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Feasibility randomised controlled trial examining the effects of the Anti-Doping Values in Coach Education (ADVICE) mobile application on doping knowledge and attitudes towards doping among grassroots coaches

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BMJ Open Sport & Exercise Medicine

Feasibility randomised controlled trial examining the effects of the Anti-Doping Values in Coach Education (ADVICE) mobile application on doping knowledge and attitudes towards doping among grassroots coaches

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ABSTRACT

Objectives Sports coaches are influential in whether athletes dope, but receive very little antidoping education, particularly within entry-level coaching qualifications. We tested the feasibility of an antidoping intervention, delivered via a mobile application, which was designed to increase coaches' knowledge of doping and to reduce favourable doping attitudes.

Methods A two-arm randomised controlled trial, with grassroots coaches who coach young amateur athletes aged between 14 and 18 years of age, was conducted. The Anti-Doping Values in Coach Education (ADVICE) mobile application included modules on fair play, substances, nutritional supplements, rules and leadership. The primary outcome was the change in doping knowledge, 6 weeks after receiving the mobile application. The secondary outcome was changes in doping attitudes.

Results Grassroots coaches (n=200; aged between 18 and 71 years, with between 1 and 42 years of coaching experience) from 29 different countries completed baseline assessments, and 85 completed follow-up assessments, and were included in mixed analysis of variance analyses. The intervention increased coaches' knowledge about doping and also reduced favourable doping attitudes in the experimental arm.

Conclusion The ADVICE mobile application is a feasible method for delivering and increasing grassroots coaches' knowledge of banned substances and the potential side effects of doping. Mobile application-based resources could facilitate a much wider dissemination of antidoping education.

What are the main findings?

- Anti-Doping Values in Coach Education (ADVICE) is a professional learning intervention for grassroots coaches that is delivered as a mobile application.
- Doping knowledge about different banned substances and the health side effects can be increased among grassroots coaches.
- Favourable attitudes towards doping can be reduced among grassroots coaches.
- Mobile applications represent a cost-effective method for providing antidoping education, which can be disseminated much wider than traditional group-based presentations.

INTRODUCTION

Taking substances or using methods to enhance performance that are banned by the World Anti-Doping Agency,[1] also known as doping, represents a significant threat to sport because it is a form of cheating.[2] Furthermore, doping can also pose a significant threat to the health of athletes who dope. Indeed, banned substances are often taken at much higher doses than for which they were designed, which can induce very severe side effects such as organ failure, heart disease and cancer, with the concomitant risk of premature death.[3] Doping can also negatively impact an athlete's mental health, with one study[4] revealing that there is a twofold to fourfold increased risk of suicide among athletes who have taken anabolic androgenic steroids (AAS). Understanding the antecedents of doping behaviour among young athletes may be important in reducing the prevalence of doping.

A recent systematic review identified nine factors that predicted doping among young athletes.[5] These included gender, age, sports participation, sport type, psychological variables, entourage, ethnicity, nutritional supplements and a willingness to engage in other health-harming behaviours. Young

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male athletes are more likely to dope than female athletes, and that the prevalence and frequency of performance-enhancing drugs (PEDs) usage increases with age during adolescence. The type of sport in which an individual competes predicts doping, with doping more common in power-based sports. Psychological variables such as attitudes and susceptibility also predict doping, as do the people that surround athletes such as coaches, peers and parents.[5]

Sports coaches and doping

Coaches can possess a strong influence over young athletes, because athletes trust their coach and view him or her as being a credible source of information.[6] Indeed, Barkoukis *et al*[7] reported that coaches have a significant influence over athletes' decisions to dope or not, particularly when there is a close coach–athlete relationship. Alarmingly, Terney and McLain[8] found that 2% of 2111 adolescent athletes stated that their coach had previously recommended they take AAS, and it is coaches who are among the most likely to obtain AAS for an athlete.[9 10] Additionally, some coaches who suspect their athletes of doping may not be confident in their ability to confront the athlete,[11] and other coaches may be reluctant to attend antidoping training because they do not want to miss a training session.[12]

To understand coaches' views of doping further, Nicholls *et al*[13] interviewed 11 coaches about doping among adolescent athletes. The coaches in the study believed that vulnerable athletes would take PEDs if their coach encouraged them to do so, because they trust their coach and would be afraid to decline. Madigan *et al*[14] echoed these findings, by reporting that coach pressure on athletes was linked to favourable doping attitudes, and attitudes towards doping are linked to doping behaviour among young athletes,[15] which further emphasise the role of the coach in influencing whether an athlete will dope. In addition, support staff also influence doping behaviour among young athletes. Hoffman *et al*[16] found that 17-year-old to 18-year-old athletes are particularly influenced by strength and conditioning coaches.

Little is known about why some coaches would recommend doping to young athletes, because of the physical and psychological side effects of taking PEDs.[3 4] One possible explanation is that coaches are not committed to preventing doping, due to a lack of interest.[9] Another explanation is some coaches lack knowledge of doping and possess favourable attitudes themselves towards doping.[17] For example, Morente-Sánchez and Zabala[17] found that 84.9% of coaches did not know about WADA's prohibited list of banned substances and methods. Further, 39% of the coaches in the sample had recommended that their athletes take nutritional supplements, despite the potential risks of supplements being contaminated with banned substances.[18] For these reasons, Morente-Sánchez and Zabala concluded that coaches' lack of knowledge is dangerous and that there is a necessity for antidoping education among coaches. Providing coaches with antidoping education may help reduce doping, because there is evidence to suggest that they can also serve as a protective mechanism against doping.[7 19]

Although coaches seem to play a key role in whether athletes will engage in doping behaviours, there is a lack of tested resources available to enhance coaches' knowledge of doping, reduce favourable attitudes among coaches who possess such attitudes, and provide strategies and support.[20] This is because formal coach education prioritises coaches developing their sport-specific and pedagogical knowledge,[21] meaning that doping education seldom appears in coach education syllabi.[13] This is particularly evident for grassroots coaches, with some coaches possessing lower levels of coaching qualifications, or in some cases no qualification at all. Entry-level coaching courses are generally short in duration and may not result in coaches learning new skills or techniques.[21] As such, coaches are mostly left to rely on undertaking their own professional development in order to improve the quality of their practices. Unfortunately, evidence indicates that this leads to coaches' existing attitudes and practices being reinforced, rather than being changed through the programme.[22] Therefore, coaches with a favourable attitude towards doping would maintain such an attitude, unless they receive specific education. One exception to this is the iPlayClean antidoping education programme,[20] which was designed to reduce favourable attitudes towards doping and doping susceptibility among young high-level athletes, coaches and parents. Although this programme contained modules for coaches and parents, the effects of iPlayClean were only assessed for athletes and not coaches or parents. Although not specifically concerned with doping attitudes, the CoachMADE[23] aimed to reduce athletes' willingness to dope by creating optimal motivational climates for athletes via empowering coaches with knowledge of motivation, communication strategies, support strategies and antidoping rules. The results of CoachMADE have not been published yet.

It is important that grassroots coaches are exposed to antidoping information to enhance their knowledge, reduce any favourable attitudes towards doping and to help them reduce doping prevalence. One plausible mechanism of reaching many coaches is to make antidoping coaching education freely available and to use technology, such as mobile applications or websites. WADA has also developed online toolkits for coaches, such as Coach True,[24] which can be used by elite and grassroots coaches. The United Kingdom Anti-Doping Agency's (UKAD) Coach Clean programme[25] is for mid-level coaches, so it is not specifically designed for grassroots coaches. Furthermore, it costs £14.99, which may be a barrier for some grassroots coaches, because many grassroots coaches are volunteers who are unpaid,[26] so might not be prepared to pay for antidoping education, especially as some coaches may lack commitment towards antidoping education.[9] Although these resources are valuable in helping raise the awareness of banned substances among coaches, the impact of these resources on coaches' knowledge has not been

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tested. Further, these resources neither explicitly attempt to reduce favourable attitudes towards doping among coaches, nor provide theory-driven information for coaches regarding how they can reduce doping among young athletes.

Mobile applications

The antidoping resources for coaches created by WADA,[24] UKAD[25] and Nicholls[20] use either online or mobile application platforms as a method of delivery. This represents a cost-effective method of educating many coaches across the world, who could then provide antidoping education to their athletes. There are two major mobile application operating systems for mobile phones and tablets: iOS and Android. Both operating systems are used widely throughout the world. Indeed, Android has a 73.3% market share, whereas iOS has a 25.89% market share, meaning the remaining mobile application devices possess just 0.81% of the market share for mobile operating systems.[27]

There is evidence to support the effectiveness of mobile applications on transforming practice in other domains. In healthcare settings, mobile applications have transformed practice, by helping healthcare professionals communicate, monitor and make more effective decisions in relation to patients' health.[28] Given that entry-level face-to-face coach education workshops for grassroots coaches may have limited impact on transforming practice,[29] other platforms such as mobile applications may transform practice, given their success in other contexts.[28 29] Using technology may help coaches reduce doping among athletes who participate in grassroots sport, as the literature indicates that mobile applications are successful in decreasing urges to abuse substances and actual substance abuse.[29] It is likely, therefore, that the effects of online resources may be transferable to doping, particularly if the content of the resource is evidence-based.

Overall aims

The aim of this feasibility randomised controlled trial was to assess the effectiveness of the ADVICE mobile application on enhancing grassroots coaches' knowledge of doping and reducing favourable attitudes towards doping. It was hypothesised that the ADVICE mobile application arm would experience an increase in doping knowledge in comparison to the control arm, and a reduction in favourable attitudes towards doping, in comparison to the control arm.

METHOD

Study design and participants

This study was a two-arm randomised control trial, with allocation at a 1:1 ratio (see figure 1 for a participant flow diagram). We assessed outcomes for coaches at baseline, before coaches in the experimental arm received the ADVICE mobile application and 6 weeks postintervention. The coaches in the control arm completed outcome measures at the same time points. To be included in the study, coaches needed to be at least 18 years of age and coach amateur athletes aged between 14 and 21 years. Using a computer-based randomisation procedure, coaches were allocated to the control arm or the intervention arm.

Gatekeepers were contacted via sporting organisations and coaching bodies, who advertised the study. Participants who wanted to participate in the experimental arm were required to download the ADVICE app and complete the consent form on the mobile application.

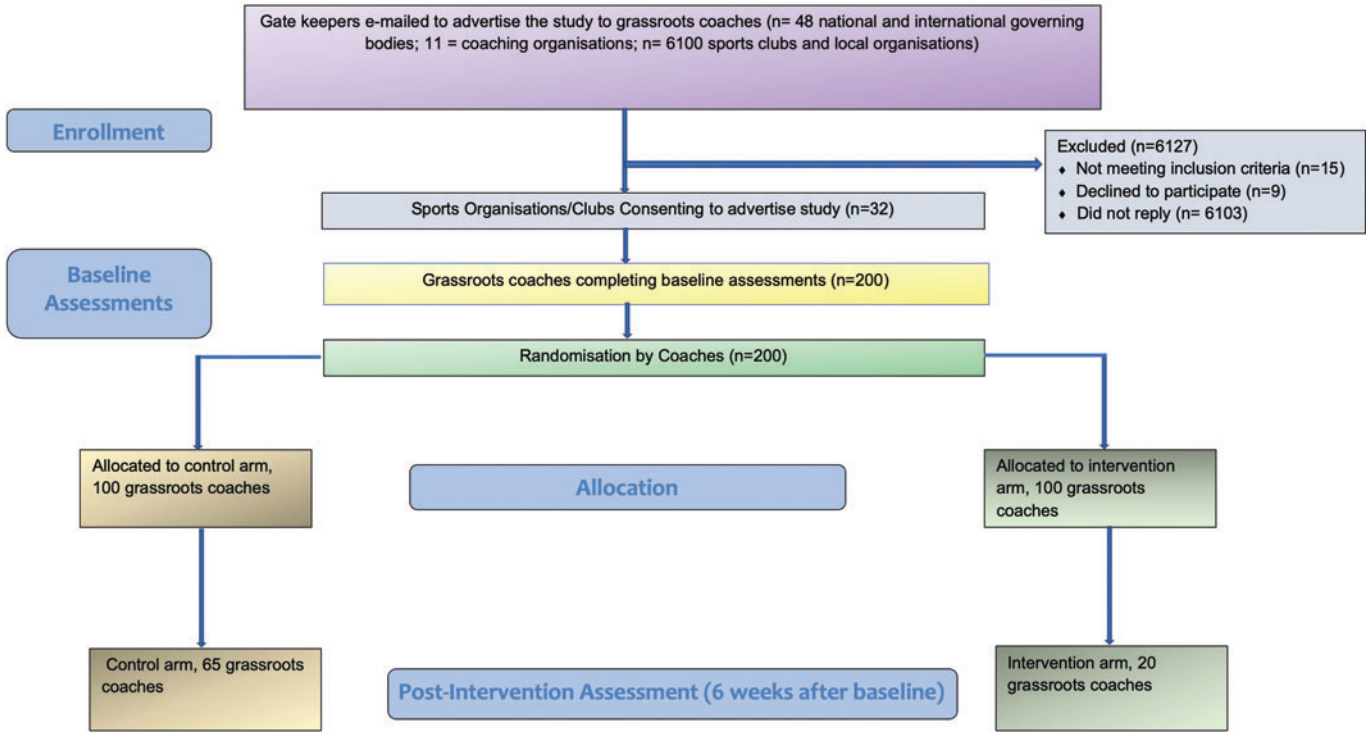


Figure 1 Participant flow diagram.

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Participants in the control arm completed the consent form online. All coaches were required to complete consent forms before participating. Participants were 200 grassroots coaches, who coached amateur athletes. Please see table 1 for demographic information. This study received ethical approval from the Faculty of Health Sciences ethics committee at the University of Hull (approval number FHS95).

Table 1 Baseline demographics

		Control arm n=100	ADVICE mobile application arm n=100
Age	Mean (SD)	42.03 (13.97)	38.9. (11.93)
	Min, max	18–71	18–65
Gender n (%)	Female	18 (18%)	15 (15%)
	Male	71 (71%)	83 (83%)
	Other	0	2 (2%)
Experience in years	Mean (SD)	13.38 (9.71)	10.13 (8.34)
	Min, max	1–42	1–30
Number of hours coached each week	Mean (SD)	13.24 (13.10)	13.35 (12.24)
	Min, max	1–70	1–50
Main sports n (%)	Team	26 (26%)	68 (68%)
	Individual	74 (74%)	74 (74%)
Highest coaching qualification n (%)	Apprentice/assistant coach	8 (8%)	23 (23%)
	Coach	41 (41%)	31 (31%)
	Senior coach	39 (39%)	28 (28%)
	Master coach	12 (12%)	18 (18%)
Country of residence	United Kingdom	79	42
	Greece	0	25
	Canada	8	0
	Ireland	6	1
	Spain	0	6
	Austria	1	0
	Cyprus	1	1
	Germany	1	1
	Italy	1	1
	Turkey	1	0
	United Arab Emirates	1	0
	USA	1	1
	Slovakia	0	2
	Algeria	0	1
	Argentina	0	1
	Brazil	0	1
	Bulgaria	0	1
	Columbia	0	2
	Estonia	0	1
	Finland	0	1
	France	0	1
	Lithuania	0	1
	Mexico	0	1
	New Zealand	0	1
	Panama	0	1
	Peru	0	1
	Serbia	0	1
	Slovakia	0	2
	Ukraine	0	1
	Uruguay	0	1

ADVICE, Anti-Doping Values in Coach Education.

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Intervention arm

The ADVICE mobile application had three specific aims: (1) increase grassroots coaches' knowledge of doping in relation to different types of banned substances and the negative health consequences of doping; (2) decrease favourable attitudes towards doping among grassroots coaches and (3) provide coaches with a resource to promote positive values in sport such as honesty, fair play and clean sport. The ADVICE mobile application can be downloaded on iOS devices from iTunes[30] and Android devices from Google Play[31] in seven different languages (eg, Danish, English, French, German, Greek, Spanish and Russian).

The ADVICE mobile application contains an introduction and modules called 'fair play', 'substances', 'nutritional supplements', 'rules' and 'leadership'. Each module contains decision exercises about the coach's values and principles, information about the particular topic and animation in which the coach is asked to think about what he/she would do in a particular situation. Each module ends with a reflective exercise, whereby the coach is asked to reflect on his/her new knowledge and how this would impact his/her behaviour. The fair play module is concerned with how athletes can promote clean sport among their athletes and the importance of doing so. The substances module provides information for coaches on banned substances, such as why some athletes may use banned substances, how coaches can identify that athletes might be doping and how coaches can respond if their athlete asks them about using painkillers, for example. The nutritional supplements module provides information about what nutritional supplements are, why some athletes use them, the dangers of nutritional supplementation and how coaches should respond to athletes if they ask about using nutritional supplements. The rules module provides information on antidoping rules, the responsibilities of coaches and the implications of a positive drugs test. Finally, the leadership module contains information on how coaches can create a positive sporting environment and values, how to be a supportive coach, promoting fair play and helping parents support their children. The ADVICE education is mapped against WADA's International Standard for Education (ISE),[32] because the ADVICE intervention is value-based, awareness-raising, provides information about doping and contains antidoping education. The ADVICE programme was designed for coaches, who were identified as a key 'education pool' and it contains topics that WADA[32] recommends in education programmes (eg, risks of supplement use, testing procedures, consequences of doping, antidoping rule violations and information on therapeutic use exemptions). We have also evaluated the effectiveness of the ADVICE intervention; which WADA recommends in their ISE document.[32]

Control arm

In accordance with a previous antidoping intervention,[20] the control group received no antidoping education and carried on coaching as normal.

Outcome measures

Primary outcome

Doping knowledge was the primary outcome. A 30-item questionnaire, adapted from Blank *et al*,[33] assessed the grassroots coaches' knowledge of performance-enhancing substances and methods and the health-harming effects of different PEDs. There were questions on general doping knowledge such as 'Which of the following substances are listed on the WADA prohibited list' and coaches were given a list of substances that are prohibited (eg, anabolic steroids and stimulants), not prohibited (eg, alcohol and protein). Knowledge about the side effects were also included in the questionnaire such as 'Taking stimulants…' to which participants had to provide an answer for 'calms you down', 'leads to psychological dependency', 'serves as a performance enhancement', 'endangers your health' and 'only shows effects for professional or elite athletes'. All questions were answered as 'yes' or 'no'. In accordance with previous scholarly activity in doping among parents[33] and pharmacists and doctors,[34] a score of at least 80% of questions being answered correctly was considered 'good knowledge' of doping. As such, this figure was used for the benchmark in the present study.

Secondary outcome

Attitude towards doping was the secondary outcome for this study. The 17-item Performance Enhancement Attitudes Scale (PEAS)[35] assessed the doping attitudes of grassroots coaches. The coaches responded to the stem 'Please answer the following questions about performance enhancing drugs honestly'. Questions included 'doping is an unavoidable part of the competitive sport' and 'athletes should not feel guilty about breaking the rules and taking performance enhancing drugs'. Each question was answered on a 6-point Likert-type scale, anchored at 1= 'strongly disagree' and 6= 'strongly agree'.

Patient and public involvement

No patients were involved in this study, because the purpose was to assess the feasibility of the ADVICE mobile application on doping knowledge and attitudes among grassroots coaches.

Data analysis

First, means and SD were calculated for doping knowledge and doping attitudes. Then, two-time × arm (baseline and follow-up; control and experimental arms) mixed analysis of variance (ANOVA) was conducted to analyse arm differences in doping knowledge and attitudes. Posthoc t-tests were conducted to compute arm differences.

RESULTS

Descriptive statistics

Means and SD for doping attitudes and doping knowledge are presented in table 2. Of the 200 coaches who completed baseline measures, 85 coaches completed follow-up measures (see figure 1).

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Table 2 Means and SD for control and experimental arms at baseline and follow-up

	Baseline	Follow-up
Doping attitudes		
Control	36.11 (8.97)	35.92 (9.14)
Experimental	40.25 (5.76)	34.55 (5.34)
Doping knowledge		
Control	38.68 (2.91)	38.91 (9.14)
Experimental	36.70 (3.84)	49.90 (6.88)

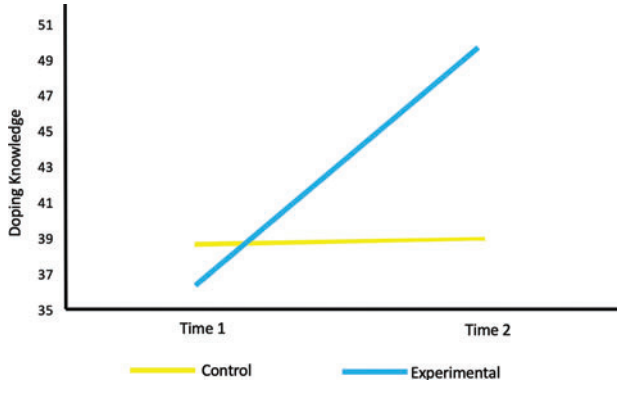


Figure 2 Graph of the change in doping knowledge at baseline (time 1) and follow-up (time 2) for control and experimental arms.

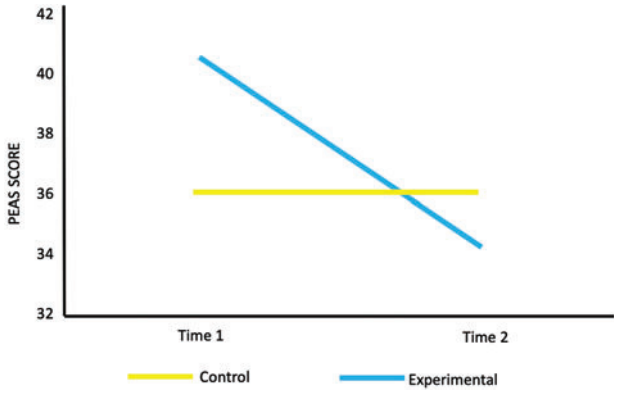


Figure 3 Graph of the change in doping attitudes at baseline (time 1) and follow-up (time 2) for control and experimental arms.

Primary outcome: changes in doping knowledge

A time × arm mixed ANOVA was conducted to examine the impact of the experimental condition on doping knowledge from baseline to follow-up (see figure 2). A significant interaction effect was found between time and condition ($F_{1,83}$=147.59, p<0.001, η_p^2=0.64). Dependent samples t-tests revealed a significant increase in doping knowledge in the experimental arm (t_{19}=7.90, p<0.001) but not in the control arm (t_{64}=0.76, p=0.79).

Secondary outcome: changes in doping attitudes

A time × arm mixed ANOVA was conducted to examine the impact of the experimental condition on doping attitudes from baseline to follow-up (see figure 3). A significant interaction effect was found between time and condition ($F_{1,83}$=15.56, p<0.001, η_p^2=0.16). Dependent samples t-tests revealed a significant decrease in favourable attitudes towards doping in the experimental arm (t_{19}= −4.70, p<0.001) but not in the control arm (t_{64}= −0.18, p=0.79). However, the experimental arm had significantly higher favourable attitudes towards doping attitudes at baseline than the control arm (t_{83}= −4.46, p=0.02).

DISCUSSION

According to previous research,[5–13] coaches are influential in determining whether young athletes will take banned substances to enhance their performance. However, they receive very little or no antidoping education in entry-level coaching qualifications, which tends to be focused on sport-specific and pedagogical learning.[21] Some coaches lack knowledge on banned substances and the side effects of doping, in addition to some coaches possessing favourable attitudes towards doping.[17] Providing coaches with a free antidoping resource appears important and valuable, to circumvent the threat of doping. The ADVICE mobile application significantly increased coaches' knowledge of banned substances and the health side effects of doping. It also had success in reducing favourable attitudes towards doping among coaches.

Comparing the effects of ADVICE with other interventions is challenging because researchers are yet to develop coach-specific antidoping resources that target the knowledge and attitudes of coaches. Although there are a number of resources available for coaches,[18–20 23] these have not been tested, so the effectiveness of such programmes remains unclear. Perhaps, the main reason why the ADVICE intervention was successful in enhancing coaches' knowledge about doping and reducing favourable attitudes was the structure of the intervention. That is, there was a strong interactive element to the intervention, which made it very personalised in that coaches were asked to list their own values and principles and consider these in relation to the particular topic. According to personal construct theory,[36] individuals often have thoughts, feelings and behaviours that they are not necessarily aware of. By enabling coaches to consider their values, principles and beliefs, it helps individuals assess different situations and shapes their thoughts and behaviours.[37] This results in people anticipating what might happen in certain situations (eg, coach thinking about what might happen if he suspects an athlete of doping).[36] Asking coaches to consider their values and principles led to them becoming immersed in reflective thought regarding these and how it associated with doping and thus may have explained the increase in doping

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knowledge. Coaches were asked to reflect upon what they would do after watching an animation and at the end of each module. Prompts to assist reflection were provided throughout the ADVICE intervention, and these prompts are associated with superior learning in comparison to people who did not receive reflective prompts.[38] Therefore, the ADVICE intervention required coaches to move beyond passive receivers of content, towards active engagement through considering their values and principles.

The content ADVICE education programme also adheres to calls from scholars to provide coaches with information on how to confront athletes,[11] the motivational climate[23] or team culture[7] and how to support athletes and antidoping rules,[23] to develop a close coach–athlete relationship[7] and to provide coaches with more information about doping.[9] As such, the ADVICE content appears to include critical information based on the contemporary evidence to help coaches reduce doping. The tasks involved and the content may explain why the ADVICE intervention was successful in enhancing doping knowledge and reducing favourable attitudes towards doping.

The present findings support the use of mobile applications within antidoping education. Although the efficacy of mobile applications has been demonstrated in other domains,[28 29] this is the first time that the effectiveness of mobile application-based antidoping education has been tested. An advantage of mobile applications as a method of delivery relates to the number of people that can access such interventions. There are over 14 billion mobile devices in the world that can download mobile applications,[39] so embracing technology may prove fruitful in reducing doping in sport.

Limitations and future research

We employed a relatively low-intensity method of recruiting coaches, which involved emailing gatekeepers, using addresses found on websites. Many of whom did not respond, so it would be interesting to see whether different techniques would increase the response rate among grassroots coaches.

The questionnaire we used to assess attitudes towards doping[35] has been criticised for exhibiting a poor model fit[40] and not being grounded in a valid theoretical framework.[41] A criticism of the doping literature in general is a lack of theory grounded and valid measures of doping attitudes and an over-reliance on questionnaires such as the PEAS.[35] As such, there is a need for theoretically grounded and valid questionnaires to assess doping attitudes, particularly among adults given that such a questionnaire now exists for adolescent athletes.[41]

Another limitation of this study is the high attrition rate, particularly among the ADVICE mobile application arm. To protect the anonymity of the coaches and enhance the validity of the findings,[42 43] no identifying data were collected. The ADVICE mobile application was built so that participants were sent a push notification 6 weeks after the baseline measurement, as a reminder to complete their second assessment. If push notifications were disabled by the user, the coaches will not have received a reminder and there was no way of contacting the participants to remind them to complete the second assessment. It may be necessary to collect the email addresses or mobile phone numbers of participants in mobile application-based research in order to send reminders when multiple data collection points are part of the methodological design. Up to two email reminders were sent to coaches in the control arm, which may explain the higher response rate 6 weeks later in the control arm compared to the intervention arm. Further, we did not assess how much exposure the participants had received to antidoping education, as either coaches or if they were athletes. This may have impacted the results, because athletes who had received antidoping would be less likely to display changes in their knowledge or attitudes after the intervention, in comparison with the coaches who had no previous exposure to antidoping education.

Future research using the ADVICE mobile application could assess the impact of the intervention on constructs such as coaching behaviour, the psycho-social variables associated with doping behaviour (eg, doping attitudes, susceptibility and willingness to cheat),[43] among athletes, and doping prevalence among young athletes, to assess the full impact of this tool.

CONCLUSION

The ADVICE mobile application is a feasible tool for delivering and increasing grassroots coaches' knowledge of banned substances and the potential side effects of doping. The intervention also had a positive impact on reducing favourable attitudes, although it should be noted that the intervention arm had a higher mean score for doping attitudes at baseline. Mobile application-based resources may offer opportunities for national governing bodies and antidoping organisations to increase the number of grassroots coaches who are exposed to antidoping education. Indeed, these could form part of continued professional development modules or be included in core coach education modules.

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