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An evaluation of UK athletics' clean sport programme in preventing doping in junior elite athletes

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ABSTRACT

The aim of this study was to evaluate UK Athletics' Clean Sport programme in preventing unintentional and intentional doping in junior elite athletes. Track and field athletes (N = 202) attended UK Athletics' Clean Sport programme. This programme delivered information about the World Anti-Doping Agency, drug testing, anti-doping rule violations, use of medications, and risks associated with sport supplements. Participants completed measures related to unintentional (i.e. knowledge of anti-doping rules, intention to use sport supplements, beliefs about sport supplements) and intentional (i.e. doping likelihood, doping moral disengagement) doping at baseline, immediately after the programme, and at 3-month follow-up. Compared to baseline, immediately after the programme, participants had more knowledge about anti-doping rules (mean differences ± SEM = 2.34 ± 0.11; d = 1.40) and lower scores for intention to use supplements (−0.92 ± 0.12; d = 0.44), beliefs about the effectiveness of supplements, (−0.57 ± 0.06; d = 0.45), doping likelihood (−0.16 ± 0.03; d = 0.20), and doping moral disengagement (−0.20 ± 0.04; d = 0.26). At follow-up, knowledge of anti-doping rules (1.94 ± 0.12; d = 1.22), intention to use supplements (−1.26 ± 0.12; d = 0.63), and supplement beliefs (−0.52 ± 0.07; d = 0.42) remained different from baseline, whereas doping likelihood (0.01 ± 0.05; d = 0.01) and moral disengagement (0.13 ± 0.03; d = 0.09) returned to baseline. After attending the programme, participants were less likely to unintentionally dope in the short and medium term and were less likely to intentionally dope in the short term. However, the effects on intentional doping were not maintained after 3-months. These findings suggest that although the programme reduces intentional doping in the short term, it needs to be strengthened to sustain effects in the long term.

1. Introduction

The World Anti-Doping Agency (WADA) is the leader of a global network of international and national organisations that attempt to reduce or eliminate doping in sport. It is argued that doping is a threat to the health and well-being of athletes and the integrity of sport (Backhouse, Griffiths, & McKenna, 2018). While some athletes dope intentionally to gain an unfair advantage, others dope unintentionally due to a lack of understanding of the anti-doping rules or because of the accidental consumption of a banned substance, which often occurs via the use of sport supplements (Chan et al., 2016; Chan, Tang, Yung, Gucciardi, & Hagger, 2017).

A primary goal of WADA is to prevent unintentional and intentional doping through anti-doping education. Accordingly, over 650 international and national organisations deliver anti-doping education programmes worldwide (WADA, 2019). In the UK, UK Anti-Doping (UKAD) spend over £300,000 per annum on anti-doping education (UKAD, 2018). Since 2009, UKAD have educated over 30,000 athletes. To help educate athletes across the UK, sport organisations work in partnership with UKAD (see: WADA, 2009). For example, the governing body for athletics in the UK, UK Athletics, delivers the *Clean Sport* programme, which was designed in line with article 18.2 of WADC to help foster a doping-free sporting environment. While the overall aim of this programme is to prevent athletes from intentionally doping, much of the content is focused on preventing unintentional doping. Similar anti-doping programmes are implemented globally (e.g. USADA's *Play Clean*, German NADA's *Together Against Doping*, European Athletics' *I Run Clean*), which focus on improving athletes' knowledge of the anti-

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doping rules and decision-making regarding use of medication and sport supplements.

Despite the worldwide investment into anti-doping education, there is a paucity of systematic evaluations of the effectiveness of existing programmes (Backhouse, Whitaker, Patterson, Erickson, & McKenna, 2016; Ntoumanis, Ng, Barkoukis, & Backhouse, 2014). Evaluation is a powerful tool to help improve the quality of programmes. The publication of WADA's handbook for the evaluation of anti-doping education programmes (Houlihan & Melville, 2011) is testament to this purpose. Evaluation can take two forms - outcome and process. Outcome evaluation aims to determine how well a programme achieves its objectives, whereas process evaluation aims to explore the way in which they are implemented (Craig et al., 2008). Outcome evaluation can indicate whether a programme has a worthwhile effect on the intended outcome[1], whereas process evaluation can indicate why a programme fails or has unexpected consequences.

Evaluating the effectiveness of anti-doping education on doping itself is difficult, in part this is because of inadequate prevalence data (de Hon, Kuipers, & van Bottenburg, 2015; Ulrich et al., 2018) and the fact that if an athlete admits to doping, they could be banned from competition. To circumvent this difficulty, researchers advocate assessing the impact of programmes on risks associated with unintentional and intentional doping (Huybers & Mazanov, 2012; Ntoumanis et al., 2014).

In the last decade, research has identified a number of risk factors for unintentional and intentional doping (Backhouse et al., 2016; Ntoumanis et al., 2014). Risk factors for unintentional doping include lack of knowledge of the anti-doping rules (Chan et al., 2016), intention to use sport supplements (Chan et al., 2017), and believing in their effectiveness (Hurst, Kavussanu, Boardley, & Ring, 2019). It is assumed that an increase in knowledge of the anti-doping rules and a decrease in the likelihood of an athlete using sport supplements, reduces the risk of athletes unintentionally doping (Hurst et al., 2019; WADA, 2016). Risk factors for intentional doping include doping likelihood (Huybers & Mazanov, 2012; Ring, Kavussanu, Lucidi, & Hurst, 2019) and moral disengagement (Kavussanu, Hatzigeorgiadis, Elbe, & Ring, 2016; Kavussanu, Yukhymenko-Lescroart, Elbe, & Hatzigeorgiadis, 2019; Ring & Hurst, 2019). Doping likelihood is used a proxy of doping behaviour (Hurst et al., 2019; Ring & Hurst, 2019), which reflects an athlete's likelihood to dope during a hypothetical situation, whereas moral disengagement refers to a set of mechanisms athletes use to justify doping without experiencing self-sanctions (e.g. guilt, regret and shame).

While there has been a considerable increase in understanding of risks factors associated with doping, experimental randomised controlled trials of education programmes often show little or no effect on doping behaviour. The ATLAS (Athletes Training and Learning to Avoid Steroids; Goldberg et al., 1996) and ATHENA (Athletes Targeting Healthy Exercise and Nutrition Alternatives; Elliot et al., 2004) programmes, for example, which both convey knowledge about unhealthy behaviours including doping, found no changes in reported cases of doping. Similar results were reported by Barkoukis, Kartali, Lazuras, and Tsorbatzoudis (2016) and Lucidi et al. (2017) whose programmes educated participants on the moral, social and psychological aspects of doping and by Elbe and Brand (2016) whose ethical decision making programme sought to change young athletes' attitudes towards doping. Importantly, none of these studies examined doping likelihood.

A paucity of research also exists for national anti-doping education programmes. Hallward and Duncan (2019) interviewed 21 athletes who attended an anti-doping education programme and found that athletes believed anti-doping education interventions were too focused on the negative consequences of doping and should be more engaging and interactive. Wippert and Fliesser (2016) investigated whether the German National Prevention Plan (NDPP) improved athletes' knowledge of doping. Young athletes ($N = 213$) attended either a *school seminar*, which included information about various doping topics, athlete-led presentations and role-playing games, or an *information tour*, which included a presentation from an anti-doping official, a personal narrative from an elite athlete, and a doping control film. Compared to a control group, athletes who attended the NDPP reported increased knowledge of doping. Crucially, neither study evaluated whether the programme reduced the likelihood of unintentional or intentional doping. To fill this gap in our understanding of anti-doping education, research needs to evaluate the impact of current anti-doping education programmes on risk factors associated with unintentional and intentional doping.

In the present study, we used an outcome evaluation approach to understand whether UK Athletics' Clean Sport programme prevents unintentional and intentional doping in junior elite track and field athletes. Examining the effectiveness of the programme in this demographic is important for two reasons. First, with over 500 track and field athletes currently serving a ban for an anti-doping rule violation (AIU, 2019) and the Russian state sponsored doping programme, doping is an important issue in athletics. Second, junior elite athletes are at a stage in their career when they are more susceptible to dope (Lentillon-Kaestner & Carstairs, 2010) and decisions towards substance use are more likely to change when doping attitudes and values are being formed (Backhouse, Patterson, & McKenna, 2012). We therefore determined whether attending UK Athletics' Clean Sport programme reduced the likelihood of athletes' unintentionally and intentionally doping immediately and 3-months after the programme.

2. Materials and methods

2.1. Participants and recruitment

Three hundred and thirty-two (57.4 % male; mean ± SD: age = 17.2 ± 0.7; years training = 5.0 ± 2.2; hours trained per week = 8.6 ± 3.4) junior elite track and field athletes were recruited to the study through a national programme (i.e. the Advanced Level Apprenticeship in Sporting Excellence). This programme offers talented athletes the opportunity to acquire educational qualifications while pursuing their sporting careers. As part of the programme, athletes were asked to attend UK Athletics' Clean Sport programme. Attendance was voluntary, but as per UK Athletics' policy, if participants aspired to compete for Great Britain and Northern Ireland in the future, they are required to have received anti-doping education in the previous two years. At the time of data collection, participants had received no other official anti-doping education from UK Athletics or UK Anti-Doping, and they were ranked in the top 1 % in Great Britain for their event discipline. The highest ever standard at which they had competed in their sport at the time of data collection was national (69.4 %) and international (30.6 %).

2.2. Role of UK athletics

The lead author established a relationship with UK Athletics to evaluate their educational programme prior to data collection. This was on the basis that evaluation about the programme would help understand how effective it is in meeting their aims of preventing intentional and unintentional doping. UK Athletics provided access to participants and had no role in study design, data col-

[1] In the case of anti-doping education, this would refer to whether an athlete is less likely to dope intentionally and/or unintentionally after attending the programme.

lection, analysis, and interpretation, or writing of the manuscript. The corresponding author had final responsibility for the decision to submit for publication.

2.3. Clean sport programme

The programme adopted a didactic approach with interactive elements. Sixteen sessions across the United Kingdom were delivered to groups of 19–25 (mean ± SD = 21 ± 3) participants using electronic presentation software in a classroom setting. Participants were grouped by UK Athletics. In each group, participants specialised in the same event (e.g. sprints, middle-distance, throws) and were familiar with each other, having competed or trained together in preceding 6-months.

The programme consisted of a 60-minute session delivered by a 27-year-old, male, ex-international track and field athlete. The facilitator received anti-doping education training from UKAD and had over four years of experience delivering the Clean Sport programme. The session provided participants with information relevant to, and consistent with, the WADC and consisted of five parts. The first part informed participants about the global governance of anti-doping with reference to WADA. The second part introduced the 10 anti-doping rule violations and provided examples of athletes and athlete support personnel committing violations. The third introduced the drug testing procedure. A mock test was performed in which participants role-played each step of the procedure using official anti-doping bottles and documentation. The fourth explained that some medications might be banned for use in competition. Participants were instructed to check their medication using the Global Dro website, which provides athletes verification of whether a medication is prohibited or sanctioned in or out of competition. The educator demonstrated how to use the website and encouraged participants to search for a medication and identify whether it was banned or sanctioned in and out of competition. In the final part, participants were told that they might commit an anti-doping rule violation by using sport supplements that are contaminated with banned substances. To minimise this risk, they were shown how to use the informed-sport programme (i.e. a quality assurance programme that batch-tests sports supplements for banned substances). A video interview of an athlete who had committed an anti-doping rule violation after using a sport supplement was shown to participants and a discussion followed on the impact contamination of sport supplements can have on an athlete's career. To ensure engagement with the content, participants were encouraged to ask questions and discussed pertinent issues in groups.

2.4. Outcome measures

In this study, we refer to knowledge of the anti-doping rules, sport supplement intention and beliefs as unintentional doping, and doping likelihood and moral disengagement as intentional doping.

2.4.1. Unintentional doping

Participants were asked to complete a bespoke questionnaire that assessed their knowledge of the anti-doping rules. While previous studies have used other measures to assess athletes' anti-doping knowledge (Kim & Kim, 2017; Murofushi, Kawata, Kamimura, Hirosawa, & Shibata, 2018; Turfus, Smith, Mansingh, Alexander-Lindo, & Roopchand-Martin, 2019), we created our own questionnaire to align with each of the five sections of the Clean Sport program (e.g., anti-doping rule violations, drug testing and medications). The questionnaire was created and refined following consultation with five anti-doping education experts from UK Athletics and UK Anti-Doping. Experts provided feedback on the relevance, clarity and simplicity of each question. Pilot testing was conducted with six international level athletes, who had previously attended the Clean Sport programme. The final questionnaire consisted of eight multiple-choice questions (e.g. "How many anti-doping rule violations are there?" and "What can an athlete use Global DRO to search for?"). A score of 1 was given to each correct answer, with scores ranging from 0-8. Higher scores indicated greater knowledge of the anti-doping rules.

Participants were asked to respond on a Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) how much they agreed with the following statement: "Over the next three months, I intend to use sport supplements". They also completed the Sports Supplements Beliefs Scale (Hurst, Foad, Coleman, & Beedie, 2017), which measures athletes' beliefs about the effectiveness of sport supplements. Participants indicated their level of agreement with six statements (e.g. "Supplements are necessary for me to be competitive" and "Supplements improve my performance") on a Likert type-scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Scale scores have shown good internal consistency ($\alpha = .89$) and factorial validity (Hurst et al., 2017). The mean of the six items was computed as a measure of sport supplement beliefs ($\alpha = .86$).

2.4.2. Intentional doping

Doping likelihood was measured using materials adapted from previous research (Huybers & Mazanov, 2012; Ring & Hurst, 2019; Ring et al., 2019). Participants were presented with the following scenario:

> *It's the week before the most important competition of your season. Lately, your performance has been below your best. You don't feel you have the necessary fitness for this competition, and you're concerned about how you'll perform. You mention this to a mate, who tells you that they use a substance that has enhanced their fitness and performance. The substance is banned for use in sport, but there's no chance that you will be caught.*

Participants were asked to imagine being in this hypothetical situation and indicate how likely they were to use the banned substance on a Likert scale ranging from 1 (*not at all likely*) to 7 (*very likely*).

The moral disengagement in doping scale (Kavussanu et al., 2016) was used to measure doping moral disengagement. Participants indicated their level of agreement with six statements (e.g. "Doping does not really hurt anyone" and "An athlete should not be blamed for doping if everyone in the club is doing it") on a Likert type-scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Scale scores have shown good internal consistency ($\alpha = .86$), test-retest reliability ($r = .78$) and factorial validity (Kavussanu et al., 2016). The mean of the six items was calculated as a measure of doping moral disengagement ($\alpha = .74$), with higher scores indicating a greater propensity to morally disengage.

2.5. Procedure

After obtaining ethical approval from our local ethics committee, participants were recruited to the study. Participants were informed about the study's aims, that participation was voluntary, and that all data collected would be kept strictly confidential and used only for research purposes. After reading the information sheet and having the opportunity to ask questions, informed consent was obtained from all participants.

Measures were administered in person by the facilitator delivering the programme and were completed at three time points: baseline, immediately after programme (post), and 3-months later (follow-up). To encourage honesty in responses, participants did not disclose any personal information (e.g. name, contact information, personal best) and returned completed questionnaires in

Table 1
Descriptive statistics for all measures at three time points.

Measure	Pre	Post	Follow up
Knowledge of anti-doping rules	4.64 ± 0.09	6.98 ± 0.08	6.58 ± 0.09
Sport supplement use intention	4.57 ± 0.14	3.65 ± 0.15	3.31 ± 0.13
Sport supplement beliefs	3.01 ± 0.08	2.43 ± 0.09	2.48 ± 0.09
Doping likelihood	1.41 ± 0.06	1.25 ± 0.05	1.42 ± 0.06
Moral disengagement	1.84 ± 0.05	1.64 ± 0.06	1.77 ± 0.06

Data are means ± standard error of the mean.
Possible range scores for knowledge of anti-doping rules: 0–8; for all other variables: 1 to 7.

a sealed envelope. Participants created a bespoke password to maintain anonymity and match responses across the three data collection points.

2.6. Statistical analysis

Of the 332 participants initially recruited to the study, 5 did not complete any measures at baseline, 38 at post, and 87 at follow-up. Their data were deleted, leaving a final sample size of 202 (60.8 % completion rate). Data were entered into SPSS version 24.0 (IBM, Armonk, NY, USA). Inspection of data revealed 24 participants (11.9 %) had incomplete data sets. Little's Missing Completely at Random test (Little, 1988) indicated data were missing completely at random (χ^2 = 874.790, *df* = 854, *p* =.303). Missing values were replaced using a multiple imputation model that generated five data sets with a maximum of parameters set at 100. The mean value of the missing data sets was used for further analyses.

We conducted repeated measures Multivariate Analysis of Variance (MANOVA), with time points (baseline, post, follow-up) as the within-participants factor, on five variables (knowledge of anti-doping rules, sport supplement intention and beliefs, doping likelihood, and doping moral disengagement). To examine trends over time, tests of linear and quadratic effects were reported. Partial eta-squared (η^2) is reported as the effect size, with values of 0.02, 0.13 and 0.26 indicating small, medium and large effects, respectively (Cohen, 1992). *Post hoc* Least Significant Difference (LSD) tests were used to examine differences between time points, with Cohen's d (*d*) reported as the effect size, with values of 0.2, 0.5 and 0.8 indicating small, medium, and large effects, respectively (Cohen, 1992). Data are reported as means ± standard error of the mean (SEM) and 95 % confidence intervals. Statistical significance was set at $p < .05$.

3. Results

Descriptive data for all variables are presented in Table 1. Repeated measures MANOVA yielded a multivariate effect for time ($F_{10, 792}$ = 64.95, p <.001, η^2 = 0.45).

3.1. Unintentional doping

Repeated measures ANOVA univariate tests indicated significant time-related differences for knowledge of anti-doping rules ($F_{2, 400}$ = 339.97, p < 0.001, η^2 = 0.63), sport supplement use intention ($F_{2, 400}$ = 74.99, p < 0.001, η^2 = 0.27) and sport supplement beliefs ($F_{2, 400}$ = 62.26, p < 0.001, η^2 = 0.24). Changes in knowledge of anti-doping scores were characterised by both linear ($F_{1, 200}$ = 277.55, p <.001, η^2 = 0.58) and quadratic ($F_{1, 200}$ = 514.50, p < 0.001, η^2 = 0.72) trends. Post-hoc LSD tests showed that compared to baseline, participants' knowledge significantly increased at post and follow-up, whereas, scores fell slightly between post-programme and follow-up (Table 2). Intention to use sport supplements scores were characterised by linear ($F_{1, 200}$ = 106.11, p < 0.001, η^2 = 0.347) and quadratic ($F_{1, 200}$ = 14.50, p < 0.001, η^2 = 0.07) trends. Compared to baseline, scores were significantly lower at post- programme and at follow-up, and were lower at follow up than post-programme (Table 2). Linear ($F_{1, 200}$ = 62.14, p < 0.001, η^2 = 0.24) and quadratic ($F_{1, 200}$ = 62.52, p < 0.001, η^2 = 0.24) patterns described the changes in sport supplement beliefs. Participants believed that supplements were less effective both immediately after completing the programme and 3-months later than baseline. Beliefs remained the same at follow-up compared to post-programme (Table 2).

Overall, participants' knowledge of anti-doping rules increased immediately and 3-months after the programme. Similarly, participants were less likely to use sport supplements and believe in their effectiveness post-programme and at follow-up.

Table 2
Differences in unintentional doping measures between time points.

Time	*vs.*	Δ	*d*
Knowledge of anti-doping rules			
Baseline	Post	2.34 ± 0.11*	1.40
	Follow up	1.94 ± 0.12*	1.22
Post	Follow up	−0.40 ± 0.05*	0.33
Sport supplement use intention			
Baseline	Post	−0.92 ± 0.12*	0.44
	Follow up	−1.26 ± 0.12*	0.63
Post	Follow up	−0.34 ± 0.07*	0.18
Sport supplement beliefs			
Baseline	Post	−0.57 ± 0.06*	0.45
	Follow up	−0.52 ± 0.07*	0.42
Post	Follow up	0.05 ± 0.04	0.04

Δ = mean difference ± standard error of the mean.
d = Cohen's *d*.
* = p < 0.01.

Table 3
Differences in intentional doping measures between time points.

Time	*vs.*	Δ	*d*
Doping Likelihood			
Baseline	Post	−0.16 ± 0.03*	0.20
	Follow up	0.01 ± 0.05	0.01
Post	Follow up	0.17 ± 0.03*	0.22
Doping moral disengagement			
Baseline	Post	−0.20 ± 0.04*	0.26
	Follow up	−0.07 ± 0.05	0.09
Post	Follow up	0.13 ± 0.03*	0.15

Δ = mean difference ± standard error of the mean.
d = Cohen's *d*.
* = p < 0.01.

3.2. Intentional doping

Repeated measures ANOVA univariate tests indicated time-related differences for doping likelihood ($F_{2, 400}$ = 11.97, p < .001, η^2 = 0.06) and doping moral disengagement ($F_{2, 400}$ = 12.66, p < .001, η^2 = 0.06). Doping likelihood scores across the three time points resembled a quadratic pattern ($F_{1, 200}$ = 51.90, p <.001, η^2 = 0.21). Post-hoc LSD tests indicated that doping likelihood was significantly lower post-programme compared to baseline and at follow-up. However, doping likelihood at follow-up did not differ from baseline (Table 3). Scores for doping moral disengagement exhibited a quadratic trend ($F_{1, 200}$ = 49.14, p < .001, η^2 = 0.20). Scores were lower post- programme compared to baseline and follow-up. Scores did not differ between baseline and follow-up (Table 3).

Overall, participants were less likely to dope and justify doing so immediately following the programme. However, these effects were not sustained at 3-months.

4. Discussion

Anti-doping educational programmes are implemented globally by national and international organisations. However, there is a paucity of empirical evidence of their effectiveness in preventing doping. To our knowledge, this is the first study to evaluate whether a national anti-doping organisation's education programme is effective in preventing unintentional and intentional doping in junior elite athletes.

Given the risk that sport supplements can be contaminated with banned substances (Chan et al., 2017; Hurst et al., 2019) and that a lack of knowledge of the anti-doping rules can lead to an unintentional anti-doping rule violation (Chan et al., 2016), anti-doping educational programmes devote a considerable proportion of their content to increase athletes' knowledge of the anti-doping rules and helping them make more informed decisions about use of sport supplements. Our results show that UK Athletics' Clean Sport programme increased knowledge of the anti-doping rules and reduced the likelihood of athletes using sport supplements immediately after and three months following the programme. This is an important finding, providing evidence for the potential effectiveness of anti-doping education programmes in reducing unintentional doping.

The Clean Sport programme was also effective in reducing doping likelihood and doping moral disengagement in the short term. That is, participants were less likely to dope and less likely to justify the use of doping immediately after attending the programme. However, these effects were short lived. At follow up, both doping likelihood and doping moral disengagement scores returned to baseline, suggesting that the Clean Sport programme was not able to maintain its anti-doping effect three months later. These results are similar to the ATHENA (Elliot et al., 2004; Ranby et al., 2009) programme, in which significant decreases in steroid use was reported immediately after the programme but were not sustained at follow-up. Backhouse et al. (2012) suggested that effective anti-doping education programmes should include booster sessions delivered across the year to help reinforce key messages. MacArthur, Harrison, Caldwell, Hickman, and Campbell (2016) conducted a meta-analysis of tobacco, alcohol, and drug education programmes, and reported that programmes were more effective with the inclusion of booster sessions. Anti-doping organisation may therefore need to incorporate booster sessions during each athlete's season to ensure the education messages are sustained.

4.1. Limitations and future research

In our study, we have reported some novel findings. However, these need to be interpreted in light of potential limitations. The first is the absence of a control group. It would be difficult to recruit an equivalent control group because our participants were junior elite track and field athletes who were ranked in the top 1 % in Great Britain. A comparable control group is unlikely to exist, given that athletes at this standard typically attend anti-doping education programmes biannually. To overcome this issue, future research could aim to capture athletes' likelihood to dope unintentionally and intentionally leading up to the programme (e.g. one-month prior), which may be a more practical alternative. Second, the programme was delivered by the same educator. Given that anti-doping organisations typically employ a team of educators to deliver their programme (UKAD, 2017), content delivered by one educator may differ in effectiveness than the same programme delivered by another educator (Beedie et al., 2018). Some educators may have more experience than others and variation in effectiveness may exist. Future research should aim to investigate whether an anti-doping education programme differs in effectiveness between educators. Finally, our study used an outcome evaluation approach to determine whether the anti-doping education programme was effective in meeting its objectives, which are to prevent both unintentional and intentional doping. While our study has revealed some important findings, it has not provided insight into *why* the programme was effective. Utilising a process evaluation strategy can help, for example, assess the fidelity and quality of implementation of the programme (e.g. was the programme delivered the same each time?), clarify casual mechanisms (e.g. what caused changes in outcome measures?), and identify contextual factors associated with variation in outcomes (e.g. what parts of the programme influenced its effectiveness?). This approach can be considered in future evaluations.

5. Conclusion

In conclusion, our results show that UK Athletics' Clean Sport programme was effective in changing unintentional doping up to three months later. Participants reported increased knowledge of anti-doping rules and were less likely to use sport supplements and believe in their effectiveness after attending the programme. Given this key finding, anti-doping organisations should continue to update their athletes' knowledge of the anti-doping rules and educate them on how to check a medication's prohibited status and a sport supplement's safety to reduce the risk of unintentional doping. Although the programme was effective in preventing unintentional doping, the current findings indicate that it was not effective in preventing intentional doping in the long term. Accordingly, anti-doping organisations need to monitor the long-term effectiveness of their programmes and consider strengthening them by including booster sessions throughout the season to reinforce key education messages.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.peh.2019.100155.

References

AIU. (2019). *Athletics integrity unit: Global list of inelgible persons* Retrieved from. https://www.athleticsintegrity.org/downloads/pdfs/disciplinary-process/en/September-2019-Sanctions-List-Full.pdf

Backhouse, S., Whitaker, L., Patterson, L., Erickson, K., & McKenna, J. (2016). *Social psychology of doping in sport: A mixed studies narrative synthesis*. Montreal, Canada: World Anti-Doping Agency.

Backhouse, S. H., Griffiths, C., & McKenna, J. (2018). Tackling doping in sport: A call to take action on the dopogenic environment. *British Journal of Sports Medicine*, *52*, 1485–1486. http://dx.doi.org/10.1136/bjsports-2016-097169

Backhouse, S. H., Patterson, L., & McKenna, J. (2012). Achieving the Olympic ideal: Preventing doping in sport. *Performance Enhancement & Health*, *1*(2), 83–85. http://dx.doi.org/10.1016/j.peh.2012.08.001

Barkoukis, V., Kartali, K., Lazuras, L., & Tsorbatzoudis, H. (2016). Evaluation of an anti-doping intervention for adolescents: Findings from a school-based study. *Sport Management Review*, *19*(1), 23–34. http://dx.doi.org/10.1016/j.smr.2015.12.003

Beedie, C., Benedetti, F., Barbiani, D., Camerone, E., Cohen, E., Coleman, D., . . . & Szabo, A. (2018). Consensus statement on placebo effects in sports and exercise: The need for conceptual clarity, methodological rigour, and the elucidation of neurobiological mechanisms. *European Journal of Sport Science*, *18*(10), 1383–1389. http://dx.doi.org/10.1080/17461391.2018.1496144

Chan, D. K., Ntoumanis, N., Gucciardi, D. F., Donovan, R. J., Dimmock, J. A., Hardcastle, S. J., . . . & Hagger, M. S. (2016). What if it really was an accident? The psychology of unintentional doping. *British Journal of Sports Medicine*, *50*(15), 898–899. http://dx.doi.org/10.1136/bjsports-2015-094678

Chan, D. K., Tang, T. C. W., Yung, P. S., Gucciardi, D. F., & Hagger, M. S. (2017). Is unintentional doping real, or just an excuse? *British Journal of Sports Medicine*, http://dx.doi.org/10.1136/bjsports-2017-097614

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: The new Medical Research Council guidance. *BMJ*, *337*, a1655.

de Hon, O., Kuipers, H., & van Bottenburg, M. (2015). Prevalence of doping use in elite sports: A review of numbers and methods. *Sports Medicine*, *45*(1), 57–69. http://dx.doi.org/10.1007/s40279-014-0247-x

Elbe, A.-M., & Brand, R. (2016). The effect of an ethical decision-making training on young athletes' attitudes toward doping. *Ethics & Behavior*, *26*(1), 32–44. http://dx.doi.org/10.1080/10508422.2014.976864

Elliot, D. L., Goldberg, L., Moe, E. L., Defrancesco, C. A., Durham, M. B., & Hix-Small, H. (2004). Preventing substance use and disordered eating: Initial outcomes of the ATHENA (athletes targeting healthy exercise and nutrition alternatives) program. *Archives of Pediatrics & Adolescent Medicine*, *158*(11), 1043–1049. http://dx.doi.org/10.1001/archpedi.158.11.1043

Goldberg, L., Elliot, D., Clarke, G. N., MacKinnon, D. P., Moe, E., Zoref, L., . . . & Miller, D. J. (1996). Effects of a multidimensional anabolic steroid prevention intervention: The Adolescents training and learning to Avoid Steroids (ATLAS) Program. *JAMA*, *276*(19), 1555–1562.

Hallward, L., & Duncan, L. R. (2019). A qualitative exploration of athletes' past experiences with doping prevention education. *Journal of Applied Sport Psychology*, *31*(2), 187–202.

Houlihan, B., & Melville, S. (2011). *Improving and proving: A handbook for the evaluation of anti-doping education programmes*. Canada: World Anti-Doping Agency.

Hurst, P., Foad, A. J., Coleman, D. A., & Beedie, C. (2017). Development and validation of the sports supplements beliefs scale. *Performance Enhancement & Health*, *5*(3), 89–97. http://dx.doi.org/10.1016/j.peh.2016.10.001

Hurst, P., Kavussanu, M., Boardley, I. D., & Ring, C. (2019). Sport supplement use predicts doping via sport supplement beliefs. *Journal of Sports Sciences*, 1–7. http://dx.doi.org/10.1080/02640414.2019.1589920

Huybers, T., & Mazanov, J. (2012). What would Kim do: A choice study of projected athlete doping considerations. *Journal of Sport Management*, *26*(4), 322–334. http://dx.doi.org/10.1123/jsm.26.4.322

Kavussanu, M., Hatzigeorgiadis, A., Elbe, A.-M., & Ring, C. (2016). The moral disengagement in doping scale. *Psychology of Sport and Exercise*, *24*, 188–198. http://dx.doi.org/10.1016/j.psychsport.2016.02.003

Kavussanu, M., Yukhymenko-Lescroart, M. A., Elbe, A.-M., & Hatzigeorgiadis, A. (2019). Integrating moral and achievement variables to predict doping likelihood in football: A cross-cultural investigation. *Psychology of Sport and Exercise*, 101518.

Kim, T., & Kim, Y. H. (2017). Korean national athletes' knowledge, practices, and attitudes of doping: A cross-sectional study. *Substance Abuse Treatment, Prevention, and Policy*, *12*(1), 7.

Lentillon-Kaestner, V., & Carstairs, C. (2010). Doping use among young elite cyclists: A qualitative psychosociological approach. *Scandinavian Journal of Medicine & Science in Sports*, *20*(2), 336–345. http://dx.doi.org/10.1111/j.1600-0838.2009.00885.x

Little, R. J. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*(404), 1198–1202.

Lucidi, F., Mallia, L., Alivernini, F., Chirico, A., Manganelli, S., Galli, F., . . . & Zelli, A. (2017). The effectiveness of a new school-based media literacy intervention on adolescents' doping attitudes and supplements use. *Frontiers in Psychology*, *8*, 749.

MacArthur, G. J., Harrison, S., Caldwell, D. M., Hickman, M., & Campbell, R. (2016). Peer-led interventions to prevent tobacco, alcohol and/or drug use among young people aged 11–21 years: A systematic review and meta-analysis. *Addiction*, *111*(3), 391–407.

Murofushi, Y., Kawata, Y., Kamimura, A., Hirosawa, M., & Shibata, N. (2018). Impact of anti-doping education and doping control experience on anti-doping knowledge in Japanese university athletes: A cross-sectional study. *Substance Abuse Treatment, Prevention, and Policy*, *13*(1), 44.

Ntoumanis, N., Ng, J. Y., Barkoukis, V., & Backhouse, S. (2014). Personal and psychosocial predictors of doping use in physical activity settings: A meta-analysis. *Sports Medicine*, *44*(11), 1603–1624. http://dx.doi.org/10.1007/s40279-014-0240-4

Ranby, K. W., Aiken, L. S., MacKinnon, D. P., Elliot, D. L., Moe, E. L., McGinnis, W., . . . & Goldberg, L. (2009). A mediation analysis of the ATHENA intervention for female athletes: Prevention of athletic-enhancing substance use and unhealthy weight loss behaviors. *Journal of Pediatric Psychology*, *34*(10), 1069–1083.

Ring, C., & Hurst, P. (2019). The effects of moral disengagement mechanisms on doping likelihood are mediated by guilt and moderated by moral traits. *Psychology of Sport and Exercise*, *40*, 33–41. http://dx.doi.org/10.1016/j.psychsport.2018.09.001

Ring, C., Kavussanu, M., Lucidi, S., & Hurst, P. (2019). Effects of personal and situational factors on self-referenced doping likelihood. *Psychology of Sport and Exercise*, *41*, 29–35.

Turfus, S., Smith, J., Mansingh, A., Alexander-Lindo, R., & Roopchand-Martin, S. (2019). Supplementation practices, perceptions and knowledge about anti-doping among Jamaican high school athletes. *Performance Enhancement & Health*, 100145.

UKAD. (2017). *Strategic plan* Retrieved from. https://www.ukad.org.uk/sites/default/files/2019-04/UK%20Strategic%20Plan%202018%20-2022.pdf

UKAD. (2018). *Annual reports and accounts* Retrieved from. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730300/UKAD_Annual_Report_2018.pdf

Ulrich, R., Pope, H. G., Cléret, L., Petróczi, A., Nepusz, T., Schaffer, J., . . . & Simon, P. (2018). Doping in two elite athletics competitions assessed by randomized-response surveys. *Sports Medicine*, *48*(1), 211–219.

WADA. (2009). *Global anti-doping organization chart* Retrieved from. https://www.wada-ama.org/sites/default/files/resources/files/WADA_PK_Global_ADO_Chart_200901_EN.pdf

WADA. (2016). *Information/Education guidelines to prevent doping in sport* Retrieved from. https://www.wada-ama.org/sites/default/files/resources/files/wada_guidelines_information_education_2016_v3.0_en.pdf

WADA. (2019). *Code signatories* Retrieved from. https://www.wada-ama.org/en/what-we-do/the-code/code-signatories

Wippert, P. M., & Fliesser, M. (2016). National doping prevention guidelines: Intent, efficacy and lessons learned - A 4-year evaluation. *Substance Abuse Treatment, Prevention, and Policy*, *11*(1), 35. http://dx.doi.org/10.1186/s13011-016-0079-9