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Research Paper

Dietary supplement use is related to doping intention via doping attitudes, subjective norms, and perceived behavioural control

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ABSTRACT

The use of dietary supplements (e.g., caffeine, creatine, dietary nitrate) has shown to be related to the intention to dope (e.g., amphetamines, anabolic steroids, erythropoietin). In this study, we integrated elements of the theory of planned behaviour to better understand the relationship between dietary supplement use and doping intention. Specifically, we tested whether dietary supplement use is indirectly related to doping via doping attitudes, doping subjective norms, and doping perceived behavioural control. Competitive athletes (N = 443; 46 % female, age = 27.0 ± 8.6 years old, years competing = 8.3 ± 3.5) completed measures of dietary supplement use, doping attitudes, doping subjective norms, doping perceived behavioural control, and doping intention. Parallel mediation analysis indicated that dietary supplement use was not directly related to doping intention, but instead was indirectly related via doping attitudes (effect size = 0.15), doping subjective norms (effect size = 0.17), and doping perceived behavioural control (effect size = 0.15). Contrast analyses reported no differences between each indirect effect. Our results suggest that athletes who use dietary supplements report stronger intentions to dope, which is related to more favourable doping attitudes, a greater social pressure to dope, and a perceived ease in which to dope.

1. Introduction

The use of dietary supplements (e.g., creatine, caffeine, and nitrate) is highly prevalent amongst athletes (Knapik et al., 2016). In the past decade, a body of research (Hurst et al., 2023; Mallick et al., 2023) has shown that dietary supplement use may be related to the use of prohibited performance enhancing substances (i.e., doping). Researchers have reported that dietary supplement users are more likely to dope due to the motivation to win and beat others (Barkoukis, Lazuras et al., 2020; Hurst et al., 2021b) and belief that dietary supplements are effective for improving performance (Hurst et al., 2019b, 2021a, 2021b). A well-known theoretical model is the theory of planned behaviour (Ajzen, 1985, 1991), which has been extensively used to examine doping behaviour (Backhouse et al., 2016; Ntoumanis et al., 2014). The aim of the present research is to extend previous work by examining whether the relationship between dietary supplement use and doping is indirectly related with Ajzen's (1985, 1991) theory of planned behaviour.

1.1. Doping and the theory of planned behaviour

Research on doping use often frames the behaviour as one of decision-making and planning (Hauw & McNamee, 2015). Based on this, doping is the outcome of a process determined by numerous factors such as an athlete's beliefs, hopes, attitudes, intentions, expectations, and perceptions of others. Several authors have used the theory of planned behaviour (Ajzen, 1985, 1991) to examine intentions, attitudes, and beliefs about doping behaviours (Backhouse et al., 2016; Ntoumanis et al., 2014). The theory of planned behaviour posits that a person's intention is the most proximal and immediate predictor of behaviour (Chan et al., 2015). Intention is the extent to which a person plans to engage in the behaviour in the future (Ajzen, 1991). Barkoukis et al. (2013) reported that participants who self-reported using prohibited substances showed stronger intentions to use these substances in the future than self-reported non-users. These results are supported by Dodge and Jaccard (2007) and Goulet et al. (2010), who reported positive relationships between prohibited substance intention and actual use. Further, in a meta-analysis of the predictors of doping (Ntoumanis

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et al., 2014), intention to dope was found to be strongly correlated with doping use (pooled $r = 0.38$, 95 % confidence interval = 0.21 to 0.55).

The theory of planned behaviour suggests that intention is determined by attitudes (i.e., how a person favours the behaviour), subjective norms (i.e., how a person perceives the social appropriateness of the behaviour) and perceived behavioural control (i.e., how a person perceives the capability to perform the behaviour). Perceived behavioural control is also suggested to be related to a person's behaviour (Ajzen, 1991). Lucidi et al. (2008) reported that the theory of planned behaviour constructs (i.e., attitudes, subjective norms, and perceived behavioural control) significantly predicted doping intentions and behaviour, whereas Goulet et al. (2010) found that intention to dope was the strongest predictor of doping behaviour, and that attitudes, subjective norms and perceived behavioural control predicted 39 % of the variance in intention. Similarly, in a meta-analysis of the psychosocial predictors of doping use (Ntoumanis et al., 2014), attitudes, subjective norms, and perceived behavioural control predicted both doping intention and doping use. In sum, the theory of planned behaviour constructs have shown to be strongly related to both intention to dope and use of doping substances.

1.2. Dietary supplements, doping and the theory of planned behaviour

A body of research has reported that dietary supplement use is positively related to doping attitudes (Backhouse et al., 2013; Hurst et al., 2021a), subjective norms (Backhouse et al., 2013; Hurst, 2023; Lazuras et al., 2017; Lucidi et al., 2008) and perceived behavioural control (Lazuras et al., 2017). It is therefore reasonable to suggest that dietary supplement use is indirectly related to doping via the theory of planned behaviour constructs. We explain this in more detail below.

It has been suggested that dietary supplement use may shape attitudes towards prohibited substances, and in turn, influence the likelihood to dope (Hurst et al., 2017, 2023; Petróczi, 2013). This is on the reasoning that dietary supplement users become comfortable using chemically active substance to facilitate their athletic endeavours, and over time, develop the attitude that stronger substances may provide similar or larger benefits to performance. Cross-sectional evidence has indicated that dietary supplement use is positively related to doping attitudes. Backhouse et al. (2013) found that dietary supplement users reported more positive doping attitudes and were 3.5 more likely to dope than non-users. Hurst et al. (2019; 2021a) discovered that dietary supplement users were more likely to self-report favourable doping attitudes than non-users, and that this relationship was mediated by beliefs that dietary supplements are effective. Finally, in a meta-analysis of the studies assessing dietary supplement use and doping attitudes (Hurst et al., 2023), authors reported that dietary supplement use was positivley correlated with doping attitudes (pooled $r = 0.20$, 95 % CI = 0.13 to 0.28). In short, it is likely that dietary supplement use may shape athletes' attitudes to dope and in turn, influence their likelihood to dope.

Athletes who use dietary supplements often seek advice about their use from those closest to them, such as friends, family and coaches (Erdman et al., 2007; Mettler et al., 2021), and are more likely to discuss substance use with those who recommend and encourage its use (Mettler et al., 2021). Dietary supplement users may therefore be more likely to discuss the use of supplements with those who use them, do not criticise their use and search for evidence that aligns with their belief that they are needed (Barkoukis, Rowe et al., 2020). As a result, dietary supplement users may perceive that those around them accept substance use and feel a greater pressure and acceptance of using permitted and prohibited performance enhancing substances. Lazuras et al. (2017) reported that dietary supplement use was related to doping subjective norms, Backhouse et al. (2013) found that dietary supplement users felt a greater pressure to dope than non-users and Hurst (2023) reported that the relationship between dietary supplement use and doping use was moderated by subjective norms. In short, athletes using dietary supplements may perceive others in their social group to approve performance enhancing substance use, and as a result, be more inclined to dope.

One of the most significant sources of information about whether a person believes that they are capable of the behaviour is the actual behaviour itself (Bandura, 1986). Given that many dietary supplements and doping substances share similar characteristics (e.g., method of consumption, appearance, effects on performance) it is reasonable to suggest that dietary supplement users are more likely to have greater confidence in using doping substances than non-users. For example, an athlete sourcing information about a dietary supplement and purchasing, preparing, and ingesting it prior to competition, is likely to feel more capable and confident of doing the same for a doping substance than an athlete who has no such experience. To our knowledge only one study has examined the relationship between dietary supplement use and perceived behavioural control to dope (Lazuras et al., 2017). While this study found that dietary supplement use was related to doping perceived behavioural control, the authors did not examine whether supplement use is indirectly related to doping via perceived behaviour control, and the sample was limited to adolescent athletes of a limited age range. Thus, a need exists in replicating and further extending what we understand about the role perceived behavioural control has in the relationship between dietary supplement use and doping on a more diverse sample of athletes.

1.3. The present research

In the past decade, a body of evidence has reported that users of dietary supplements may be more likely to dope (Hurst et al., 2023; Mallick et al., 2023) and that the theory of planned behaviour constructs (i.e., attitudes, subjective norms and perceived behavioural control) are associated with both dietary supplement use and doping intention (e.g., Backhouse et al., 2013; Hurst et al., 2019b; Lazuras et al., 2017). However, while several studies have reported positive relationships, no research has examined whether the supplement use-doping relationship is indirectly related to the theory of planned behaviour constructs. To progress knowledge and understanding of this association, we examined whether dietary supplement use is indirectly related to doping intention via doping attitudes, subjective norms, and perceived behavioural control.

2. Methods

This study is reported in accordance with the guidelines provided by the Strengthening the Reporting of Observational Studies in Epidemiology checklist (Von Elm et al., 2014).

2.1. Sample size and participants

Sample size calculations were based on Fritz MacKinnon's (2007) recommendation. Using a bias-corrected bootstrap test to detect a medium effect size of the direct effect and a small effect of the indirect effect, a sample size of 400 was required for 80 % power. We therefore recruited 443 (46 % female, age = 27.0 ± 8.6 years old, years competing = 8.3 ± 3.5) competitive athletes, competing at club (13 %), university (14 %), county (8 %), regional (22 %), national (27 %) and international (17 %) level. Participants competed in 21 different sports, with the most popular being football (31 %), weightlifting (15 %) and athletics (12 %). Eligible criteria stipulated participants competed in sports that were signatories to the World Anti-Doping Code, trained regularly (≥twice a week), and were aged 16 years or older.

2.2. Measures

The measures for doping subjective norms, perceived behavioural control and intention were used from previous research (Chan et al., 2015a; Chan et al., 2015b), which were constructed according to Ajzen

(2002) considerations. Prior to answering questions about doping, participants were presented with the following "Some athletes use substance that are prohibited for use in sport (e.g., anabolic steroids, human growth hormone, amphetamines)".

2.2.1. Dietary supplement use

Similar to previous research (Backhouse et al., 2013; Hurst et al., 2019a) and given that single-item measurements in relation to behaviours can help with ease of interpretation (Bowling, 2005), participants were asked to indicate whether they use dietary supplements, with responses scored as 0 (non-user) and 1 (user). To ensure accuracy in responses, participants were presented with a definition of dietary supplements (i.e., "Dietary supplements are a food, food component, nutrient or non-food compound that is purposefully ingested in addition to the habitually consumed diet with the aim of achieving a specific health and/or performance benefit") and examples (i.e., Lucozade, protein shakes, and creatine) prior to responding.

2.2.2. Doping attitudes

Using a scale adapted from Horcajo and De La Vega (2014), participants were presented with the following: "An international sport organisation is considering a proposal that would change their current anti-doping policy by legalising doping. The proposal is that any athlete should always be allowed to use any substance and method to enhance their performance, either directly or indirectly (e.g., aiding recovery from training or injury), in competitive sport". They were then asked to indicate their opinion using six 7-point semantic differential scales: negative/positive, bad/good, unfavourable/favourable, against/for, harmful/beneficial, foolish/wise. The mean of the six scales were calculated, with higher scores indicating more favourable doping attitudes.

2.2.3. Doping subjective norms

Participants first read the statement "For me, to use prohibited substances in the forthcoming month is something…" and were then asked to indicate their agreement to four items (e.g., "Most people who are important to me in sport think I should do" and "Expected of me") on a 7-point Likert-type scale anchored by 1 (*strongly disagree*) and 7 (*strongly agree*). The mean of the four statements was calculated, with higher scores indicating greater social acceptance of doping.

2.2.4. Doping perceived behavioural control

Participants were asked to read the statement "For me, to use prohibited substances in the forthcoming month is something…" and then indicate their agreement to five items (e.g., "Possible for me to do" and "I could do if I want to") on a 7-point Likert-type scale anchored by 1 (*strongly disagree*) and 7 (*strongly agree*). Ratings for five items were averaged to yield a measure of doping perceived behavioural control, with higher scores indicating a greater capability to dope.

2.2.5. Doping intention

Participants were presented with the following: "For me, using prohibited substances in the forthcoming month is something" and then indicated their agreement to three items (i.e., "I intend to do", "I plan to do" and "I will try and do") on a 7-point Likert-type scale anchored by 1 (*strongly disagree*) and 7 (*strongly agree*). The mean of the three items was calculated, with higher scores indicating a stronger intention to dope.

2.2.6. Procedure

After obtaining ethical approval from the lead author's institutional ethics committee, participants were recruited online via social media (e.g., Facebook, Twitter, and Instagram). They were sent a link to an anonymous online survey on a Jisc platform and read the participant information sheet, where they were informed that participation was voluntary, and their data would remain completely anonymous. Participants then provided informed consent before completing measures described above.

2.3. Data analysis

Data were entered into SPSS version 29.0 (IMB, Armonk, NY, USA). Little's Missing Completely at Random test (MCAR; Little, 1988) identified 11 (2.5 %) participants with missing data, which were missing completely at random ($p = 0.15$). Missing data were replaced using a multiple imputation model that generated five data sets with maximum parameters set at 100 (Royston, 2004). The mean of the five data sets were used to replace missing data.

To assess the reliability and validity of the measures, we used partial least squares (PLS) using SmartPLS (v.3.3.3) to evaluate convergent and discriminant validity, and internal consistency for each multi-item measure (i.e., doping attitudes, doping subjective norms, doping perceived behavioural control, and doping intention). Consistent with prior research (Chan, Hardcastle et al., 2015), and given that PLS is not sensitive to sample sizes and normality (Hair et al., 2011), variance-based structural equation modelling was chosen. To assess convergent validity, the average variance extracted (AVE) was calculated, which refers to the amount of variance in a set of indicators explained by their latent variables. To help improve the validity of the measures, loadings of less than 0.60 for each item were considered for removal (Fornell & Larcker, 1981). To assess discriminant validity, the squared root of the AVE was calculated. Discriminant validity was satisfied when a latent variable's AVE is greater than the squared bivariate correlation between it and other latent variables in the model (Hair et al., 2011). Finally, internal consistency for each measure was assessed by examining the composite reliabilities, which can provide a better estimate of variance by a set of indicators than Cronbach's alpha (Peterson & Kim, 2013). Composite reliability scores of 0.70 or higher were considered as evidence for good internal consistency (Fornell & Larcker, 1981).

Frequencies were computed for the dietary supplement use measure and descriptive statistics and Cronbach alphas were calculated for all other measures. Point biserial and zero-order correlations were conducted to examine relationships between measures, with coefficients (r) interpreted as small (0.1), medium (0.2), and large effect sizes (0.3; Gignac & Szodorai, 2016). We used PROCESS (v4.0; Hayes, 2017) Model 4 to test direct and indirect (via doping attitudes, subjective norms, and perceived behavioural control) effects of dietary supplement use on doping intention. Bootstrapping was set at 10,000 samples and bias-corrected 95 % confidence intervals (CIs) were estimated for all effects. Contrast analyses were performed to compare strength of indirect effects for each mediator. An effect was significant when the CI did not cross zero and the partially standardised indirect effect (PSIE) was reported as the effect size, with magnitudes of 0.01, 0.09, and 0.25 indicating small, medium, and large effects, respectively (Preacher & Kelley, 2011). Statistical significance was set at $p < 0.05$.

3. Results

3.1. Convergent and discriminant validity and internal consistency

One item from doping subjective norms (i.e., "Most people who are important to me in sport think I should"), two items from doping perceived behavioral control (i.e., Over which I have complete control" and "That is completely down to me to decide to do"), and one item from doping intention (i.e., (I will try and do") had AVE loadings less than 0.60. As a result, these were deleted. After removal, the AVE for all measures was higher than 0.69, suggesting high convergent validity for each multi-item measure (Table 1). Correlation coefficients between each measure (r range = 0.20 to 0.78) were lower than the correspondent square root of AVE (range = 0.84 to 0.97), confirming the discriminant validity of the measures. Finally, composite reliabilities were above 0.90, indicating very good internal consistency for all

Table 1
Descriptive statistics, composite reliability, average variance extracted and zero-order correlations ($N = 443$).

	Mean ± SD	AVE	1	2	3	4
1. Dietary supplement use	0.82 ± 0.38	N/A				
2. Doping attitudes	1.61 ± 0.82	0.70	0.20			
3. Doping subjective norms	2.03 ± 1.57	0.83	0.20	0.49		
4. Doping perceived behavioural control	3.56 ± 1.69	0.84	0.18	0.37	0.61	
5. Doping intention	2.71 ± 2.03	0.94	0.23	0.58	0.66	0.63

Note: SD = Standard deviation. AVE = Average variance extracted. Possible range scores for dietary supplement use: 0 to 1; all other measures: 1 to 7. All zero-order correlations were significant at $P < 0.01$.

measures (Table 1). In sum, analyses suggest that the multi-item measures have good convergent and discriminant validity, and very good internal consistency.

3.2. Descriptive statistics, and zero-order correlations

Descriptive statistics and zero-order correlations for all measures are reported in Table 1. Briefly, 82 % of participants used dietary supplements and the sample was characterised by low scores for doping attitudes and subjective norms, and moderate scores for doping perceived behavioural control and intention. Dietary supplement use was moderately and positively associated with doping attitudes, subjective norms, perceived behavioural control and intention. Associations between doping attitudes, subjective norms, perceived behavioural control and intention were large and positive.

3.3. Main analyses

We examined whether the relationship between dietary supplement use and doping intention was indirectly related to doping attitudes, subjective norms, and perceived behavioural control. Results showed that dietary supplement use was not directly related to doping intention, but instead indirectly related via doping attitudes, subjective norms, and perceived behavioural control (Table 2 and Fig. 1). The total indirect effect was significant and large (Table 2) and contrast analyses revealed no differences in indirect effects (Table 3). In sum, the relationship between dietary supplement use and doping intention was indirectly related to doping attitudes, subjective norms, and perceived behavioural control. Overall, the model accounted for 59 % of the variance on doping intention ($F_{(4,\ 438)} = 158.96$ $p < 0.01$, $rR = 0.77$).

Table 2
Direct and indirect effects of doping attitudes, doping subjective norms, and doping perceived behavioural control on dietary supplement use and doping intention.

Pathways	*b*	95 % CI	PSIE	95 %CI
Direct effect of dietary supplement use on				
Doping attitudes	0.42*	0.22 to 0.62		
Doping subjective norms	0.84*	0.46 to 1.22		
Doping perceived behavioural control	0.79*	0.38 to 1.20		
Doping intention	0.27	−0.06 to 0.60		
Indirect effects of dietary supplement use on doping intention via				
Doping attitudes	0.31*	0.19 to 0.52	0.15	0.10 to 0.22
Doping subjective norms	0.35*	0.19 to 0.52	0.17	0.09 to 0.25
Doping perceived behavioural control	0.30*	0.16 to 0.46	0.15	0.08 to 0.22
Doping attitudes, subjective norms, and perceived behavioural control	0.96*	0.76 to 1.27	0.47	0.35 to 0.59

Note: Unstandardized coefficients are shown. PSIE = partially standardised indirect effect.
* = $p < 0.01$.

4. Discussion

This is the first study to examine whether dietary supplement use is indirectly related to doping intention via the theory of planned behaviour constructs (i.e., attitudes, subjective norms, and perceived behavioural control). Consistent with previous research we showed that dietary supplement users were more likely to express a greater intention to dope (Hurst et al., 2023). We also provide novel evidence to help further understand why a dietary supplement may be more likely to dope by showing that the relationship between supplement use and doping intention is indirectly related to doping attitudes, subjective norms, and perceived behavioural control. These results suggest that athletes who use dietary supplements may be more likely to develop favourable attitudes to dope, perceive others in their social group to accept the use of prohibited substances, and have greater confidence in using doping substances, which in turn, might increase their intention to dope. Our results further extend understanding of the relationship between dietary supplement use and doping intention (Hurst et al., 2023) and highlight the importance of targeting theory of planned behaviour constructs in anti-doping educational interventions.

The relationship between dietary supplement use and doping was indirectly related to doping attitudes. Previous research has reported positive associations between dietary supplement use and doping attitudes (Backhouse et al., 2013; Hurst et al., 2019b, 2021a) and our results extend this understanding and suggest that users of dietary supplements may develop favourable doping attitudes and report stronger intentions to use prohibited substances. This may happen because athletes who use dietary supplements may have positive experiences (e.g., personal best, enhanced recovery), which in turn develops the attitude that performance enhancing substances are beneficial (Hurst et al., 2017; Petróczi, 2013). The development of a more favourable attitude may therefore increase the likelihood of an athlete intending to dope.

Our results show that doping subjective norms may play a role in dietary supplement users developing intentions to dope. This suggests that athletes who use dietary supplements report stronger doping intentions due to the perception that those around them accept and endorse doping. Given that dietary supplement users are more likely to discuss substance use with those who support and encourage its use (Barkoukis et al., 2020; Boardley et al., 2014; Mettler et al., 2021), dietary supplement users may seek out discussions with those who hold similar beliefs or perceive themselves as similar to others who dope (Whitaker et al., 2014). As a result, this may bring an athlete in contact with others who use prohibited substances and encourage its use. While evidence for this is limited, qualitative research supports that social pressures to take substances (Lentillon-Kaestner et al., 2012), discussions with other athletes about its use (Boardley & Grix, 2014) and the perceived acceptance of using them amongst peers (Boardley et al., 2014), are likely to be key factors in an athletes decision to dope. Thus, athletes using dietary supplements, may be more likely to have relationships with those who dope and support its use, and overtime, report a stronger intention to use prohibited substances.

Dietary supplement use was indirectly related to doping intention via perceived behavioural control. Given that prior experience of a behaviour can increase a person's perception that they are capable of doing it, dietary supplement use may increase an athlete's perception that they have the capability to dope, and therefore be more likely to form intentions to use prohibited substances. As dietary supplements (e.g.,

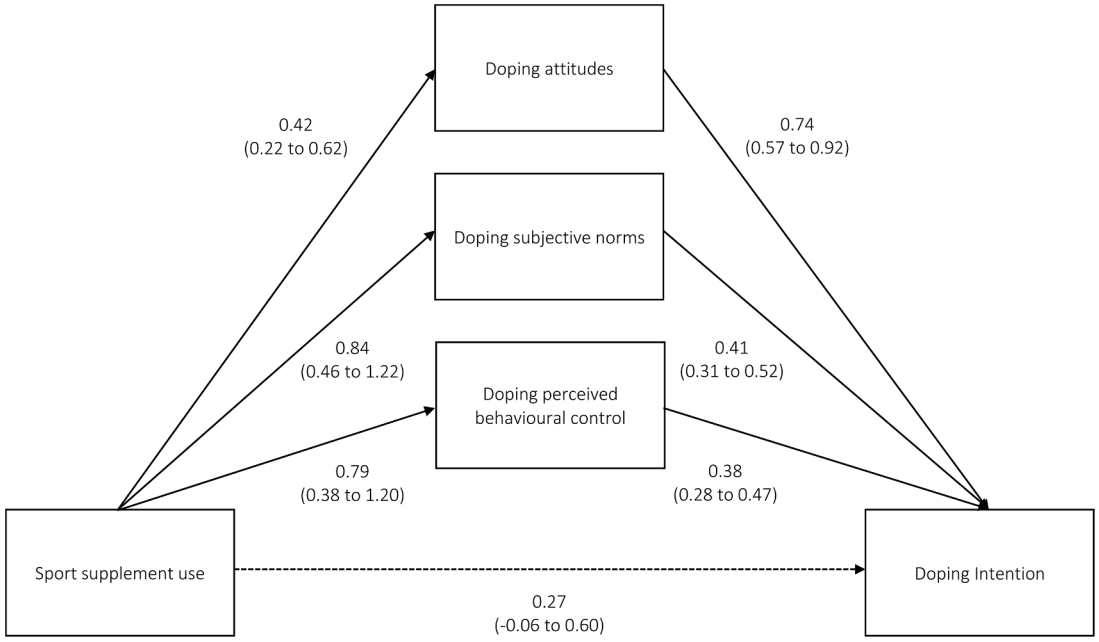

Fig. 1. The effects of dietary supplement use on doping intention and the mediating role of doping attitudes, subjective norms, and perceived behavioural control. *Note:* Values presented are unstandardized regression coefficients with 95 % CI in parentheses. A solid line represents a significant relationship at $p < 0.01$.

Table 3
Comparisons of indirect effects of dietary supplement use on doping intention.

Comparison	Effect	BootSE	95 % CI
Doping attitudes vs. Doping subjective norms	−0.03	0.11	−0.24 to 0.19
Doping attitudes vs. Doping perceived behavioural control	−0.15	0.06	−0.09 to 0.11
Doping subjective norms vs. Doping perceived behavioural control	−0.14	0.08	−0.09 to 0.13

Note: SE = Boot Standard error, 95CI = 95 % Confidence Interval.

caffeine and creatine) share similar characteristics to doping substances (e.g., anabolic steroids), such as appearance (e.g., pill form), method of administration (e.g., orally) and effect on performance (e.g., increase in strength and power), after using a supplement, an athlete may therefore feel confident in using a doping substance, and in turn, report stronger intentions to dope. In short, our data suggest that dietary supplements users may be more likely to have stronger perceptions of perceived behavioural control to dope, and in turn be more likely to form intentions to dope.

Collectively, the theory of planned behaviour accounted for 61 % of the variance in explaining the relationship between dietary supplement use and doping intention. No differences were shown between all three indirect effects of doping attitudes, subjective norms, and perceived behavioural control, suggesting that all three act independently on the dietary supplement-doping intention relationship. The absence of a direct effect of dietary supplement use on doping intention underscores the importance of the theory of planned behaviour constructs as possible reasons for why dietary supplement use is related to doping intention. In sum, our results underlie the important role doping attitudes, subjective norms, and perceived behavioural control have in the relationship between dietary supplement use and doping.

5. Practical implications

The results of our study have important implications for those interested in preventing doping in sport and suggest that interventions should target the theory of planned behaviour constructs. Specifically, anti-doping organisations should target attitudinal change towards doping, perceptions of the accepted practice of doping, and decrease perceptions of control. Targeting attitudes could be achieved through educating athletes about the negative health and social consequences doping can have, which has recently been shown to be effective in reducing favourable doping attitudes (Nicholls et al., 2020). Changing the perceptions that doping is an accepted practice could be achieved by targeting athlete support personnel (e.g., coach, physiotherapist, family member) in educational interventions, so that any discussions with their athletes is related to downplaying the benefits and challenging the accepted practice of using performance enhancing substances. Recently, Ntoumanis et al. (2020) developed a motivation and anti-doping intervention that educated coaches about how to create a need supportive motivational environment which minimises the temptation to dope, and thus engender an unfavourable attitude towards doping to the athletes they work with. Finally, as perceived behavioural control can be influenced through prior experience (Bandura, 1986), education efforts should target the use of dietary supplements so that athletes do not become confident in using dietary supplements and in turn, develop the perception that the same can be achieved with doping. Providing athletes with a food-first approach, could provide athletes with alternatives to dietary supplements so that they do not feel the need to use these substances to enhance their performance (Whitaker & Backhouse, 2017) or by highlighting that the benefits in performance could be related to the placebo effect (Hurst et al., 2020).

6. Limitations and future directions

Limitations should be noted when interpreting the findings of our study. First, we used a cross-sectional design so cannot make any casual inferences. While we suggest that dietary supplement use is indirectly related to doping intention via doping attitudes, subjective norms and perceived behavioural, it may be that the theory of planned behaviour constructs influence dietary supplement use, which in turn, leads to doping, or that doping substances precede the use of dietary supplements. Longitudinal or experimental designs are needed to provide evidence of the direction and influence the theory of planned behavioural constructs on the relationship between dietary supplement use and doping intention. Second, all measures were self-report, which has

inherent limitations related to social desirability and under/over-reporting. While attempts were made to prevent socially desirable responses (e.g., anonymous questionnaire), future research should aim to control for this using other measurements, such as hair analysis (Petroczi et al., 2011). Third, we did not measure whether participants had received anti-doping education or their country of origin. These variables may influence the strength of the relationship whereby athletes who receive anti-doping education frequently (e.g., national, and international level athletes in the UK Anti-Doping are required to attend anti-doping education once every two years), and of better quality (e.g., some anti-doping organisations offer more comprehensive education programmes than others (Gatterer et al., 2020; Woolf, 2020) may be less likely to dope than those who do not receive anti-doping education from their national organisation. Future research should consider examining whether history of anti-doping education and the anti-doping organisation responsible for educating athletes influences outcomes in future research. Finally, we only measured doping intention and not use. Given that there may be differences between doping intention and behaviour (Ntoumanis et al., 2014), future research should aim replicate the results of our study with the inclusion of a more direct measure of doping use.

7. Conclusion

In conclusion, the results of our study indicate that dietary supplement use is indirectly related to doping intention via the theory of planned behaviour constructs (i.e., attitudes, subjective norms, and perceived behavioural control). This suggests that dietary supplement users may report stronger intentions to dope due to having a more favourable doping attitude, the perceptions that those closest to them accept doping use, and the belief that they are capable to dope. These results provide explanations as to the reason why positive relationships are reported between dietary supplement use and doping and highlight that anti-doping organisations should target attitudinal change, perceptions of the accepted practice of doping, and decrease perceptions of control in educational interventions.

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CRediT authorship contribution statement

Philip Hurst: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. **Poh Yen Ng:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Leyla Under:** Data curation, Investigation, Project administration, Writing – original draft, Writing – review & editing. **Caroline Fuggle:** Conceptualization, Data curation, Investigation, Project administration, Writing – original draft, Writing – review & editing.

Declaration of competing interest

Authors declare that the no conflict of interest

References

Ajzen, I. (1985). *From intentions to actions: A theory of planned behavior*. Springer.
Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.
Ajzen, I. (2002). Constructing a TPB questionnaire: Conceptual and methodological considerations.
Backhouse, S., Whitaker, L., Patterson, L., Erickson, K., & McKenna, J. (2016). Social Psychology of Doping in Sport: A Mixed Studies Narrative Synthesis.
Backhouse, S. H., Whitaker, L., & Petroczi, A. (2013). Gateway to doping? Supplement use in the context of preferred competitive situations, doping attitude, beliefs, and norms. *The Scandinavian Journal of Medicine & Science in Sports, 23*(2), 244–252. https://doi.org/10.1111/j.1600-0838.2011.01374.x
Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4*(3), 359–373.
Barkoukis, V., Lazuras, L., Ourda, D., & Tsorbatzoudis, H. (2020a). Are nutritional supplements a gateway to doping use in competitive team sports? The roles of achievement goals and motivational regulations. *Journal of Science and Medicine in Sport*. https://doi.org/10.1016/j.jsams.2019.12.021
Barkoukis, V., Lazuras, L., Tsorbatzoudis, H., & Rodafinos, A. (2013). Motivational and social cognitive predictors of doping intentions in elite sports: An integrated approach. *Scandinavian Journal of Medicine and Science in Sports, 23*(5), e330–e340. https://doi.org/10.1111/sms.12068
Barkoukis, V., Rowe, R., Harris, P. R., & Lazuras, L. (2020b). Self-affirmation effects on doping related cognition among exercisers who use nutritional supplements. *Psychology of Sport and Exercise, 46*, Article 101609.
Boardley, I. D., & Grix, J. (2014). Doping in bodybuilders: A qualitative investigation of facilitative psychosocial processes. *Qualitative Research in Sport, Exercise and Health, 6*(3), 422–439.
Boardley, I. D., Grix, J., & Dewar, A. J. (2014). Moral disengagement and associated processes in performance-enhancing drug use: A national qualitative investigation. *Journal of Sports Sciences, 32*(9), 836–844. https://doi.org/10.1080/02640414.2013.862842
Bowling, A. (2005). *Just one question: If one question works, why ask several?* (Vol. 59, pp. 342–345). BMJ Publishing Group Ltd. In.
Chan, D. K., Dimmock, J. A., Donovan, R. J., Hardcastle, S., Lentillon-Kaestner, V., & Hagger, M. S. (2015a). Self-determined motivation in sport predicts anti-doping motivation and intention: A perspective from the trans-contextual model. *Journal of Science and Medicine in Sport, 18*(3), 315–322. https://doi.org/10.1016/j.jsams.2014.04.001
Chan, D. K., Hardcastle, S., Dimmock, J. A., Lentillon-Kaestner, V., Donovan, R. J., Burgin, M., et al. (2015b). Modal salient belief and social cognitive variables of anti-doping behaviors in sport: Examining an extended model of the theory of planned behavior. *Psychology of Sport and Exercise, 16*, 164–174. https://doi.org/10.1016/j.psychsport.2014.03.002
Dodge, T., & Jaccard, J. J. (2007). Negative beliefs as a moderator of the intention–behavior relationship: Decisions to use performance-enhancing substances. *Journal of Applied Social Psychology, 37*(1), 43–59.
Erdman, K. A., Fung, T. S., Doyle-Baker, P. K., Verhoef, M. J., & Reimer, R. A. (2007). Dietary supplementation of high-performance Canadian athletes by age and gender. *Clinical Journal of Sport Medicine, 17*(6), 458–464.
Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research, 18*(1), 39–50.
Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science, 18*(3), 233–239.
Gatterer, K., Gumpenberger, M., Overbye, M., Streicher, B., Schobersberger, W., & Blank, C. (2020). An evaluation of prevention initiatives by 53 national anti-doping organizations: Achievements and limitations. *Journal of sport and health science, 9*(3), 228–239.
Gignac, G. E., & Szodorai, E. T. (2016). Effect size guidelines for individual differences researchers. *Personality and Individual Differences, 102*, 74–78. https://doi.org/10.1016/j.paid.2016.06.069
Goulet, C., Valois, P., Buist, A., & Cote, M. (2010). Predictors of the use of performance-enhancing substances by young athletes. *Clinical Journal of Sport Medicine, 20*(4), 243–248. https://doi.org/10.1097/JSM.0b013e3181e0b935
Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice, 19*(2), 139–152.
Hauw, D., & McNamee, M. (2015). A critical analysis of three psychological research programs of doping behaviour. *Psychology of Sport and Exercise, 16*, 140–148. https://doi.org/10.1016/j.psychsport.2014.03.010
Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.
Horcajo, J., & De La Vega, R (2014). Changing doping-related attitudes in soccer players: How can we get stable and persistent changes? *European Journal of Sport Science, 14*(8), 839–846.
Hurst, P. (2023). Are dietary supplements a gateway to doping? a retrospective survey of athletes' substance use. *Substance Use and Misuse*, 1–6.
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. https://doi.org/10.1016/j.peh.2016.10.001.
Hurst, P., Kavussanu, M., Boardley, I. D., & Ring, C. (2019a). Sport supplement use predicts doping attitudes via sport supplement beliefs. *Journal of Sports Sciences, 37*(15), 1734–1740. https://doi.org/10.1080/02640414.2019.1589920
Hurst, P., Kavussanu, M., Boardley, I. D., & Ring, C. (2019b). Sport supplement use predicts doping via sport supplement beliefs. *Journal of Sports Sciences*, 1–7. https://doi.org/10.1080/02640414.2019.1589920
Hurst, P., Ring, C., & Kavussanu, M. (2021a). Athletes using ergogenic and medical sport supplements report more favourable attitudes to doping than non-users. *Journal of Science and Medicine in Sport*. https://doi.org/10.1016/j.jsams.2020.09.012
Hurst, P., Ring, C., & Kavussanu, M. (2021b). Ego orientation is related to doping likelihood via sport supplement use and sport supplement beliefs. *European Journal of Sport Science*, 1–19.
Hurst, P., Schiphof-Godart, L., Kavussanu, M., Barkoukis, V., Petróczi, A., & Ring, C. (2023). Are dietary supplement users more likely to dope than non-users?: A systematic review and meta-analysis. *International Journal of Drug Policy, 117*, Article 104077.

Hurst, P., Schipof-Godart, L., Szabo, A., Raglin, J., Hettinga, F., Roelands, B., … Beedie, C. (2020). The placebo and nocebo effect on sports performance: a systematic review. *European Journal of Sport Science, 20*(3), 279–292.

Knapik, J. J., Steelman, R. A., Hoedebecke, S. S., Austin, K. G., Farina, E. K., & Lieberman, H. R. (2016). Prevalence of dietary supplement use by athletes: Systematic review and meta-analysis. *Sports Medicine, 46*(1), 103–123. https://doi.org/10.1007/s40279-015-0387-7

Lazuras, L., Barkoukis, V., Mallia, L., Lucidi, F., & Brand, R. (2017). More than a feeling: The role of anticipated regret in predicting doping intentions in adolescent athletes. *Psychology of Sport and Exercise, 30*, 196–204. https://doi.org/10.1016/j.psychsport.2017.03.003

Lentillon-Kaestner, V., Hagger, M. S., & Hardcastle, S. (2012). Health and doping in elite-level cycling. *Scandinavian Journal of Medicine and Science in Sports, 22*(5), 596–606. https://doi.org/10.1111/j.1600-0838.2010.01281.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., Zelli, A., Mallia, L., Grano, C., Russo, P. M., & Violani, C. (2008). The social-cognitive mechanisms regulating adolescents' use of doping substances. *Journal of Sports Sciences, 26*(5), 447–456. https://doi.org/10.1080/02640410701579370

Mallick, M., Camacho, C. B., Daher, J., & El Khoury, D. (2023). Dietary supplements: A gateway to doping? *Nutrients, 15*(4), 881.

Mettler, S., Lehner, G., & Morgan, G. (2021). Widespread Supplement Intake and Use of Poor Quality Information in Elite Adolescent Swiss Athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 1*(aop), 1–8.

Nicholls, A. R., Morley, D., Thompson, M. A., Huang, C., Abt, G., Rothwell, M., et al. (2020). The effects of the iPlayClean education programme on doping attitudes and susceptibility to use banned substances among high-level adolescent athletes from the UK: A cluster-randomised controlled trial. *International Journal of Drug Policy, 82*, Article 102820. https://doi.org/10.1016/j.drugpo.2020.102820

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. https://doi.org/10.1007/s40279-014-0240-4

Ntoumanis, N., Quested, E., Patterson, L., Kaffe, S., Backhouse, S. H., Pavlidis, G., et al. (2020). An intervention to optimise coach-created motivational climates and reduce athlete willingness to dope (CoachMADE): A three-country cluster randomised controlled trial. *British Journal of Sports Medicine*.

Peterson, R. A., & Kim, Y. (2013). On the relationship between coefficient alpha and composite reliability. *Journal of Applied Psychology, 98*(1), 194.

Petróczi, A. (2013). The doping mindset—Part I: Implications of the Functional Use Theory on mental representations of doping. *Performance Enhancement & Health, 2*(4), 153–163. https://doi.org/10.1016/j.peh.2014.06.001

Petroczi, A., Uvacsek, M., Nepusz, T., Deshmukh, N., Shah, I., Aidman, E. V., … Naughton, D. P. (2011). Incongruence in doping related attitudes, beliefs and opinions in the context of discordant behavioural data: in which measure do we trust? *PLoS One, 6*(4), Article e18804.

Preacher, K. J., & Kelley, K. (2011). Effect size measures for mediation models: Quantitative strategies for communicating indirect effects. *Psychological Methods, 16*(2), 93–115. https://doi.org/10.1037/a0022658

Royston, P. (2004). Multiple imputation of missing values. *The Stata Journal, 4*(3), 227–241. https://doi.org/10.1177/1536867X0400400301

Von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2014). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *International Journal of Surgery, 12*(12), 1495–1499.

Whitaker, L., & Backhouse, S. H. (2017). Doping in sport: An analysis of sanctioned UK rugby union players between 2009 and 2015. *Journal of Sports Sciences, 35*(16), 1607–1613. https://doi.org/10.1080/02640414.2016.1226509

Whitaker, L., Long, J., Petróczi, A., & Backhouse, S. H. (2014). Using the prototype willingness model to predict doping in sport. *Scandinavian Journal of Medicine and Science in Sports, 24*(5), e398–e405. https://doi.org/10.1111/sms.12148

Woolf, J. J. R. (2020). An examination of anti-doping education initiatives from an educational perspective: Insights and recommendations for improved educational design. *Performance Enhancement & Health*, Article 100178.