



Pharmacotherapeutic undertreatment of ADHD in elite-level cycling and anti-doping regulations

Preliminary analysis from 2020–2021

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Abstract: *Introduction:* Attention Deficit/Hyperactivity Disorder (ADHD) in elite-level cycling is an overlooked area of clinical enquiry. Whilst former riders have raised awareness about ADHD, there is scant evidence about pharmacotherapeutic treatment levels of this disorder. This is a pertinent concern amidst contemporaneous anti-doping contexts, as common medicines for ADHD are prohibited during active competition by the World Anti-Doping Agency and thus require a Therapeutic Use Exemption (TUE). *Methods:* We conducted a preliminary investigation into pharmacotherapeutic treatment rates of ADHD in elite-level riders. We gathered secondary, publicly-available data about cyclists in the Registered Testing Pool (RTP) from the professional body, the Union Cycliste International (UCI), in 2020 and 2021. We then compared this with the total TUEs for prohibited medications granted on behalf of the UCI during this timeframe. *Results:* 1,265 elite-level riders were included in the RTP sample in 2020, as compared to 10 TUEs. 1,234 elite-level riders were included in the 2021 RTP sample, as compared to 10 TUEs. *Discussion:* Based on these data, we estimate that ADHD may be undertreated in this cohort of elite-level cyclists per general trends. We highlight the adverse mental health effects of medicinal undertreatment for ADHD and its implications for the sport. We also hypothesise potential reasons for this, including stigmatisation, negative conceptions of doping allegations, and possible medicolegal consequences. *Conclusion:* ADHD in elite-level cycling has received little coverage, especially in relation to treatment rates. Detailed research examining this issue and awareness campaigns are required to protect the mental health of elite-level riders.

Keywords: ADHD, cycling, undertreatment, mental health, anti-doping offences

Introduction

ADHD and athletes

A neurodevelopmental disorder with its onset in childhood, Attention-Deficit/Hyperactivity Disorder (ADHD) has a sizable prevalence in adult populations. Estimates are that 2–4.4% of adults have this disorder [1, 2, 3]. ADHD has predominantly been linked to genetic factors and heritability [4], but environmental determinants have also been highlighted [5].

According to the DSM-5, ADHD's core symptoms can be grouped into three presentations hyperactive/impulsive, inattentive, and mixed [6]. "Hyperactivity/impulsivity" can exhibit in behaviours like restlessness, fidgeting, impatience, and short-term relationships (amongst others), and "inattention", may present in characteristics like impunctuality, disorganisation, distractibility, and forgetfulness

(amongst others) [7]. Emotional dysregulation has also been noted as a feature of ADHD, along with the trait of "hyperfocus" [8]. Per DSM-5 diagnostic criteria, five or more symptoms must be evident from the "hyperactivity/impulsivity" and "inattention" groups, and these must present in two or more settings [6]. Effective treatment approaches for ADHD are multimodal and interdisciplinary, encompassing a combination of psychotherapy, psychoeducation, and pharmacotherapy [7].

A burgeoning evidence-base has developed around ADHD in sports. Renowned athletes have publicised their ADHD diagnoses; preeminent examples are Simone Biles, the seven-time Olympic medal winning gymnast, and Michael Phelps, the most decorated swimmer in history [9]. Significantly, research suggests that ADHD may have an elevated presentation in athletes as compared to the general population. Han et al. have approximated this to be between 7–8% [10]. Other samples had a prevalence of

10.1% [11] and 14.3% [12]. Correlations between ADHD and neurocognitive deficits in athletes have also been observed [13]. Furthermore, studies have examined the implications of ADHD symptoms within a competitive sporting environment. Nelson et al. have illustrated higher athlete safety and injury risks, notably for concussion [14], and White et al. note that ADHD's symptoms may adversely affect participation in team sports [15]. Contrastingly, some have suggested that ADHD may theoretically entail competitive advantages, as impulsivity and "hyperfocus" could improve decision-making and increase performance levels [10].

In the context of anti-doping regulations, athletes with an ADHD diagnosis who require substances prohibited by the World Anti-Doping Agency (WADA) for their treatment programmes need a Therapeutic Use Exemption (TUE). TUEs are granted by an appropriate anti-doping regulator, which is conditioned by the nature of the event and the athlete's competitive level; this may be a National Anti-Doping Organization (NADO) or a sporting governance federation. The TUE application process typically involves a comprehensive summary of relevant symptoms, diagnoses, medical history, and tests, before clinical validation and a TUE decision [15, 16]. An example of a WADA requirements checklist for ADHD TUE applications can be found in [17]. Generally, when granted, TUEs are annually reviewed and may be applicable for longer periods if continuous treatment is necessary [15, 16, 18].

Sporting governance, anti-doping, and ADHD in elite-level cycling competitions

Worldwide, elite-level cycling is governed by the Union Cycliste Internationale (UCI), which manages international events covering road cycling, track cycling, mountain biking, BMX, indoor cycling, and cyclo-cross. The UCI is responsible for classifying races, administering points and ranking systems, and introducing and enforcing policies. Within this body, there are over 5,000 riders, who compete as part of around 600 registered teams across various events [19]. Teams are usually professional organisations with commercial sponsors, management staff, coaches, and in-house physicians or medical expertise. Nonetheless, the specific discipline, competitive level, and funding provisions may determine a team's makeup.

The UCI oversees anti-doping regulations for international-level riders, whereas NADOs are responsible for national-level riders [20]. To that end, the UCI has established a Registered Testing Pool (RTP), predicated on stipulated parameters. Namely: "All professional men road riders (from WorldTour teams and Professional Continen-

tal Teams)", "The best ranked athletes in all cycling disciplines, including but not limited to road, track, mountain-bike, cyclo-cross, BMX and para-cycling (road and track)", and "Other criteria based on performances and intelligence" [21].¹ Separately, the UCI also has its own Medical Rules and breaches can result in financial penalties or temporary suspensions for repeat offences. However, contravening these regulations does not necessarily constitute a recognised anti-doping infringement [22].

Since 2021, the UCI has delegated its anti-doping procedures to the International Testing Agency (ITA), an independent organisation established under the guidance of WADA and the International Olympic Committee, to provide neutral expertise. The ITA handles anti-doping programmes for sporting federations and during major events, like the 2022 Tokyo Olympics. Alongside other services for the UCI, the ITA is responsible for testing and administering TUEs for the cohort of elite-level riders within the RTP [18, 23]. A committee of medical specialists appointed by the ITA assesses TUE applications [24]. As TUEs can be granted for numerous medical conditions and substances, these experts cover a range of clinical areas, including psychiatry and sports psychiatry [24].

Generally, public knowledge is growing about psychological issues in elite-level cycling. Popular media is increasingly covering this subject (e.g. [25]). At an institutional level, since the ITA was appointed to conduct anti-doping programmes, there has been a renewed emphasis on mental health awareness; the ITA recently hosted a webinar about mental health within the framework of anti-doping [26]. Nevertheless, as highlighted by Currie and Lunn, there is sparse scientific evidence about psychiatric disorders and elite-level cycling [27].

This knowledge-gap is notable in relation to ADHD, especially given the substantial research about this disorder across different sporting disciplines, as previously outlined. Moreover, akin to other sports, prominent former cyclists have discussed ADHD after their career. For instance, Greg LeMond, a three-time Tour de France winner, revealed his symptom presentations: "the teachers recommended for one of my kids to go see a doctor for ADD [. . .] just as they were getting examined I'd read this thing 20 questions [. . .] and I had every one of them" [28]. Similarly, a fellow Tour de France champion, Jan Ullrich disclosed his ADHD diagnosis [29]. Despite these anecdotal accounts, to the authors' knowledge, there are no published studies examining this disorder in current elite-level riders, especially in relation to pharmacotherapeutic treatment levels. Accordingly, we sought to gain a preliminary insight within the context of anti-doping regulations, to identify open questions, and to raise awareness about this topic.

¹ Our use of the term "elite-level cycling" throughout this paper follows these definitional criteria as stipulated by the UCI.

Table 1. Elite-level riders in UCI RTP and number of granted TUEs 2020–2021

Year	Number of riders in the UCI RTP	Number of TUEs granted on behalf of the UCI (for any WADA-prohibited substance)
2020	1,265	10
2021	1,234	10

Methods

Secondary data analysis formed the basis of our investigation. We collated information about the number of elite-level riders included in the UCI RTP and the total number of granted TUEs for all medical conditions between 2020 and 2021.

All sources were publicly accessible via an internet search. Current UCI RTP information is updated annually and is accessible on the UCI website (e.g. [30]). Similarly, figures for granted TUEs are updated yearly and are available through the ITA website [18]. After cross comparing RTP and TUE data, we then contacted the ITA to verify our understanding of this information.

Results

The cross-comparison of elite-level riders in the UCI RTP and the number of granted TUEs is shown in Table 1. Based on these data, there were 1,265 elite-level riders in the UCI RTP in 2020 and 1,234 riders in 2021. Of these, 10 elite-level riders were granted a TUE for a medical condition in 2020 and 2021. No further materials within these time periods were obtainable from these data.

Discussion

ADHD pharmacotherapeutic undertreatment in elite-level cyclists in the UCI RTP 2020–2021?

The TUEs in our results refer to any medical condition, not solely ADHD; from these data, there is no means of distinguishing between different pharmaceuticals or medical conditions. Nevertheless, if we were to assume the highest case scenario that all 10 TUEs in both years were granted for ADHD, this would indicate a treatment rate of 0.79% for this cohort of elite-level cyclists in 2020 and 0.81% in 2021. In the alternative lowest case scenario, if we were to assume that 0 TUEs were granted for ADHD, this would signify a treatment rate of 0% in this sample over this time period. Both the lowest and highest case scenarios suggest a lower treatment rate for ADHD in these elite-level cyclists,

as compared to 20% that has been found in the general adult population [31].

It should be noted that treatment levels are not a proxy for prevalence rates in this sample. This could be ascertained through more granular secondary data or collating primary data, as discussed in the limitations. Moreover, pharmacotherapeutic treatment represents a single aspect of multimodal treatment programmes for ADHD. However, it is a particularly pertinent concern within the context of antidoping frameworks, as commonly-prescribed medicines for ADHD have been found to contain ergogenic properties and can increase sporting levels or have physiological effects, although evidence is mixed [15, 16, 32, 33]. WADA has prohibited typical ADHD pharmacotherapeutics as stimulants in active competition, including Amphetamine, Methamphetamine, and Methylphenidate [32, 34]. There are suggestions that these substances may inhibit thermoregulation and increase rates of heat-illness in cyclists, depending on the dosage [35]. Nonetheless, we believe that the consequences of pharmacotherapeutic ADHD undertreatment outweigh this risk, as we outline below.

Consequences of insufficient pharmacotherapeutic ADHD treatment in elite-level cycling

From a sporting perspective, insufficient treatment for ADHD will likely affect sporting ability. Perhaps more so than other activities, being a successful cyclist entails dedication, intense training and focus, continuous discipline and concentration, and a sustained emphasis on teamwork and data-driven analytics. Amongst other attributes, all of these could be adversely influenced by ADHD symptomatology [8].

Elite-level cycling comprises high speeds and potential risks of crashes and injuries for cyclists and spectators. Recently, competitors and spectators were hurt in a track-cycling crash at the 2022 Commonwealth Games [36] and there have been other dangerous collisions across various disciplines. After an incident at the Tour de France in 2021, the UCI President discussed the reasons for such events: “the majority of crashes are due to a lack of attention but I can understand them [the riders], they are so stressed out during the entire day. And inevitably it’s edgy, everybody wants to be up there [in the peloton]” [37]. The frequency of these accidents may be heightened a lack of

attention, impulsivity, and risk-taking, which, importantly, are all key symptoms of ADHD. Notably, the UCI has emphasised rider safety in relation to other pharmaceuticals. Albeit not outlawed by WADA, Tramadol was prohibited by the UCI's in-house medical regulations for "nausea, drowsiness and loss of concentration (increasing the risk of race crashes)" [38].

As with other psychiatric disorders, the undertreatment of ADHD may entail psychological and social implications and increase the likelihood of comorbidities [39]. For example, research shows that individuals with ADHD had a 4–9 times higher rate of anxiety, depression, bipolar and personality disorders, schizophrenia and substance use disorder compared to the general adult population [40]. Further, ADHD has correlates with comorbid eating disorders [41], which is significant as eating disorders and related behaviours have been observed amongst elite-level riders [42].

In addition, it should be re-emphasised that the list of WADA's banned substances for ADHD are relevant only during active competitions [34]. With this in mind, it is not inconceivable that a cyclist could be using ADHD pharmacotherapeutics outside of competitions; this is not determinable from our results. From our point of view, this is unlikely, because ritalinic acid as an (inactive) metabolite of methylphenidate (MPH) is still detectable in urine 72 hours after ingestion. Some authors suggest discontinuing MPH at least 4 days before competition, in order to stay below WADA's limit of 300 ng/ml ritalinic acid [43].

Nevertheless, the possibility of an on-off pharmacotherapeutic programme for ADHD outside- and inside-competition raises mental health concerns. Intermittent psychotherapeutic treatment and medication breaks for ADHD have been associated with poorer long-term outcomes [44] and WADA's ADHD guidelines strongly discourage this practice [45]. We acknowledge that some therapists may decrease or discontinue pharmacotherapeutic dosages for ADHD for several reasons [46]. However, we believe this is not appropriate during a competitive sporting event and may provoke compensation strategies, including self-medicating, which in turn could have adverse health consequences and increase the risk of anti-doping offences.

Reasons for insufficient pharmacotherapeutic ADHD treatment in elite-level cycling

In our view, there are several hypotheses for why ADHD may be undertreated in elite-level cycling.

Firstly, riders may not wish to apply for a TUE because of stigmatisation patterns. As research has found, adulthood

ADHD remains a misunderstood and stigmatised disorder [47]. Burch illustrates the paucity of general awareness, which can lead to higher levels of public- and self-stigmatisation [48]. The internalisation of stigma and the self-anticipation of societal discrimination are prevalent in adults with ADHD, which may aggravate psychosocial issues and lead to social withdrawal [49]. Accordingly, with their elevated status in the public eye as international competitors, it is plausible that elite-level cyclists may not wish to disclose an ADHD diagnosis. Whilst anti-doping agencies seek to uphold confidentiality about TUEs, there have been previous incidents where cyclists' medical data has been publicly revealed, which might exacerbate this hesitancy [50].

Athletes who use prohibited medications could experience stigmatisation from the public and their peers. Societal attitudes are often sceptical towards TUEs, with suggestions that athletes are attempting to gain a competitive advantage by using a prohibited medicinal substance. These controversies have been discussed in relation to elite-level riders [51]. Such conceptions may also be relevant for fellow competitors; in a questionnaire of athletes across various sports, Overbye and Wagner found that 51% of respondents believed that fellow competitors were using therapeutics without a legitimate medical condition [52]. Allen et al. have argued that such factors could prevent an athlete from divulging their diagnosis or applying for a TUE to avoid perceptions of cheating [53]. This may be particularly pertinent within elite-level cycling, where notorious doping transgressions have undermined perceptions of sporting integrity for competitors and spectators alike [54].

Furthermore, athletes require extensive knowledge about anti-doping regulations and are solely liable for any substance use [53]. Yet, studies have identified a lack of understanding about these issues [55], which could lead to an increased chance of anti-doping violations, especially for those who are self-medicating. Fear of offence-related recriminations may hinder help-seeking behaviours and TUE applications, and in some countries doping violations entail criminal charges [56]. The appeal process for anti-doping violations is often complex and can involve an appeal to the Court of Arbitration for Sport (CAS). Significantly, CAS was recently found to have violated an athlete's constitutional "right to justice" in a doping case in Germany [57]. Accordingly, it is possible that cyclists with an ADHD diagnosis may be deterred from seeking a TUE for medico-legal reasons, prioritising a risk to their career over a risk to their health.

Paradoxically, ADHD symptomatology has been associated with sporting advantages [10], which may also affect TUE applications. For instance, riders may conceivably deem traits like increased risk-taking and impulsivity as

giving them a competitive edge in elite-level cycling. Consequently, this perception could also reduce treatment levels. In our view, more research is needed to evaluate individual motivations and attitudes towards the TUE process for psychiatric disorders, including ADHD.

Limitations

We deemed our approach to be the best-available method to gain a preliminary insight into this underreported subject. However, our study is not without its limitations.

Firstly, we used publicly available secondary datasets from two different sources as the basis of our investigation. Secondary information from multiple sources may raise concerns about data availability, validity, and reproducibility, which cannot be discounted in our results [58]. Moreover, the UCI RTP data lacks granularity. For example, there is no information about age, sex, or cycling disciplines of individual riders, which obstructs more detailed analysis. Correspondingly, the ITA TUEs refer to the total TUEs granted for all medical disorders and pharmacological substances, and are not solely related to ADHD or ADHD medicines. In addition, the TUE data does not provide indications as to the use of ADHD pharmacotherapeutics outside of active competitions.

By focusing on elite-level riders in the UCI RTP who would need to apply to the ITA for a TUE, our study only included a subset of the total number of professional cyclists affiliated with the UCI (roughly 25% of the total number of UCI registered riders); the inclusion criteria of the UCI RTP has been previously criticised on social media as omitting key competitors [59]. Future studies could incorporate a wider cohort of cyclists, such as those whose TUEs are handled by their respective NADO, or amateur-level riders. This would allow for the collection of broader and more in-depth evidence.

Due to data availability constraints, our results pertain to a two year time-period (2020 and 2021). Analysing information over a lengthier duration could produce more robust evidence, enabling longer-term trends to be interpreted.

Given these limitations, our study is not intended to be an exhaustive overview, but rather seeks to raise awareness and provide preliminary insights into potential ADHD undertreatment in a cohort of elite-level cyclists in 2020 and 2021. Others have used secondary data in a similar way when looking at anti-doping and TUEs [60]. Consequently, we hope this forms the starting-point for primary research in this area. As a next step, studies involving the participation of current or former riders could be conducted to fully scrutinise this topic, although sample sizes may be limited owing to potential difficulties in recruiting elite-level cyclists during active competition.

Conclusion

ADHD in elite-level cycling has received little coverage in scientific literature, especially in relation to treatment rates. For us, this is a particularly timely area of clinical enquiry amidst contemporaneous anti-doping policies. This may also be a more generalisable concern within other disciplines given the relatively low proportion of granted TUEs as compared to total competitors. Further research is needed across different sports.

We cross-referenced data about riders in the UCI's RTP with the total number of granted TUEs in this cohort between 2020 and 2021. Using this, we suggest that ADHD is likely undertreated amongst this group of elite-level riders. We outline the adverse effects of this and hypothetical causal factors. Our study provides a preliminary insight into this subject and we hope it raises awareness about ADHD within the sport.

In our view, increased education campaigns and knowledge-exchanges amongst psychiatrists, team physicians, and anti-doping agencies about ADHD are required to ensure the safety and welfare of elite-level riders. This is necessary to protect the notion of fair-play and uphold sufficient provisions of mental healthcare, thus providing a balance between sporting integrity and individual wellbeing.

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