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Associations between Doping Knowledge, -Susceptibility and Substance Use of Austrian Junior Elite Athletes?

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Abstract

Doping in sport is not only an issue in adult but also in adolescent athletes. Prevention measures shifted from secondary prevention and detection towards primary prevention, often based on education as deterrent for future doping behavior. Prior to developing the latter, target groups need to be identified and their current state of knowledge and doping use, respectively susceptibility needs to be assessed. The current study aims at evaluating Austrian adolescent athletes' knowledge about doping and its side effects and relates it to doping susceptibility and current substance use. A self-reporting questionnaire was distributed to 1,310 adolescent athletes and included socio-demographic and situational data (e.g. training, trainer team, competitions etc.) as well as questions about current substance use (not necessarily prohibited), doping susceptibility, knowledge about substances and side effects. The overall knowledge was at a satisfying level (mean of 0.73 of 1.0) with low doping susceptibility (0.77 of 4.0) and substance use indicators (prevalence between 0.3% and 5.8%). Doping knowledge was positively associated with gender and male athletes have an increased knowledge about side effects when compared to females (0.74 vs 0.70; $p<0.05$). There was no association between knowledge and doping susceptibility and a very low negative association with current substance use ($r=-0.08$, $p<0.05$). Even though there are still diverse findings on the preventing power of profound knowledge, it can be concluded that this knowledge cannot be the exclusive and unique pillar in doping prevention. A suggestion would be to change the focus of prevention from purely informing to rather inclusively educating athletes and their surrounding network.

Keywords: Doping Knowledge; Doping Susceptibility; Adolescent Athletes; Austria

Introduction

Doping, as the violation of the regulations written down in the World Anti-Doping Code (WADC) [1] leads to competitive advantages in sport, even though this argument has been discussed at length in the literature [2-4]. Doping can still be regarded as issue in sport, being unfair and immoral. Among others, research focused on the prevalence of substance misuse with regards to anabolic steroids and on creating so-called risk profiles of performance enhancing substances (PES) users [5-7] as well as growth hormones [8]. Results outlined that doping in sport is not only an issue in adult but also in adolescent elite sport. Whitehead et al. [9], Tanner et al. [10] and Scott et al. [11] showed a consumption rate of anabolic steroids of 2.5% - 5.3% in adolescents, aged 13 to 19. Based on these

findings, research in doping has shifted away from detection and secondary prevention and increasingly been directed towards primary prevention of doping through education to avoid new incidences [12]. The hypothesis behind was that athletes who have an increased knowledge about doping and especially about health affecting side effects will be deterred from applying negative doping behavior. The same was reflected by Strelan and Boeckmann [13], who developed the theoretical "Drugs in Sports Deterrence Model" that, among others, includes cost and benefit appraisal. Increased knowledge about negative consequences of doping (e.g. bans, health effects) is supposed to lead to a cost appraisal which exceeds the benefit appraisal, deterring the athlete from doping and athletes' surrounding personnel from doping encouragement.

An essential component for preparing educational material is the identification of target groups and the evaluation of their current state of knowledge about doping and especially the health affecting side effects. Even though still in its infancy, some research has already been conducted on the knowledge and the attitudes of athletes [5,14-19], coaches [20,21], medical personnel [22-25] and parents [26]. Results of these studies demonstrate some consistent findings with respect to knowledge and attitudes. Groups questioned generally endorse statements which characterize the use of prohibited substances as ethically and morally reprehensible, whereas knowledge about prohibited substances and especially about their medical side effects showed the need for improvement.

The current study is a follow up study of Fürhapter et al. [15], expanding the study population from Tyrol to entire Austria and evaluates athletes' knowledge about doping and its side effects. Socially desirable responding, which is said to be present if athletes, especially junior athletes [27], are directly asked about their doping beliefs and behavior [28] might bias results. Therefore, the questionnaire of the follow up study was slightly adapted. As suggested by previous researchers, doping susceptibility, indirectly questioning PES use, and said to be an addictional proximal correlate for predicting negative doping behaviour (e.g. PES use) [13,29,30], was included in addition to actual substance use. Summarizing, the current scientific work aims at two major goals. It intends to evaluate the general knowledge about doping and its health affecting side effects to draw comparisons to previous evidence and secondly, it wants to link general knowledge about doping and its health affecting side effects not only to current substance use, but also to doping susceptibility, which was, to our best knowledge not analyzed hitherto.

Methods

Ethics statement

The current study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Prior to the collection of data, this cross-sectional survey study was reviewed for human subjects protection and approved by the ethics committees of the Medical Universities of Innsbruck, Graz, Vienna and the ethics committee of the county of Lower Austria (Innsbruck: AN3854, 284/4.1., Graz: 23-206 ex 10/11, Vienna: 1096/2010, St.Pölten: GS4-EK-4/121-2011). It is part of a research project evaluating knowledge and attitudes of Austrian junior elite athletes, their parents and trainer. All study participants were informed about the study goals and provided written informed consent. Based on Austrian law (§21 ABGB), children aged 14 and above (matching the age criteria of the study sample) are politically mature minors who were, in this specific situation, allowed to sign the written informed consent form on their own. The written consent forms from all participants were detached from the survey prior to analyses and kept in a separate storage.

Study design

Austrian elite sport schools were invited to participate in this research project and in total, ten sport schools in five Austrian counties (Salzburg, Vienna, Styria, Lower Austria, and Vorarlberg) agreed to participate. Survey data was collected over a period of one year between April, 2010 and April, 2011 by distributing self-reporting questionnaires to Austrian junior athletes between the ages of 14 and 19 years. Athletes received a copy of the questionnaire and were asked to directly fill in the forms with at least one member of the study team attending. Data was collected by the study team at the end of the session.

Questionnaire structure

The questionnaire was self-reporting and defined in an easy answer format. Within the socio-demographic section, questions with respect to age, sex and school as well as parents' education, training and competition routines and general questions (nominal scales) on whether athletes know about the World- and National Anti-Doping Agency (WADA and NADA Austria) were included. Another question referred to the sport practiced and allowed multiple responses. For analyses this item was grouped high risk sport and low risk sport. "High risk" sports included at least one of the following (athletes could indicate more than one sport): running, swimming, bodybuilding, cross-country skiing, biathlon, biking, athletics and triathlon as classified in previous research [26].

Next to socio-demographic variables, the following constructs were included to answer the main research questions:

Substance use

Athletes were provided with a list of 11 substances (cigarettes, snus, anabolic steroids, human growth hormones, alcohol, stimulants, nutritional supplements,

cannabis, diuretics, cocaine and erythropoietin (EPO)) and asked about the frequency of use during the last 12 months (5-point likert scale; "never" – "very often"). Since previous literature indicates an association between PES use and the use of non-prohibited substances (e.g. tobacco, alcohol) [31], these were also included within the list.

Doping susceptibility

This construct was operationalized for presenting the athletes four hypothetical situations followed by the question of whether they would be willing to take prohibited substances within these scenarios (e.g., "Your strongest opponent has doped, and you know about it. Would you take prohibited substance to increase your chances of winning?"), as previously described in the literature (Barkoukis et al., 2014; Hodge et al., 2013; Lazuras et al., 2010) (Cronbach's-α=0.82). Items utilized a five-point Likert scale (0="no" –4="yes"). For data analyses, a construct mean was calculated by adding up the responses and dividing this value by the total number of items (min=0, max=4).

General doping knowledge

This section included five items with respect to whether certain substances are listed on the WADA 2010 prohibited list (true-false format) and additionally seven items on for whom doping is prohibited (e.g. "doping is prohibited for elite athletes only"). For data analyses a total score was computed. A score of 1 was achieved when all questions were answered correctly, whereas a score of 0 indicated no correct answer at all.

Knowledge about health effecting side effects

This section included 11 items with respect about possible health affecting side effects of anabolic steroids (true-false format). For data analyses a total score was computed. A score of 1 was achieved when all questions were answered correctly, whereas a score of 0 indicated no correct answer at all.

Statistical analysis

Data was analyzed using SPSS 20.0 (Statistical Package for the Social Sciences, Chicago, Illinois). To picture the study population, descriptive statistics were used including mean±standard deviation (SD). Non-parametric tests were applied (pK-S<=0.05). Mann-Whitney U-Tests were used to compare doping susceptibility, doping knowledge (general and about side effects) between gender, risk sport as well as PES offer. Kruskal-Wallis test was used to analyses differences in doping susceptibility with respect to the variables "school", "trainer team", "competition/year" and "parents' education". By applying post-hoc Mann-Whitney U-Tests, differences were located; p-values were adapted using Bonferroni correction.

Spearman correlation analyses were used to analyze associations between doping susceptibility, doping knowledge (general and about side effects) as well as substance use. Results are displayed with the corresponding correlation coefficient r and the significance value p. Partial correlation analysis were used to control for gender and age. Mulitcollinearity (tolerance value as well as r-values of bivariate correlation analyses) and skewness indices were verified to analyze whether applying a linear multiple regression analysis was valid. The two-sided significance level was defined with p<0.05.

Results

Demographic data

The total sample consists of 1,265 Austrian junior athletes with a mean age of 16.2±1.5 years (response rate 96.6%). Two thirds of the sample are male (66.9%) and 61.3% visit a "Sportgymnasium" (i.e. sport high school), whereas 15.2% visit a national intensive training center, 12.5% a commercial high school and 2.2% a regional intensive training center. Aside their parents, 14.1% of the fathers have obtained university degrees (10.9% of the mothers). A fifth of the athletes reported to participate in "risk sport" as defined by the authors of this study.

Table 1: Association of situation factors with substance use

	Training/week	Training Schedule	Trainer Team	Competition/year	Cigarettes	Snus	**AS**	**Growth Hormones**	Alcohol	**Stimulants**	NS	**Diuretics**	**EPO**
Training/week	1.0	.40***	.29***	.37***	-.24***	.05	**.03**	**.012**	-.17***	**.01**	.23***	**-.01**	**-.01**
Training Schedule		1.0	.40***	.25***	-.19***	-.00	**.05**	**.04**	-.18***	**-.02**	.18***	**.05**	**.05**
Trainer Team			1.0	.31***	-.14***	-.01	**.03**	**.00**	-.13***	**-.07****	.06*	**-.01**	**-.01**
Competition/year				1.0	-.13**	.08**	**.03**	**-.00**	-.07*	**-.04**	.08**	**.03**	**.03**
Cigarettes					1.0	.21**	**.09****	**.06***	.29**	**.14****	.00	**.08****	**.06***
Snus						1.0	**.17*****	**.06***	.18***	**.14*****	.07*	**.10*****	**.08****
AS							**1.0**	**.52*****	-.01	**.18*****	.06*	**.56*****	**.47*****
Growth Hormones								**1.0**	-.07*	**.12*****	.02	**.36*****	**.31*****
Alcohol									1.0	**.08****	.07*	**.03**	**.00**
Stimulants										**1.0**	.12***	**.20*****	**.17*****
NS											1.0	**.07***	**.05**
Diuretics												**1.0**	**.87*****
EPO													**1.0**

* p<0.05, ** p<0.01,*** p<0.001; AS anabolic steroids; NS nutritional supplements; EPO: Erythropoetin; **bold**: prohibited substances (WADA list 2010)

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Training Schedule		1.0	.40***	.25***	-.19***	-.00	**.05**	**.04**	-.18***	**-.02**	.18***	**.05**	**.05**
Trainer Team			1.0	.31***	-.14***	-.01	**.03**	**.00**	-.13***	**-.07****	.06*	**-.01**	**-.01**
Competition/ year				1.0	-.13**	.08**	**.03**	**-.00**	-.07*	**-.04**	.08**	**.03**	**.03**
Cigarettes					1.0	.21**	**.09****	**.06***	.29**	**.14****	.00	**.08****	**.06***
Snus						1.0	**.17*****	**.06***	.18***	**.14*****	.07*	**.10*****	**.08****
AS							**1.0**	**.52*****	-.01	**.18*****	.06*	**.56*****	**.47*****
Growth Hormones								**1.0**	-.07*	**.12*****	.02	**.36*****	**.31*****
Alcohol									1.0	**.08****	.07*	**.03**	**.00**
Stimulants										**1.0**	.12***	**.20*****	**.17*****
NS											1.0	**.07***	**.05**
Diuretics												**1.0**	**.87*****
EPO													**1.0**

* p<0.05, ** p<0.01, *** p<0.001; AS anabolic steroids; NS nutritional supplements; EPO: Erythropoetin; **bold**: prohibited substances (WADA list 2010)

Sport (high- vs. low-risk), working with a trainer team, and amount of training per week was not associated with doping susceptibility; yet, the number of competitions per year showed significant differences in doping susceptibility (p=0.009). Bonferroni-corrected post-hoc tests resulted in a marked difference in susceptibility between 5 – 10 competitions and more than 10 competitions a year (0.60±0.78 vs. 0.82±0.87; p=0.03). Lastly, those athletes who were offered performance enhancing substances showed a higher mean doping susceptibility (1.25±1.05 vs. 0.69±0.8; p>0.001) and current substance use (except for diuretics) was associated with doping susceptibility (0.07≤r≤0.22; 0.001≤p≤0.05) (refer to table 2).

doping institutions. Almost 30% indicated that nutritional supplements are prohibited, 59.3% correctly indicated they are not on the prohibited list. In terms of therapeutic use exemptions (TUE), 80.4% of the athletes indicated not to be familiar with this term. Respectively, 67.5% and 80.9% did not know that a TUE is needed for asthma medication (i.e. terbutalin) and peptide hormones. The mean knowledge scores for general doping knowledge and knowledge about side effects are 0.73±0.09 and 0.73±0.14 respectively (not significant) and show a significant positive association (r=0.21, p<0.001). Both are positively associated with age (r=0.31 and r=0.35; p<0.001) but only knowledge about side effects is significantly associated with gender ($\bar{x}$; male=0.74±1.4 vs.a $\bar{x}$;female=0.70 ±1.5; p<0.005).

Table 2: Associations between Supplement Use, Doping Susceptibility and Doping Knowledge

	DS	DK	KSE	Ciga-rettes	Snus	AS	HGH	Alcohol	Stimulants	NS	Hashish	Diuretics	Cocaine	EPO
DS	1.00	-.04	.05	.20***	.18***	.15***	.12***	.22***	.12***	.14***	.18***	.05	.18***	.067*
DK		1.00	.21***	-.05	-.03	-.14***	-.08*	-.01	-.01	.16***	-.03	-.01	-.11***	-.02
KSE			1.00	.01	.05	-.09**	-.07*	.05	-.03	.15***	.01	-.02	-.07*	-.01
Cigarettes				1.00	.23***	.07*	.07*	.48***	.20***	.01	.40***	.15***	.18***	.14***
Snus					1.00	.16***	.10**	.32***	.16***	.08*	.25***	.15***	.23***	.15***
AS						1.00	.52***	.01	.30***	.06	.34***	.57***	.73***	.55***
HGH							1.00	-.02	.16***	.02	.27***	.46***	.59***	.44***
Alcohol								1.00	.14***	.03	.26***	.11**	.07*	.10**
Stimulants									1.00	.13***	.26***	.31***	.32***	.30***
NS										1.00	.07*	.10**	.05	.10**
Hashish											1.00	.30***	.56***	.29***
Diuretics												1.00	.63***	.97***
Cocaine													1.00	.64***
EPO														1.00

* p<0.05, ** p<0.01, *** p<0.001
DS: Doping Susceptibility; DK: Doping Knowledge; KSE: Knowledge about Side Effects; AS: Anabolic Steorids; HGH: Human Growth Hormone; EPO: Erythropoetin

Knowledge about doping and its side effects

A third of the athletes (33.5%) indicate to know the WADA 2010 prohibited list (significantly more men; p=0.003), 54.2% know the WADA and 66.5% know the NADA as anti-

Athletes, who know about WADA and NADA display significantly higher knowledge scores (p<0.001). Those athletes who indicated to know the 2010 prohibited list reported better scores in knowledge about side effects (p<0.001).

Additionally general knowledge about doping and knowledge about side effects was negatively associated with current use of anabolic steroids, growth hormones and cocaine ($r=-0.14$, $p<0.001$ and $r=-0.08$, $p<0.05$ and $r=-0.11$, $p<0.001$; $r=-0.08$, $p<0.01$ and $r=-0.07$, $p<0.05$ and $r=-0.07$, $p<0.05$) respectively.

Knowledge about health affecting side effects of doping was significantly associated with doping susceptibility, yet only marginally ($r=-0.08$, $p=0.005$). Associations of supplement use (PES and non-PES) with doping knowledge and doping susceptibility, controlled for gender and age are outlined in table 2. Stepwise linear multiple regression analyses was not expedient due to a high mutlicollinearity between (tolerance <0.5) and extreme skewness for some of the predicting factors.

Discussion

The current study aimed at evaluating the knowledge and PES use, respectively susceptibility of Austrian adolescent athletes aged 14 – 19 years. The mean doping susceptibility was very low, yet some of the athletes reported to have used PES during the last 12 months. Generally, knowledge about doping and its side effects, which was at a good level in this sample, was negatively associated with athletes' current substance use, even only marginally. It did not show associations with doping susceptibility though. There are uncertainties in terms of therapeutic use exemptions and its use.

Current doping susceptibility and PES use

Athletes were not only questioned in regard to PES but also to substances such as alcohol, tobacco and nutritional supplements. A review by Dodge and Hoagland [31] outlined that the use of anabolic steroids was associated with additional use of alcohol, tobacco and cannabis use. These findings are supported by the results of this study. Moderate associations were also found for using different PES (e.g. anabolic steroids, growth hormones and diuretics; $0.52 \leq r \leq 0.56$), which is likewise in line with previous research [16]. Yet, most of previous research indicates that the PES used the most are anabolic steroids [32], which could not be supported by our study. Results of this study were rather in line with Strano, Rossi and Botre [33] where stimulants were the substances most often used. Generally, the prevalence rate of substance use in this study was quite low which is comparable with previous literature on adolescents' use of PES [15,16,34]. As suggested by previous researchers, we used an additional measure of doping susceptibility as proximate to PES use, which was shown to be very low as well. Previous research used this method of proposing hypothetical questions to athletes as well with similar results [35].

Overall, prevalence and doping susceptibility are quite low. Yet, there is a range of prevalence rates that cannot be denied and according to Laure [36], this fact is founded in different approaches on how to question PES use (e.g. provide the PES list in advance or not). Associations with PES professionalism of training including trainer team, schedule, amount of training and competitions per year (only non-prohibited substances). Whereas these findings are in line with most of previous research especially in regard to age and gender associations [16], Laure [36] also found associations between training hours and prohibited PES use. Additionally, research analyzing predictors for doping susceptibility and PES use, additionally including psychosociological variables, mostly resulted in non-significant associations of gender and age [27,30,37].

Interestingly, doping susceptibility was positively associated with both current use of prohibited and non-prohibited PES. One could hypothesize that it does not matter whether a substance is prohibited or not, if an athlete is susceptible to enhance performances with the help of substances. This assumption finds support in the finding that the use of non-prohibited and prohibited PES is positively associated as well.

Knowledge about doping and its side effects

Half of the respondents knew the WADA and almost 70% knew the NADA Austria, yet only a third indicated to know the WADA prohibited list. This statement contrasts the finding that the general knowledge score of the athletes is actually quite good (0.73). Athletes classified most of the substances correctly. This finding is in line with some of the previous research that confirmed a good overall knowledge about doping substances and methods [15,17,38] and contrasts others that reported bad knowledge [18,19,39]. Especially, the low percentage of athletes knowing the prohibited list is in line with previous research [15,18].

In contrast to earlier findings, the knowledge about health affecting side effects of the current sample did not significantly differ from their general knowledge and was equally good (0.73). This finding is surprising and attests Austrian adolescent athletes a good knowledge about health affecting side effects, which was not found in any of the previous studies, where knowledge about side effects was, except for one study [38], significantly lower than general knowledge about doping [10,15,16,40]. The finding that male athletes had a significantly better knowledge about side effects supports findings of a study from Schwellnus et al. [39]. Notably the studies by Tanner et al. [10] and Williamson [40] were performed in the early 90s and it seems that educative prevention with respect to side effects was successful in view of the current findings. This can be seen as positive development if, as stated by deterrence theories such as the one of Strelan and Boeckmann [13], the knowledge about the negative health affecting side effects has the potential to deter the athletes using prohibited PES.

A lack in knowledge that deserves further attention is the one in regard to TUEs. The majority of the athletes is not familiar with this term and in addition does not know that TUEs are needed for certain asthma medication. Yet, athletes targeted in this research were adolescents, which can be expected to be in good health and which might not often be in direct contact with medication. Another explanation might be that the majority of these athletes is not part of a testing pool yet, therefore only needing a retrospective TUE in cases of testing. There are to our best knowledge no studies that explicitly questioned the knowledge about TUEs, which is why comparisons are hard to draw. Nevertheless, a special focus of educational programs should be directed on the issue of TUEs to prevent doping by mistake.

Doping knowledge and its association with doping susceptibility and PES use

The hypothesis that a profound knowledge might deter athletes from using PES can be ratified in parts by our study. There were some negative associations between knowledge and PES use (growth hormone, anabolic steroids and cocaine) within the Austrian sample, yet they were all rather marginal. Likewise, previous research outlines diverse results. Wanjek et al. [19] found evidence for associations between knowledge about doping and doping behavior. However, results of a Tyrolean study found only very weak correlations [15] and additional research from Canada and the UK showed no correlations at all [28,41-43]. The problem of socially desired responses when directly asking sensible questions such as PES use were acknowledge in this study by additionally introducing the variable of doping susceptibility that is said to be a proximate step to PES use [30,44]. Interestingly, general knowledge about doping and knowledge about side effects was not associated with doping susceptibility. Either, significant associations with PES use and doping knowledge are founded in the big sample size but are not relevant (supported by the low r-values) or doping susceptibility is not a direct proxy to behavior indicating that there are additional steps in between being doping susceptible (not influenced by knowledge) and finally applying negative doping behavior (influenced by knowledge). Either way, in view of the correlation analysis, results must not be interpreted in terms of cause-effect relationships but rather as associations.

In terms of the theory by Strelan and Boeckmann [13], knowledge about side effects does not seem to act as deterrent. Even though, athletes have quite a good picture about the negative results of doping they still apply negative doping behavior. One explanation could be linked to the time factor. Using prohibited PES to win a competition is present, negative health affecting side effects that might (or might not) occur in the future are mentally too far away to function as deterrent. The time factor was acknowledged very early by Ajzen and Fishbein [45] as part of their theory of planned behavior,even though this theory focused on attitudes in relation to behavior and not on deterrence factors per se. Another explanation could be found in the sensation seeking theory that was shown to be a predictor of positive and negative risk behavior among adolescents [46].

Limitations

Some limitations of this study need to be addressed. The questionnaire used in this study is self-reporting, even though adding the construct of doping susceptibility, socially desirable behavior might eventually result in over or underestimation of the findings. In a previous study by Barkoukis, Lazuras, and Tsorbatzoudis (2014), the effects of socially desirable behavior were actually rather small. In addition, athletes were allowed to indicate participation in more than one sport, which precludes conclusions on their main, competitive sport. The high prevalence of athletes indicating that nutritional supplements are prohibited (almost 30%) might result of a misunderstanding of the question. There is the possibility that some of the athletes specified “yes” to the question but relating it to contaminated nutritional supplements. Lastly, due to its cross-sectional and observational nature of this study, the results may not be interpreted causally. Correlations analyses only provide information on possible predictors of doping susceptibility, but further research in the form of case-control studies is needed to define causes in order to develop future prevention strategies. In this regard, social science research on doping is still in its infancy.

Conclusion and Prospective

This study generally shows a good knowledge about doping substance and methods as well as their side effects even though only a third of the athletes report to know the WADA prohibited list. In view of the hypothesis that a profound knowledge, especially about the health affecting side effects, might be an efficient deterrent for doping use, these findings were promising. Yet, also shown by the results, there is merely any association between doping knowledge and doping susceptibility and/or behavior. It seems that doping is too complex as to assume its prevalence could be decreased by solely informing athletes about the phenomenon and its side effects. Even though a profound knowledge is necessary for the athletes, especially about TUEs, to prevent doping by mistake, others variables need to be incorporated within future prevention strategies as well. Even though there are still diverse findings on the preventing power of profound knowledge, it can be concluded that this knowledge cannot be the exclusive and unique pillar in doping prevention. A suggestion for further research would be to change the focus of prevention from only informing to rather inclusively educating athletes. This means to also include their surrounding personnel within prevention strategies and to go into more detail with respect to ethical issues. Additionally, supplementary socio-psycho-

a primary intervention point for elite athlete doping. J Sci Med Sport. 2010, 14(2): 106-110.

13. Strelan P, Boeckmann RJ. A New Model for Understanding Performance-Enhancing Drug Use by Elite Athletes. J Appl Sport Psychol. 2003, 15(2): 176-183.

14. Bloodworth AJ, Petroczi A, Bailey R, Pearce G, McNamee MJ. Doping and supplementation: the attitudes of talented young athletes. Scand J Med Sci Sports. 2012, 22(2): 293-301.

15. Fürhapter C, Blank C, Leichtfried V, Mair-Raggautz M, Müller D, Schobersberger W. Evaluation of West-Austrian junior athletes' knowledge regarding doping in sports. Wien Klin Wochenschr. 2013, 125(1-2): 41-9.

16. Morente-Sanchez J, Zabala M. Doping in sport: a review of elite athletes' attitudes, beliefs, and knowledge. Sports Med. 2013, 43(6): 395-411.

17. Mottram D, Chester N, Atkinson G, Goods D. Athletes' Knowledge and Views on OTC Medication. Int J Sports Med. 2008, 29: 851-855.

18. Peters C, Schulz T, Oberhoffer R, Michna H. Doping und Dopingprävention: Kenntnisse, Einstellungen und Erwartungen von Athleten und Trainern. Dtsch Z Sportmed. 2009, 60(3): 73-78.

19. Wanjek B, Rosendahl J, Strauss B, Gabriel HH. Doping, drugs and drug abuse among adolescents in the State of Thuringia (Germany): prevalence, knowledge and attitudes. Int J Sports Med. 2007, 28(4): 346-353.

20. Blank C, Leichtfried V, Fürhapter C, Müller D, Schobersberger W. Doping in sports: West-Austrian sport teachers' and coaches' knowledge, attitude and behavior. Dtsch Z Sportmed. 2014, in press.

21. Laure P, Thouvenin F, Lecerf T. Attitudes of coaches towards doping. J Sports Med Phys Fitness. 2001, 41: 132-6.

22. Ambrose PJ. Drug Use in Sports: A Veritable Arena for Pharmacists. 2004, 44(4): 501-516.

23. Ambrose PJ. Educational Opportunities and Anti-Doping Roles and Responsibilities for Pharmacists. 2011, 131(12): 1761-1764.

24. Auersperger I, Topic MD, Maver P, Pusnik VK, Osredkar J, Lainscak M. Doping awareness, views, and experience: a comparison between general practitioners and pharmacists. Wien Klin Wochenschr. 2012, 124(1-2): 32-8.

25. Blank C, Müller D, Schobersberger W. Discrepancy between knowledge and interest of Austrian sports physicians with respect to doping and doping prevention in sports. ISMJ. 2014, 15(2): 136-45.

26. Blank C, Leichtfried V, Schaiter R, Furhapter C, Müller D, Schobersberger W. Doping in sports: Knowledge and attitudes among parents of Austrian junior athletes. Scand J Med Sci Sports. 2013, in press.

27. Barkoukis V, Lazuras L, Tsorbatzoudis H. Beliefs about the causes of success in sports and susceptibility for doping use in adolescent athletes. J Sports Sci. 2014, 32(3): 212-219.

28. Petroczi A. Attitudes and doping: a structural equation analysis of the relationship between athletes' attitudes, sport orientation and doping behaviour. Subst Abuse Treat Prev Policy. 2007, 2(34): 1-15.

29. Gucciardi DF, Jalleh G, Donovan RJ. Does social desirability influence the relationship between doping attitudes and doping susceptibility in athletes? Psychol Sport Exerc. 2010, 11(6): 479-86.

30. Jalleh G, Donovan RJ, Jobling I. Predicting attitude towards performance enhancing substance use: A comprehensive test of the Sport Drug Control Model with elite Australian athletes. J Sci Sports Med. 2013, in press.

31. Dodge T, Hoagland MF. The use of anabolic androgenic steroids and polypharmacy: a review of the literature. Drug and alcohol dependence. 2011, 114(2-3): 100-9.

32. Yesalis CE. Anabolic steroids in sports and exercise. Champaign, IL: Human Kinetics; 2000.

33. Strano Rossi S, Botre F. Prevalence of illicit drug use among the Italian athlete population with special attention on drugs of abuse: a 10-year review. J Sports Sci. 2011, 29(5): 471-6.

34. Laure P, Binsinger C. Doping prevalence among predolescent athletes: a 4-year follow-up. Br J Sports Med. 2007, 41: 660-663.

35. Bloodworth AJ, McNamee MJ. Clean Olympians? Doping and anti-doping: The views of talented young British athletes. Int J Drug Policy. 2010, 21: 276-282.

36. Laure P. Le dopage: données épidemiologiques. La Presse Médicale. 2000, 29(24): 1365-1372.

37. Donahue EG, Miquelon P, Valois P, Goulet C, Buist A, Vallerand RJ. A Motivationa Model of Performance-Enhancing Substance Use in Elite Athletes. J Sport Exerc Psychol. 2006, 28: 511-520.

38. Bents RT, Tokish JM, Goldberg L. Ephedrine, Pseudoephedrine and Amphetamine Prevalence in College Hockey Players. Phsy Sportsmed. 2004, 32(9): 30-34.

26. Blank C, Leichtfried V, Schaiter R, Furhapter C, Müller D, Schobersberger W. Doping in sports: Knowledge and attitudes among parents of Austrian junior athletes. Scand J Med Sci Sports. 2013, in press.

27. Barkoukis V, Lazuras L, Tsorbatzoudis H. Beliefs about the causes of success in sports and susceptibility for doping use in adolescent athletes. J Sports Sci. 2014, 32(3): 212-219.

28. Petroczi A. Attitudes and doping: a structural equation analysis of the relationship between athletes' attitudes, sport orientation and doping behaviour. Subst Abuse Treat Prev Policy. 2007, 2(34): 1-15.

29. Gucciardi DF, Jalleh G, Donovan RJ. Does social desirability influence the relationship between doping attitudes and doping susceptibility in athletes? Psychol Sport Exerc. 2010, 11(6): 479-86.

30. Jalleh G, Donovan RJ, Jobling I. Predicting attitude towards performance enhancing substance use: A comprehensive test of the Sport Drug Control Model with elite Australian athletes. J Sci Sports Med. 2013, in press.

31. Dodge T, Hoagland MF. The use of anabolic androgenic steroids and polypharmacy: a review of the literature. Drug and alcohol dependence. 2011, 114(2-3): 100-9.

32. Yesalis CE. Anabolic steroids in sports and exercise. Champaign, IL: Human Kinetics; 2000.

33. Strano Rossi S, Botre F. Prevalence of illicit drug use among the Italian athlete population with special attention on drugs of abuse: a 10-year review. J Sports Sci. 2011, 29(5): 471-6.

34. Laure P, Binsinger C. Doping prevalence among predolescent athletes: a 4-year follow-up. Br J Sports Med. 2007, 41: 660-663.

35. Bloodworth AJ, McNamee MJ. Clean Olympians? Doping and anti-doping: The views of talented young British athletes. Int J Drug Policy. 2010, 21: 276-282.

36. Laure P. Le dopage: données épidemiologiques. La Presse Médicale. 2000, 29(24): 1365-1372.

37. Donahue EG, Miquelon P, Valois P, Goulet C, Buist A, Vallerand RJ. A Motivationa Model of Performance-Enhancing Substance Use in Elite Athletes. J Sport Exerc Psychol. 2006, 28: 511-520.

38. Bents RT, Tokish JM, Goldberg L. Ephedrine, Pseudoephedrine and Amphetamine Prevalence in College Hockey Players. Phsy Sportsmed. 2004, 32(9): 30-34.

39. Schwellnus MP, Lambert MI, Todd MP, Juritz JM. Androgenic anabolic steroid use in matric pupils. SAMJ. 1992, 82: 154-158.

40. Williamson DJ. Anabolic steroid use among students at a British college of technology. Br J Sportsmed. 1993, 27(3): 200-201.

41. Goulet C, Valois P, Buist A, Côté M. Predictors of the Use of Performance-Enhancing Substances by Young Athletes. Clin J Sport Med. 2010, 20: 243-248.

42. Petroczi A. Attitude-Behavior Relationship Regarding the Use of Performance Enhancing Drugs and/or Methods. Med Sci Sports Exerc. 2003, 35(5): 1.

43. Uvacsek M, Nepusz T, Naughton DP, Mazanov J, Ranky MZ, Petroczi A. Self-admitted behavior and perceived use of performance-enhancing vs psychoactive drugs among competitive athletes. Scand J Med Sci Sports. 2011, 21(2): 224-34.

44. Gucciardi DF, Jalleh G, Donovan RJ. An examination of the Sport Drug Control Model with elite Australian athletes. J Sci Med Sport. 2011, 14(6): 469-476.

45. Ajzen I, Fishbein M. Attitude-Behavior Relations: A Theoretical Analysis and Review of Empirical Research. Psychol Bull. 1977, 84(5): 888-918.

46. Hansen EB, Breivik G. Sensation seeking as predictor of positive and negative risk behavior among adolescents. Pers Indiv Differ. 2001, 30: 627-640.