



Asthma medication in athletes: a qualitative investigation of adherence, avoidance and misuse in competitive sport

Hayden Allen, Oliver J. Price, James H. Hull & Susan H. Backhouse

To cite this article: Hayden Allen, Oliver J. Price, James H. Hull & Susan H. Backhouse (2022) Asthma medication in athletes: a qualitative investigation of adherence, avoidance and misuse in competitive sport, Journal of Asthma, 59:4, 811-822, DOI: [10.1080/02770903.2021.1881968](https://doi.org/10.1080/02770903.2021.1881968)

To link to this article: <https://doi.org/10.1080/02770903.2021.1881968>



© 2021 The Author(s). Published with license by Taylor & Francis Group, LLC.



Published online: 08 Mar 2021.



[Submit your article to this journal](#)



Article views: 1134



[View related articles](#)



[View Crossmark data](#)



Citing articles: 3 [View citing articles](#)

Asthma medication in athletes: a qualitative investigation of adherence, avoidance and misuse in competitive sport

Hayden Allen, MRes^a , Oliver J. Price, PhD^{a,b} , James H. Hull, PhD^{c,d}  and Susan H. Backhouse, PhD^a 

^aCarnegie School of Sport, Leeds Beckett University, Leeds, UK; ^bLeeds Institute of Medical Research at St. James's, University of Leeds, Leeds, UK; ^cDepartment of Respiratory Medicine, Royal Brompton Hospital, London, UK; ^dInstitute of Sport, Exercise and Health (ISEH), UCL, London, UK

ABSTRACT

Objectives: The purpose of this qualitative study was to utilize the Capability, Opportunity, Motivation - Behavior model (COM-B) to: (1) evaluate athlete knowledge and understanding of current asthma-related anti-doping regulations, (2) explore the impact of environmental and societal influences on athletes with asthma, and (3) examine athlete perception of asthma medication use in competitive sport.

Methods: Semi-structured interviews were conducted with ten competitive endurance athletes (five athletes with asthma and five without asthma). Interviews were guided by the COM-B model and transcripts were analyzed inductively and deductively using reflexive thematic analysis.

Results: Mapping the experiences and perceptions of athletes against an established behavioral framework identified that: (1) athletes' possess limited knowledge and understanding of the World Anti-Doping Agency (WADA) Prohibited List and Therapeutic use exemption (TUE) policy with respect to asthma medication; (2) the use of sub-optimal diagnostic methods is commonplace and increases the risk of misdiagnosis and unnecessary inhaler therapy; (3) negative media portrayal of high-profile asthma-related doping allegations impacts public opinion and contributes to the perception of wrongdoing within the sporting community.

Conclusion: The novel application of behavioral science highlights several factors that may contribute to asthma medication avoidance and promote misuse in competitive sport. The findings from this study provide a foundation for the development and implementation of targeted education programmes, and it is hoped that employing this approach will ultimately improve overall perceptions of asthma treatment in athletes, which is necessary to maintain respiratory health, optimize performance and protect the integrity of sport.

ARTICLE HISTORY

Received 1 October 2020

Revised 21 January 2021

Accepted 24 January 2021

KEYWORDS

Treatment; education; exercise induced

Introduction

Multiple high-profile elite endurance athletes have been implicated in anti-doping cases for the use of asthma medication over the past decade (1,2). In 2016, Russian espionage group 'Fancy Bears' released confidential data highlighting asthma medication use requiring a therapeutic use exemption (TUE) in elite sport (3). Although there was no evidence or suggestion of anti-doping rule violations, an apparent resentment appears to be building toward athletes who are using asthma medication (4,5). This is despite the fact that many recommended and commonly prescribed asthma therapies (other than systemic administration of corticosteroids to treat acute severe exacerbations) are currently permitted by the World Anti-Doping

Agency (WADA), without requirement for a TUE (for review see Allen et al. 2019) (6).

It has been proposed that the current stigma associated with the use of asthma therapy and/or fear of breaching anti-doping regulations may actually be contributing to therapy non-adherence in some athletes (7). Conversely, the perception of asthma medication providing some form of performance enhancement may actually promote the use of unnecessary inhaler therapy in some individuals (i.e. athletes seeking performance gain). This is despite the fact that no definitive evidence currently exists to support the performance enhancing properties of asthma medication - particularly when administered at standard prescribed inhaled doses (8,9).

CONTACT Hayden Allen  hayden.allen@leedsbeckett.ac.uk  Carnegie School of Sport, Leeds Beckett University, Leeds LS6 3QT, UK.

© 2021 The Author(s). Published with license by Taylor & Francis Group, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

To navigate the complexity surrounding asthma therapy in elite sport and provide insight into the factors that may encourage medication avoidance or promote misuse, it is important to consider the experiences and beliefs of those involved or directly affected. The behavioral system proposed by Michie and colleagues (10) in which Capability (C), Opportunity (O) and Motivation (M) interact to influence Behavior (B) (COM-B) is an established framework that has recently been suggested to offer value in this setting (6).

The purpose of this qualitative study was therefore to utilize the COM-B model to: (1) evaluate athlete knowledge and understanding of current asthma-related anti-doping regulations, (2) explore the impact of environmental and social influences on athletes with asthma, and (3) examine athlete perception of asthma medication use in competitive sport.

Methodology

Research design

Face-to-face semi-structured interviews were conducted in order to achieve detailed and multi-layered insights (11) which were subsequently thematically analyzed and mapped to the COM-B model (10). Specifically, the model proposes that for any behavior to occur a person must have the psychological and physical capability to perform a behavior (i.e. knowledge and skill); the physical (environmental resources) and social opportunity to engage in it (i.e. social influences), and they must be motivated due to conscious (reflective) and unconscious (automatic) brain processes. In the context of athletes and asthma medication, it has been proposed that capability, opportunity and motivation may include, but are not limited to, knowledge of the Prohibited List, interaction with support personnel or clinicians, and the perceived consequences of using asthma medication, respectively (6). The COM-B model is a meta-theory created from a systematic analysis of nineteen existing behavior intervention frameworks (10), that has been utilized to investigate other complex behaviors in athletes (e.g. nutritional adherence) (12). This study is situated

within an interpretive paradigm, whereby reality is recognized as being multi-layered and complex. When seeking to understand a phenomenon of interest, interpretivists acknowledge the existence of multiple meanings and interpretations (13). In view of the limited knowledge on this topic, a qualitative study was deemed to be most appropriate as the methodology can provide a valuable source of new ideas and information, particularly in relation to how athletes interpret and interact within their competition and training environment. Participants received study information and provided written informed consent prior to the interviews. All interviews were conducted individually, in a convenient location by the investigator (HA) and were audio-recorded.

Study population and data collection

Following approval from the local Research Ethics Committee, purposive sampling was employed to recruit ten athletes (five athletes with a physician diagnosis of asthma prescribed inhaler therapy and five without asthma) involved in previous research studies of the Clinical Exercise and Respiratory Physiology Research Group, Leeds Beckett University (14,15). Purposive sampling describes the inclusion of individuals that provide a rich and detailed insight into the research question (16). All athletes had prior experience of competitive endurance sport in events governed by national anti-doping policy (i.e. potential for doping control) but were not currently registered on the anti-doping administration management system (ADAMS) (Table 1). Semi-structured interviews include a short list of guiding questions that are supplemented with follow-up, probing questions, dependant on the participant's response. In the present study, interview questions were guided by the COM-B model and tailored specifically for athletes with and without asthma. Interview frameworks were initially trialed to ensure coherence and the final interview guide included questions regarding competition and sports performance in order to build rapport (e.g. can you tell me about what you do, if anything, to

Table 1. Study population.

ATHLETE	SEX	AGE (YRS.)	SPORT	EXPERIENCE (YRS.)	STANDARD	ASTHMA	MEDICATION
1	Male	23	Triathlon	4	Elite	No	–
2	Male	22	Triathlon	4	Elite	No	–
3	Male	25	Cycling	4	Sub-elite (Regional)	Yes	Budesonide and salbutamol
4	Male	20	Cycling	3	Sub-elite (National)	No	–
5	Male	28	Cycling	2	Sub-elite (Regional)	Yes	Fluticasone propionate and salbutamol
6	Male	41	Cycling	5	Sub-elite (Regional)	Yes	Salbutamol
7	Female	23	Triathlon	5	Elite	Yes	Beclomethasone and salbutamol
8	Male	19	Cycling	3	Sub-elite (National)	Yes	Salbutamol
9	Female	24	Triathlon	4	Elite	No	–
10	Male	32	Cycling	3	Sub-elite (Regional)	No	–

optimize your performance?). Subsequently, experiences and the perception of asthma medication use in sport were considered (e.g. ‘You have a diagnosis of EIB or asthma and I am keen to hear about your experiences of the condition and the treatment’, ‘do you feel asthma impacts your ability to participate or compete in sport?’ and ‘do you have a peer or fellow athlete that uses asthma medication?’) before moving on to athletes knowledge and understanding of anti-doping rules and regulations (i.e. permitted and prohibited asthma medication and the current TUE policy) and perceptions of asthma medication use.

Data analysis and interpretation

The interviews lasted approximately one hour in duration and were transcribed verbatim and managed using NVivo 12 (QSR International, Australia). Interview transcripts were analyzed inductively and deductively using reflexive thematic analysis (17). First, the transcripts were read and re-read, to familiarize with the data and assist the second phase of the analysis. Second, initial codes were assigned to excerpts of the data. Third, all the codes were organized into potential themes that

reflected the content and meaning of the data; this stage was guided by components of the COM-B (10). Fourth, the themes were reviewed and refined. Fifth, the themes were labeled and defined. Sixth, the analytic narrative presented in this manuscript was drafted, reviewed and refined. HA and SB engaged in frequent collaborative and reflexive discussion and interpretation of the findings throughout the six-stage reflexive thematic analysis process. OP and JH contributed to the analytical process during phases five and six.

Results

Descriptions of the main findings are organized according to the inductive theme, with the associated deductive COM-B component shown in parentheses. Codes and data assigned to each theme (i.e. athlete quotes) are presented in Tables 2–5. The main findings are aligned to the COM-B model in Figure 1.

Asthma medication and anti-doping regulations (psychological capability)

Limited knowledge and understanding of the WADA Prohibited List and TUE policy with respect to asthma

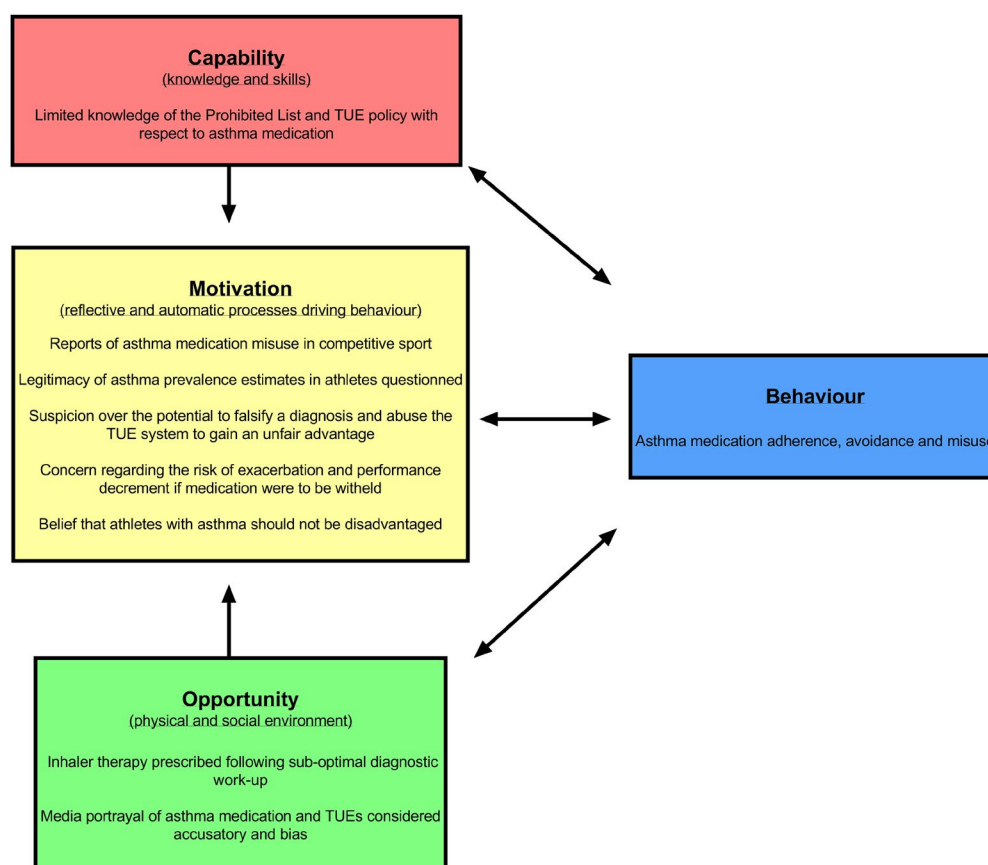


Figure 1. The main findings aligned to the Capability, Opportunity, Motivation Model of Behavior (COM-B) (10).

medication was demonstrated by all athletes. Although some athletes acknowledged that common reliever therapies such as inhaled salbutamol have a maximum permitted dose and that the route of administration (i.e. inhaled vs. oral treatment) is relevant in the context of anti-doping - none of the athletes were able to articulate any further specific details regarding a recommended dosage, strength or permitted limits. Likewise, most athletes provided a superficial overview concerning the therapeutic effects of reliever and maintenance asthma therapy. Despite apparent gaps in knowledge, only one athlete with asthma reported that they had previously sought guidance from their primary care physician or team doctor regarding permitted treatment levels. Those without asthma considered they may have limited knowledge as they are not personally affected by the condition (Table 2).

Screening and detection methods (physical opportunity)

Asthma medication was most frequently prescribed following a symptom-based diagnosis; i.e. athletes reported receiving inhaler therapy having presented to their physician reporting troublesome exercise-related respiratory symptoms. In the few athletes who underwent objective testing, baseline spirometry or peak expiratory flow (pre-and-post exercise) were the most commonly employed diagnostic methods. Although one athlete attended an annual asthma review, none of the athletes had previously been referred for specialist testing (i.e. assessment of airway inflammation or indirect bronchial provocation) to confirm a diagnosis and inform treatment (Table 3).

Media impact and public views (social opportunity)

Media portrayal of asthma medication use and TUEs in elite sport was considered accusatory and bias by all athletes and interpreted as a strategy to attract interest and increase readership. The opinion of most was that the negative press surrounding recent high-profile asthma-related doping allegations impacts public opinion and contributes to the perception of wrongdoing within the sporting community. Of concern, some athletes confirmed that they had previously avoided using asthma medication due to the negative associated connotations. Likewise, experiences of peers being reluctant to administer asthma medication in public due to fear of criticism (i.e. risk of being labeled a cheat) were shared (Table 4).

Athlete perception of asthma medication in sport (reflexive motivation)

The potential for asthma medication misuse in competitive sport was voiced by athletes with and without asthma. Specifically, short-acting inhaled bronchodilators were believed to improve 'in-exercise' ventilatory function, whereas maintenance therapies (i.e. inhaled and oral steroids) were associated with favorable physiological adaptation (i.e. increased muscle mass and reduced body fat) and improved recovery time between training sessions. Several athletes questioned the legitimacy of current prevalence estimates (i.e. why do so many elite sportsmen and women have asthma?) and expressed concern regarding the potential to falsify a diagnosis and abuse the TUE system with a view to gain an unfair advantage. In contrast, some athletes held the belief that athletes with asthma should not be disadvantaged due to an underlying health condition - and that medication is justified in this instance in order to 'level the playing field'. All athletes with asthma raised concern over the risk of exacerbation and potential for performance decrement if inhaler therapy was to be withheld (Table 5).

Discussion

This study is the first to qualitatively examine athlete knowledge of asthma-related anti-doping regulations and perceptions of asthma medication use in competitive sport. The novel application of the COM-B model (i.e. mapping the experiences and perceptions of athletes against an established behavioral framework) has identified several factors that may interact to contribute to medication avoidance and promote misuse in those seeking performance gain.

The current WADA Prohibited List states that athletes are permitted to administer inhaled salbutamol ($\leq 1600 \mu\text{g}$ in 24-h and $800 \mu\text{g}$ in 12-h), formoterol ($\leq 54 \mu\text{g}$ in 24-h), salmeterol ($\leq 200 \mu\text{g}$ in 24-h), inhaled vilanterol ($\leq 25 \mu\text{g}$ in 24-h) and inhaled corticosteroid maintenance therapy - whereas all other inhaled and systematic beta-2-agonists and oral corticosteroids are prohibited without a TUE (the process required to use an otherwise prohibited substance or medication dose) (updated annually: www.wada-ama.org/) (18,19). A key finding from the present study was that the majority of athletes possessed limited knowledge of anti-doping regulations (i.e. either the Prohibited List or TUE policy) with respect to asthma therapy, which is in line with similar findings from previous anti-doping research in both elite and recreational athletes (20-22).

Table 2. Asthma medication and anti-doping policy (psychological capability).

CODES	ATHLETE QUOTES
Medication	<ul style="list-style-type: none"> • 'Maybe if I knew a little bit more about it, or maybe if I was asthmatic myself, I'd probably be more aware of the level that the lads take and how it would affect the sport' (athlete 1: non-asthmatic). • 'I think it depends if it actually helps, I don't really know much about the science behind it and stuff so if you take too much of something does it actually help you?' (athlete 2: non-asthmatic). • 'I know a bit about exercise-induced asthma and inhalers and how they work and things but I'm not too knowledgeable on what advantages it's gives somebody' (athlete 6: asthma). • 'It's not like every puff you take brings all your airways further and further out so you get like loads more oxygen or something, it just doesn't work, you don't change physiology that acutely' (athlete 9: non-asthmatic).
Prohibited List	<ul style="list-style-type: none"> • 'Not officially, I don't know. I know that it's maybe a couple of puffs of the inhalers roughly allowed but I wouldn't know what's the right amount or wrong amount...I'm quite ignorant to that' (athlete 1: non-asthmatic). • 'My understanding is that broadly most things that are inhaled are basically fine' (athlete 5: asthma). • 'I remember asking the doctor at the time, you know in principle I'm subject to, you know, is this stuff okay?' (athlete 5: asthma). • 'To be honest I'm not certain because I've never really looked because I've never been... if I'd been prescribed it by the doctors or something like that then you look more and check. I know enough people use inhalers, but I know the other ones contain steroids. Obviously if I was given anything else then I'd look it up but because I've never taken it, I've not really looked into it. I mean I think you can take it, but you have to declare it don't you...'(athlete 6: asthma). • 'I know that I'm allowed to take salbutamol but only up to a certain limit a day, is it 1600 or...800?' (athlete 7: asthma). • 'At one point when it felt like it was really bad, (I) got Beclotide and that is allowed which I found surprising because it's more long acting' (athlete 7: asthma). • 'I just remembered that I also know that there's some situations where they are banned in conjunction with other things because their name comes up in the WADA list somewhere else. The beta-2-antagonist or something comes up somewhere else as it can be a sign of a masking agent if you've used it with something else' (athlete 7: asthma). • 'I think a lot of the, what is it, so preventer style medications are sort of prohibited unless you have a TUE umm and then even, and then there's a limit as to how much you can take from there, umm, so yes, there might be some completely prohibited I'm not entirely sure but so you know sort of, a lot of, sort of, that sort of style medication is' (athlete 8: asthma). • 'Not really...I think that the blue one is okay but you can't exceed a certain limit and it's the same with the steroids ones as well isn't it...but I think you have to get TUEs because they're steroid ones but I don't really know' (athlete 9: non-asthmatic).
TUEs	<ul style="list-style-type: none"> • 'To my knowledge a TUE is a... substance that is sanctioned by the governing body for an athlete to use because it levels the playing field for that athlete. So, with asthma, your allowed to take your inhaler... well I guess the thought process is that it puts that athlete at a level of an athlete who doesn't have asthma' (athlete 3: asthma). • 'I wouldn't say I'm an expert but I'm vaguely aware that they have to get a doctor to diagnose them and say that he needs more than just the normal inhaler and he can have the corticosteroids or whatever it is, if it's a good idea for them' (athlete 5: asthma). • 'I mean, depends what lab tests they've got or things like that, I don't know how you get it, how you test somebody really so I'm not that knowledgeable' (athlete 6: asthma). • 'No, I have no idea. I thought you just needed a TUE by going to your doctor and requesting that they provide proof for you for whatever symptom it was' (athlete 7: asthma) • 'I'm not entirely sure what the rules are on getting a TUE and which doctors are allowed to diagnose you' (athlete 8: asthma).

Although some athletes in the current study recognized that the dose and route of administration impacts the permitted or prohibited status of asthma medication, the majority demonstrated uncertainty, which in turn, may contribute to medication avoidance (i.e. due to concerns of committing an anti-doping rule violation) or inadvertent medication misuse (i.e. reliance on inhaled

short-acting reliever therapy) (6). In the context of asthma management, medication avoidance is recognized to impact long-term respiratory health (i.e. deterioration in condition) (23), whereas the adverse effects of regular high-dose beta-2-agonist therapy have been recognized for some time (24); including a heightened risk of severe exacerbation and incidence of asthma-related death (25).

Table 3. Screening and detection methods (physical opportunity).

CODES	ATHLETE QUOTES
Diagnosis	<ul style="list-style-type: none"> • ‘Eventually I got it looked at and they did gave me a blowy reader thing, asked me to track my max output or peak output, peak flow I guess you’d call it, consistently throughout the day so in the morning, in the evening, but then also do it when I was exercising. After I’d exercised and, on the graph, you could see when I had come back from exercise my peak flow would drop drastically from what it was in the morning and in the afternoon. They basically deduced it was exercise-induced asthma and put me on a prescription of the steroid inhaler 2 puffs in the morning 2 in the evening and then they also gave me the blue one as well’ (athlete 3: asthma). • ‘I think it was before I started cycling, so it’d probably have been around 2014-15, I had a bad cough for a while and went to the doctor and said yeh you you’ve got fairly moderate to severe asthma. and they gave me the steroid inhaler. It’s a mixed kind of long-term reliever/steroid thing and I was on that for a year, and then I went off that and I seemed I’ve always had the blue Ventolin and I’ve still got that’ (athlete 5: asthma). • ‘A few people had sort of said you might have asthma so went to the GP. Sounds like it could be asthma, or exercise induced asthma, try an inhaler and I did try the inhaler’ (athlete 6: asthma) • ‘I reported the symptoms and he said well it sounds like sports induced asthma he says, I’ll prescribe you an inhaler and see if that works’ (athlete 6: asthma). • ‘I went to the doctor about it and he prescribed me a Ventolin inhaler and he didn’t actually tell me that it meant I had asthma... he just gave me the inhaler for clearing the cough which it did but then I went to the doctor and I mentioned to the doctor when I was I seeing him about something else that I had gotten this inhaler for coughing and he said well he wouldn’t have prescribed it if you didn’t have cough, if you didn’t have asthma even, if you even if it was initially for the cough or something like that. I think that was all that came of it and I didn’t really think that much about it. I was kind of like... maybe I do have some form of asthma, but I don’t really know...he said that if they prescribed it, that means you’ve got asthma and you should be using it for sport’ (athlete 7: asthma). • ‘I went to see someone and I said, it wasn’t a repeat prescription because I got my last one from an Irish doctor, I’ve got exercise-induced asthma, and my inhalers run out, and I brought my inhaler to show them and then they did the spirometry test then he just prescribed me’ (athlete 7: asthma). • ‘So every year I have to go and see a doctor or a nurse and they assess whether I need continue to have a prescription for the following year...it wasn’t anything major, I remember they’d ask me a few questions and I’d do a couple of puffs on the peak flow’ (athlete 8: asthma).

Table 4. Media impact and public views (social opportunity).

CODES	ATHLETE QUOTES
Media	<ul style="list-style-type: none"> • ‘I think because he is so good it means that people look for scapegoats for why he’s so good. They don’t look at the fact of how much training he does or that fact that he’s got a good somatotype and body type for it, he’s naturally lean, or they don’t look at things like that. They just look at he’s doing this performance, he’s on this drug and I think they just assume... whereas in the peloton there’s, you know, I remember seeing a stat, there’s a crazy amount of people have exercise-induced asthma within the peloton. It’s stupidly high but it’s only people like him that are doing exceptionally well that get the sticks. I feel like it’s probably unjust the amount of stick that’s he’s getting but it’s because he’s such a high profile, he’s done so well. I feel like if you’re a professional cyclist but not doing so well no one cares what you’re on, no you know, no one cares how many different TUEs you’ve got but it’s only if you’re the higher level you get the pressure’ (athlete 1: non-asthmatic). • ‘And then the media have made the hype because, well the media needs to make their hype to make their money, that’s what, personally that’s what I feel like’ (athlete 1: non-asthmatic). • ‘I think that a lot of the cases, when it comes out in the media, especially you find that over here, it’s always the British people that get aimed at. That’s what I think anyway’ (athlete 2: non-asthmatic). • ‘I mean the media only ever seems to hone in when something goes wrong’ (athlete 3: asthma). • ‘I’m aware of what’s been said in the media that you know obviously cyclists maybe don’t have chronic asthma but they’re getting TUEs for chronic asthma which they shouldn’t be...’ (athlete 6: asthma). • ‘Yeh I’m sure you know that there are people that hear of the way it’s portrayed in the media’ (athlete 8: asthma). • ‘I don’t think it’s that bigger issue, I think the public are probably given a different idea from the media so...’ (athlete 8: asthma). • ‘I think the only time they’re ever in the news is for bad news, which I can understand cause that’s what the media do, they try and obviously sell whatever they’re selling in terms of their publications but at the same time there needs to be a bit more of an awareness around what TUEs are, what they are, why they are offered to athletes and just a bit more of a balanced view rather than, getting at a guy puffing on an inhaler before a stage, then there’s a big question around is that legal, why is that legal and it’s not really a balanced argument, it’s very one sided around this is going to give them a performance enhancement because of x y and z’ (athlete 10: non-asthmatic).

(Continued)

Table 4. Continued.

CODES	ATHLETE QUOTES
Public	<ul style="list-style-type: none"> • 'I'd say definitely people with the inhalers, you can sometimes see they'll use it sheepishly, or they'll go around the corner to use it, not because I think they're hiding it just because they don't want people to think they're cheating or anything...and because of all the, especially recent stick with [athlete X] having exceeding high levels of the asthma drug... salbutamol...yeh it kind of makes it look a bit suspicious. I think people are getting a little bit like oh well you know there's a limit and then people are just using the inhalers way too much' (athlete 1: non-asthmatic). • 'I think from the public aspect there will always be a lot of criticism' (athlete 1: non-asthmatic). • 'I think it's the same with people with inhalers, they might think they need it because they've got a medical reason, without it it'll be detrimental to their performance. But people's stigmatism of you know, mental kind of, how they feel about the drug...they might think, ah they're just cheating, but actually they're not and that might make them feel a little bit... but it's kind of catch twenty-two because they go and look sheepishly using it, hiding...It makes them look guilty but they're not, they might not be guilty they just don't want people to be accusing them of things, but if people see them sort of hiding it then it gives them a reason to accuse them' (athlete 1: non-asthmatic). • '[Athlete X] got a TUE, will suddenly become, is [athlete X] doping? Not that, oh he's got a medical condition and I think that portrays a lot of club cyclists because they might not know, they're just the cyclist that reads the newspaper that says somebodies taken this and or someone's had a good performance and they might have taken this. I feel like a lot of cyclists will make their own assumptions which might be very uneducated assumptions cause they know very little about training or very little about physiological or medical conditions and then they'll go and chat to their friend who isn't on the group ride and then before you know it that group ride is suddenly convinced that this one rider is doping, not because of any hard fact, just because they saw an article that they'd taken this or done this' (athlete 1: non-asthmatic). • 'Other athletes who will be using the same medications that [athlete X] is on because they have a medical condition, will probably now be, not scared to use it but will be worried about people knowing they use it which then I think might make them hide it which then makes it look suspicious even though it's not but it's just because they're worried they'll suddenly get thrown under the bus and people will have a negative impact on them...' (athlete 1: non-asthmatic). • 'I think it varies quite a bit; I think there's certainly a level of you know... I mean you see it in the cycling media or just people I've ridden with where it's probably a similar attitude to what I've sort of expressed previously saying well if they're winning they're probably, pushing the right up to the line, they're winning and that there is kind of a real sort of sinisterism about it' (athlete 5: asthma). • 'I think lots of people think that people cheat it... especially when they talk about the Tour de France, it's unusual... the fact that lots have inhalers is dodgy' (athlete 7: asthma). • 'I remember someone saying something about the people the sort of professional perception of how many athletes have it and I was like I use the same stuff as them and they get loads of flack' (athlete 7: asthma). • 'Yeh I think having a Ventolin on the start line of the race, I think there are some people that associate inhaled salbutamol as a sort of PED [performance enhancing drug]' (athlete 8: asthma). • 'I can only see people taking inhalers, I don't know about people taking other umm... I've only seen a couple of people. I think those who race probably can see inhalers being used, so as far as I'm concerned, and I think the racers are concerned, I don't think it's that bigger issue... I think the public are probably given a different idea from the media so...' (athlete 8: asthma). • 'Within the communities in which I circulate it's something which isn't really an issue, I think there's if there's an asthmatic on a ride and someone has a puff on their inhaler there is a lot of jokes that go round about enhancing performance umm whether that's a social ride or that's a training ride whatever it is but I think that's just the nature of it and I think the stigma around it after some high profile incidents... I think there's always discussion around the famous case, the [athlete X] case and things like that but I don't think it's something which from my point of view, other people take that seriously certainly in my circle anyway.' (athlete 10: healthy).

Several challenges exist with respect to the way a diagnosis of asthma in athletes is currently established (26,27). Indeed, it is now widely recognized that self-report respiratory symptoms and baseline lung function offer limited diagnostic precision in athletes (28,29), and thus objective testing (i.e. indirect bronchial provocation) is recommended to avoid misdiagnosis and ensure appropriate treatment (30–32). Despite this, none of the athletes in the present study

reported having been referred for specialist testing, which corroborates with a prior national survey in the UK, conducted by Hull and colleagues (33), who found that approximately one-quarter of primary care physicians initiated treatment for suspected asthma or exercise-induced bronchoconstriction based on clinical history alone without robust objective testing.

The use of sub-optimal diagnostic methods in the assessment of athletes reporting respiratory symptoms

Table 5. Perception of asthma medication in sport (reflexive motivation).

CODES	ATHLETE QUOTES
Stigma	<ul style="list-style-type: none"> • ‘They might have something... amongst the lads it might be a bit of joking like oh here comes the next dooper’ (athlete 1: non-asthmatic). • ‘If I saw them just absolutely going to town on it [inhaler], I might feel a little bit different cause I assume there’s a limit where the amount that they’re having becomes not just bringing them to a level playing field, it takes them up and above’ (athlete 1: non-asthmatic). • ‘If I was just diagnosed with asthma, I might feel cautious or negative about using it [asthma medication] because I’d feel that there is a stigmatism that makes me feel like it’s a bad thing to use. But at the same time, part of me feels that everyone else is using it so should it be acceptable for me to use it? Would that make it a level playing field? You talk about finding what that level playing field is. I think that’s why it’s so, so hard to measure what’s doping and what’s treating a medical condition and what’s stepping up the line. You can’t deny that someone doesn’t need a medicine to make their better quality of life but then it’s where that kind of, steps up... edges it up’ (athlete 1 non-asthmatic). • ‘I think if I was competing at a higher level and somebody saw me taking a steroid inhaler before an event, it’d be like, hang on that guy has got an advantage, he’s taking an inhaler. I think it definitely depends what level you compete and how serious people are taking it. Those-minute kind of advantages actually make a big difference’ (athlete 3: asthma). • ‘I think there’s a fine line with it. If someone, if someone is losing a little bit of performance from exercise-induced asthma and requires a TUE to help them. Like maybe 2%, and it increases themselves up to 100% then that is, you know a little bit...what are you doing? If there’s like a big decrease, then they do warrant it. It’s tricky.’ (athlete 4: non-asthmatic). • ‘If I have it on the start line someone might make a bit of a joke, but I don’t think anyone’s really too bothered you know. It’s not like I’m constantly puffing on it or anything ... usually it’s a good place for a joke...usually I end up making it myself. There have been times, usually it’s just a mate or something, like “have you a got a TUE for that” or something like that, but you know it’s out of good gest’ (athlete 8: asthma). • ‘I think if you’re just puffing on an inhaler, I’ve no issues with that, but I think I know other asthma drugs that some people take that might then have a larger stigma attached’ (athlete 8: asthma). • ‘I can imagine someone being a bit hesitant taking an asthma inhaler in case they are seen to be wanting to get an advantage. I can imagine if I was an asthmatic and I’m stood there on the line taking a couple of puffs on my inhaler, I can imagine there are a few people looking around’ (athlete 10: non-asthmatic).
Distrust	<ul style="list-style-type: none"> • ‘I see a lot in the news, it’s really easy to get hold of asthma medication, you just need to go to your GP and say x y and z and you can almost get one [inhaler]’ (athlete 1: non-asthmatic). • ‘you hear of people getting them when they probably don’t need them. They’ve just gone and said what they felt would get them, and the GP’s quite readily just gone, well try this it might help you out. Whether that’s just kind of Chinese whispers amongst athletes just picking up on using them and then twisting it whatever themselves, or just not hearing the full knowledge, might be a case... that’s quite often I find’ (athlete 1: non-asthmatic). • ‘I think people are getting a little bit like oh well you know there’s a limit and then people are just using the inhalers way too much...I think if they used it above their allotted amount, I think there’s definitely...I’ve seen stuff that shows you how much it can actually help you; I think they would probably get an advantage from it personally’ (athlete 1: non-asthmatic). • ‘I think there is more to it than just the two people because you can’t have your high-profile names absolutely smashing TUEs or taking things in higher doses and then say that no-one else is doing it. So, I think in these cases, I imagine everyone’s probably on the TUEs or on the asthma medication, there’s probably more than one person doing it’ (athlete 2: non-asthmatic). • ‘My very uneducated opinion is that the TUEs are too easy to get hold of for athletes, but I don’t really know what I’m basing that on. I think I’ve probably heard something somewhere. So yes, I’d say my opinion would be that it’s probably too easy to obtain, but again I don’t really know what I’m basing that off’ (athlete 3: asthma). • ‘I’m not sure what the real stat is of the pro peloton but the like half of them have TUEs or something. A large proportion of them of have TUEs, and it’s like how many of these athletes. How are they all asthmatics? What’s going on?’ (athlete 4: non-asthmatic). • ‘Depending on whether the team doctors can issue the TUEs too people, probably not. I reckon if someone can be made to fit the little bracket that you need to be in to have a TUE, then there obviously not because you can manipulate and you can be made to fit in this bracket’ (athlete 4: non-asthmatic). • ‘I mean some of these contain steroids, when they take them does that give them better muscle building qualities, better recovery...’ (athlete 6: asthma). • ‘They wouldn’t pass a spirometry test, but they have asthma ... I think they do push the boundaries and again a lot of them are probably taking the asthma medication when they don’t need it and they’ve, the whole, pretty much the peloton has asthma. They wouldn’t pass a spirometry test, but they have asthma cause they, they, I’m guessing they’re using some sort of asthma steroid to strip the body fat out...’ (athlete 6: asthma). • ‘I think ingesting salbutamol from what I’ve read can be an effective performance enhancing drug, so if you can claim your asthmatic and make use of that then, you know, that may be a sly way of doping in sport’ (athlete 8: asthma). • ‘There are a lot of asthmatics in the pro peloton... you can say asthmatic with quotation marks you know... I’m sure there are ways of using a false asthma medication as a PED [performance enhancing drug]...I’m sure there are plenty of genuinely asthmatics in professional cycling, but I reckon a significant proportion... are claiming it for a doping purposes’ (athlete 8: non-asthmatic). • ‘I think even that can be a bit hit and miss, it’s just too easy to fabricate, you know I can go to a doctor and say yeh I’ve been really wheezy you and I exercise and I struggle to breath and I get wheezy and it’s like ah yes that’s asthma...’ (athlete 8: Asthma).

(Continued)

Table 5. Continued.

CODES	ATHLETE QUOTES
Acceptance	<ul style="list-style-type: none"> • 'If they've been diagnosed with asthma, I don't feel like it's a problem because I've seen them taking a few puffs of the inhaler. From my experience I've only ever seen what I justify as a fair amount. Just a few puffs here and there to just open up their lungs, I guess. (athlete 1: non-asthmatic). • 'I think it's justified and if they're using within the allowed medication limits, I don't see any problem with it at all' (athlete 1: non-asthmatic). • 'if you have some kind of condition where you, you can't perform to your best without it [medication] then it's unfair, you need to try and make it so everyone's starting at almost their maximum ability and then they can go from there.' (athlete 4: non-asthmatic). • 'He's a cyclist, he's got chronic asthma something like that then he should be allowed to use it like. If the inhaler doesn't work for him or something like that, he should be allowed to use something but within limits I suppose to not give himself an advantage, a major advantage over competitors' (athlete 6: asthma). • 'At the same time if that is required to make sure that person doesn't have an asthma attack during the race or something like that then that's obviously worth doing so.' (athlete 10: non-asthmatic). • 'There are conditions that you can't not take stuff for, if people have a medical condition it needs treating' (athlete 10: non-asthmatic).
Sports performance	<ul style="list-style-type: none"> • 'There have been incidences where my asthma has flared up mid-ride, so it happened in Majorca actually on the second day. We were doing 5-hours riding but we'd been out for hours and it was pretty dry, and I wasn't used to it. My asthma really started to play up to the extent where my breathing became really shallow and that did impact my ability to ride so I nearly got dropped going up one of the last climbs' (athlete 3: asthma). • 'We go to the alps every year and I really have to use it there because the air's thinner and really notice that I can't breathe as well and if I don't do a warm up, all the other people around even though, even people that normally are not nearly the same pace as me, they can deal fine and ride quite fast up the mountains without a warm up whereas if I don't get a warm I literally have to stop after like 5 min' (athlete 7: asthma). • 'One year I had a really bad flare up going up Alpe d'Huez where we didn't warm up because we were living right at the bottom of it and we tried to go up Alpe d'Huez and then I had to stop and I was really upset and I was wheezing loads and I had to go home because I couldn't get it back under control' (athlete 7: asthma).
Risk of exacerbation	<ul style="list-style-type: none"> • 'When I see guys at the club taking it, that shows that you're concerned your asthma is going to flare up' (athlete 3: asthma). • 'I don't like trying to cycle hard if I'm feeling asthmatic' (athlete 5: asthma). • 'You know that it's going to bother you, so you put it in your tri suit for the run' (athlete 7: asthma). • 'I'm not sure, as far as I know it could be placebo more than anything else, but I think it helps me, like at least if I've got it I don't have to worry about it, I'm not worrying about having to have a puff on my inhaler you know, I haven't got that extra stress... I can get a bit stressed and worried if I don't have it... I might do an effort and I might find that I need it just to help keep my lungs open' (athlete 8: asthma).

has previously been reported to increase the risk of misdiagnosis and unnecessary inhaler therapy which likely contributes to the widespread perception of medication misuse (14,34). Likewise, the challenges associated with screening and detection may also add to the belief that it is possible to falsify a diagnosis and abuse the TUE system. This view was held by many athletes in the present study and also perceived to exist in the wider sporting community. In-keeping with this concept, a previous study in a large cohort of Danish athletes ($n=645$) reported that over half demonstrated distrust toward the TUE system and approximately one in ten recalled a period of medication avoidance despite therapeutic need (35). Irrespective of these findings, it should be noted that the recently published official WADA report indicates that the prevalence of granted TUEs at the Olympic Games (between 2010–18) was <1% - with no meaningful association observed with the likelihood of winning a medal (36,37).

The media have previously been recognized to influence beliefs and behaviors toward anti-doping policy and medication use in sport (38,39). In the

present study, the negative media portrayal of asthma medication was described by all athletes with several reflecting on recent examples of widely publicized asthma-related doping articles concerning high-profile elite athletes (40,41). In combination with the aforementioned evidence regarding limited athlete knowledge and concerns over the potential to falsify a diagnosis, it is probable that information disseminated by the media also contributes to perceptions and/or suspicion that some athletes abuse the system. This theory aligns with previous findings from a qualitative investigation in elite cyclists concerning reports of injury falsification in order to obtain medication known to optimize performance and/or speed recovery (e.g. oral corticosteroid therapy) (42). Of note, the majority of athletes in the present study failed to discern between the class of medication or route of administration when discussing the performance enhancing properties of asthma therapy. A lack of understanding in this area likely leads to generalization and the common misconception that all asthma medication constitutes doping and may contribute further to medication avoidance or misuse.

Implementing targeted behavioral interventions

The findings of this study underscore the need for interventions that enable optimal medication adherence to preserve athlete respiratory health and protect the integrity of sport. Based on these findings, educational programmes should aim to address athlete knowledge and the negative stigma attached to the use of asthma therapy. Improving knowledge and understanding of the health and performance implications of asthma medication, alongside anti-doping regulations and rule-violations, will likely improve the capability and motivation for adherence. Moving forward, educational programmes should be directed toward primary care physicians and athlete support personnel (i.e. sports medics and coaches etc.), in whom knowledge may be comparably limited, to improve athlete support and increase self-efficacy toward medication and anti-doping policy (33,43). Whilst the funding for education within anti-doping organizations is often limited (43,44), the high prevalence of asthma among athletes (45) warrants increased commitment to the development of accessible resources. In this respect, increasing referrals to respiratory specialists may improve the care afforded to athletes reporting breathing difficulty (46). Indeed, long-term widespread use of sub-optimal diagnostic methods may continue to reinforce the belief that TUEs and medication are open to abuse. In addition, there is an urgent need to address the widespread negative stigma toward asthma medication within the athletic community. Although it is important to avoid compromising athlete confidentiality (i.e. medical records), increasing the transparency of medication use and TUEs may help reduce the growing perception of wrongdoing (1).

Methodological considerations and future research

Adopting a relativist, rather than a criteriological approach (47), we sought to build credibility and trustworthiness of the data and exemplify our contribution to the field, by drawing upon markers of quality in qualitative research (48). For example, worthiness of the topic and qualitative methodology is illustrated in the pertinence of asthma medication adherence, avoidance and misuse within the field of sport science and medicine, and the complexities of athlete behavior (49), respectively. Indeed, for the first time, the use of established qualitative methodology elicited direct quotations from multiple perspectives, revealing numerous

barriers to optimal athlete health that are of significance to the implementation of evidence-based behavior change strategies. Rich rigor was ensured by the transparency of the data analysis process and the recruitment of an appropriate athlete sample to meet the study aims. Whilst it is acknowledged that the present study sample is not demographically diverse, and the sample size is smaller than those typically found in quantitative research studies, statistical generalizability and large sample sizes are not germane to qualitative research (50). Rather, this study achieves transferability through the detailed methodological description and presentation of all data (48), that enables readers to interpret the study findings in relation to their individual context. Indeed, these novel athlete accounts and the patterns of talk generated highlight the need to elicit further questioning and initiate further investigations in recreational and elite athlete populations, and support personnel.

Conclusion

In summary, the novel application of behavioral science highlights several factors that potentially interact to contribute to asthma medication avoidance and promote misuse in competitive sport. The findings from this study provide a foundation for the development and implementation of targeted education programmes, and it is hoped that employing this approach will improve overall perceptions of asthma treatment in athletes, which is necessary to maintain respiratory health, optimize performance and protect the integrity of sport.

Contributors

All authors contributed to design of this study. HA, SB and OP contributed to the data analysis of this study. All authors contributed to writing and reviewing the manuscript.

Ethical approval

This study was approved by the local research ethics committee (application reference: 39303). All participants provided written informed consent to include their responses in the study.

Declaration of interest

JH has a continuing role as a respiratory advisor at the English Institute of Sport and is a TUE committee member for UK Anti-Doping, Union of European Football Associations and the Cycling Anti-Doping Foundation mandated by the Union Cycliste Internationale. JH has received funding from pharmaceutical companies Roche, Teva, AstraZenca and Novartis. OP

and JH provide exercise-induced asthma testing for elite athletes. HA and SB have no conflicts of interest.

Data availability statement

All data relevant to the study are included in the article.

ORCID

Hayden Allen  <http://orcid.org/0000-0002-2302-8298>
 Oliver J. Price  <http://orcid.org/0000-0001-8596-4949>
 James H. Hull  <http://orcid.org/0000-0003-4697-1526>
 Susan H. Backhouse  <http://orcid.org/0000-0002-4810-5173>

References

- Cox L, Bloodworth A, McNamee M. Olympic doping, transparency, and the therapeutic exemption process. *Diagoras: Int Acad J Olympic Stud.* 2017;1:55–74.
- Aguilar-Navarro M, Salinero JJ, Muñoz-Guerra J, Plata MM, Del Coso J. Sport-specific use of doping substances: analysis of world anti-doping agency doping control tests between 2014 and 2017. *Subst Use Misuse.* 2020;55(8):1361–1369. doi:10.1080/10826084.2020.1741640.
- WADA. WADA statement regarding additional data leak via Russian cyber hacker Fancy Bear. WADA; 2016 Sep 16 [accessed 2017 Aug 10]. <https://www.wada-ama.org/en/media/news/2016-09/wada-statement-regarding-additional-data-leak-via-russian-cyber-hacker-fancy-bear>.
- Pike J. Therapeutic use exemptions and the doctrine of double effect. *J Philos Sport.* 2018;45(1):68–82. doi:10.1080/00948705.2017.1416621.
- Digital Culture Media and Sport Committee. Combatting doping in sport. Fourth Report of Session 2017–19. House of Commons; 2018. Mar 15 [accessed 2019 Aug 13]. <https://publications.parliament.uk/pa/cm201719/cmselect/cmcomeds/366/366.pdf>.
- Allen H, Backhouse SH, Hull JH, Price OJ. Anti-doping policy, therapeutic use exemption and medication use in athletes with asthma: a narrative review and critical appraisal of current regulations. *Sports Med.* 2019;49(5):659–668. doi:10.1007/s40279-019-01075-z.
- Hull JH, Pavord ID. Treating asthma exacerbations in athletes: TUE or not TUE? *Lancet Respir Med.* 2018;6(1):8–10. doi:10.1016/S2213-2600(17)30428-9.
- Price OJ, Hull JH, Backer V, Hostrup M, Ansley L. The impact of exercise-induced bronchoconstriction on athletic performance: a systematic review. *Sports Med.* 2014;44(12):1749–1761. doi:10.1007/s40279-014-0238-y.
- McKenzie DC, Fitch KD. The asthmatic athlete: inhaled beta-2 agonists, sport performance, and doping. *Clin J Sport Med.* 2011;21(1):46–50. doi:10.1097/IAE.0b013e318203c0ef.
- Michie S, Van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci.* 2011;6(1):42. doi:10.1186/1748-5908-6-42.
- Smith B, Sparkes AC. *Routledge handbook of qualitative research in sport and exercise.* London: Routledge; 2016.
- Bentley MRN, Patterson LB, Mitchell N, Backhouse SH. Athlete perspectives on the enablers and barriers to nutritional adherence in high-performance sport. *Psychol Sport Exercise.* 2021;52:101831. doi:10.1016/j.psychsport.2020.101831.
- Sparkes AC, Smith B. *Qualitative research methods in sport, exercise and health: From process to product.* London: Routledge; 2013.
- Jackson A, Allen H, Hull JH, Hopker J, Backhouse SH, Price OJ, Dickinson J. Diagnosing exercise-induced bronchoconstriction: over- or under-detection? *Allergy.* 2020;75(2):460–463. doi:10.1111/all.14005.
- Allen H, Hull J, Backhouse SH, De Carné T, Dimitriou L, Price OJ. The Allergy Questionnaire for Athletes provides value in ruling-out exercise-induced bronchoconstriction. *Allergy.* 2019;74 (9):1794–1790. doi:10.1111/all.13778.
- Devers KJ, Frankel RM. Study design in qualitative research-2: sampling and data collection strategies. *Educ Health (Abingdon).* 2000;13(2):263–271. doi:10.1080/13576280050074543.
- Braun V, Clarke V. Reflecting on reflexive thematic analysis. *Qual Res Sport Exercise Health.* 2019;11(4):589–597. doi:10.1080/2159676X.2019.1628806.
- WADA. Prohibited List January 2021. WADA; 2020. [accessed 2021 5 Jan]. https://www.wada-ama.org/sites/default/files/resources/files/2021list_en.pdf.
- WADA. Therapeutic use exemptions. WADA; 2018. Sep 20 [accessed 2020 18 Aug]. https://www.wada-ama.org/sites/default/files/resources/files/istue_2019_en_new.pdf.
- Mottram D, Chester N, Atkinson G, Goode D. Athletes' knowledge and views on OTC medication. *Int J Sports Med.* 2008;29(10):851–855. doi:10.1055/s-2008-1038403.
- Locquet M, Beaudart C, Larbuisson R, Leclercq V, Buckinx F, Kaux J-F, Reginster J-Y, Bruyère O. Self-administration of medicines and dietary supplements among female amateur runners: a cross-sectional analysis. *Adv Ther.* 2017;33(12):2257–2268. doi:10.1007/s12325-016-0426-2.
- Backhouse S, Whitaker L, Patterson L, Erickson K, McKenna J. *Social psychology of doping in sport: a mixed studies narrative synthesis.* Institute for Sport, Physical Activity and Leisure, Leeds Beckett University; 2016. [accessed 2019 Aug 1]. https://www.wada-ama.org/sites/default/files/resources/files/literature_review_update_-_final_2016.pdf.
- Vergès S, Flore P, Blanchi MPR, Wuyam B. A 10-year follow-up study of pulmonary function in symptomatic elite cross-country skiers-athletes and bronchial dysfunctions. *Scand J Med Sci Sports.* 2004;14(6):381–387. doi:10.1111/j.1600-0838.2004.00383.x.
- Abramson MJ, Walters J, Walters EH. Adverse effects of beta-agonists: are they clinically relevant?. *Am J Respir Med.* 2003;2(4):287–297. doi:10.1007/BF03256657.
- Reddel HK, FitzGerald JM, Bateman ED, Bacharier LB, Becker A, Brusselle G, Buhl R, Cruz AA, Fleming L, Inoue H, et al. GINA 2019: a fundamental change in asthma management. *Eur Respir J.* 2019;53(6):1901046. doi:10.1183/13993003.01046-2019.
- Price OJ, Hull JH, Ansley L. Advances in the diagnosis of exercise-induced bronchoconstriction. *Expert Rev Respir Med.* 2014;8(2):209–220. doi:10.1586/17476348.2014.890517.

27. Weiler JM, Hallstrand TS, Parsons JP, Randolph C, Silvers WS, Storms WW, Bronstone A. Improving screening and diagnosis of exercise-induced bronchoconstriction: a call to action. *J Allergy Clin Immunol Pract.* 2014;2(3):275–280.e7. doi:10.1016/j.jaip.2013.11.001.
28. Bonini M, Lapucci G, Petrelli G, Todaro A, Pamich T, Rasi G, Bonini S. Predictive value of allergy and pulmonary function tests for the diagnosis of asthma in elite athletes. *Allergy.* 2007;62(10):1166–1170. doi:10.1111/j.1398-9995.2007.01503.x.
29. Price OJ, Hull JH, Ansley L, Thomas M, Eyles C. Exercise-induced bronchoconstriction in athletes - a qualitative assessment of symptom perception. *Respir Med.* 2016;120:36–43. doi:10.1016/j.rmed.2016.09.017.
30. Parsons JP, Hallstrand TS, Mastrorarde JG, Kaminsky DA, Rundell KW, Hull JH, Storms WW, Weiler JM, Cheek FM, Wilson KC, et al. An official American Thoracic Society clinical practice guideline: exercise-induced bronchoconstriction. *Am J Respir Crit Care Med.* 2013;187(9):1016–1027. doi:10.1164/rccm.201303-0437ST.
31. Hallstrand TS, Leuppi JD, Joos G, Hall GL, Carlsen K-H, Kaminsky DA, Coates AL, Cockcroft DW, Culver BH, Diamant Z, et al. ERS technical standard on bronchial challenge testing: pathophysiology and methodology of indirect airway challenge testing. *Eur Respir J.* 2018;52(5):1801033. doi:10.1183/13993003.01033-2018.
32. Weiler JM, Brannan JD, Randolph CC, Hallstrand TS, Parsons J, Silvers W, Storms W, Zeiger J, Bernstein DI, Blessing-Moore J, et al. Exercise-induced bronchoconstriction update-2016. *J Allergy Clin Immunol.* 2016;138(5):1292–1295. doi:10.1016/j.jaci.2016.05.029.
33. Hull JH, Hull PJ, Parsons JP, Dickinson JW, Ansley L. Approach to the diagnosis and management of suspected exercise-induced bronchoconstriction by primary care physicians. *BMC Pulm Med.* 2009;9(1):29. doi:10.1186/1471-2466-9-29.
34. Ansley L, Kippelen P, Dickinson J, Hull J. Misdiagnosis of exercise-induced bronchoconstriction in professional soccer players. *Allergy.* 2012;67(3):390–395. doi:10.1111/j.1398-9995.2011.02762.x.
35. Overbye M, Wagner U. Between medical treatment and performance enhancement: an investigation of how elite athletes experience therapeutic use exemptions. *Int J Drug Policy.* 2013;24(6):579–588. doi:10.1016/j.drugpo.2013.03.007.
36. UCI. Therapeutic Use Exemptions. UCI; 2020. [accessed 2020 May 11]. <https://www.uci.org/inside-uci/clean-sport/anti-doping/therapeutic-use-exemptions>.
37. Vernec A, Healy D. Prevalence of therapeutic use exemptions at the Olympic Games and association with medals: an analysis of data from 2010 to 2018. *Br J Sports Med.* 2020;54(15):920–924. doi:10.1136/bjsports-2020-102028.
38. Erickson K, McKenna J, Backhouse SH. A qualitative analysis of the factors that protect athletes against doping in sport. *Psychol Sport Exercise.* 2015;16:149–155. doi:10.1016/j.psychsport.2014.03.007.
39. Engelberg T, Moston S. Inside the locker room: a qualitative study of coaches' anti-doping knowledge, beliefs and attitudes. *Sport Soc.* 2016;19(7):942–956. doi:10.1080/17430437.2015.1096244.
40. Yorke H. Why do so many professional athletes have asthma – and does it help or hinder them? *The Telegraph.* 2016. Sep 20. [accessed 2019 Aug 13]. <https://www.telegraph.co.uk/men/thinking-man/why-do-so-many-professional-athletes-have-asthma-and-does-it-he/>.
41. Ingle S. What is a TUE? 11 key questions on the Fancy Bears Wada leaks. *The Guardian.* 2016 Sep 15. [accessed 2018 Apr 12]. <https://www.theguardian.com/sport/2016/sep/15/tue-fancy-bears-wada-leaks>.
42. Lentillon-Kaestner V, Carstairs C. Doping use among young elite cyclists: a qualitative psychosociological approach. *Scand J Med Sci Sports.* 2010;20(2):336–345. doi:10.1111/j.1600-0838.2009.00885.x.
43. Patterson LB, Backhouse SH, Duffy PJ. Anti-doping education for coaches: qualitative insights from national and international sporting and anti-doping organisations. *Sport Manage Rev.* 2016;19(1):35–47. doi:10.1016/j.smr.2015.12.002.
44. Gatterer K, Gumpfenberger M, Overbye M, Streicher B, Schobersberger W, Blank C. An evaluation of prevention initiatives by 53 national anti-doping organizations: Achievements and limitations. *J Sport Health Sci.* 2020;9(3):228–239. doi:10.1016/j.jshs.2019.12.002.
45. Price OJ, Ansley L, Menzies-Gow A, Cullinan P, Hull JH. Airway dysfunction in elite athletes-an occupational lung disease? *Allergy.* 2013;68(11):1343–1352. doi:10.1111/all.12265.
46. Price OJ, Hull JH. Asthma in elite athletes: who cares? *Clin Pulm Med.* 2014;21(2):68–75. doi:10.1097/CPM.000000000000030.
47. Smith B, McGannon KR. Developing rigor in qualitative research: problems and opportunities within sport and exercise psychology. *Int Rev Sport Exerc Psychol.* 2018;11(1):101–121. doi:10.1080/1750984X.2017.1317357.
48. Tracy SJ. Qualitative quality: eight “big-tent” criteria for excellent qualitative research. *Qual Inq.* 2010;16(10):837–851. doi:10.1177/1077800410383121.
49. Bekker S, Bolling C, H Ahmed O, Badenhorst M, Carmichael J, Fagher K, Hägglund M, Jacobsson J, John JM, Litzy K, et al. Athlete health protection: why qualitative research matters. *J Sci Med Sport.* 2020;23(10):898–901. doi:10.1016/j.jsams.2020.06.020.
50. Smith B. Generalizability in qualitative research: misunderstandings, opportunities and recommendations for the sport and exercise sciences. *Qual Res Sport Exercise Health.* 2018;10(1):137–149. doi:10.1080/2159676X.2017.1393221.