wonder what I may have done differently, had I received my genetic results at the start of my career. It's tempting to consider I may have changed things, but would I—or my coach and support staff—have been brave enough to make changes against the status quo, with no evidence base to support the decisions? This is where we are left with genetic testing in sport; pragmatically, whilst

there is a desire to utilise it, there is no real evidence, outside of a few initial studies (e.g., Jones et al., 2016; Pickering et al., 2018) supporting its utility (Tanisawa et al., 2020). This is the next challenge for researchers in this field; given that end-users have shown a hunger to utilise genetic testing, can we move away from hypothetical uses of genetic information in sport (e.g., Kikuchi & Nakazato, 2015; Pickering & Kiely, 2018b) towards evidence-informed interventions? In doing so, we will be better positioned to utilise the recommendation by McAuley et al. (2023), and ensure athletes are adequately protected when undergoing genetic testing—an important step for the sporting field.

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