

DISSERTATION FROM THE
NORWEGIAN SCHOOL OF
SPORT SCIENCES
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Jan Åge Kristensen

The Darker Side of Youth Sport

Unraveling Psychosocial Factors Driving Health-
Compromising Behaviors Among Adolescent Athletes

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“...Dreams without goals are just dreams and ultimately they may fuel disappointment. On the road to achieving your dreams, you must apply *commitment* and *consistency*. Because without commitment, you’ll never start, and without consistency, you’ll never finish.”

Denzel Washington

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Jan Åge Kristensen

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List of papers

Paper I

Kristensen, J. Å., Skilbred, A., Abrahamsen, F. E., Loland, S. & Ommundsen, Y. (2022). Performance-enhancing and health-compromising behaviors in youth sports: A systematic mixed-studies review.

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<https://doi.org/10.1016/j.peh.2022.100237>.

Paper II

Kristensen, J. Å., Haugen, T. & Ommundsen, Y. Perceived social pressure and intention to play through injuries in junior ice hockey: The sporting environment matters.

Accepted for publication in *Journal of Sports Sciences*.

Paper III

Kristensen, J. Å., Kavussanu, M. & Ommundsen, Y. Perceived performance climate, doping attitudes and temptation among elite youth athletes: Exploring the moderating role of perfectionistic concerns.

Submitted to *European Journal of Sport Science*.

Paper IV

Kristensen, J. Å., Haugen, T. & Ommundsen, Y. Supplement usage and doping attitudes in elite youth sports: The mediating role of dietary supplement acceptance.

Submitted to *PLOS ONE*.

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Abbreviations

AGT	Achievement goal theory
CFI	Comparative fit index
CI	Confidence interval
PBC	Perceived behavioral control
RMSEA	Root mean square error of approximation
SEM	Structural equation modeling
SRMR	Standardized root mean square residual
TLI	Tucker–Lewis’s index
TPB	Theory of planned behavior
TPBS	Theory of planned behavior scale
WADA	World Anti-Doping Agency

Summary

Background: The overall aim of this research project was to increase understanding of the psychosocial factors that influence health-compromising behaviors among young athletes. To achieve this, an integrative social cognitive approach was adopted by deepening and broadening the theory of planned behavior (Ajzen, 1991). Health-compromising behaviors encompassed painkiller use, participation in sports despite injuries, use of dietary supplements, and doping. A range of theoretically informed personal and contextual factors were hypothesized to either offer protection against or trigger these behaviors. By providing a better understanding of these factors, this thesis contributes to the development of strategies for reducing health-compromising behaviors in youth sports.

Objectives: To achieve the overall aim of this doctoral thesis, four studies were conducted, each of which targeted a specific objective. These four objectives were: (*Paper I*) identify the personal and contextual factors influencing athletes' health-compromising behaviors through a systematic review; (*Paper II*) examine the relationship between perceived social pressure and intention to play through injuries; (*Paper III*) explore the interplay between perceptions of a performance climate and doping temptation antecedents, while also examining the moderating role of perfectionistic concerns; and (*Paper IV*) investigate the mediating role of the acceptance of dietary supplements in the relationship between supplement use and doping attitudes during a competitive season.

Methods: The four individual studies encompassed both qualitative (*Paper I*) and quantitative research designs (*Papers II, III, and IV*). In *Paper I*, a systematic mixed-studies review was conducted, synthesizing and analyzing qualitative, quantitative, and mixed-methods studies. Exploratory data analysis combined convergent qualitative meta-integration and thematic analysis to interpret emerging themes and patterns. *Paper II* employed parallel multiple mediation analysis with cross-sectional data to examine whether social pressure was directly and indirectly (via attitudes, subjective norms, perceived behavioral control avoidance, and situational temptation) related to the intention to play when injured (N = 186 junior ice hockey players). *Paper III* utilized conditional process analysis with cross-sectional data to explore whether the performance climate was directly and indirectly (via pro-doping attitudes) related to doping temptation, while also considering the moderating role of perfectionistic concerns (N = 420 adolescent athletes). *Paper IV* employed structural equation

modeling analysis with a half-longitudinal data collection approach in a two-wave design to test the mediating role of dietary supplement acceptance in the relationship between supplement use and doping attitudes during a competitive season (N = 217 adolescent athletes).

Results and discussion: The findings indicate that there is a dynamic interplay between the personal factors of the athletes and the contextual factors summarized from athletes' self-described perceptions of the sporting environment, which shapes their health-compromising behaviors (*Paper I*). A wide range of theoretically informed personal and contextual factors, functioning either as protective or eliciting factors, were identified. Ice hockey players perceived social pressure from the sporting environment to play despite being injured (*Paper II*). This perception appeared to increase players' intention to play through injuries. Additionally, the players' perception of social pressure seemed to influence their attitudes, subjective norms, and situational temptations, thereby strengthening their intention to play the game when injured. Furthermore, athletes who perceived their sports environment as performance-oriented, characterized by an increased pressure to win and outperform others, were more likely to be tempted to use prohibited substances. Perceptions of a performance-oriented climate also appeared to shape athletes' beliefs that using prohibited substances would yield more positive consequences than negative ones, making them more prone to doping. This tendency was particularly notable among athletes who had moderate or high levels of perfectionistic concerns (*Paper III*). Finally, dietary supplements were widely used among young athletes. However, the frequent use of supplements might be a potential risk factor for developing pro-doping attitudes. The findings suggest that when athletes used dietary supplements at the start of the season to improve their performance, they were more likely to view the use of supplements as acceptable and to report more favorable attitudes toward doping six months later at the end of the season (*Paper IV*).

Conclusion: In summary, the overall findings highlight important psychosocial factors underlying young athletes' health-compromising behaviors. Thus, the findings also underline the role of the sporting environment in helping athletes refrain from dysfunctional behavioral patterns. Coaches, sports practitioners, and others are encouraged to create environmental conditions that reduce social pressure and downgrade the importance of winning.

Sammendrag på norsk (Summary in Norwegian)

Bakgrunn: Målet med avhandlingen er å øke forståelsen for de ulike psykososiale faktorene som påvirker usunne helsevalg blant unge idrettsutøvere. Usunne helsevalg inkluderer dysfunksjonelle valg som bruk av smertestillende preparater, deltakelse i idrett til tross for skade, bruk av kosttilskudd og doping. For å oppnå dette målet valgte jeg en integrerende sosial-kognitiv tilnærming og anvendte teorien om planlagt atferd som teoretisk rammeverk. Flere personlige og kontekstuelle faktorer ble identifisert som enten hadde en beskyttende eller utløste rolle mot de nevnte atferdene. Ved å øke forståelsen av disse faktorens samspill, bidrar denne avhandlingen til kunnskap for utvikling av forebyggende strategier for å redusere usunne helsevalg i ungdomsidretten.

Mål: For å oppnå det overordnede målet med denne doktoravhandlingen gjennomførte jeg fire studier. Disse fire studiene hadde følgende mål: (*Paper I*) identifisere personlige og kontekstuelle faktorer som påvirker unge utøvers usunne helsevalg gjennom en systematisk oppsummeringsstudie; (*Paper II*) undersøke forholdet mellom oppfattet sosialt press og intensjon om å spille til tross for skade; (*Paper III*) utforske samspillet mellom oppfatninger av et prestasjonsklima og fristelser for doping, og undersøke den modererende rollen til perfektjonistiske bekymringer; og (*Paper IV*) utforske den medierende rollen til aksept av kosttilskudd i forholdet mellom bruk av kosttilskudd og holdninger til doping i løpet av en idrettslig sesong.

Metoder: De fire studiene omfattet både kvalitative (*Paper I*) og kvantitative forskningsdesign (*Papers II, III, and IV*). *Paper I* er en systematisk oppsummeringsstudie som syntetiserte og analyserte kvalitative, kvantitative og studier med blandet forskningsdesign. Utforskende dataanalyser kombinert med meta-integrasjon og tematisk analyse ble tatt i bruk for å tolke ulike temaer og mønstre i datasettet. *Paper II* brukte parallell multippel medieringsanalyse med tverrsnittsdata for å undersøke om sosialt press var direkte og indirekte (gjennom holdninger, subjektive normer, oppfattet kontroll og fristelse) relatert til intensjon om å spille når man er skadet (N = 186 junior ishockeyspillere). *Paper III* anvendte betinget prosessanalyse med tverrsnittsdata for å utforske om prestasjonsklima var direkte og indirekte (gjennom holdninger til doping) relatert til fristelser for doping, samtidig som den modererende innflytelsen til perfektjonistiske bekymringer ble vurdert (N = 420 ungdomsutøvere). *Paper IV* brukte strukturell ligningsmodellanalyse med en longitudinal

data i et to-målingsdesign for å teste den medierende rollen til aksept av kosttilskudd i forholdet mellom bruk av kosttilskudd og holdninger til doping i løpet av en idrettslig sesong (N = 217 ungdomsutøvere).

Resultater og diskusjon: Funnene viste at det er et samspill mellom personlige faktorer og utøveres opplevelse av kontekstuelle faktorer. Dette samspillet påvirker utøveres usunne helsevalg (*Paper I*). En rekke teoretiske forankrede personlige og kontekstuelle faktorer ble identifisert. Disse fungerte enten som beskyttende eller utløsende faktorer. Ishockeyspillere oppfattet sosial press fra idrettsmiljøet om å spille til tross for skade (*Paper II*). Denne oppfatningen økte spillernes intensjon om å trene og konkurrere til tross for skade. I tillegg påvirket spillernes oppfatning av sosialt press deres holdninger, subjektive normer og opplevd fristelse. Dette samspillet styrket spillernes intensjon om å spille når man var skadet. Idrettsutøvere som oppfattet idrettsmiljøet som prestasjonsorientert, karakterisert av økt press for å vinne og utkonkurrere andre, var mer tilbøyelige til å bruke forbudte stoffer. Oppfatninger av et prestasjonsorientert klima formet også utøveres tro på at bruk av forbudte stoffer ville gi flere positive konsekvenser enn negative, noe som gjorde dem mer tilbøyelige til å bruke de. Dette forholdet var spesielt merkbart blant utøvere som hadde moderate eller høye nivåer av perfektjonistiske bekymringer (*Paper III*). Avslutningsvis, kosttilskudd var svært utbredt blant de unge idrettsutøverne. Funn fra *Paper IV* viste at hyppig bruk av kosttilskudd var en mulig risikofaktor for utvikling av positive holdninger til doping. Når utøvere brukte kosttilskudd ved starten av sesongen for å øke prestasjon, var de mer tilbøyelige til å anse bruk av kosttilskudd som akseptabelt og rapporterte mer positive holdninger til doping seks måneder senere.

Konklusjon: De overordnede funnene viser samspillet mellom sentrale psykososiale faktorer som ligger til grunn for usunne helsevalg blant unge idrettsutøvere. Funnene understreker også idrettsmiljøets mulige rolle til å hjelpe utøvere med å avstå fra usunne helsevalg.

1 Introduction

In the realm of elite sports, athletes have pushed their bodies beyond their limits for decades in the pursuit of athletic excellence. Many athletes have endured pain, played through injuries, and experimented with the use of various substances and methods to enhance their performance (Gleaves et al., 2021; Mayer & Thiel, 2018). This short-term gains approach seems to have been integrated into elite sports and is often celebrated as an expression of true determination and dedication to sports (Theberge, 2008). However, these behaviors not only violate the spirit of sports but also have the potential to compromise the health of athletes and lead them to violate anti-doping rules (Helle et al., 2019; Mayer & Thiel, 2018; Obasa & Borry, 2019).

The World Anti-Doping Agency (WADA)¹ was established to protect athletes, promote integrity among them, and preserve the true spirit of sports. In pursuit of these goals, WADA has crafted a set of rules to guide athletes in their performance enhancement. Certain substances and methods used by athletes for performance enhancement (e.g., anabolic steroids, hormones, and amphetamines) are prohibited, and their use has been categorized as doping, while other substances are more or less considered acceptable. An example of the latter is dietary supplements, which include various products that claim to be capable of enhancing athletes' short-term performances (Maughan et al., 2004). Despite WADA's efforts to develop, harmonize, and coordinate anti-doping rules, reports of athletes using doping persist. This raises alarms as the same trend has emerged among young athletes, giving rise to a darker side in youth sports.

Young athletes are widely influenced by factors such as single-sport specialization, high training loads, frequent competition, and performance pressure, which make them more prone to dysfunctional behavioral patterns than older athletes (DiFiori et al., 2014; Ommundsen et al., 2006). The transitional phase between childhood and adulthood, known as adolescence, marked by a range of biological, cognitive, and psychosocial changes, further complicates their situation (Rutter, 1995). Situated in this phase, young athletes driven by aspirations to enter professional sports may face the aforementioned pressures without full awareness of their potential risks (Rutter, 1995).

¹ WADA was established in 1999 as an independent international agency to lead a collaborative worldwide movement for doping-free sports. The cited information was retrieved from WADA (2023).

Introduction

Previous research on adolescent athletes revealed that young athletes use painkillers to cope with pain (Denham, 2014), continue participating in their sports despite injuries (Von Rosen et al., 2018), and utilize various performance-enhancing substances (Knapik et al., 2016; Silva et al., 2017). These dysfunctional behavioral patterns prompt the need for action to protect young athletes from sacrificing their health in the pursuit of greater sports achievement and outstanding athletic performance. Therefore, this research project mainly aimed to gain a greater understanding of the psychosocial risk and protective factors influencing young athletes' health-compromising behaviors, including painkiller use, participation in sports despite injuries, dietary supplement use, and doping.

2 Theoretical perspectives

Health-compromising behaviors are multifaceted phenomena, and comprehending the diverse psychosocial processes underlying such behaviors requires the use of different theoretical perspectives. To better capture the complexity of the various psychosocial factors influencing young athletes' health-compromising behaviors, this research project took advantage of a social cognitive approach by utilizing a multi-theoretical framework in the following referred to as an integrative approach. The sections ahead provide a brief overview of the social cognitive approach and introduce the integrative framework used for studying potential facilitative and protective antecedents of health-compromising behaviors in the realm of sports.

2.1 An integrative social cognitive approach to studying the potential antecedents of health-compromising behaviors

According to the social cognitive approach, both proximal and distal determinants influence individuals' mental and behavioral processes (see Figure 1). Proximal determinants refer to factors personal to the individual, such as personality and cognition, whereas distal determinants denote factors external to the individual, such as bans on dangerous substances (Fiske & Taylor, 2013). Scholars and researchers have mostly focused on examining proximal determinants of behavior, with cognitive factors notably standing out as the most important among them (Armitage & Conner, 2000). Theoretical models explaining how these cognitive factors predict a variety of behaviors are commonly referred to as social cognition models. While these models often emphasize immediate or prospective influences of cognitive factors on behavior that are partially within an individual's control, they also offer insight into the potential contributions of external factors (Conner & Norman, 2015).

Numerous social cognitive models are commonly employed to predict various types of behaviors and outcomes, including the health belief model (Becker, 1974), self-determination theory (Ryan & Deci, 2007), and social cognitive theory (Bandura, 1982). However, aligned with Armitage and Conner's (2000) comparison of key social cognition models and their prominence in understanding and predicting behavior, this research project explored a selection of health-compromising behaviors through an integrative approach by deepening and broadening the Theory of planned behavior (TPB; Ajzen, 1991).

Theoretical perspectives

Integrative models of behavior strive to consolidate diverse sources of influence into a cohesive theoretical and explanatory framework (Fishbein & Cappella, 2006). In accordance with the social cognitive approach, behavior does not arise solely from personal factors; thus, it is elucidated through the comprehension of the dynamic connections between intra-personal characteristics (e.g., beliefs) and contextual factors. According to Armitage and Conner (2000), TPB stands out as a social cognition model and has substantiated itself as the preeminent reference theory for comprehending an array of behaviors across various contexts. These include the initiation of smoking (Conner et al., 2006), the use of dietary supplements (Barkoukis et al., 2015), and the use of prohibited substances (Lazuras et al., 2015).

2.1.1 Theory of planned behavior

TPB views behavior as a conscious, rational, and planned action driven by the proximal influence of intention and perceptions of control over a specific behavior. According to Ajzen (1991), intention reflects careful planning and the motivation to engage in a certain behavior or exert effort to perform it. Intention is determined by three sets of social cognitions: (1) attitudes, which represent an individual's overall evaluation of the behavior in question; (2) subjective norms, encompassing beliefs about whether significant others think that the individual should engage in the behavior; and (3) perceived behavioral control (PBC), which reflects an individual's perception of how easy or difficult it is to perform the behavior. Moreover, PBC encompasses an individual's expectancy that performing the behavior is within their control, thus hypothesizing an additional influence on behavior (Ajzen, 2002). Therefore, the concept of PBC resembles Bandura's (1982) concept of self-efficacy, wherein control is viewed as a continuum with easily achievable behaviors on one end and demanding behavioral goals on the other, including demanding resources, opportunities, and specialized skills.

Each of the three sets of social cognitions in TPB is believed to have prior determinants. Attitudes stem from salient behavioral beliefs, with each belief signifying the perceived likelihood that performing the behavior in question will lead to more positive consequences than negative ones (Ajzen & Fishbein, 1975). Subjective norms derive from normative beliefs, which entail perceptions of significant others' opinions about whether one should or should not engage in the behavior in question or approval of one's engagement in the

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behavior, coupled with the individual's motivation to align with these expectations. Judgments of PBC are influenced by beliefs about whether one possesses the necessary resources and opportunities to successfully engage in the behavior in question, weighted by the ease or difficulty of facilitating or avoiding the behavior. As such, PBC captures internal control factors, such as information, skills, and abilities, alongside external control factors encompassing opportunities, dependence on others, and barriers (Ajzen, 2002).

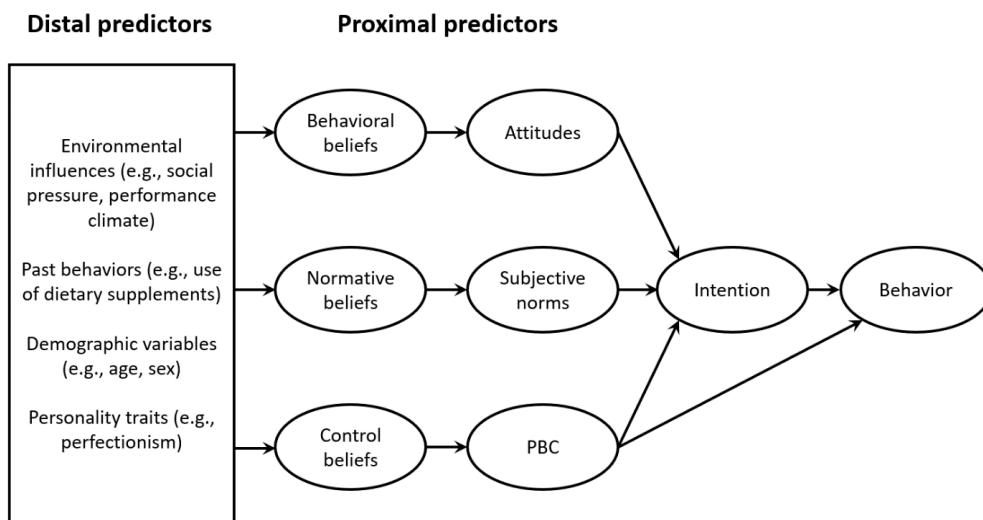


Figure 1. Proposed integrative model of the distal and proximal determinants influencing health-compromising behaviors (modified from Conner and Sparks, 2015, p. 148). In this research project, behavior was considered to be exemplified by doping temptation.

As depicted in Figure 1, the integrative causal model of TPB is regarded as a comprehensive theory of behavior. This is due to the assumption that any additional influences on behavior, such as demographic, personality traits, or environmental constraints that are more distal and external to the individual, are believed to exert an impact on behavior by influencing the three sets of social cognitions in TPB. However, Fishbein (2009) acknowledges that broadening and deepening the roles of contextual sources of influence and their relationships with TPB's original components will enable a more comprehensive explanation of the impacts of distal predictors on intentions and behavior. Hence, this research project has incorporated additional distal influences, such as social pressure, motivational climate, perfectionism, and the use of dietary supplements.

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2.1.2 Achievement goal theory

To better understand the influence of distal predictors on intentions and behavior, this research project integrated Achievement goal theory (AGT; Nicholls, 1989) with TPB. According to Nicholls (1989), AGT combines individual difference variables with situational determinants to elucidate behavior. These situational determinants encompass the achievement criteria perceived as salient in a given context, also referred to as the perceived motivational climate.

According to Ames (1995), the motivational climate pertains to the goals and behaviors emphasized and the salient values in the social environment fostered by significant others such as coaches, peers, and parents. The significant others determine what should be considered important achievement criteria, and via their interactions and behaviors, they convey which criteria hold value in a given athletic context. Consequently, coaches play a vital role in shaping and reinforcing sports' motivational climates (Ntoumanis & Biddle, 1999). On the one hand, coaches may come to create a performance-oriented motivational climate by defining success in terms of victory, rewarding only the top performers, and emphasizing outperforming others (Ames, 1992). On the other hand, coaches may reinforce a mastery-oriented motivational climate by providing their athletes with opportunities and a clear rationale for improvement while acknowledging their feelings and efforts (Hodge & Gucciardi, 2015).

Drawing on the social-contextual constructs from AGT (Harwood et al., 2015), the perceived motivational climate assumes a distal role in shaping behavior by impacting the components of TPB (see Figure 1). However, there is also evidence suggesting that levels of perfectionism could moderate the relationship between proximal predictors and behavior, potentially increasing athletes' susceptibility to health-compromising behaviors (Conner & Norman, 2015).

2.1.3 Perfectionism

Perfectionism is about the self and refer to individual's motivational orientation dominated by the pursuit of self-image goals (Nepon et al., 2016). Consequently, perfectionism nurture enduring mental patterns and specific thoughts, behavior, perceptions, and interpersonal dynamics (Flett & Hewitt, 2022). Perfectionists, as described by Flett and Hewitt (2022),

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pursue perfection and often set excessively high standards, coupled with a tendency to critically evaluate their own behavior. According to Stoeber and Madigan (2016), perfectionism is best conceptualized as a multidimensional construct in which perfectionistic concerns and strivings have been identified as two higher-order dimension, viewing perfectionism as a personality trait. Perfectionistic concerns entail athletes' concerns over making mistakes, fear of adverse reactions from others, and the consequences of failing to achieve high standards (Hill, 2016). Conversely, perfectionistic strivings encompass athletes' striving for flawlessness and setting unrealistically high personal standards of performance.

There is a large body of research on the outcomes associated with the two higher-order perfectionism dimensions in sport, linking them to both maladaptive and adaptive outcomes. On the one hand, perfectionistic concerns have been positively associated with psychological maladjustments such as fear of failure, worry, anxiety, negative affect, and pro-doping attitudes (Hardwick et al., 2022; Hill et al., 2018; Madigan et al., 2020). On the other hand, the relationship between perfectionistic strivings and the aforementioned outcomes has been inconsistent to the abovementioned outcomes, thus being negatively related to pro-doping attitudes (Madigan et al., 2016). As competitive sports often include the combination of pressure to perform in both training and competition, the constant evaluation of performance, comparisons with others, and the rewards for outstanding performances, we deemed it more appropriate to only include the dimension of perfectionistic concerns as a moderator in the integrative model central for the current research project (Dunn et al., 2005).

This integrative approach to studying the antecedents of health-compromising behaviors has the potential to provide valuable insights, particularly concerning practical implications. However, it is important to note that certain studies within the scope of this research project examined a specific set of distal and proximal antecedents of health-compromising behaviors. That is to say, these studies integrated either the concept of perceived social pressure (*Paper II*) or that of the perceived motivational climate, along with perfectionistic concerns (*Paper III*) and use of dietary supplements (*Paper IV*), as distal predictors, and explored the influence of these predictors on the proximal determinants of intention (*Paper II*), doping temptation (*Paper III*), and attitudes toward doping (*Paper IV*).

3 Previous research

There are a variety of factors that contribute to individual differences in behavioral tendencies, including demographics, personality, and emotional, cognitive, and social factors (Conner & Norman, 2015). This section discusses the diverse personal and contextual factors influencing health-compromising behaviors (as explored in *Paper I*) in depth and encapsulates previous studies on the topic.

3.1 A systematic mixed-studies review

Aligned with the overall aim of this research project (i.e., to gain a greater understanding of the psychosocial risk and protective factors influencing young athletes' health-compromising behaviors), an effort was made to identify relevant *personal* and *contextual* factors hypothesized to influence health-compromising behaviors in young athletes.

3.1.1 Personal factors

Based on the systematic literature review (*Paper I*), personal factors have received substantial attention in explaining the behavioral tendencies behind young athletes' engagement in health-compromising behaviors. Some factors are theoretically defined as risk factors, while others are considered protective factors. Figure 2 gives a summarize of the various factors found in *Paper I* and illustrates their protective or eliciting role. To illustrate, self-esteem has been related to athletes' substance use and risk of injury in various ways. For instance, Denham et al. (2014) found that athletes tended to use prescription pain relievers more frequently than non-competitors, and that athletes with low self-esteem were likely to be more vulnerable to excessive substance use than those with high self-esteem. In another study, Von Rosen et al. (2017) reported that athletes with high self-esteem were likelier to incur injury than athletes with low self-esteem. Evidently, both low and high self-esteem may contribute to athletes' increased risk of engaging in dysfunctional behaviors.

Schnell et al. (2014) aimed to identify groups of athletes who were notably willing to accept the negative physical and social consequences of their pursuit of athletic excellence. The athletes in their study who attached great importance to fulfilling their athletic roles tended exhibit perfectionistic tendencies, focus highly on their performance, be willing to conceal

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pain, persist in training, and compete despite injuries or illnesses. On the other hand, the athletes who did not assign exceedingly high importance to fulfilling their social roles as athletes and who also valued the fulfillment of their non-sport social life roles, were the least willing to accept physical and social risks (Schnell et al., 2014). Taken together, these findings support the notion that athletes with a broader distribution of interests and goals beyond sports and who are not overly perfectionistic may be less inclined to jeopardize their health for the sake of performance enhancement.

Von Rosen et al. (2018) explored athletes' viewpoints on injuries, their experiences of injury, and the lessons that they learned from being injured. They found that athletes associated pain and injury with average sports participation, where injury prevalence was reported to be as high as 46% within the athletic sample. However, the athletes who had encountered injuries (e.g., stress fractures) described a change in their perceptions of injury risks, coupled with an enhanced understanding of their bodies. Specifically, these athletes transitioned from accepting pain to recognizing it as an abnormal response of the body to training. Some athletes also began to question their identity as athletes and were frequently overwhelmed by the apprehension of not being able to regain their past optimal physical condition following an injury (Von Rosen et al., 2018). Another important finding was that several athletes who suffered injury and underwent rehabilitation therapy expressed feelings of loneliness, despite being involved in a training environment alongside their peers.

In an independent study, Von Rosen et al. (2019) demonstrated a link between severe injuries (e.g., overuse injuries) and lower levels of self-reported well-being. When athletes encountered reduced levels of well-being, they exhibited a higher susceptibility to injury and incurred more severe injuries in the subsequent week. This could be due to the triggering impact of stressful life events and daily challenges, encompassing factors such as mistrust and ineffective coping (Johnson & Ivarsson, 2011).

Previous research has also shed light on the interesting associations between the use of dietary supplements and doping behaviors among adolescent athletes. Rodríguez-Serrano et al. (2018) noted that many athletes turn to various supplements to manage the demands of their sports endeavors more effectively. This sentiment was echoed by one of the athletes in their study, who stated, "Energy drinks are good [because they help] you become more alert" (Rodríguez-Serrano et al., 2018, p. 1275). In Barkoukis et al.'s (2015) study, the athletes who were using dietary supplements exhibited more favorable attitudes toward doping and

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reported stronger intentions to engage in such behavior than the athletes who refrained from using dietary supplements. In contrast to their non-user counterparts, the athletes who consumed dietary supplements displayed reasoning in favor of doping, such as that doping would lead to more positive consequences than negative ones, perceived supplement use as less risky, thereby potentially endorsing the use of prohibited performance-enhancing substances in the future (Barkoukis et al., 2015).

Previous research has linked other personal factors, such as personality traits and social cognitions, to doping behavior. Madigan et al. (2016) investigated the impact of perfectionism on male athletes' attitudes toward the use of prohibited substances. The athletes in their study who exhibited high levels of perfectionistic strivings, focusing on achieving their sports goals, were likely to have more negative attitudes toward doping. Concerns about making mistakes and facing disapproval from others due to one's imperfections (e.g., perfectionistic concerns) surprisingly showed a non-significant relationship with pro-doping attitudes.

Lazuras et al. (2015) explored various cognitive and emotional factors associated with athletes' intentions to dope. Among team and individual athletes, those who reported having little respect for rules, officials, and social conventions, and those who perceived more positive than negative consequences of using prohibited substances (e.g., attitudes toward doping use), showed a stronger intention to engage in doping. The tendencies toward problematic sportspersonship orientations and intention to dope were also more notable in the athletes who anticipated fewer negative emotional repercussions from doping (e.g., anticipated regret from using prohibited substances).

Another important finding of Lazuras et al. (2015) was that performance-oriented athletes had stronger intentions to engage in doping, driven by a heightened temptation to do so. In contrast, athletes with a mastery-oriented mindset reported lower intentions to engage in doping owing to a reduced temptation to dope. Evidently, the athletes who centered their sports achievements on top performance struggled to resist the temptation to use doping, while those who embraced a mastery approach focused on improving their skills displayed a greater resolve to resist the allure of doping.

Barkoukis et al. (2014) investigated athletes' beliefs regarding the causes of success in sports and their susceptibility to doping. Accordingly, athletes who attributed their success to

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external factors, such as cheating and deception strategies, were likely to report a higher susceptibility to doping. In a related study, Chan, Dimmock et al. (2015) found that athletes who were autonomously motivated to engage in sports were likely to be autonomously motivated to avoid doping. These athletes also exhibited more adaptive motivational and social cognitive patterns (e.g., attitudes, subjective norms, and PBC) concerning the intention to avoid doping. Similarly, Chan, Lentillon-Kaestner et al. (2015) found a negative correlation between athletes' self-control and pro-doping attitudes and intention. Conversely, self-control showed a positive association with intention and adherence to doping avoidance behaviors.

Previous research has also documented the various means and methods employed by young athletes to enhance their skills and achieve better performance, including the use of dietary supplements and prohibited substances. In a study by Silva et al. (2017), it was revealed that approximately 39% of the school athletes in Brazil at the time of the study used dietary supplements to enhance their performance. Regarding prohibited substances, 1.7% of the athletes reported the use of stimulants, 2.2% illicit drugs, 0.5% anabolic steroids, and 1.7% hormones and other similar substances. It is important to note, however, that the use of the various performance-enhancing substances seemed to differ depending on the specific sports the athletes were engaged in.

Mroczkowska (2011) investigated the decision-making process regarding doping among young athletes. The researcher found that the athletes' evaluation of objective risk relied more heavily on what might be lost than on what could be gained. Consequently, the athletes who placed importance on their health and on respect for others exhibited a lower risk of resorting to doping.

3.1.2 Contextual factors

As illustrated in Figure 2, athletes may also engage in health-compromising behaviors due to the influence of various contextual factors. Schnell et al. (2014) reported that athletes were more willing to conceal pain, persist in training, and participate in competitions despite injuries or illnesses when they perceived social pressure from their sporting environment. These findings align with those of Mayer et al. (2018), who demonstrated that athletes' ages and sports discipline contributed to their willingness to compete when injured or in pain. Specifically, 17- to 18-year-old athletes taking part in ball games and weight-dependent and

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aesthetic sports were more prone to compete when hurt, underscoring the challenge they faced in justifying breaks from training and competition when dealing with injuries or minor health problems.

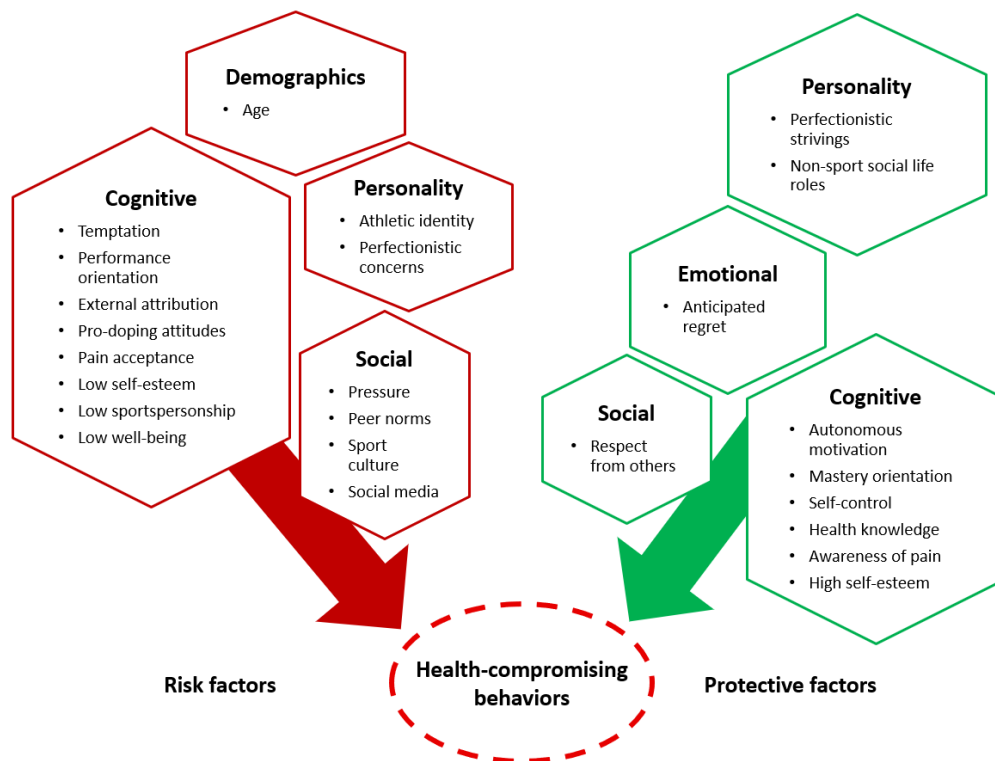


Figure 2. Overview of the diverse personal and contextual factors believed to influence athletes' engagement in health-compromising behaviors. The various behaviors include painkiller use, participation in sports despite injuries, use of dietary supplements, and doping.

In another study, Madigan et al. (2016) showed that athletes who believed that their parents expected perfect performance from them were likely to have a more permissive attitude toward doping than those who did not perceive such expectations from their parents. Furthermore, as reported by Denham (2014), peer norms and social acceptance could elicit a higher frequency of substance use in sports. For example, as a function of “bravado and peer-driven expectations,” athletes may be likely to engage in the nonmedical use of prescription pain relievers to lessen their physical pain and to continue competing (Denham, 2014, p. 152). These underlying social influences are also believed to have a stronger presence in

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aggressive team sports (e.g., football) and to drive males and females toward distinct types of substances.

Lastly, social media is also believed to influence athletes' decisions to engage in health-compromising behaviors. Rodríguez-Serrano et al. (2018) noted that social media enables young athletes to share information about themselves, receive guidance from health experts, and gain opportunities to garner validation from their peers. Consequently, social media may shape athletes' cognitive processes regarding how to deal with health issues, and thus lead them to experiment with and adopt detrimental behaviors.

3.2 Supplementary findings

The psychosocial risks and protective factors underlying health-compromising behaviors in young athletes mentioned in the extensive body of literature reviewed appear to align with those in the case of older athletes (Backhouse et al., 2016; Martin et al., 2021; Ntoumanis et al., 2014). However, older athletes seem to be more heavily involved in experimentation with the use of performance-enhancing substances.

According to Knapik et al. (2016), approximately two-thirds (60%) of elite athletes utilize dietary supplements to enhance their performance. However, the use of dietary supplements, often referred to as “clean performance-enhancing substances” by athletes, still presents a risk in terms of the allure of doping. Hurst et al. (2023) revealed that the prevalence of doping was 2.74 times higher among dietary supplement users than among non-users (95% confidence interval [CI]: 2.10–3.57). Furthermore, compared to non-users, dietary supplement users had more permissive attitudes toward doping and stronger intentions to engage in doping. Nonetheless, dietary supplement users who demonstrated greater task orientation and a stronger sense of morality were less likely to participate in doping.

Represented by Gleaves et al. (2021), the WADA working group conducted a comprehensive analysis of doping prevalence by collating and synthesizing relevant evidence from scientific papers published since 1975. Their findings revealed a broad spectrum of doping behavior, with prevalence rates in elite sports ranging from 0% to 73%, with most instances falling below 5% (Gleaves et al., 2021). This alarming range of prevalence shows that elite athletes use various prohibited means of enhancing their performances to a greater or lesser extent. To protect young athletes from falling into destructive behavioral patterns similar to those that

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their older counterparts fall into, further research is needed to enhance the understanding of the factors influencing health-compromising behaviors in young athletes.

4 Rationale for the research project

From the review of the literature concerning health-compromising behaviors among adolescent athletes, certain theoretical and methodological trends emerged (as elaborated in *Paper I*). First, it is notable that most of the examined studies concerned the antecedents of doping behavior, paying less attention to other forms of dysfunctional behavior. Second, whereas previous research embraced a multi-theoretical approach, encompassing both proximal and distal predictors of behavior, there is a dearth of theoretically modelled studies exploring a wider range of distal predictors that encompass the characteristics of risk-conductive situations or contexts. Further, studies in which antecedents are taking a mediating or moderating role in theoretical models used, are still limited. Lastly, most of the examined studies utilized quantitative methods and a cross-sectional research design.

In brief, the extensive body of reviewed literature vividly illustrates the diverse personal and contextual factors that shape athletes' engagement in health-compromising behaviors (explored in *Paper I*). The findings indicate that there is a dynamic interplay between the personal factors of the athletes and the contextual factors summarized from athletes' self-described perceptions of the sporting environment, which shapes their health-compromising behaviors. Based on a social cognitive integrative framework, this research project attempted to build on this groundwork by delving into the established risk and protective factors identified in previous research (*Paper I*), which serve as facilitative or protective precursors to health-compromising behaviors (*Papers II, III, and IV*). Aligned with the alarming trend of injuries and the widespread use of performance-enhancing substances in youth sports, this research project will contribute to exploring personal and contextual factors that either offer protection against or trigger injury and doping behaviors (*Papers II, III, and IV*). This research focus was considered highly relevant given the current landscape of youth sports and young athletes' situated phase, referred to as adolescence, which may increase further susceptibility to health-compromising behaviors.

Rational for the research project

4.1 Research aims and objectives

The overall aim of this research project was to gain a greater understanding of the psychosocial risk and protective factors influencing young athletes' health-compromising behaviors, including painkiller use, participation in sports despite injuries, use of dietary supplements, and doping. We endeavored to identify a diverse set of theoretically informed personal and contextual factors hypothesized to contribute to the development of effective preventive measures aimed at reducing health-compromising behaviors in youth sports. Each paper in this research project targeted a specific objective, as follows:

- I. Identify the personal and contextual factors influencing athletes' engagement in health-compromising behaviors through a systematic review of previous research (*Paper I*).
- II. Examine whether there is a link between athletes' perception of social pressure from the sporting environment to keep participating in sports despite injury and their intention to play despite injury (*Paper II*).
- III. Explore the interplay between athletes' perception of a sporting environment characterized by rivalry and competition and their doping temptation antecedents, and examine whether athletes concerned about making mistakes are likelier to be tempted to use banned substances than those who do not have the same concern (*Paper III*).
- IV. Investigate whether athletes' acceptance of dietary supplements (e.g., clean performance-enhancing substances) is likely to facilitate their supplement use and doping attitudes relationship during a competitive season (*Paper IV*).

5 Methods

This section presents an overview of the methodological approach employed in this research project, including the underlying philosophical assumptions and research design. Ethical considerations related to the study, procedure, and participants are also presented herein, alongside a brief description of the research methods used in each of the studies reported *Papers I–IV*.

5.1 Philosophical underpinning - Postpositivism

The research process or approach used to conduct a study depends on the views and beliefs of the researcher. These views and beliefs are also known as philosophical assumptions, and they derive from the researcher's training in a specific discipline or field of study, prior research experiences, and cultural environment (Creswell & Creswell, 2023). Acknowledging the traditional form of research within the discipline of psychology, the present thesis is positioned within the philosophical realm of postpositivism.

According to Creswell and Creswell (2023), the postpositivist worldview embraces a deterministic philosophy in which certain factors are seen as determining effects or outcomes. Consequently, the problems studied by postpositivists reflect the need to identify and evaluate the causes of outcomes. An example of these problems is whether athletes' attitudes toward prohibited substances influence their doping behavior. Postpositivists are also reductionistic in that they intend to reduce complex concepts to a compact, discrete set of concepts for testing, such as the variables that comprise hypotheses and research questions.

The postpositivist lens assumes, however, that knowledge is conjunctive and that absolutely true knowledge cannot be found when studying the behavior and actions of humans (Creswell & Creswell, 2023). Thus, the evidence derived from research is inherently imperfect and fallible. For this reason, researchers do not prove a hypothesis, they emphasize falsifiability and indicate a failure to reject the hypothesis based on the available evidence. Furthermore, theories govern the world, but these theories need to be tested, verified, and refined. Therefore, the postpositivist research approach begins with a theory and then proceeds to the collection of data that either support or refute the theory. Necessary revisions are then made based on the collected data, and additional tests are conducted. As such, tests are conducted

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to validate findings, ensure their reliability, and refine theories, consequently contributing to the advancement of scientific knowledge.

5.2 Research designs

Embedded within the postpositivist worldview and adhering to the traditional form of research in psychology, this research project had a quantitative research design (*Papers II, III, and IV*). However, it is important to note that the study also made use of a qualitative research method to systematically review the literature to gain a better understanding of the risk and protective factors influencing athletes' health-compromising behaviors, and to map the methodological practices of previous research (*Paper I*). Figure 3 illustrates the research methods used for the studies in this research project, which were inspired by Creswell and Creswell (2023).

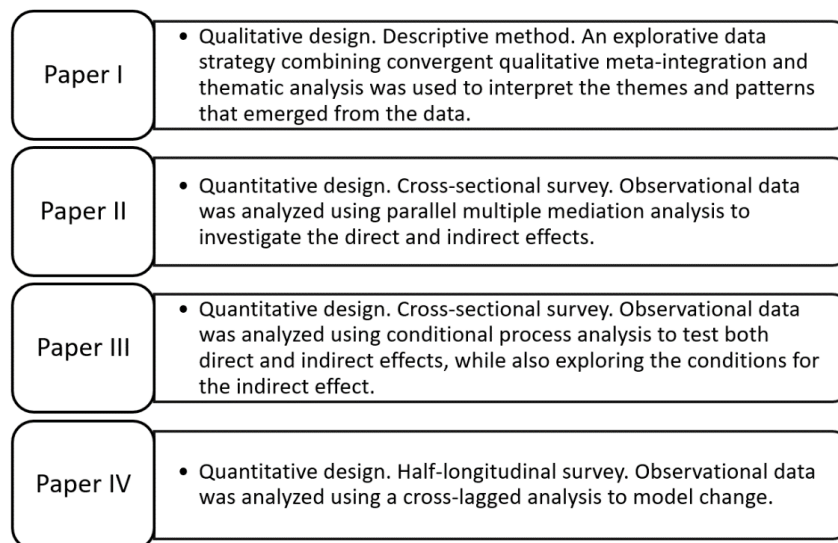


Figure 3. Overview of the research designs and methods used for the studies in the current research project.

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5.3 Ethics

The national board of ethics and integrity in research, the Norwegian Center for Research Data, approved the Norwegian studies reported in the following papers: *Paper II* (reference no.: 675256), *Paper III* (reference no.: 283647), and *Paper IV* (reference no.: 571848). The studies were also approved by the Research Ethics Committee of the Norwegian School of Sport Sciences, available in the Appendices, Appendix B. In all three studies, athletes and their parents or legal guardians were informed about the purpose of the study through an information sheet that also explained the voluntary nature of participation in the study and how the participants' confidentiality would be ensured. In Norway, informed consent from parents or legal guardians of individuals over 16 years of age is not required. As the studies in this research project did not involve sensitive health information, they required only written consent from the participants themselves (*Papers II and III*). However, for the participants under 16 years of age, informed consent was obtained from their parents or legal guardians (*Paper IV*).

The data for the three studies were collected using the SurveyXact digital survey tool (Ramboll, 2023), which securely stored the data on an encrypted server.

5.4 Participants and procedures

We conducted a systematic mixed-studies review (*Paper I*) and three quantitative studies that built on the review's findings (*Papers II, III, and IV*). Consequently, the latter papers rely on independent athlete samples chosen because of their levels of ambition and talent and the sports they engaged in (e.g., similarities in physical characteristics and the period of the playing season), particularly sports in which the athletes are seen as being more inclined toward health-compromising behaviors.

In the study reported in *Paper II*, the sample consisted of 186 junior ice hockey players, 163 of whom were males and 23 females, all aged 16–20 years old (mean age [M_{age}] = 17.85; standard deviation [SD] = 1.35). The participants were recruited from 11 Norwegian junior elite sports clubs competing within two national ice hockey leagues (participated in by athletes under 18 and under 20 years of age, respectively). Notably, over one-third of the participants (N = 63) reported having played for Norway's national team (under 18 or under 20 years of age), suggesting that they were regarded as being among the most talented players

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in their respective age groups. The participants also reported that they had been under their current coach's guidance for an average of 1.61 seasons ($SD = 1.47$).

The sample used in the study reported in *Paper III* included 420 adolescent athletes, 188 of whom were males, 209 females, and 23 with missing gender information. The participants were in the 16–18 year age range ($M_{age} = 16.94$; $SD = 0.81$) and were recruited from five Norwegian sports academy high schools that provide high-level extracurricular, training and specialization for youth athletes. The participants represented 19 sports, with the majority competing in handball (21%), football (19%), and ice hockey (12%). Additionally, they reported an average of 9.67 years ($SD = 3.19$) of organized training sessions in their respective sports and devoted an average of 14 hours per week to their sport-specific training. It is worth noting that these sports academies are known for being prestigious and for following a competitive audition process for admission. Thus, those attending these schools could be considered among the most ambitious and talented athletes in their age group.

For the final study reported in *Paper IV*, we recruited the sample from eight Norwegian sports academy high schools. A total of 598 adolescent athletes completed the measures at the start of the competitive season (time point 1 [T1]), and 217 completed the end-of-season measures (time point 2 [T2]), approximately 6 months later. Thus, the final sample size was reduced to 217 participants, consisting of 102 males and 115 females. The participants were 15–19 years old ($M_{age} = 16.98$; $SD = 0.88$) and competed in a variety of sports, including team sports ($N = 93$; basketball, floorball, handball, and ice hockey) and individual sports ($N = 124$; alpine skiing, biathlon, cross-country skiing, swimming, and tennis). Furthermore, the participants reported having participated in organized training sessions in their respective sports for an average of 9.36 years ($SD = 3.07$), and most of them ($N = 187$) dedicated more than 11 hours per week to their sport-specific training.

For the recruitment procedure, we contacted ice hockey clubs (*Paper II*) and sports academies (*Papers III* and *IV*) directly. Upon agreeing to participate in the research project, they directed us to set appointments with the coaches for data collection. The data collection for *Papers II* and *III* took place at the end of the 2020–2021 sports season during winter. As for *Paper IV*, the first data collection (T1) was conducted at the start of the 2020–2021 sports season, during autumn, while the second data collection (T2) took place about 6 months later, at the end of the 2020–2021 sports season. The Norwegian Ice Hockey Association and Anti-

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Doping Norway provided letters of support and encouraged the participation of clubs and sports academies in the research project (see Appendix C).

5.5 Research methods

5.5.1 Paper I

Research question

- ❖ What personal and contextual factors are associated with adolescent athletes' health-compromising behaviors?

To address this question, we conducted a systematic mixed-studies review and reviewed 15 studies: 13 quantitative studies, 1 qualitative study, and 1 mixed-methods study.

Literature search

To identify relevant studies, we developed a specific search strategy in collaboration with a librarian specializing in systematic review searches. Initially, we searched central bibliographic databases (e.g., PsycINFO and SPORTDiscus) to identify relevant search terms by examining the titles, abstracts, and subject indices in the relevant records. We then conducted a calibration exercise consisting of two pilot searches to refine the search strategy and make the necessary adjustments. A draft search strategy was created using the identified search terms and was further expanded based on the results of its application. The search terms were established a priori and were strategically designed to be broad, minimizing the risk of missing relevant literature (Gough et al., 2012). Additionally, after initiating the search, we manually examined the reference lists of papers that met the inclusion criteria and the references cited in systematic review reports on similar topics (Blank et al., 2016; Morente-Sánchez & Zabala, 2013).

To be eligible for inclusion in the review, papers had to meet the following criteria: written in English, published in peer-reviewed academic journals from 2000 onward, and presenting original empirical findings about personal and contextual factors influencing health-compromising behaviors among 14- to 20-year-old athletes participating in organized sports. The methodological quality assessment of the studies was performed using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018), widely recognized as a reliable tool for appraising the quality of studies included in reviews combining quantitative, qualitative, and mixed-methods studies.

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Data analyses

To address our research question, we employed an explorative data analysis strategy, combining convergent qualitative meta-integration (Frantzen & Fetters, 2016) with thematic analysis (Braun et al., 2016). In the convergent qualitative meta-integration, we extracted qualitative data from studies with purely qualitative, quantitative, or mixed-methods research designs.

When coding the qualitative data, we transformed information from quantitative and mixed-methods studies into a qualitative format, using text from their respective Results sections rather than their numerical outputs. For example, we converted the correlation between coach pressure and athletes' perfectionistic strivings (e.g., 0.53; $p < 0.001$) from Madigan et al. (2016) into the qualitative code "pressure from the coach," which later contributed to the theme of "social drama."

Following Braun and Clarke's (2006) recommendations, we closely read and coded the results of the studies. The coding process was conducted independently by the first author team, with the goal of capturing essential knowledge related to the research question. Furthermore, the coding process was empirically rooted, meaning that we closely followed the text and adopted an inductive approach. Subsequently, the first author team came together and reviewed all the generated codes through close inspection and discussion. Initially, five distinct and meaningful themes were constructed, which extended the description and understanding of the data material analyzed. The themes were "social drama," "sense of self," "emotions," "cognitions," and "a means to an end."

5.5.2 Paper II

Research question

- ❖ Is perceived social pressure directly and indirectly (via attitudes, subjective norms, perceived behavioral control avoidance, and situational temptation) related to the intention to play when injured?

To answer the aforementioned research question, we utilized a sample of 186 junior ice hockey players, as previously introduced in section 5.4.

Methods

Measures

Social pressure

Perceived social pressure from the sporting environment to play when injured was measured based on a single-item measure adopted from Mayer et al. (2018, p. 145; i.e., “I am competing hurt because I feel pressured by the ones from my sporting environment”). The responses were recorded on a 5-point scale (1 = totally disagree; 5 = totally agree). Mayer and Thiel (2018) and Mayer et al. (2018) have successfully used the single-item measure in the youth sports context.

Theory of Planned Behavior Scale

Ajzen (1991) developed the Theory of Planned Behavior Scale (TPBS) to better explain intentional behavior and actual behavior by considering cognitive components such as attitudes, subjective norms, PBC, and intention. TPBS has been proven to be predictive of a wide range of behavioral patterns and has demonstrated acceptable reliability and construct validity (Barkoukis et al., 2015; Lazuras et al., 2015). It was employed in the study reported in *Paper II* in accordance with Ajzen’s (1991) recommendations.

Attitudes toward injury were measured with the proposition stem “Playing with an injury this season is ...,” followed by four semantic differential evaluative adjectives (bad/good, useless/useful, harmful/beneficial, and unethical/ethical) scored on a 7-point scale (e.g., 1 = bad; 7 = good). The omega coefficient for the scale was 0.87, indicating acceptable internal reliability (DeVellis, 2017; Hayes & Coutts, 2020).

Subjective norms, reflecting the perceived normative beliefs about other people’s opinions and approval of playing when injured were assessed with four items (e.g., “Most people who are important to me would want me to play despite being injured during this season”), scored on a 7-point scale (1 = strongly disagree; 7 = strongly agree). The omega coefficient for the scale in the current study was 0.89.

PBC concerning participants’ beliefs about their control over perceived resources and their perceived control over avoiding playing when injured was measured by three items (e.g., “How difficult is it for you to avoid playing despite being injured this season”). The responses were recorded on a 7-point scale anchored on an evaluative adjective tailored to a specific item (e.g., ranging from very difficult to very easy). The omega coefficient for the scale was 0.74.

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Intention to play when injured was assessed with three items (e.g., “I intend to play despite being injured during this season”) scored on a 7-point scale (1 = definitely not; 7 = definitely yes). The omega coefficient for the scale was 0.96.

Situational temptation

Perceived situational temptation to play despite being injured was measured using the question stem “How much would you be tempted to play despite being injured this season ...?,” followed by five prospective situations (e.g., “when your coach suggests so”). The responses were recorded on a 5-point scale (1 = not at all tempted; 5 = very much tempted). The omega coefficient for the scale was 0.82. This measure has been used successfully in previous studies and has shown an acceptable level of reliability and adequate construct validity (Barkoukis et al., 2014; Lazuras et al., 2015).

Data analyses

Testing direct and indirect effects

To address the research questions in *Paper II*, we employed a parallel multiple mediation analysis using PROCESS macro v4.0 (model 4) within SPSS. This method assesses both the total and direct effects of an independent variable on a dependent variable while controlling for the effects of multiple mediators. Consistent with Hayes’s (2009) recommendations, we utilized a bias-corrected bootstrapping technique to test the indirect effects. Bootstrapping generates a number of resamples and estimates the indirect effects in each resampled dataset. It also provides point estimates and bias-corrected CIs for each hypothesized indirect effect and point estimates for the remaining direct effect. If the 95% CI’s lower and upper bounds do not include 0, a significant indirect effect can be inferred (Hayes, 2017).

5.5.3 Paper III

Research question

- ❖ Is performance climate directly and indirectly (via pro-doping attitudes) related to doping temptation, and do perfectionistic concerns moderate the indirect relationship between performance climate and doping temptation via attitudes toward doping?

To answer the aforementioned research question, we drew upon the first sample from sports academy high schools, consisting of 420 adolescent athletes.

Methods

Measures

Perceived motivational climate

The participants' perceptions of the motivational climate were assessed using a short version of the Perceived Motivational Climate in Sport Questionnaire (PMCS-2; Newton et al., 2000). Seven items measured perceived performance climate (e.g., "The coach devotes most of his/her attention to the best players"), while nine items evaluated perceptions of a mastery climate (e.g., "My coach made sure players felt successful when they improved"). The participants were asked to reflect on their typical team experiences and indicate their levels of agreement on a 5-point scale (1 = strongly disagree; 5 = strongly agree). Both subscales demonstrated good internal reliability, with an omega coefficient of 0.86 for both the performance and mastery climates. The short version of PMCSQ-2 has been successfully employed in previous research (Appleton et al., 2016).

Attitudes toward doping

In accordance with Ajzen's (1991) guidelines, attitudes toward doping were measured with the proposition stem "The use of doping substances to enhance my performance this season is ...," followed by four semantic differential evaluative adjectives (bad/good, useless/useful, harmful/beneficial, and unethical/ethical) scored on a 7-point scale (e.g., 1 = harmful; 7 = beneficial). We also provided WADA's (2021) definition of doping, including specific examples of prohibited substances, such as hormones, anabolic-androgenic steroids, and amphetamines. To enhance the internal consistency of this measure (initial omega = 0.59), we removed one item related to the ethical evaluation of using doping substances. Consequently, the omega coefficient for the scale increased to 0.66, resulting in a three-item measure for attitudes toward doping. According to Hair et al. (2018), reliability values near 0.60 are considered acceptable for short scales.

Perfectionistic concerns

We assessed perfectionistic concerns using a contextualized version of the Frost Multidimensional Perfectionism Scale-Brief (Burgess et al., 2016). Four items measured perfectionistic evaluative concerns (e.g., "The fewer mistakes I make in my activity, the more people will like me"), rated on a 5-point scale (1 = totally disagree; 5 = totally agree). The scale demonstrated acceptable internal consistency with an omega coefficient of 0.78. The Frost Multidimensional Perfectionism Scale-Brief is a shorter adaptation of the Frost

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Multidimensional Perfectionism Scale (Frost et al., 1990), which has been established as reliable and valid in the context of youth sports (Haraldsen et al., 2019).

Situational temptation

We measured situational temptation using a scale derived from Lazuras et al. (2015), which reflected the temptation to use doping substances under specific circumstances that athletes might encounter. The question stem was “How much would you be tempted to use doping substances to enhance your performance this season ...?” followed by five prospective situations: “... when your coach suggests so,” “... when you believe that most colleagues of yours use doping substances,” “... when you were told to enhance your performance,” “... when you prepare for an important game/competition,” and “... when feeling disadvantaged.” The participants rated their responses on a 5-point scale (1 = not at all tempted; 5 = very much tempted). The scale demonstrated good internal consistency, with an omega coefficient of 0.87, and has been previously utilized in research related to doping in sports (Lazuras et al., 2010).

Data analyses

Conditional process analysis

To address the research question shown in *Paper III*, we employed conditional process analysis using PROCESS macro v4.0 (model 14) in SPSS. This method simultaneously tests the direct and indirect effects while testing for moderation of the indirect effect. Conditional values of the moderator for the indirect effect are estimated, and moderated mediation is tested at three levels: one SD below the mean (i.e., low), the mean (i.e., moderate), and one SD above the mean (i.e., high). If the indirect effect is moderated, its strength and/or direction varies based on the moderator scores (Hayes, 2017).

Following Hayes’s (2009) recommendation, we included bootstrapping to estimate the conditional indirect effect, as previously described in the Data analyses section for *Paper II*. Conditional indirect effects that fell outside the 95% CI’s bounds (excluding 0) were considered demonstrating significant moderated mediation.

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5.5.4 Paper IV

Research question

- ❖ Does the dietary supplement acceptance of athletes mediate the relationship between their dietary supplement use and their doping attitudes across a sports season?

The second sample from the sports academy high schools, consisting of 217 athletes, was employed to answer the aforementioned research question.

Measures

Supplement use

Following previous research (i.e., Barkoukis et al., 2015), supplement use was assessed using a single item: “How often do you use dietary supplements to improve your athletic performance?” We adopted the definition of dietary supplements from the 1994 Dietary Supplement Health and Education Act (Young & Bass, 1995), which included specific examples of dietary supplements, and presented it to the survey respondents (i.e., “Dietary supplement is defined as a product taken orally that contains a dietary ingredient intended to supplement the diet and may be found in many forms such as a tablet, capsule, softgel, gelcap, liquid, powder, or bar. Examples of dietary supplements are vitamins, protein, creatine, and energy drinks.”). The participants were asked to recall their dietary supplement use over the last month and to provide their responses on a 5-point scale that reflected the frequency of their supplement use to improve their athletic performance (“never,” “rarely,” “sometimes,” “frequently,” and “very frequently”).

Acceptable use of dietary supplements

We assessed the participants’ views on the acceptable use of dietary supplements in sports using a hypothetical scenario adopted from Fruchart et al. (2017), with some modifications for clarity and conciseness. The scenario mirrored real sports situations and emphasized literature-based information cues on performance enhancement in sports in which athletes are believed to be influenced by (a) short-term success, (b) health consequences, (c) detectability, and (d) the perceived attitudes of their important others (e.g., the coach, peers, or competitors) toward dietary supplement use. The scenario is shown below.

Jonas is a high-level athlete and member of a renowned national club. He decided to absorb regular doses of PERFORM, a dietary supplement that significantly increases muscular mass and vital capacity. The use of this supplement is not banned, and it is totally

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undetectable. In the long term, this product has no known negative effects on health. In the short term, it enhances performance and guarantees immediate success. Jonas is encouraged to use this supplement by his coach.

After reading the scenario, the participants were asked, “To what extent do you think the use of PERFORM is acceptable?”. Their responses were rated on a 7-point scale (1 = not at all acceptable; 7 = completely acceptable). The use of scenarios has been shown to be valid in research related to doping in sports (Kavussanu & Ring, 2017).

Attitudes toward doping

We measured the participants’ attitudes toward doping by tapping into their positive and negative evaluations of doping use, as previously described in the Measures section for *Paper III*. We went further with the four-item-based measures as the omega coefficients for the scale were 0.78 and 0.76 in T1 and T2, respectively. The measure has been used successfully in previous studies (Barkoukis et al., 2015).

Data analyses

Structural equation modeling

To address the research question shown in *Paper IV*, we employed structural equation modeling (SEM) analysis with *Mplus* version 8.5 (Muthén & Muthén, 1998–2017). We utilized a half-longitudinal design, which required only two data collection points (Little, 2013). Mediation involves a statement of change, and a half-longitudinal model considers prior levels of the mediator and outcome variable to isolate the change variance (Little, 2013). The primary paths of interest were the relationship between the predictor and the mediator, controlling for prior mediator levels (path *a*), and the relationship between the mediator and the outcome, controlling prior outcome levels (path *b*). Assuming stationarity, product *ab* estimates the mediation effect. This was calculated for the mediator (i.e., dietary supplement acceptance) using the model constraint command in *Mplus* (Muthén & Muthén, 1998–2017).

In our SEM analysis, we used maximum likelihood estimation with standard errors to test the half-longitudinal model. Thus, manifested variables were used in the structure model to ensure statistical power and to address Hayes’s (2017) critique related to the estimation of the interaction variables and the sample size of the current study. We explored the paths of interest using bootstrapping, as described in the Data analyses sections of *Papers II* and *III*

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(Hayes, 2009). Model fit was evaluated using common goodness-of-fit indices, including the chi-square test, comparative fit index (CFI), Tucker–Lewis’s index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Following Geiser’s (2013) guidelines, a good fit was indicated by CFI and TLI values close to or greater than 0.90, and RMSEA and SRMR values less than 0.08.

Given that the participants were recruited from eight different sports academy high schools, clustering effects at the school level were possible. To address the shared variance between the academies, we used a method that adjusts standard errors and goodness-of-fit model testing to account for the nested data (Muthen & Satorra, 1995). This was done by specifying Type = Complex in *Mplus*.

Table 1. Summary of the original papers included in the current thesis

		Summary of the papers			
Methodological characteristics		Paper I	Paper II	Paper III	Paper IV
Research questions		What personal and contextual factors are associated with adolescent athletes' health-compromising behaviors?	Is perceived social pressure directly and indirectly (via attitudes, subjective norms, perceived behavioral control avoidance, and situational temptation) related to the intention to play when injured?	Is performance climate directly and indirectly (via pro-doping attitudes) related to doping temptation, and do perfectionistic concerns moderate the indirect relationship between performance climate and doping temptation via attitudes toward doping?	Does the dietary supplement acceptance of athletes mediate the relationship between their dietary supplement use and their doping attitudes across a sports season?
Participants		N = 8,584 adolescent athletes (4,730 males, 3,854) aged 15–20 years (mean age [Mage] = 16.84; standard deviation [SD] = not reported)	N = 186 junior ice hockey players (163 males, 23 females) aged 16–20 years (Mage = 17.85; SD = 1.35)	N = 420 adolescent athletes (188 males, 232 females) aged 16–18 years (Mage = 16.94; SD = 0.81) attending sports academy high schools	N = 217 (102 males, 115 females) aged 15–19 years (Mage = 16.98; SD = 0.88) attending sports academy high schools
Research design and data analysis methods used		Qualitative, systematic mixed-studies review; convergent qualitative meta-integration and thematic analysis	Quantitative, cross-sectional; parallel multiple mediation analysis	Quantitative, cross-sectional; conditional process analysis	Quantitative, half-longitudinal; structural equation modeling analysis

6 Results

6.1 Paper I

The results of this study are presented through five constructed themes, each derived from the included studies, and codes falling under each theme. The themes are “social drama,” “sense of self,” “emotions,” “cognitions,” and “a means to an end.” Together, they encompass the diverse factors believed to influence athletes’ health-compromising behaviors. However, considering the overall aim of this research project, the results of the systematic literature review were synthesized and categorized as personal and contextual factors and are presented in the Introduction section.

6.2 Paper II

The full multiple-mediator model explained 41% of the total variance in intention to play when injured (adjusted $R^2 = 0.41$; $F(16,160) = 7.03$; $p < 0.001$). As can be seen in Figure 4, the athletes’ perceived social pressure was positively related to their intention to play when injured, as indicated by the significant positive direct effect (unstandardized beta [b] = 0.83; 95% $CI_c = 0.09$ to 1.57; $p < 0.05$).

In addition, the parallel multiple mediation analysis revealed indirect links between perceived social pressure and intention. More specifically, perceived social pressure was found to have significant positive indirect effects on intention via attitudes ($b = 0.27$; 95% $CI_{a1b1} = 0.02$ to 0.68), subjective norms ($b = 0.26$; 95% $CI_{a2b2} = 0.01$ to 0.68), and situational temptation ($b = 0.22$; 95% $CI_{a4b4} = 0.03$ to 0.52). However, it had no significant indirect effect on intention through PBC avoidance ($b = 0.11$; 95% $CI_{a3b3} = -0.12$ to 0.39).

When the relative strengths of the three unique mediators (attitudes, subjective norms, and situational temptation) were compared by contrasting their respective indirect contributions to the mediation model, no significant differences were found. Thus, no mediator could be considered stronger than the others. Additionally, after controlling for team and sex variables, the latter accounted for the variations in PBC, indicating differences between males and females. That is, the males had higher perceived control over avoiding playing when injured than the females ($b = -3.40$; 95% $CI = -5.86$ to -0.94 ; $p < 0.01$).

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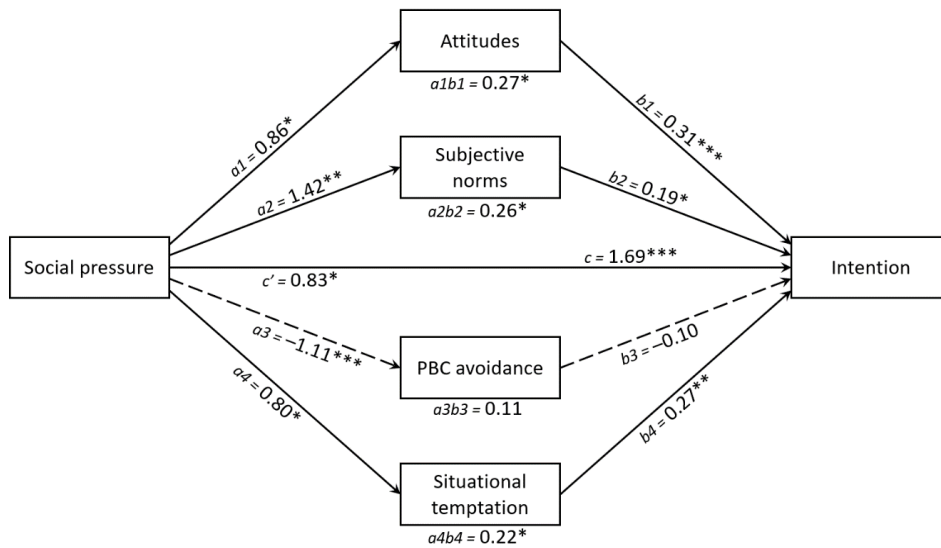


Figure 4. Statistical diagram of the parallel multiple-mediator model of the presumed influence on intention to play when injured. The regression coefficients and the total-, direct-, and indirect-effect values are reported as unstandardized indices. The solid lines represent positive paths, and the dashed lines represent negative paths. For ease of presentation, the team and sex, included in the analysis as dummy variables, are not shown in the figure. PBC = perceived behavioral control. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6.3 Paper III

The moderated mediation model explained 20% of the total variance in doping temptation (adjusted $R^2 = 0.20$; $F(6,401) = 16.17$; $p < 0.001$). This included a significant positive direct effect of performance climate on doping temptation (unstandardized beta [b] = 0.13; 95% CI $_c$ = 0.03 to 0.22; $p < 0.01$) and a significant positive indirect effect of performance climate on doping temptation via attitudes toward doping ($b = 0.28$; 95% CI $_{b_1}$ = 0.17 to 0.38; $p < 0.001$).

The conditional process analysis also revealed that perfectionistic concerns ($b = 0.11$; 95% CI $_{b_2}$ = 0.01 to 0.20; $p < 0.05$) and the interaction between them and attitudes ($b = 0.14$; 95% CI $_{b_3}$ = 0.05 to 0.23; $p < 0.01$) were significant positive predictors of doping temptation. To investigate the interaction, we tested the conditional indirect effects of performance climate on doping temptation (via attitudes) at three levels of perfectionistic concerns: low ($W = -1.00$), moderate (0.00), and high (1.00). These tests revealed that the indirect relationship between performance climate and doping temptation (via attitudes) was significant only when

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the scores for perfectionistic concerns were moderate (effect = 0.05; 95% CI = 0.02 to 0.10) or high (effect = 0.08; 95% CI = 0.01 to 0.16), but not when the scores were low (effect = 0.03; 95% CI = -0.02 to 0.07).

Furthermore, after controlling for the potential influence of mastery climate and sex, the latter accounted for the variation in attitudes toward doping, indicating that male athletes had more permissive attitudes toward doping than female athletes ($b = 0.52$; 95% CI = 0.34 to 0.71; $p < 0.001$). Figure 5 provides a visual representation of the conditional indirect effect of performance climate on doping temptation via attitudes. The slope of the line for the indirect effect corresponds to how much the indirect effect of performance climate on doping temptation via attitudes change as perfectionistic concerns changes by one unit.

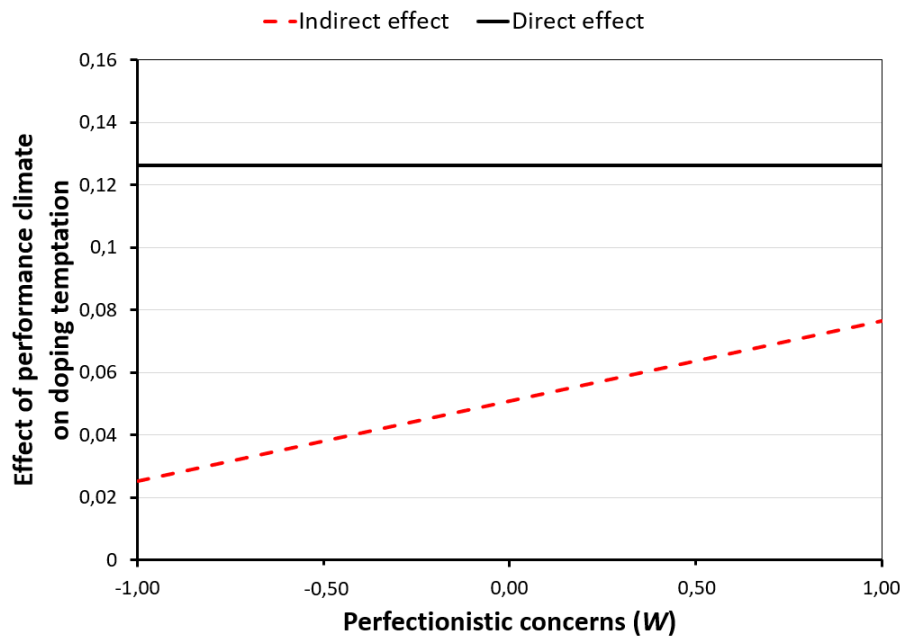


Figure 5. Visual representation of the conditional indirect and direct effects of performance climate on doping temptation, with the indirect effect operating through attitudes toward doping.

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6.4 Paper IV

The structural model generated for this study demonstrated an acceptable fit to the data ($\chi^2(1) = 1.50$; $p = 0.22$; RMSEA = 0.05; 90% CI = 0.00 to 0.20; CFI = 1; TLI = 0.98; SRMR = 0.02). As illustrated in Figure 6, the use of dietary supplements at T1 predicted the perceived acceptability of using dietary supplements at T2 ($\beta = 0.15$; 95% CI_a = 0.05 to 0.25), controlling for the T1 levels of the mediator and the covariate sex ($\beta = -0.15$; 95% CI = -0.25 to -0.05). Additionally, a significant temporal link emerged between dietary supplement acceptance at T1 and doping attitudes at T2 ($\beta = 0.16$; 95% CI_b = 0.05 to 0.28), controlling for the T1 levels of the outcome and sex ($\beta = 0.01$; 95% CI = -0.06 to 0.08).

To probe the mediation, product *ab* was created to explore how dietary supplement use influences doping attitudes via dietary supplement acceptance. Product *ab* was statistically significant and different from zero ($\beta = 0.07$; 95% CI_{ab} = 0.01 to 0.14), indicating that dietary supplement acceptance (i.e., the mediator) facilitates the relationship between dietary supplement use and doping attitudes.

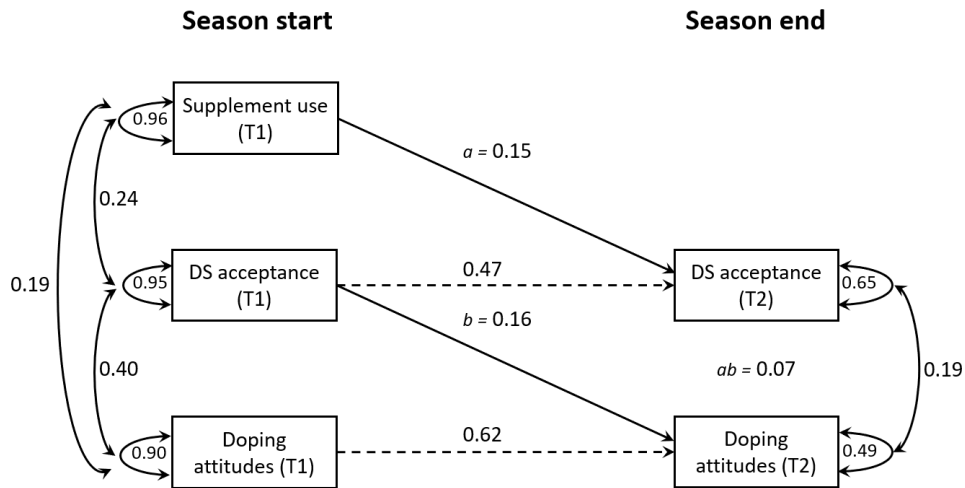


Figure 6. Half-longitudinal mediation model for dietary supplement (DS) acceptance in the relationship between dietary supplement use and doping attitudes. Time point 1 (T1) and time point 2 (T2) were separated by six months. The dashed lines represent the autoregressive paths. For ease of presentation, only the significant ($p < 0.05$) standardized parameter estimates for the structural model are presented, and the covariate sex is not shown in the diagram.

7 Discussion

The overall aim of the present research project was to gain a greater understanding of the psychosocial factors influencing the health-compromising behaviors of young athletes. These behaviors encompassed painkiller use, participation in sports despite injuries, use of dietary supplements, and doping. We conducted a mixed-studies review to identify various personal and contextual factors hypothesized to influence these behaviors (*Paper I*). Building upon the foundational research presented in *Paper I*, the subsequent three papers delve into the established risk and protective factors that serve as precursors to the intentionality of playing despite injuries (*Paper II*), doping temptation (*Paper III*), and attitude toward doping (*Paper IV*). Grounded in a social cognitive framework, the present research project explored health-compromising behaviors through an integrative approach by deepening and broadening TPB (Ajzen, 1991).

In the following section, we focus on the main findings presented in *Papers I–IV* related to the three overarching themes, discussing relevant research, theory, and methodological considerations. Finally, we present the findings' implications for practice, the strengths and limitations of the present research project, and future research directions.

7.1 Influence of the sports environment on athletes' health-compromising behaviors

In the extensive body of literature reviewed in *Paper I*, we highlight the wide range of personal and contextual factors that influence athletes' engagement in health-compromising behaviors. *Paper I* also emphasizes the dynamic interplay between contextual factors and intrapersonal characteristics. Extending previous research, we found that (*Paper II*) young ice hockey players' perceptions of social pressure from the sports environment for them to play despite being injured were directly and positively related to their intentions to play when injured. In addition, perceived social pressure was indirectly and positively related to players' intentionality of playing despite injuries via attitudes, subjective norms, and situational temptation.

Perceiving social pressure from the sports environment to play despite being injured appeared to increase hockey players' intention to play even when injured. Additionally, the athletes'

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perceptions of social pressure seemed to influence their behavioral, normative, and control beliefs, thereby strengthening their intention to play despite being injured. Specifically, such perceptions fostered beliefs that playing when injured would lead to more positive than negative consequences, that their important others would endorse their playing while injured, and that game-specific temptations to continue playing despite being injured would increase. The relationship between perceived social pressure and intention to play when injured, as investigated in the study reported in *Paper II*, lends support to Ajzen's (1991) openness to broadening and deepening the role of contextual influences and brings novelty to the TPB literature. Consequently, including a distal predictor such as perceived social pressure helped elucidate the psychosocial mechanisms that underlie hockey players' intention to play through injuries.

Previous research on sports injuries has indicated that the sports environment, including coaches, peers, and parents, represents a set of social interactions and expectations that may elevate the injury risk for athletes (Malcom, 2006; Roderick et al., 2000). Malcolm (2006) suggests that some of these social interactions and expectations revolve around notions of physical and mental toughness, which young athletes take into account when they incur an injury. Consequently, young athletes may tend to conform to these behavioral expectations and thus learn to deal with injuries by "toughing them out" and not letting them affect their sports participation (Malcom, 2006, p. 495). Roderick and Waddington (2000) described similar tendencies in professional soccer players. Specifically, not only were these athletes willing to play through injuries and downgrade their injuries' severity, but they also reported no fear of incurring an injury.

There is also evidence that a competitive sports environment can foster athletes' beliefs favoring the continuation of sports participation despite being injured and their intention to do so. Weinberg et al. (2013) found that recreational basketball players who aligned more closely with the expectations of athletes and the norms associated with them exhibited more positive attitudes toward playing through injuries and reported higher behavioral tendencies to do so. In another study, Lazuras et al. (2015) revealed that subjective norms and situational temptation acted as influential mediators in the indirect relationship between distal factors and sport-related intentions. Taken together, findings presented in *Paper II* align with those obtained from previous research, emphasizing that a competitive sports environment may encourage athletes to continue training and competing despite the presence of injury. This

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influence lies in shaping social cognitive beliefs, including behavioral and normative beliefs in favor of playing through injuries, as well as perceived game-specific temptations to do so.

The findings presented in *Paper II* support the notion that external influences, such as perceived social pressure to play despite injury, impact behavioral intention by influencing components of TPB (Ajzen, 1991; Conner & Sparks, 2015). However, contrary to our expectations, PBC avoidance did not emerge as a mediator in the study reported in *Paper II*. Although PBC was incorporated into TPB to shed light on control perceptions over performance of the behavior, it appeared that perceived self-efficacy held greater value. Specifically, hockey players' beliefs about the difficulty of avoiding playing the game while injured were less powerful than their beliefs about their capacity to resist playing injured in game-specific situations. This finding aligns with Blank et al.'s (2016) identification of the capacity to resist situational temptation as one of the most influential predictors of sport-related intentions, emphasizing its contribution alongside other proximal predictors of intention, such as attitudes, subjective norms, and PBC.

Several meta-analyses have examined TPB (e.g., Ajzen, 1991; Armitage & Conner, 2001). When it comes to predicting intention, attitudes and PBC typically emerge as stronger predictors than subjective norms (Armitage & Conner, 2001). In contrast to earlier findings, attitudes, subjective norms, and situational temptation were the only significant predictors of intention identified in the study reported in *Paper II*, with PBC avoidance being non-significant. When their relative strengths as independent predictors were compared, attitudes proved to be the strongest predictor of intention. However, when their unique contributions as mediators were explored, it was found that one could not be considered stronger than the other. Therefore, beliefs regarding behavior, norms, and self-efficacy were all found to be important determinants of hockey players' intent to play the game even when injured.

Some methodological aspects of the study reported in *Paper II* deserve attention. Notably, there is an overlap in the meaning of social pressure and subjective norms as both of these constructs encompass elements of social influence. Subjective norms, in their conceptualization of how one perceives important others and their approval of one's playing through injury, may implicitly indicate subtle pressure to engage in such behavior. This aligns with Ajzen's (1991) characterization of subjective norms as a social factor that taps into perceptions of social pressure to perform a particular behavior or not to perform the behavior. However, despite these similarities between the predictor social pressure and the

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mediator subjective norms, as shown in *Paper II*, the low correlation ($r = 0.21$; $p < 0.01$) between the two constructs indicates notable differences.

Another methodological consideration pertains to the use of self-prediction in assessing the intention to play even when injured. Fishbein (2009) suggests that self-predictions are more relevant for adolescents compared to standardized intention items primarily used with adult populations. Therefore, framing intention items as self-predictions (e.g., “I intend to play despite being injured during this season”) is likely to capture young athletes’ true intentions to continue training and competing in sports despite being injured, regardless of whether they are currently injured or have never experienced an injury (Gibbons et al., 1998). The use of self-predictions has been employed in the sports context among adolescent athletes (Lazuras et al., 2015).

The link between the sports environment and athletes’ intent to play through injuries, as examined in the study reported in *Paper II*, highlights the potential risk for injury among hockey players engaging in sports environments marked by social pressure. However, such sports environments may also elicit other health-compromising behaviors, such as doping (Backhouse et al., 2016). Based on the objectives of the study reported in *Paper III*, we explored the interplay between athletes’ perceptions of the motivational climate and their doping temptation antecedents. In doing so, we integrated elements from AGT (Nicholls, 1989) and TPB (Ajzen, 1991), as well as the concept of perfectionistic concerns (Flett & Hewitt, 2014). This integration enabled a more comprehensive explanation of the sports climate, which is known for its dual focus on performance and mastery, and its influence on doping behavior.

The study findings presented in *Paper III* further support the notion that external influences affect behavioral tendencies by influencing proximal antecedents. Specifically, in our sample of high school athletes attending sports academies, we discovered a positive link between athletes’ perceptions of a performance-oriented climate and their temptation to dope. This relationship was evident both directly and indirectly via attitudes toward doping. In other words, athletes who perceived their sports environment as performance oriented, with increased pressure on them to win and outperform others, seemed likely to be more tempted to turn to doping. This perception of a performance-oriented climate also appeared to shape athletes’ beliefs that taking prohibited substances would lead to more positive consequences than negative ones, thus strengthening their temptation to resort to doping.

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Previous research on doping has supported the link between a sports environment characterized by rivalry and competition and athletes' tendencies to take prohibited substances (Guo et al., 2021; Kavussanu et al., 2020). Kavussanu et al. (2020) found that elite football players who perceived their team climate as performance-oriented due to the coach's emphasis on winning at all costs were more likely to take banned substances to enhance their performances. Similarly, Guo et al. (2021) showed that a perceived performance-oriented climate heightened athletes' intentions to engage in doping.

There is also evidence that athletes' perceptions and interpretations of the social aspect of their sports environment may influence their beliefs about taking prohibited substances and their intentions to dope. Lazuras et al. (2015) found that athletes who lacked respect for their opponents and for rules and officials were likely to have permissive attitudes toward doping and a stronger intention to engage in it. In their meta-analysis, Ntoumanis et al. (2014) identified attitudes toward doping as one of the strongest predictors of doping, underlining its important role as a proximal antecedent of doping behavior. Taken together, the findings presented in *Paper III* are in line with those of previous research, suggesting that the sports environment may shape athletes' attitudes toward doping and drive them to engage in it.

The findings concerning a coach-created sports environment characterized by social pressure (*Paper II*) and a performance-oriented climate (*Paper III*) offer valuable insights into athletes' engagement in health-compromising behaviors. The findings presented in *Paper II* indicate that sports environments characterized by social pressure for athletes to train and compete despite being injured may increase athletes' intentions to do so. Furthermore, the findings presented in *Paper III* suggest that athletes who perceive the motivational climate of their team as predominantly performance-oriented may be more tempted to use banned substances to establish superiority over others and cope with their coaches' expectations and the pressure from these. These findings empirically support the conclusion that coaches must strive to reduce athletes' perceptions of social pressure for them to train and compete despite being injured and must downgrade the importance of winning.

There is evidence that a moral climate within sports influences moral behaviors similar to those within the scope of the current research project exists within sports. In their meta-analysis, Spruit et al. (2019) found that in sports environments characterized by antisocial moral climates, where coaches approve of cheating, injuries are accepted, and team members engage in aggressive behaviors in the field, young athletes are likely to engage in such

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antisocial behaviors. Conversely, in a prosocial moral climate marked by fair play attitudes and caring behaviors among players, athletes are likely to exhibit less antisocial and more prosocial behaviors (Spruit et al., 2019). The relationship between the moral climate of sports and the moral behavior of young athletes supports the notion that athletes' moral behaviors are shaped by the shared norms and values in the sports context (Shields et al., 2018). Apparently, believing that certain behaviors are right or acceptable can increase one's motivation to act in accordance with such belief.

The findings presented in *Paper III* concerning the influence of the coach-created mastery climate do not support the notion that such a climate has a significant relationship with athletes' doping temptation. According to Hodge and Gucciardi (2015), coaches establish a mastery climate by providing athletes with opportunities and a clear rationale for improvement while acknowledging athletes' feelings and efforts. In the context of doping, a mastery climate is believed to encourage athletes to view their achievement as a matter of individual development, reducing the influence of environmental pressure that emphasizes social comparison standards for success and thus helping reduce athletes' temptation to take prohibited substances.

Previous research on doping behavior in sports has highlighted mastery climate as a protective factors and found a direct negative relationship between perceptions of a mastery motivational climate and athletes' intentions to engage in doping (Guo et al., 2021). However, the directionality between a mastery climate and doping temptation was not detected in the study reported in *Paper III*. One possible explanation for the discrepancy between our study's findings and the findings of Guo et al. (2015) could well be that a coach-created environment that defines success as winning, rewards only the best athletes, and places emphasis on outperforming others may have a greater influences on athletes' doping temptation than environments that see achievement as a matter of individual development. Another possible explanation for the lack of a significant relationship between mastery climate and doping temptation in our study is that a mastery climate typically predicts positive outcomes, such as enjoyment, engagement, and autonomous motivation (Harwood et al., 2015; Ntoumanis & Biddle, 1999). Thus, it may not strongly predict dysfunctional outcomes such as doping.

Some methodological aspects of the study reported in *Paper III* must be considered. As measuring doping behavior is challenging, doping-related social cognition was measured in

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the study reported in *Paper III*. Specifically, we measured athletes' beliefs about the use of prohibited substances to enhance their performances and athletes' doping temptation via Ajzen's (1991) attitudes scale and the situational temptation scale (Lazuras et al., 2015), respectively. Consequently, the information about athletes' doping-related social cognitions was directly self-reported by the athletes themselves. Given the prevailing social norms surrounding doping, its sensitivity, and its potential career-changing consequences, obtaining reliable, valid, and relevant information on doping prevalence, attitudes, and perceived norms poses multiple methodological challenges (Petróczi, 2016). One of these is social desirability responding.

Paulhus (2002) describes social desirability responding as a conscious or unconscious attempt to distort one's responses by overemphasizing positive qualities or behaviors or underemphasizing negative qualities or behaviors. Consequently, individuals may distort their responses to make a desirable impression on others, thus introducing bias into the data. Hence, in an effort to counterbalance the social desirability related to the social cognitive variables (e.g., attitudes and subjective norms), we chose most of the variables reported in *Papers II* and *III* to serve as proxy indicators for health-compromising behaviors (Petróczi, 2016). Additionally, in the study reported in *Paper IV*, we tried to capture athletes' rationalization and thinking processes regarding dietary supplement acceptance using an indirect measure (i.e., a hypothetical scenario).

7.2 Perfectionistic concerns – a potential predisposition to doping temptation

The findings presented in *Paper III* highlight the positive relationship between a performance motivational climate and doping temptation among young sports academy athletes, both directly and indirectly, via doping attitudes. Moreover, perfectionistic concerns moderated the indirect relationship between a performance-oriented motivational climate and doping temptation via doping attitudes. In Figure 5, the slope of the indirect-effect line indicates the change in the indirect effect of a performance-oriented motivational climate on doping temptation via doping attitudes as perfectionistic concerns change by one unit. Consequently, the indirect relationship was larger among athletes with greater concerns about mistakes and statistically significant only among athletes who had moderate to high levels of

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perfectionistic concerns. Interestingly, among athletes with low perfectionistic concerns, the indirect relationship seemed to dampen.

In summary, the findings presented in *Paper III* suggest that athletes in teams with performance-oriented climates tend to report more positive attitudes toward doping. These permissive attitudes were related to a greater temptation to dope, particularly among athletes with moderate to high concerns about making mistakes. These findings are important as they emphasize the impact of the sports environment on athletes' doping-related behaviors. They suggest that a performance-oriented motivational climate, coupled with permissive attitudes toward doping, may operate synergistically to facilitate doping temptation. Additionally, the study reported in *Paper III* revealed that athletes with concerns about making mistakes were more prone to succumbing to the temptation of doping than those without such concerns. Thus, perfectionistic concerns may serve as a predisposing factor for doping temptation.

To our knowledge, the study reported in *Paper III* was the first to explore the interplay between motivational climate, doping temptation, and the moderating role of perfectionistic concerns. Previous research by Madigan et al. (2020) revealed a positive relationship between perfectionistic concerns and pro-doping attitudes. The results of their study suggest that athletes concerned about making mistakes or facing the consequences of not meeting high sports standards are likely to have more favorable attitudes toward doping. A similar pattern emerged in a recent study by Hardwick et al. (2022), which also noted that athletes with high perfectionistic concerns could develop more favorable attitudes toward doping due to their tendency to equate success with outperforming others. In another study, Nordin-Bates et al. (2014) found that young dancers with higher perfectionistic concerns were likely to perceive their training environment as more performance-oriented and less focused on mastery over time. The latter findings are interesting as they suggest that perfectionistic concerns may color one's perception of the sports environment as one in which mistakes are deemed unacceptable and only superior performance is valued.

The results of Nordin-Bates et al.'s (2014) support the notion that highly competitive sports environments may trigger athletes' perfectionistic tendencies and concerns about making mistakes. These sports environments, often characterized as performance-oriented climates, may echo athletes' experiences of failure and mistakes and thus intensify their concerns about making mistakes. Additionally, environments marked by competition and rivalry bring considerable pressure and stress due to the constant focus on performance and achievement.

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This heightened stress may lead to psychological and emotional difficulties (Lizmore et al., 2017; Ruiz et al., 2023), and in some circumstances, elicit a stronger temptation to take prohibited performance-enhancing substances. Thus, considering the findings presented in *Paper III* regarding perfectionism, coaches are encouraged to invest in the sports environment and help reinforce the environmental conditions that downgrade the importance of winning. By doing so, coaches may help lessen athletes' concerns about making mistakes, which in turn may lessen their chances of turning to doping.

Some methodological aspects related to the study reported in *Paper III* require further attention. In the present research project, perfectionism was defined as a personality trait related to cognitive processes and emotional experiences (Donachie et al., 2018). Perfectionists, as described by Flett and Hewitt (2022), pursue perfection and often set excessively high standards, coupled with a tendency to critically evaluate their own behaviors. Consequently, a multidimensional conceptualization of perfectionism has been advocated, identifying two higher-order dimensions of the trait: perfectionistic strivings and perfectionistic concerns (Stoeber & Madigan, 2016). However, due to the substantial body of research linking these two higher-order perfectionism dimensions in sports, in which perfectionistic concerns were positively related with psychological maladjustments such as fear of failure, worry, anxiety, negative affect, and pro-doping attitudes (Hardwick et al., 2022; Hill et al., 2018; Madigan et al., 2020), our study in reported in *Paper III* exclusively focused on the dimension of perfectionistic concerns.

We measured athletes' perfectionism using the Frost Multidimensional Perfectionism Scale-Brief, which includes eight items, four of which assess perfectionistic concerns (Burgess et al., 2016). To increase the domain specificity, we made minor amendments to some of the items to better capture athletes' perfectionism related to their sports (e.g., "The fewer mistakes I make in my activity, the more people will like me"). This adjustment aligns with research suggesting that assessing perfectionism at the domain level can improve its predictive ability (Dunn et al., 2011). It is worth noting that ongoing debates surround whether perfectionism should be considered a dispositional trait (Hill, 2016). While some argue that it is a personality characteristic observable across various life domains, there is also evidence that it may manifest in specific domains (Dunn et al., 2011; Gotwals et al., 2010).

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The sports context is often seen as a potential trigger for perfectionism among athletes. This is due to the combination of the pressure to perform excellently in both training and competition, the constant evaluation of performance, comparisons with others, and the rewards for outstanding performances (Dunn et al., 2005). In line with the notion that perfectionism is multidimensional and that its two dimensions ought to be differentiated, we included perfectionistic concerns in our study reported in *Paper III* to address athletes' potential predisposition to doping temptation, and in turn, provide insight into the opposing effects of dimensions of perfectionism.

7.3 Relationships between dietary supplement use, its acceptance, and doping attitudes

The literature reviewed in *Paper I* sheds light on the various associations between the use of dietary supplements and doping behavior among young athletes. It provides evidence that the use of dietary supplements is prevalent in sports and that experimenting with taking supplements may prompt more permissive attitudes toward doping, increasing the risk of doping behavior in young athletes (Backhouse et al., 2013; Knapik et al., 2016). Therefore, assessing attitudes toward doping may be an important step in furthering our understanding of athletes who are most at risk of developing a doping habit (*Paper III*).

In line with the objective of the study reported in *Paper IV*, we set out to determine whether athletes' acceptance of dietary supplement use is likely to facilitate their supplement use and doping attitudes relationship during a competitive season. This investigation was driven by empirical data and drew on the theoretical reasoning of TPB. Thus, we utilized variables derived from TPB and complemented them with additional measures, such as dietary supplement acceptance. We found that the use of supplements positively predicted residual change in dietary supplement acceptance when accounting for prior levels of the mediator, and that dietary supplement acceptance positively predicted residual change in doping attitudes when accounting for prior levels of the outcome (see Figure 6). These findings suggest that when young athletes used dietary supplements at the start of the season to improve their performance, they were likely to view the use of dietary supplements as acceptable and to report more favorable attitudes toward doping at the end of the season six months later.

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In line with Ajzen's (1991) openness to including additional predictors to TPB's main constructs, we included the use of dietary supplements as past behavior. This was deemed reasonable due to the assumption that doping use in sports grows out of habitual engagement in performance-enhancing practices (Petróczi & Aidman, 2008), potentially from experimentation with using dietary supplements capable of enhancing or improving physical performance. This is also consistent with research suggesting that the use of dietary supplements may be a gateway to experimentation with the use of prohibited performance-enhancing substances (Hurst, 2023).

Paper I reveals that athletes widely use dietary supplements, also referred to as clean performance-enhancing substances, for what they believe to be these substances' performance and health benefits. A meta-analysis by Knapik et al. (2016) found that approximately two-thirds of athletes use dietary supplements and that the prevalence could be considered similar for men and women. However, the prevalence of supplement use can vary depending on the sport and the athletes' elite status (Knapik et al., 2016). While the previously reported prevalence rates were relatively high, the rates presented in *Paper IV* appear to align with those in general and collegiate populations (Knapik et al., 2016). Although dietary supplements are often considered a safe means of enhancing performance in the context of sports, they also bring certain risks.

Many supplement users may not be aware that some dietary supplements available on the market can be contaminated and/or mislabeled, which may lead such users to inadvertently ingest substances prohibited in sports. In a study by Helle et al. (2019), they investigated the prevalence of doping substances in dietary supplements in the Norwegian market. Alarming, they found that 21 out of the 93 analyzed products contained prohibited substances, such as pharmaceutical drugs and/or prohibited amounts of caffeine. Additionally, substances listed on the WADA Prohibited List were detected in 8 of the 93 dietary supplements (WADA, 2023a). Consequently, athletes who experiment with performance enhancement using dietary supplements without proper guidance or information on safe supplement use may be at high risk of violating anti-doping rules. Lauritzen and Gjelstad (2023) recently emphasized this risk and revealed that over half of the doping controls tested by the Anti-Doping Norway contained information about at least one dietary supplement.

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Backhouse et al. (2013) found that athletes who used dietary supplements were likely to have more permissive attitudes toward doping than those who abstained from supplements.

Apparently, dietary supplement users were more prone to believe that the benefits of taking prohibited substances outweighed the potential negative consequences. This aligns with the existing doping literature (Hurst et al., 2023; Ntoumanis et al., 2014), lending support to the notion that the use of dietary supplements may influence athletes' tendency to feel comfortable taking substances to improve their performance, which may elicit more permissive attitudes toward experimenting with the use of prohibited performance-enhancing substances. Extending previous research, the study results presented in *Paper IV* suggest that athletes' acceptance of dietary supplements mediates the relationship between their supplement use and pro-doping attitudes. The latter is interesting because it implies that athletes' views on supplement use may be a risk for their potential involvement in doping.

The study findings presented in *Paper IV* complement those presented in *Papers II* and *III*, collectively offering valuable insights that can help deter athletes from engaging in health-compromising behaviors. As previously discussed, pressure-filled sports environments (*Paper II*) and performance-oriented climates (*Paper III*) pose potential risks for health-compromising behaviors, both directly and indirectly. These factors influence athletes' intentionality of playing through injuries (*Paper II*), their temptation to turn to doping (*Paper III*), and the shaping of their social cognitions, which increases dysfunctional behavioral tendencies. Athletes who experiment with taking various substances to enhance their performance may increase their risk of engaging in health-compromising behaviors. The study findings presented in *Paper IV* suggest that dietary supplements may serve as a potential forerunner to taking prohibited substances. That is, a stronger acceptance of dietary supplements may facilitate more positive attitudes toward prohibited substances among dietary supplement users.

Finally, some methodological aspects of the study reported in *Paper IV* also require consideration. In this study, we measured dietary supplement use with a single item reflecting the frequency of supplement use for enhancing athletic performance, rather than a single item asking whether the athlete was using supplements at all, as in previous research (e.g., Barkoukis et al., 2015). This allowed us to include the entire sample and relate our psychosocial factors to the frequency of dietary supplement use rather than to their dietary supplement use.

7.4 Implications for practice

The findings from the present research project and the examinations of the contextual and personal antecedents associated with health-compromising behaviors have important theoretical and practical implications. The findings presented in *Papers I–IV* suggest that athletes' perceptions of a sports environment characterized by social pressure and a high performance orientation may increase their health-compromising behaviors, such as playing through injuries and turning to doping. Specifically, athletes who experience heightened pressure to train and compete despite being injured, to win at all costs, and to outperform others tend to show social cognitions (e.g., attitudes) favoring dysfunctional behavioral tendencies. These findings also indicate that athletes who are more perfectionistic and who are concerned about making mistakes are likely to be tempted to take prohibited substances. Coaches, practitioners, and others aiming to prevent health-compromising behaviors among young athletes need to understand their important roles in influencing them. Therefore, as mentioned earlier, they are encouraged to create environmental conditions that reduce social pressure and downgrade the importance of winning. Such environments should also echo a sports ethic that cultivates long-term perspectives on athletes' health and careers. Targeting athletes' behavioral beliefs (e.g., attitudes) about injury and performance-enhancing substances may also be an important step in helping athletes refrain from risking their health in their pursuit of excellent performance.

7.5 Strengths, limitations, and future research

The present research project has several strengths. First, the use of an integrative approach enhanced our understanding of the complex psychosocial processes underlying health-compromising behaviors. The integrative approach allows for the examination of a broader range of distal predictors that cannot be easily addressed by single theoretical models, such as TPB (Fishbein, 2009). Importantly, the present research project sought to maintain TPB's parsimony while acknowledging the role of external sources of influence and their relationships with TPB's main components. Second, the studies reported in *Papers I–IV* used diverse research methods, including qualitative and quantitative methods and a variety of data analysis methods. Lastly, in an effort to counterbalance the social desirability related to the social cognitive variables, the study reported in *Paper IV* employed an indirect measure (i.e., a hypothetical scenario) to assess athletes' dietary supplement acceptance. Hypothetical

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scenarios have been used in doping research and are believed to evoke the target emotions and activate relevant social knowledge in the respondents by requiring them to judge how they are likely to feel, think, or behave in similar situations (Petróczi, 2016).

Notwithstanding the aforementioned strengths, the present research project had limitations. First, the studies reviewed and synthesized in *Paper I* employed various research methods. To account for this diversity, we coded the results of each reviewed study using qualitative descriptions that captured their nuances. Consequently, we closely adhered to the results of each included study and refrained from drawing conclusions beyond their scope. Second, *Papers II* and *III* used a cross-sectional design, which precluded precedence and causal order by referring to the strength of the relationship between variables. Third, *Paper IV* employed a half-longitudinal design that included only two measurement points, which did not allow for testing stationarity or the significance of a potential direct effect between dietary supplement use and attitudes toward doping (Cole & Maxwell, 2003). Fourth, all the studies reported in *Papers I–IV* relied on self-reported measures, making the data vulnerable to self-presentational biases. Lastly, it is important to note that the generalizability of the findings from the present research project to the elite athlete context may be limited due to the unique sample consisting of young athletes.

For more robust evidence of causal directions, future research should use a longitudinal design with at least three time points (Little, 2013). To enhance our understanding of young athletes' health-compromising behaviors and their determinants, future research should use expanded integrative models of behavioral prediction that include physical, psychological, and sociocultural factors.

8 Conclusion

The overall aim of this research project was to gain a greater understanding of the psychosocial risk and protective factors influencing young athletes' health-compromising behaviors, including painkiller use, participation in sports despite injuries, use of dietary supplements, and doping. To achieve this aim, we adopted an integrative social cognitive approach and examined a range of theoretically informed personal and contextual factors hypothesized to protect against or elicit the aforementioned health-compromising behaviors. These factors were explored to help further identify strategies to prevent or reduce health-compromising behaviors in youth sports.

In summary of our main findings, *Papers II and III* revealed that sports environments characterized by social pressure and a predominant focus on performance are likely to increase young athletes' intention to play through injuries and temptation to engage in doping. These environments can also influence young athletes' social cognitions, making them more inclined to adopt health-compromising behaviors. Additionally, *Paper III* highlights the finding that athletes with perfectionistic concerns about making mistakes were more prone to succumbing to the temptation of doping, thus, emphasizing the role of perfectionism as a potential predisposing factor. Finally, *Paper IV* demonstrated that the frequent use of dietary supplements among young athletes increased their risk of developing permissive attitudes toward taking prohibited substances by eliciting their acceptance of using supplements.

Taken together, the aforementioned findings lend support to the important psychosocial factors hypothesized to underlie young athletes' health-compromising behaviors. Coaches, sports practitioners, and others aiming to prevent dysfunctional behavioral patterns among young athletes are encouraged to create environmental conditions that reduce social pressure and downgrade the importance of winning. Targeting young athletes' behavioral beliefs (e.g., attitudes) about injury and performance-enhancing substances may also be an important step in helping such athletes refrain from risking their health in pursuit of excellent performance.

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Appendices

Appendices

In this doctoral thesis, the Appendices comprise four papers, along with ethical approval from the Research Ethic Committee of the Norwegian School of Sport Sciences and letters of support from the Norwegian Ice Hockey Association and Anti-Doping Norway.

Appendix A: Paper I – IV

Paper I

Kristensen, J. Å., Skilbred, A., Abrahamsen, F. E., Loland, S. & Ommundsen, Y. (2022). Performance-enhancing and health-compromising behaviors in youth sports: A systematic mixed-studies review. *Performance Enhancement & Health*, 10(4), 1–12.
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Review Article

Performance-enhancing and health-compromising behaviors in youth sports: A systematic mixed-studies review

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ABSTRACT

Success in sports entails striving toward greater achievement and outstanding performance. In their pursuit of these goals, adolescent athletes use various means and resort to behaviors that may cause adverse consequences for their health. As they are still in the developmental stage, they are particularly vulnerable to unwanted health consequences. This study aimed to systematically review previous studies on the contextual and personal factors associated with adolescent athletes' performance-enhancing and health-compromising behaviors. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines. Several databases were searched, including SPORTDiscus, Pubmed, PsycINFO, and Web of Science. The literature search and additional manual searches of sources yielded a total of 2,808 articles. These were screened against the inclusion criteria, and the remaining 15 were assessed for eligibility using Mixed Methods Appraisal Tool 2018. Convergent meta-integration with thematic analysis was performed by converting quantitative and qualitative data from young athletes aged 14–20 years into relevant codes and themes. Within these themes, the study's findings are presented through narratives that are perceived to influence young athletes' use of doping and other behaviors that may lead to doping, such as the use of nutritional supplementation and non-prescription painkillers and playing despite being injured and having pain. Our findings indicate that athletes' entourages (e.g., their coaches, peers, and parents) matter in a variety of ways in athletes' socialization toward refraining from risking their health in pursuit of greater achievement and outstanding performance.

1. Introduction

The concept of sports reflects many ideal values of modern society, such as effort, hard work, progress, and fair play. However, sport participation has a dark side, including the various problematic ways to enhance athletic performance. According to the World Anti-Doping Agency (WADA), certain means of enhancing athletic performance, such as substance abuse or doping, are unacceptable and often banned. Other means with potential short-term positive effects on performance are considered more or less acceptable. These include using various nutritional supplements and non-prescription painkillers. However, in the long run, these means may run counter to performance enhancement and may have adverse effects on health (Hurst et al., 2019; Mayer & Thiel, 2018).

Various types of assumed performance-enhancing behaviors that pose health risks seem to have been integrated into elite sports

(Ljungqvist et al., 2016; Wilson & Derse, 2001). Similar practices have emerged among young athletes in different sporting contexts (de Hon et al., 2015), and these may predispose them to more serious risk behaviors later in their careers. Young athletes often face high expectations of improvement and considerable pressure to perform well (Yesalis, 2000) and are forced to cope with pressure and expectations to improve their performance in both training and competition (Mellalieu et al., 2009).

Young individuals generally go through a transitional phase between childhood and adulthood. During adolescence, they experience biological, cognitive, and psychosocial changes (Rutter, 1997). These changes can either provide new opportunities for growth and constructive development or pose overwhelming and stressful challenges, eliciting health risk behaviors. When it comes to sports, concerns about unfulfilled goals and expectations in training and competitions and difficulties with one's coach or teammates may influence young athletes to

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accept and take behavioral risks that can harm their health (Backhouse et al., 2015; Hanton et al., 2005).

In recent years, research investigating performance-enhancing and health-compromising behaviors has gathered momentum. However, previous reviews that investigated the phenomenon focused on doping in sports and on adult athletes (Backhouse et al., 2015; Blank et al., 2016; Morente-Sánchez & Zabala, 2013). Hence, there is a need for a review that includes doping and other forms of health-compromising behavior among young athletes. Thus, the current work systematically reviewed previous studies related to doping, the use of nutritional supplementation and non-prescription painkillers, and the practice of playing despite being injured and having pain. Our focus was exclusively on young athletes aged 14–20 years taking part in organized sports.

Many athletes at the aforementioned age level have the ambition of nurturing a professional career in sports, which means that there are higher stakes contingent upon their improved performance (Backhouse et al., 2015). Like everyone else, athletes develop a capacity for abstract reasoning (Inhelder & Piaget, 1958) and decision-making (Weithorn & Campbell, 1982) during adolescence, but compared to their adult counterparts, young athletes may not yet be fully aware of possible risks and may not yet fully consider future consequences. Moreover, some adolescents who engage in risky behaviors may perceive themselves as less vulnerable to health consequences than those who do not engage in such behaviors (Yeretzian & Afifi, 2009). Such differences may influence their willingness to accept and take behavioral risks in problematic ways.

Given the dearth of literature reviews exclusively regarding young athletes, the current study reviewed and synthesized previous studies to find the answer to the following research question: What contextual and personal factors are associated with adolescent athletes' performance-enhancing and health-compromising behaviors?

2. Materials and methods

For the current systematic mixed-studies review, advanced qualitative convergent meta-integration was used, which involved combining evidence and results from quantitative, qualitative, and mixed-method studies (Frantzen & Fetters, 2016; Pluye & Hong, 2014). This systematic review was informed by the 2020 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021), following typical recommendations (e.g., Frantzen & Fetters, 2016; Pluye & Hong, 2014). In accordance with the guidelines and to ensure completeness and transparency, a protocol was registered with PROSPERO, an international database of prospectively registered systematic reviews in health and social care, on December 27, 2020, with the following ID registration number: CRD4202022435.

2.1. Literature search

To identify articles on the current study's topic, the literature search was divided into two stages. First, on April 20, 2020, four bibliographic databases were searched: PubMed, PsycINFO, SPORTDiscus, and Web of Science. We developed a specific search strategy with the assistance of a librarian specializing in systematic review searches. The search terms were identified by examining the titles, abstracts, and subject indices found in relevant records. A calibration exercise consisting of two pilot searches was performed to refine the search strategy. A draft search strategy was then developed using the search terms, and additional search terms were identified from the results of applying that strategy. The search terms were agreed upon a priori and were strategically conceived to be broad enough to minimize the risk of missing relevant literature (Gough et al., 2012). For example, the following is a draft of the PubMed search strategy: ("Youth athlete*" OR "Youth sport*") AND ("Performance enhancing drug*" OR "Performance enhancing substance*" OR Doping OR Drug* OR "Painkiller*" OR "Playing hurt" OR Pain OR Injuries OR "Dietary supplement*" OR "Nutritional

supplement*" OR "Nutrition supplement*"). Once the PubMed strategy was finalized, it was modified to fit the syntax and subject headings of other databases.

The second stage of the literature search involved a manual search of the reference lists of the articles that met the inclusion criteria and the references cited in the systematic review reports on similar topics (Blank et al., 2016; Morente-Sánchez & Zabala, 2013; Nicholls et al., 2017). Finally, we updated the database searches on June 15, 2021. We used the same search strategy, but we narrowed the searches to articles published from 2020 onwards.

The literature search yielded a total of 4424 articles that potentially met the inclusion criteria (see Fig. 1). In addition, 35 articles were identified through manual searches. Following the use of automation tools, 1651 articles were marked as ineligible. The titles and abstracts of the remaining 2808 articles were then screened for relevance, and 2793 articles were discarded as they did not meet the inclusion criteria. Next, a full-text review was performed in cases where the titles and abstracts did not provide adequate information. This process resulted in the identification of 15 studies that fully met the inclusion criteria, which were included in this systematic mixed-studies review.

2.2. Inclusion and exclusion criteria

To be included in the review, articles had to be written in English and published in peer-reviewed academic journals from 2000 onward. The rationale for the latter was the establishment of WADA in 1999 and its movement for doping-free sports, and the consequent trends reflected in previous systematic reviews (Backhouse et al., 2015; Blank et al., 2016; Morente-Sánchez & Zabala, 2013). Furthermore, the included articles should present original empirical findings about personal and contextual factors that had been hypothesized to influence performance-enhancing and health-compromising behaviors among young athletes (aged 14–20 years) involved in organized youth sports. For the purpose of this review, our definition of "performance-enhancing and health-compromising behaviors" included the use of performance-enhancing substances, nutritional supplements, and non-prescription painkillers and playing during competitions despite being injured and having pain.

To eliminate articles before screening, a set of automation tools was used in the respective databases, which limited the number of articles through search filters (e.g., dates, duplicates, peer-reviewed works, and studies written in languages other than English). The articles were then screened by reviewing the titles and abstracts yielded by the search against the inclusion criteria. The members of our research group conducted the screening to enhance objectivity and reduce the possibility of excluding relevant studies. In case of disagreement, a consensus on the articles whose full text would be screened was reached through further discussion. Articles that did not meet the inclusion criteria were excluded. As for the articles that did not provide adequate information, the corresponding authors were contacted via email to request additional information.

2.3. Methodological quality assessment

In accordance with the systematic review guidelines (Page et al., 2021) and the recent reviews within the field of sports psychology (Cook et al., 2020; Scott et al., 2019), a peer review team consisting of three members of our research group reviewed the articles' eligibility.

The methodological quality assessment of the studies was conducted using the Mixed Methods Appraisal Tool (MMAT; Hong, Fàbregues, et al., 2018), as shown in Table 2. MMAT is widely recognized as a reliable and critical tool for appraising the quality of the studies included in systematic reviews combining quantitative, qualitative, and mixed-method studies (Hong, Gonzalez-Reyes, et al., 2018).

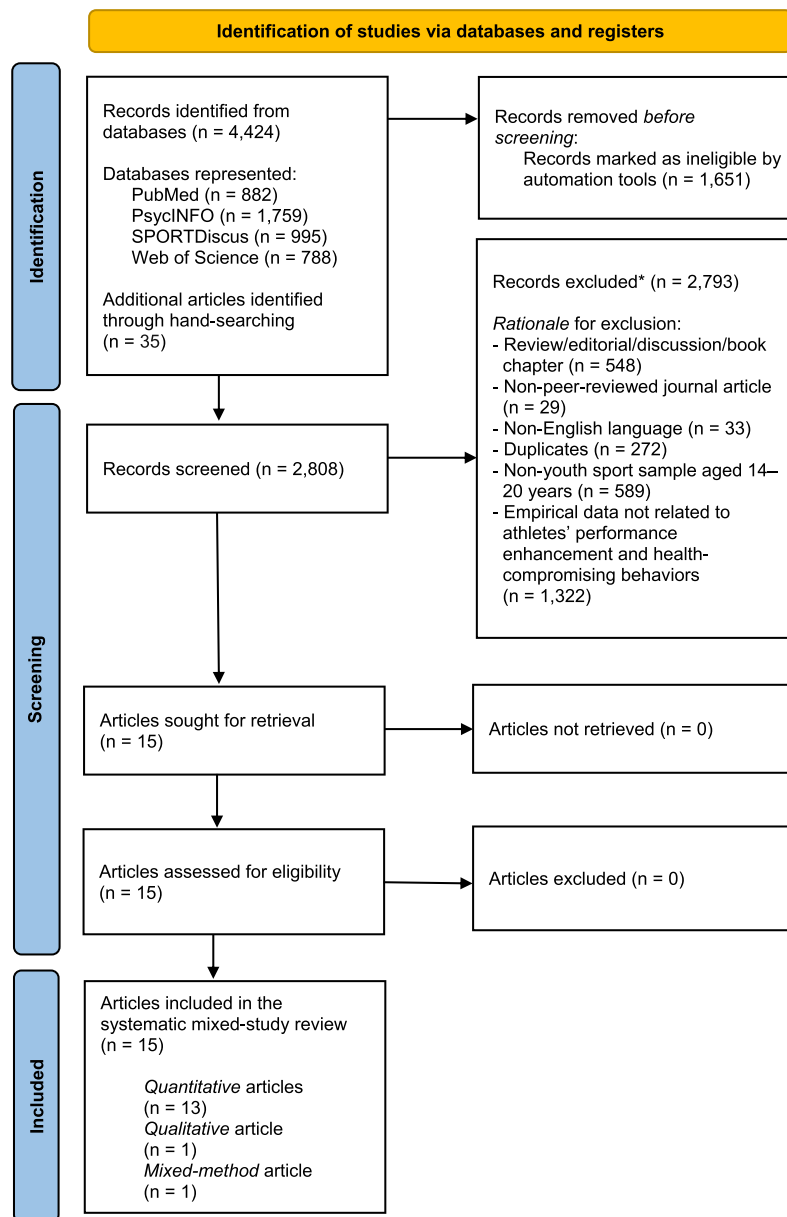


Fig. 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram.

2.4. Data extraction

Inspired by previous research (Cook et al., 2020), we extracted the following study characteristics: study purpose, participants and their sports, design, and data collection, and present them in Table 1.

2.5. Data analysis

Most of the studies included in the current systematic review used a

quantitative method for investigating multiple variables, making the conduct of a qualitative investigation involving searching for codes and themes more viable. Therefore, to find the answer to our research question, we employed an explorative data analysis strategy combining convergent qualitative meta-integration (Frantzen & Fetters, 2016; Pluye & Hong, 2014) and thematic analysis (Braun & Clarke, 2006; Braun et al., 2016).

The convergent qualitative meta-integration was conducted by extracting qualitative data from studies with a purely qualitative or

Table 1
Summary of the studies included in the review.

Author(s)	Purpose	Participants	Sport(s)	Design	Data collection
Barkoukis et al. (2014)	To examine adolescent athletes' beliefs about the causes of success in sports and how such beliefs relate to doping intentions	N = 309 adolescent athletes (178 males); age range: 14–18 years; mean age: 16.64 years; competitive athletes participating in systematic training and national championships in the past 3 years, recruited from sports organizations across Greece	Athletics, swimming, Tae Kwon Do, rowing, basketball, football, volleyball, and handball	Quantitative	Measures: Beliefs about the Causes of Success in Sport Questionnaire (Duda & Nicholls, 1992) The short 10-item version of the Marlowe-Crowne Social Desirability Scale (MC-SDS; Strahan & Gerbasi, 1972) The items measured attitudes, subjective norms, descriptive norms, and situational temptation.
Barkoukis et al. (2015)	To determine whether adolescent athletes who reported nutritional supplement use displayed more favorable reasoning regarding doping use compared to those who do not consume nutritional supplements	N = 650 adolescent athletes (444 males); age range: 14–20 years; mean age = 16.09 years; recruited from sports organizations throughout Northern Greece	Athletics, swimming, shooting, Tae Kwon Do, bowling, water polo, football, basketball, volleyball, and handball	Quantitative	Measures: Team norms (Ommundsen, Roberts, Lemyre, & Treasure, 2003) Attitudes (Ajzen, 2002) Subjective norms (Ajzen, 2002) Doping susceptibility scenario (Gucciardi, Jalleh, & Donovan, 2010) Supplement and doping use Health and gateway beliefs Descriptive norms
D. K. C. Chan et al. (2015)	To examine the role of individual differences in self-control on doping decision-making and actual behavioral responses	N = 410 young elite and sub-elite athletes (227 males); age range = not reported; mean age: 17.70 years; 9.05 years average experience in competitive sports; 12.43 average training hours per week; recruited from sports clubs in Western Australia	Athletics-track, athletics-field, badminton, gymnastics, swimming, triathlon, basketball, cricket, field hockey, rugby, water polo, and soccer	Quantitative	Measures: The brief version of the Trait Self-Control Scale (Tangney, Baumeister, & Boone, 2004) Performance Enhancement Attitude Scale (Petróczi & Aidman, 2009) Intentions (Ajzen, 2002) Doping Avoidance Adherence version of the Self-reported Treatment Adherence Scale (Chan, Dimmock, et al., 2014) Prevention of Unintended Doping (Chan, Donovan, et al., 2014)
D. K. C. Chan et al. (2015)	To determine whether motivations in sports are predictive of motivations and social-cognitive factors related to doping avoidance	N = 410 young elite and sub-elite athletes (227 males); age range = not reported; mean age: 17.70 years; 9.1 years average experience in competitive sports; 12.43 average training hours per week; recruited from sports clubs in Western Australia	Athletics-track, athletics-field, badminton, gymnastics, swimming, triathlon, basketball, cricket, field hockey, rugby, water polo, and soccer	Quantitative	Measures: Behavioral Regulation in Sport Questionnaire (Lonsdale, Hodge, & Rose, 2008) Treatment Self-Regulation Questionnaire (Levesque, Williams, Elliot, et al., 2007) Attitude, subjective norms, perceived behavioral control, and intentions (Fishbein & Ajzen, 2002; Chan et al., 2014) Questionnaire adopted from the Prohibited List Substances of World Anti-Doping Agency 2006
da Silva et al. (2017)	To investigate the self-reported use of illegal substances among young Brazilian school-aged athletes participating in the National Youth Scholar Games	N = 402 young athletes (197 males); age range: 14–17 years; mean age = not reported; with at least 2 years' training and competition experience; randomly selected during the National Youth Scholar Games of 2006 in Brazil	Athletics, judo, swimming, table tennis, chess, basketball, indoor soccer, handball, and volleyball	Quantitative	Questionnaire adopted from the Prohibited List Substances of World Anti-Doping Agency 2006
Denham (2014)	To examine the relationships between participation in competitive high school sports and substance use behaviors	N = 1971 high school students (948 males), including 233 black respondents, 1348 white respondents, and 390 Hispanics; a subsample included 1663 respondents (799 males) who answered questions about specific sports; age range = not reported; mean age = not reported; recruited from the United States	Track, swimming, baseball, basketball, football, soccer, volleyball, and softball	Quantitative	Measures: Use of alcohol, marijuana, and prescription drugs Race and sport participation Self-esteem index
Lazuras et al. (2015)	To investigate adolescent athletes' doping intentions	N = 650 adolescent athletes (444 males); age range 14–20 years; mean age: 16.09 years; recruited from sports	Athletics, swimming, shooting, Tae Kwon Do, bowling, water polo, football, basketball, volleyball, and handball	Quantitative	Measures: Social Desirability Scale (Stroeber, 2001) Age and gender Sport Motivation Scale (Pelletier,

(continued on next page)

Table 1 (continued)

Author(s)	Purpose	Participants	Sport(s)	Design	Data collection
		organizations in Northern Greece			Fortier, Vallerand, Tuson, & Briere, 1995) Approach and Avoidance Achievement Goal Questionnaire for Sports (Gonroy, Elliot, & Hofer, 2003) Multidimensional Sportspersonship Orientation Scale (Vallerand, Briere, Blanchard, & Provencher, 1997) Attitudes toward doping use (Barkoukis et al., 2013; Lazuras et al., 2010) Norms (Petroczi et al., 2008; Ravis & Sheeran, 2003) Self-efficacy (Barkoukis et al., 2013; Gucciardi et al., 2010; Lazuras et al., 2010; Pierce et al., 1996)
Madigan et al. (2016)	To examine the relationship between perfectionism in sports and attitudes toward doping among male junior athletes	<i>N</i> = 130 male junior athletes, age range: 16–19 years, mean age: 17.30 years, averaging 9.7 h of training per week, recruited from two sports academies in the UK	Tennis, squash, athletics and soccer, rugby, and basketball	Quantitative	Measures: The Sport Multidimensional Perfectionism Scale (Dunn et al., 2006) Multidimensional Inventory of Perfectionism in Sport (Stoeber et al., 2006) The Performance Enhancement Attitude Scale (Petroczi & Aidman, 2009)
Mayer et al. (2018)	To investigate the willingness to compete while hurt (WCH) in a sample of elite adolescent athletes, explore whether there exist subsets with notably different WCH values, and identify groups that are willing to take the highest and lowest health risks to maintain their sports activities	<i>N</i> = 1138 elite adolescent athletes (638 males); age range: 14–18 years; mean age: 16.33 years; engaging in one of the 54 Olympic sports; competing at one of the four highest national squad levels or a corresponding team level in Germany	Not reported, but contrasting sports groups were categorized into subcategories (technical, esthetic, power, endurance, antigravitation, and ball games)	Quantitative	Measures: Revised leadership style of the coach (Lewin, Lippit, & White, 1939) Perceptions of direct and indirect pressure to compete while hurt, and willingness to compete while hurt
Mroczkowska (2011)	To examine the probability of loss in the view of young sportspersons	<i>N</i> = 89 adolescent athletes (sex not reported); age range: 16–18 years; mean age: 17.20 years; recruited from the Sport Championship School in Poland	Fencing, track and field, martial arts and football	Quantitative	Measures: Perception of risk of doping (Mroczkowska, 2011)
Rodríguez-Serrano et al. (2018)	To explore adolescent athletes' knowledge and reasoning about health and to describe how health knowledge management structures are associated with different social systems	<i>N</i> = 65 adolescent athletes (sex not reported); age range: 16–17 years; mean age = not reported; represented the general population of young persons involved in organized sports in Sweden	Equestrian, soccer, and floorball	Qualitative	Measures: Focus group interviews
Schnell et al. (2014)	To identify groups of athletes who are particularly willing to take risks and the possible determinants of their risk acceptance	<i>N</i> = 1138 elite adolescent athletes (638 males); age range: 14–18 years; mean age: 16.33 years; athletes who practiced 13.71 h per week on average, had been squad members for a mean length of 2.89 years, engaging in one of the 54 Olympic sports, and competing at one of the four highest national squad levels or a corresponding team level in Germany	Not reported, but contrasting sports groups were categorized into subcategories (technical, esthetic, power, endurance, antigravitation, and ball games)	Quantitative	Measures: Risk perception and willingness to accept the negative physical and psychosocial consequences of their athletic activities Willingness to take physical risks in a very extreme way
von Rosen et al. (2017)	To identify risk factors for injury in adolescent elite athletes	<i>N</i> = 496 adolescent elite athletes (270 males); age range: 15–19 years; mean age not reported; recruited from national sports high schools in Sweden	Skiing, orienteering, tennis, athletics, water skiing, canoeing, rowing, wrestling, bowling, triathlon, golf, cycling, American football, basketball, handball, and volleyball	Quantitative	Measures: The Oslo Sport Trauma Research Center (OSTRC) Overuse Injury Questionnaire (Clarsen, Rønsen, Myklebust, Flørenes, & Bahr, 2014) Sleep (Kecklund & Åkerstedt, 1992) Perceived Stress Scale (Cohen & Mermelstein, 1983) The Swedish Nutrition Food Agency index (Sepp, Ekelund, &

(continued on next page)

Table 1 (continued)

Author(s)	Purpose	Participants	Sport(s)	Design	Data collection
von Rosen et al. (2018)	To explore injury consequences and adolescent elite athletes' perceptions and experiences of injuries	N = 340 adolescent elite athletes (185 males); age range: 15–19 years; mean age: 17 years; recruited from national sports high schools in Sweden	Athletics, cross-country skiing, orienteering, ski orienteering, downhill skiing, freestyle skiing, triathlon, golf, cycling, American football, and handball	Mixed methods	Becker, 2014) Competence-Based Self-Esteem Scale (Johnson & Blom, 2007) Measures: OSTRC Overuse Injury Questionnaire (Clarsen, Myklebust, & Bahr, 2013) Focus group interviews
von Rosen and Heijne (2019)	To explore the association of subjective well-being with injury and injury severity in adolescent elite athletes	N = 386 adolescent elite athletes (204 males); age range: 15–19 years; mean age not reported; recruited from national sports high schools in Sweden	Athletics, cross-country skiing, downhill skiing, freestyle skiing, orienteering, ski orienteering, and handball	Quantitative	Measures: OSTRC Overuse Injury Questionnaire (Clarsen, Myklebust, & Bahr, 2013) Well-being was rated on a scale of 0–100.

quantitative design or with a mixed-method design. More specifically, when coding the qualitative data, we transformed the data from the quantitative and mixed-method studies into a qualitative format using the text from their respective Results sections instead of the numerical outputs. For example, we transformed the correlation between pressure from the coach and athletes' perfectionistic striving (Madigan et al., 2016; i.e., 0.53, $p < 0.001$) into the qualitative code "pressure from the coach", which was one of the several codes constructing the theme "Social drama".

In the first phase of the thematic analysis, we familiarized ourselves with the data by reading and rereading all the articles, with considerable emphasis on the written presentation of the results, which was the basis for the thematic analysis.

In the second phase (coding), we read closely and coded the studies' results. Throughout the coding, we conducted a parallel cross-check of the quantitative articles, ensuring that the qualitative codes corresponded with the numerical results. This coding process was done independently, aiming to capture essential knowledge related to contextual and personal factors associated with adolescent athletes' performance-enhancing and health-compromising behaviors. The coding process was empirically rooted, that is, we stayed close to the texts and worked inductively throughout the process. The authors came together and reviewed all the generated codes. Those that overlapped at first glance were removed, resulting in 55 codes. After closer inspection and discussion, 26 more codes were excluded as they did not add new meaning to the coding, resulting in 29 unique codes.

In the third and fourth phases (creating and reviewing themes), the 29 codes were unfolded in a visual way using a smart board to facilitate an overview of the codes and the construction of meaningful themes. The codes that emphasized a common topic were grouped together under the same theme with the aim of providing an extended description and understanding of the data material analyzed.

Finally, the themes were defined and named, resulting in five themes: *social drama*, *sense of self*, *emotions*, *cognitions*, and *a means to an end*.

3. Results

This section presents the study characteristics, the quality appraisal, and the five constructed themes by drawing on the studies and codes falling under each theme.

3.1. Study characteristics

The 15 studies included in the current systematic review provided data from 8584 athletes with a mean age of 16.84 years, of whom 3700 (44%) were females, and 4730 (56%) were males (154 athletes did not

answer the question about gender). The competitive level ranged from regional to international. The 15 studies covered a wide variety of individual and team sports. Represented nations were Sweden, Poland, Germany, Greece, the United Kingdom, the United States, Brazil, and Australia. See Table 1 for a detailed description of the study and sample characteristics.

3.2. Quality appraisal

The details of the MMAT methodological quality criteria are provided in Table 2, and the resultant appraisal of each study is presented in Table 3. MMAT focuses on core relevant methodological criteria and has five criteria per study design category (Hong, Fàbregues, et al., 2018). Each included study was independently appraised using methodology-specific criteria. All the criteria were rated as "yes," "no," or "can't tell," producing an overall quality score ranging from 0 to 5. Notably, the score did not provide an exact metric for study quality; instead, it guided the relative fulfillment of each included study, which was yielded against the MMAT criteria. In addition, the percentage of studies that met each of the relevant criteria was calculated, thus providing trends across the included studies.

3.3. Social drama

Social drama refers to the contextual influences associated with adolescent athletes' performance-enhancing and health-compromising behaviors. This theme comprised five codes: social pressure, peer norms, social acceptance, social media, and sources of information. Six studies presented findings that referred to such conditions.

Social pressure was identified in three studies. In one of them, the researchers, Schnell et al. (2014), reported that young athletes were more willing to take psychosocial risks in sports by resorting to health-compromising behaviors when they perceived a greater amount of pressure to hide pain, continue training, and compete despite being injured or experiencing illnesses. Moreover, Madigan et al. (2016) reported that young athletes who thought their parents expected them to be perfect had more positive attitudes toward doping than those who did not think that their parents had such expectations of them. Collectively, these findings suggest that parental pressure and exceedingly high expectations to perform well may lead young athletes to favor health-compromising behaviors.

In line with the findings related to social pressure, one study identified sport discipline and age as contributors to athletes' willingness to compete when injured or in pain. Athletes taking part in ball games and esthetic and weight-dependent sports are more willing to compete hurt when experiencing greater social pressure than those competing in other sports (Mayer, Giel, et al., 2018). However, there were no differences

Table 2
Mixed Methods Appraisal Tool criteria.

Screening questions (for all types)	Qualitative	Quantitative randomized controlled trials	Quantitative non-randomized	Quantitative descriptive	Mixed methods
S1. Are there clear research questions?	1.1. Is the qualitative approach appropriate to answer the research question?	2.1. Is randomization appropriately performed?	3.1. Are the participants representative of the target population?	4.1. Is the sampling strategy relevant to address the research question?	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?
S2. Do the collected data allow to address the research questions?	1.2. Are the qualitative data collection methods adequate to address the research question?	2.2. Are the groups comparable at baseline?	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	4.2. Is the sample representative of the target population?	5.2. Are the different components of the study effectively integrated to answer the research question?
	1.3. Are the findings adequately derived from the data?	2.3. Are there complete outcome data?	3.3. Are there complete outcome data?	4.3. Are the measurements appropriate?	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
	1.4. Is the interpretation of results sufficiently substantiated by data?	2.4. Are outcome assessors blinded to the intervention provided?	3.4. Are the confounders accounted for in the design and analysis?	4.4. Is the risk of nonresponse bias low?	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
	1.5. Is there coherence between qualitative data sources, collection, analysis, and interpretation?	2.5. Did the participants adhere to the assigned intervention?	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?	4.5. Is the statistical analysis appropriate to answer the research question?	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

Table 3
Scores of the studies included in the review against the Mixed Methods Appraisal Tool criteria.

Author(s)A	Screening questions		Qualitative					Quantitative descriptive					Mixed methods					Overall quality score	Quality score (%)
	S1	S2	1.1	1.2	1.3	1.4	1.5	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	5.4	5.5		
Barkoukis et al. (2014)	✓	✓						✓	✓	X	X	✓						3	60%
Barkoukis et al. (2015)	✓	✓						✓	✓	X	X	✓						3	60%
D. K. C. Chan et al. (2015)	✓	✓						✓	X	✓	X	✓						3	60%
D. K. C. Chan et al. (2015)	✓	✓						✓	X	✓	X	✓						3	60%
da Silva et al. (2017)	✓	✓						✓	✓	✓	X	✓						4	80%
Denham (2014)	✓	✓						✓	✓	✓	X	✓						4	80%
Lazuras et al. (2015)	✓	✓						✓	✓	✓	✓	✓						5	100%
Madigan et al. (2016)	✓	✓						✓	X	✓	✓	✓						4	80%
Mayer et al. (2018)	✓	✓						✓	✓	X	✓	✓						4	80%
Mroczkowska (2011)	✓	✓						✓	X	✓	X	✓						3	60%
Rodríguez-Serrano et al. (2018)	✓	✓	✓	✓	✓	✓	✓											5	100%
Schnell et al. (2014)	✓	✓						✓	✓	X	✓	✓						4	80%
von Rosen et al. (2017)	✓	✓						✓	✓	✓	X	✓						4	80%
von Rosen et al. (2018)	✓	✓											✓	X	X	X	X	1	20%
von Rosen and Heijne (2019)	✓	✓						✓	✓	✓	✓	✓						5	100%
Percentage of studies that met relevant criteria	100	100	100	100	100	100	100	100	69	69	38	100	100	0	0	0	0		

Notes: ✓ = criteria met; x = criteria not met or insufficient information provided in the study.

related to gender. Mayer, Giel, et al. (2018) suggested that this could be related to the fact that highly specialized groups of elite athletes adopt the same fundamental values, which may increase the difficulty of legitimizing a break from competition when injured or in pain.

Three studies addressed peer norms and social acceptance. According to Denham (2014), young sports participants might use performance-enhancing substances more often due to “bravado and peer-driven expectations” (p. 152). These results are in line with the findings of Barkoukis et al. (2015), who stated that these patterns of reasoning serve a self-justification purpose and protect young athletes from counterarguments and reasoning against doping. Young athletes may end up rationalizing such a practice by thinking, “If everyone is doing it and it is acceptable, why shouldn’t I do it?” (Barkoukis et al., 2015, p. 587).

Finally, environmental conditions related to social media and sources of information were investigated in Rodríguez-Serrano et al. (2018) study. In particular, the study findings suggest that young athletes receive confirmation and share information about themselves on social media and pay close attention to the opinions of their peers, even though the latter are not their close friends. The availability of health experts’ advice was also found to be important. Adolescent athletes emphasized the value of receiving advice from health experts and of a communication mechanism that enabled them to rapidly establish “fast help and fast response” with such experts (p. 1276).

3.4. Sense of self

The theme *Sense of self* comprised five codes: athletic identity,

expanded sense of self, identity threat, future concern, and sports-personship. This theme drew attention to athletes' understanding of the question "Who am I?" and to what nurtures and threatens their identity in relation to performance-enhancing and health-compromising behaviors. Three articles in our review shed light on these issues.

von Rosen et al. (2018) explored adolescent elite athletes' perceptions and experiences of injury and injury consequences. One of their main findings suggests that athletes start questioning their identity as elite athletes and are often struck by the fear of not being able to reach the same physical status again. The athletes also expressed a need to belong and be considered part of the group even while they were injured. They highlighted that their teammates' perception of them as normal athletes rather than "the injured ones" was vital to maintaining their athletic identities. For example, a runner can struggle with the sense of "I am a runner" if she is unable to run, which may threaten his or her athletic identity. Injured athletes also expressed a desire to continue to experience admiration and attention from others, as they were used to in their athletic lives.

Schnell et al. (2014) aimed to identify groups of athletes who were notably willing to take health risks, particularly a willingness to accept the negative physical and social consequences of their athletic activities as they strove to achieve peak performances. Their findings suggest that athletes who have a strong athletic identity and do not engage in non-sport practices in their social lives are more inclined to take risks. Furthermore, the authors found that athletes who were concerned with athletic role fulfillment and were highly perfectionistic were part of a high-risk group. Taken together, these findings support the notion that young athletes with a broader distribution of interests and goals and who are not overly perfectionistic can reduce their willingness to take risks for performance-enhancing reasons.

In another study, Lazuras et al. (2015) examined several predictors of doping intentions among young athletes. Their results suggest that sportpersonship orientations, the way athletes respect rules, officials, and/or social conventions influence young athletes' attitudes toward doping. In other words, the athletes who reported being less fair than those respecting rules of good sportpersonship had more positive attitudes toward doping and had stronger intentions to engage in such behavior.

3.5. Emotions

The theme *Emotions* comprised six codes: self-blame, self-esteem, anticipated regret, loneliness, temptation, and well-being. Five articles that represented these codes described athletes' ways of experiencing and handling different, primarily negative emotions, which activate varying degrees of perceived discomfort.

Self-esteem is related to athletes' substance use and risk of injury in various ways. Denham (2014) investigated the association of self-esteem with the use of different substances (e.g., non-prescription painkillers) and found that female athletes reporting lower self-esteem demonstrated higher vulnerability to more excessive use of different substances than their peers with higher self-esteem. von Rosen et al. (2017) found that high self-esteem was associated with a higher risk of injury. Apparently, both high and low self-esteem increased the risk of engaging in different yet unhealthy practices.

In a study by von Rosen et al. (2018), athletes who were injured and received rehabilitation therapy reported feeling lonely despite taking part in a training context with their peers. Therefore, despite the fact that the injured athletes were included in the training, this was not enough to enable them to overcome their sense of solitude. Those athletes who felt lonely also often expressed experiencing other negative emotions, such as self-blame and/or criticism.

Concerning well-being, one study (von Rosen & Heijne, 2019) showed an association between severe injuries (e.g., acute and overuse injuries) and lower levels of self-reported well-being. Accordingly, when experiencing lower levels of well-being, athletes were found to be more

prone to injury and injury severity the subsequent week. Von Rosen and Heijne (2019) suggested that the association between lower well-being and injury risk could be modified by stressful life-events (Johnson & Ivarsson, 2011) and daily hassles (Laux et al., 2015). The results also revealed gender differences, with more injured female athletes reporting a higher sense of well-being than injured male athletes. These findings may suggest that injury has a greater effect on well-being in males than in female athletes. The authors suggested that coaches of young elite athletes should consider monitoring the athletes' subjective well-being as this may influence the potential risk of their incurring injuries (von Rosen & Heijne, 2019)

Lazuras et al. (2015) reported that situational temptation (e.g., when the coach suggests that an athlete should use performance-enhancing substances) and the anticipated negative effects of doping were two of the several predictors in their study that influenced young athletes' doping intentions. Their findings suggest that higher temptation and less anticipated regret predict stronger intentions to engage in doping.

3.6. Cognitions

The theme *Cognitions* consisted of seven codes: attributions, perfectionism, cognition as a first step, self-control, attitudes, values, and types of motivation. This theme was found in six studies that described various cognitions influencing athletes' decision-making.

Barkoukis et al. (2014) examined a set of predictors of doping intentions, including attributions about the causes of success in sports. One of their findings suggests that athletes who attribute their success to external factors, such as cheating, are more likely to report doping intentions. Madigan et al. (2016) examined how perfectionism influences athletes' attitudes toward doping. They found that athletes who had high scores in perfectionistic striving and were focused on their achievement goal were more likely to hold more negative attitudes toward doping compared to their counterparts who were more concerned about making mistakes and experiencing other people's negative reactions to their imperfection. In a related study, Chan, Lentillon-Kaestner, et al. (2015) found that athletes with low self-control were more likely to have heightened attitudes and intentions toward doping and reduced awareness of the importance of doping avoidance and intentions toward and behavioral adherence to it.

Concerning cognitions, Barkoukis et al. (2015) investigated the association between nutritional supplement use and doping among adolescent athletes. They found that nutritional supplement users held more positive attitudes toward doping and reported stronger intentions to engage in it compared with athletes who did not use nutritional supplements. The authors argued that nutritional supplement users may have a biased reasoning pattern toward doping, and that their "shared mental representations" might be a factor behind these associations. In other words, using supplements might start a value slide for athletes toward accepting prohibited performance-enhancing measures in the future. In terms of values, the findings of the aforementioned authors also suggest that the use of nutritional supplements influences athletes' reasoning patterns and motivational impetus to resort to doping. Compared to their non-user counterparts, nutritional supplementation users displayed reasoning in favor of doping (e.g., behavioral beliefs that doping will lead to a favorable outcome or a specific attribute) and perceived supplement use as less risky for progressively endorsing prohibited performance-enhancement in the future (Barkoukis et al., 2015).

Finally, in line with the findings related to the types of motivation, two studies were identified. Lazuras et al. (2015) examined the mediating role of situational temptation in the relationship between achievement goal orientations and doping intentions. They found that mastery-oriented athletes had lower intentions to practice doping, which was mediated by a reduced temptation to do so. Apparently, athletes who were mastery-oriented were more capable of overcoming the temptation to use doping. In a related study, Chan, Dimmock, et al. (2015) examined motivational factors and their associations with

attitudes, subjective norms, perceived behavior control, and doping avoidance intention. Their results revealed that different types of motives were differentially related to doping attitudes. For instance, controlled motives, such as winning and financial rewards, were associated with less adaptive motivational and social cognitive patterns (e.g., attitudes, subjective norms, and perceived control) concerning the intention to refrain from doping.

3.7. A means to an end

The theme *A means to an end*, which refers to overt and observable actions, comprised six codes: health views, appearance, perception of pain, rest, shortcuts, and differences among sports. Five studies presented findings that were interpreted as referring to overt and observable actions associated with adolescent athletes' performance-enhancing and health-compromising behaviors.

Health views and appearance were identified in two studies. Rodríguez-Serrano et al. (2018) reported that young athletes viewed health as a resource for sports performance and achievement in life. In addition, athletes' interpretations of health were related to striving for the perfect body. Consequently, many athletes reported engaging in maladaptive strategies, such as an excessive use of energy drinks, saying that "energy drinks are good [because they help] you become more alert" (Rodríguez-Serrano et al., 2018, p. 1275). Alongside these findings, Schnell et al. (2014) concluded that young athletes' carefree attitude toward their health and predominant focus on the present pose risks to their psychosocial health. Conversely, the young athletes in their study who had knowledge about health-damaging factors, such as ignoring pain, were less willing to accept the physical consequences resulting from sports engagement. Furthermore, in relation to the potential consequences of using doping, Mroczkowska (2011) reported a lower risk of doping among those athletes who valued their health and appearance and the respect of others.

Two studies were related to perceptions of pain and rest. In a study by von Rosen et al. (2018), young athletes associated pain with average sports participation. As one athlete stated concerning the use of coping strategies when injured, "Everybody gets injured, and you have to accept the injury to be able to continue with sports participation" (von Rosen et al., 2018, p. 736). However, the athletes who had sustained injuries described a change in their awareness of injury threats, accompanied by an increased understanding of their bodies. Furthermore, the perceptions of pain of young athletes who sustained an injury changed from accepting pain to recognizing it as an abnormal training response. However, the athletes who had sustained injuries (e.g., stress fracture) described a change in their awareness of injury threats, accompanied by an increased understanding of their bodies. Furthermore, the perception of pain of young athletes who sustained an injury changed from accepting pain to recognizing it as an abnormal training response. Hence, coaches are encouraged to educate athletes about the interpretation of pain signals and the importance of listening to one's body.

In another study, von Rosen et al. (2017) argued for a holistic approach to understanding the causes of injuries among adolescent athletes. In their appeal to change, the researchers stressed the relevance of behaviors in relation to injuries. For example, increasing one's sleep volume may reduce one's risk of injury. Conversely, increased training load and intensity, along with decreased sleep volume, may pose a higher risk of injury to young athletes.

Finally, overt and observable actions related to shortcuts to enhance performance and differences among sports were identified in two studies. The findings related to the use of doping and increased training loads suggest that some adolescent athletes aim for rapid gains in performance to compensate for short practice periods (da Silva et al., 2017). Other means employed to cope with emotional stress were the use of specific medicines (e.g., beta-blockers) and the use of illicit drugs (e.g., marijuana).

The aforementioned results are in line with the findings of Rodríguez-Serrano et al. (2018), which suggest that some athletes resort to excessive and maladaptive strategies (e.g., the use of energy drinks) to achieve attractive bodies and improve their physical performance.

4. Discussion

In the current systematic review, we explored the literature by searching for contextual and personal factors associated with adolescent athletes' performance-enhancing and health-compromising behaviors. Our thematic analysis identified five themes and provided essential insights into them. These themes are discussed separately in the following subsections.

In the context of youth sports, many adolescents have demanding obligations and participate in stressful competitions, causing them to worry about unfulfilled goals and the pressure to perform well (Mellalieu et al., 2009). These experiences during adolescence, a period characterized by ongoing changes and transitions, either facilitate or inhibit behaviors that may have negative consequences for their health (Petersen & Leffert, 1997). Generally, the studies included in the current review revealed how performance-enhancing and health-compromising behaviors are directly and indirectly affected by contextual influences, including the coach, peers, and family.

4.1. Social drama

The extracted studies revealed a notable focus on identifying athletes' use of social media and sources of social pressure, such as coaches, peers, and parents. In particular, young athletes use social media for confirmation and share information about themselves with peers and health experts. Social media are also an avenue where adolescents share their "good", "bad" and "ugly" side of life and discuss and express different viewpoints (O'Reilly, 2020). When doing so, adolescents may also experience some downsides, such as being exposed to peer pressure, and to unrealistic views of other people's lives, which may influence their behavior and mental health (O'Reilly et al., 2018). In relation to social pressure, young athletes were found to be more prone to risking their health when they perceived a great amount of pressure from their entourage. Moreover, when experiencing greater social pressure, older athletes found it difficult to legitimize a break from competition. Thus, the extent of taking health risks is not solely dependent on age but is a function of the norms and values within a specific sports culture (D'Amico & Barni, 2019).

The experience of parental pressure for one to be perfect led to more positive attitudes toward doping among young athletes. This finding may also suggest that parental pressure influences young athletes more, whereas pressure from coaches may have a greater impact on adult athletes (Madigan et al., 2016). These findings corroborate the findings of Barkoukis et al. (2019), which suggest that athletes' entourages play an essential role in shaping their attitudes toward and decisions regarding doping. Therefore, for young athletes, in addition to their coaches and peers, their parents play an important role in their sports careers.

4.2. Sense of self

Athletic identity can be a positive driving force for enhanced sports performance among young athletes. However, the findings of the studies in the current review suggest that holding several identities acts as a protective measure against health risks for athletes because it enables them to acquire an "expanded sense of self." In other words, playing several social roles must not be considered a limitation in achieving sports performance because it can liberate young athletes from pressure and help them deal better with their situations when injured. Athletes identifying with other social roles are likely to take fewer risks, which could consequently drive them to stay longer in sports, experience fewer

injuries, and achieve greater well-being (von Rosen et al., 2018).

At the same time, injured athletes receiving rehabilitation therapy express feelings of loneliness despite taking part in a training context with their peers. This may illustrate different dimensions of identity, both a personal one ("I") and a social one ("us") (Turner et al., 1994), and injured athletes may experience fractures in both these identity dimensions. Turner et al. (1994) concluded that the experience of group affiliation is dynamic and context-dependent and can thus be especially challenging for injured athletes.

One study (Barkoukis et al., 2015) revealed that sportspersonship orientations shape athletes' attitudes toward doping. In contrast, an earlier study by Barkoukis et al. (2011) also examined sportspersonship profiles concerning doping behavior and found no relationship between sportspersonship orientation and past doping use or doping intention. Taken together, these findings support the idea that athletes with a fair sportspersonship profile do not necessarily perceive doping as immoral.

4.3. Emotions

Athletes' emotions have received little explicit attention in relation to studies on performance-enhancing and health-compromising behaviors. In line with the findings of Friesen et al. (2013), our findings suggest that emotions, whether positive or negative, provide valuable information about fulfillment of needs.

On the one hand, von Rosen et al. (2017) suggested that athletes with high competence-based self-esteem may be more willing to downgrade their rehabilitation time and to compete and train without protective equipment. The authors argued that these athletes may also have negative patterns of perfectionism, which may trigger risk behaviors when dealing with setbacks and stress. On the other hand, Laure and Binsinger (2007) showed that athletes with low self-esteem, accompanied by other risk factors, engage more often in doping compared to their peers with higher self-esteem. Although the studies operationalized self-esteem in somewhat different ways, in both of them, athletes reporting high self-esteem and those reporting low self-esteem both expressed a willingness to take risks. Taken together, these findings underline the complex pathway between athletes' self-esteem and their risk behaviors. Hence, coaches and other support personnel should acknowledge that both high and low self-esteem can have undesirable consequences when it comes to health risk practices.

Barkoukis et al. (2014) studied athletes' vulnerability to doping and found that athletes who are situationally tempted are more susceptible to doping. The authors observed that athletes' experience of greater temptation activates both cognitive and affective responses favoring the use of performance-enhancing substances.

4.4. Cognitions

We observed a notable trend toward identifying cognitions influencing athletes' decision-making processes and their regulation of performance-enhancing and health-compromising behaviors. With respect to cognitive influences, adolescent athletes' attitudes toward situational temptation and beliefs about their ability to resist it guide their decision-making. The studies also highlighted that the quality of motivational regulation could influence subsequent behaviors, such as doping. Taken together, these findings suggest that the value-expressive functioning of adolescent athletes' attitudes toward situational temptation and beliefs about their ability to resist it may act as a buffer against external factors under risk-conducive circumstances. Athletes with extrinsic motives for participating in sports, such as winning or financial rewards, may have less adaptive motivational and cognitive patterns (Reeve et al., 2012).

Consistent with the findings of other studies (Barkoukis et al., 2011, 2013), the aforementioned findings suggest that individuals who are more autonomously guided are more likely to reinforce their intrinsic values and effectively self-regulate their behaviors. Hence, although

anti-doping work based on rules and regulations seems to have merits, psychologically supportive educational approaches that help reinforce athletes' self-regulation and autonomous motivation appear to be better avenues.

4.5. A means to an end

We observed a trend in the included studies as we identified antecedents to the behavior in question. The studies' findings mostly suggest that young athletes view health as a resource for achieving their life goals rather than as a bodily state or condition. In their struggle toward performance enhancement and greater achievement both on and off the sports arena, young athletes are more willing to employ maladaptive types of coping, such as using energy drinks. In the context of youth sports, such means could be considered typical as athletes use them to better cope with the demands of competition. However, athletes' over-reliance on these means over time might cause adverse effects on health such as insomnia, dehydration, and heart complications (Breda et al., 2014) and make them more vulnerable to endorse prohibited performance-enhancement in the future (Barkoukis et al., 2015; Lazarus et al., 2017). The studies also underlined young athletes' carefree attitudes toward health and predominant focus on the present. These findings are somewhat alarming because they indicate the existence of rationalizing cultural norms that push athletes to do anything for the sake of athletic success. As such, athletes may be more willing to persevere against injury, accept pain, and take unacceptable substances to obtain an advantage over their competitors (Schneider et al., 2019).

5. Limitations

When exploring our research question in the existing literature, we found that the different methods employed by the studies caused variance in the construction of knowledge in the studies. Systematic reviews are mainly done as meta-analyses of quantitative studies or meta-syntheses of qualitative studies. As a consequence of the increasing conduct of mixed-method research in recent decades, a third option for systematic reviews has evolved: synthesizing quantitative, qualitative, and mixed-method articles in the same systematic review (Pluye & Hong, 2014).

There are some apparent challenges when combining various study designs. Not only is the knowledge derived using different methods, but the studies are also based on different ontological and epistemological assumptions. To accommodate this variance and as described in the first phase of our data analysis, we coded the results presented in words for all the research design types. The codes were given names that captured meaning and, at the same time, stayed close to the results they represented to hinder making conclusions past them.

The recommended MMAT framework was used to judge the quality of the included articles because it consists of evaluation criteria for different research designs. Furthermore, to judge the quality of the results of the current systematic review, we made the data analysis process transparent by presenting a rich and detailed description of each phase of the thematic analysis.

According to Thomas and Harden (2008), thematic analysis is a viable research synthesis method in systematic reviews. This approach has recently been used in sports research reviews (e.g., Edwards et al., 2017). Dixon-Woods et al. (2005) stated that thematic analysis is a structured and flexible method for integrating quantitative and qualitative studies. However, they also identified challenges. For instance, they found that previous examinations failed to be transparent regarding whether the analyses followed an inductive or deductive path, and that many previous thematic analyses did not go beyond simply summarizing themes from the primary studies, thus failing to develop higher-order themes that could make an original contribution to the literature (Dixon-Woods et al., 2005).

To address the aforementioned issues, we made our findings and our

interpretation of more general themes represent more than what was reported in the selected studies. When constructing themes, we strove to stay true to the nature of qualitative analysis by focusing on the nuances in the study findings, without overemphasizing the frequency of codes. However, we also acknowledge that thematic analysis is never exhaustive.

6. Future research directions

Further research is needed to obtain knowledge about the complex interplay between contextual and personal factors shaping performance-enhancing and health-compromising behaviors among young athletes. To better understand the decision-making processes involved in prohibited substance use, we must also investigate various health-compromising and performance-enhancing practices and behaviors that represent the forerunners of doping. Furthermore, most of the studies reported in the articles published to date utilized quantitative methods and cross-sectional research designs. There is a need for more longitudinal and qualitative studies that can capture the interplay between contextual and personal influences. Longitudinal studies can deepen the understanding of how this interplay influences athletes' cognitive processes and subsequent behaviors concerning the developmental changes they experience during adolescence. Moreover, qualitative research can provide rich descriptions of athletes' experiences and interpretations of meaning (or the lack thereof) regarding different substances and other health-compromising behaviors.

In line with previous studies suggesting a more comprehensive social and sociocultural approach to investigating athletes' decision-making processes (Aubel & Ohl, 2014; Connor, 2009; Ohl et al., 2013; Pappa & Kennedy, 2012), we believe that research and practice should examine athletes' entourages and sports culture more broadly. We recommend that future research recognize, to a larger extent, the complexity of personal and contextual factors. Without such recognition, research may oversimplify athletes' lives, which may lead to reduced validity and transferability of its results.

7. Conclusion

To the best of our knowledge, the current study was the first to synthesize all the relevant published data on personal and contextual factors associated with performance-enhancing and health-compromising behaviors among young athletes. Our identified themes (*social drama, sense of self, emotions, cognitions, and a means to an end*) synthesize the results of previous studies that provided insights into the lives of athletes from their own perspectives.

A key finding of the current study is that coaches, peers, and parents all matter in the formation of norms and values, indicating that athletes' entourages are essential sources of socialization. Apart from facilitating athletes' performance, such entourages offer unique opportunities to meet athletes' other psychological and social needs. For example, they can foster environmental conditions in which young athletes can expand their identities and achieve a greater sense of self beyond sports.

Another important finding is that athletes who are autonomously motivated to engage in sports are more likely to avoid health-compromising behaviors than those motivated by external factors such as gaining rewards or avoiding punishment. Although legislation, control, and punishment may all be effective measures against doping, athletes' entourages must look into the potential benefits of facilitating athletes' autonomous values and life meanings and the satisfaction they attain with learning and personal growth in sports. In addition, the entourages of athletes must support them and provide expert advice to them when needed. In the long run, athletes in these situations are more likely to refrain from resorting to health-compromising behaviors when pursuing their sporting careers.

Authors' contributions

Kristensen and Skilbred contributed equally to this work and therefore share co-first authorship. Ommundsen and Loland proposed the initial idea for the study, whereas Kristensen and Skilbred presented a conception of the work. Kristensen, Skilbred, and Abrahamsen assessed the eligibility of the included studies. Kristensen and Skilbred systematically reviewed the literature and performed the synthesis. All the authors critically revised the manuscript and approved the final version.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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Paper II

Kristensen, J. Å., Haugen, T. & Ommundsen, Y. Perceived social pressure and intention to play through injuries in junior ice hockey: The sporting environment matters.
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Perceived social pressure and intention to play through injuries in junior ice hockey:

The sporting environment matters

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Perceived social pressure and intention to play through injuries in junior ice hockey:

The sporting environment matters

Playing when injured is a risky yet common business among ice hockey players.

Conceptualized within the framework of the theory of planned behavior, the current cross-sectional study aimed to test a multiple-mediator model linking players' perceived social pressure to their intention to play when injured. We tested whether social pressure is directly and indirectly (via attitudes, subjective norms, perceived behavioral control avoidance, and situational temptation) related to intention to play when injured. We recruited 186 junior players aged 16–20 years (mean age = 17.85; standard deviation = 1.35) from two Norwegian ice hockey leagues (under 18 and under 20 years of age). The data were analyzed using a linear regression procedure and a bias-corrected bootstrapping technique to measure indirect effects. The results revealed a positive direct and indirect (via attitudes, subjective norms, and situational temptation) relationship between players' perceived social pressure and their intention to play when injured. In conclusion, players that perceived pressure to play despite being injured, who perceived positive consequences of doing so, who believed that people close or important to them approved of them doing so, and who perceived game-specific temptations, were more likely to report a stronger intent to play the game when injured.

Keywords: athletes, coaching, injury, pain, theory of planned behavior, youth

Introduction

Injuries in sports are often normalized and even celebrated as expressions of true determination and dedication (Theberge, 2008). However, the mentality that a player must accept risks and play through injury to achieve sporting goals may also have adverse effects on players' health and performance (K. J. Schneider et al., 2021; S. Schneider et al., 2019). Labeled the toughest sport on ice, hockey has the reputation of being as cold and unforgiving as the surface on which it is played. Due to environmental conditions and cultural expectations of how one should deal with pain and injuries, hockey players may be particularly prone to the social pressure to keep playing when injured (Mayer et al., 2018; K. J. Schneider et al., 2021; Yeldon & Pitter, 2017). With the increasing rate of injuries among professional ice hockey players (Nordstrøm et al., 2020), there is a growing interest in primary interventions that will reverse this trend before it finds its way into youth sporting cultures (Bjørndal et al., 2021; Nemeth et al., 2005; Nordstrøm et al., 2021). Therefore, the purpose of the current study was to investigate the possible link between social pressure from the sport environment as perceived by players and players' intention to play when injured. Toward this end, we drew upon the theory of planned behavior (TPB; Ajzen, 1991) to determine how behavioral, normative, and control beliefs relate to young players' intention to keep playing when injured.

A growing body of literature in the context of elite youth sports has suggested that environmental conditions could facilitate young athletes' willingness to take physical risks (Mayer et al., 2018; Schnell et al., 2014). When experiencing great pressure from the sports environment to fulfill role expectations as athletes, adolescent athletes were found to be more willing to hide their pain, continue their training, and compete despite being injured or suffering from an illness (Schnell et al., 2014). In addition, Schnell et al. (2014) reported that athletes who focused on their performance and attached much importance to their respective

sports environments were particularly willing to risk their health. Mayer et al. (2018) found that perceptions of social pressure were positively related with athletes' willingness to engage in their respective sports despite being injured. Athletes representing ball games and weight-dependent and aesthetic sports were more prone to compete when hurt, further indicating that it was harder for them to justify taking a break from training and competition when experiencing injuries or minor health problems (Mayer et al., 2018). These findings may be considered important as they indicate that athletes adopt similar fundamental values and structural principles within their respective sports, even if these include irrational beliefs about risking everything for sporting success.

Theoretical framework

Various theoretical frameworks have been proposed to deal with the psychological processes involved in health-compromising behaviors. One of the most prominent ones, TPB (Armitage & Conner, 2000), emphasizes the role of effortful thinking and premeditation and assumes that attitudes, subjective norms, and perceived behavioral control (PBC) are of central importance in predicting and explaining behavioral intention and behavior (Ajzen, 1991). According to Ajzen and Fishbein (1980), *attitudes* refer to a function of salient behavioral beliefs, each of which represents the perceived likelihood that the performance of the behavior will lead to a particular outcome or is associated with a specific attribute. *Subjective norms* consist of beliefs about whether significant others (in the present study, the coach, peers, and parents) think one should engage in a certain behavior. *PBC* reflects beliefs concerning whether one has access to the necessary resources (e.g., skills, information, abilities, emotions) and opportunities to execute or avoid the target behavior (in the present study, perceived control to avoid the targeted behavior was used). As such, PBC sheds light on the individual's internal and external control mechanisms. According to Ajzen (1991),

PBC is also compatible with Bandura's (1982) concept of perceived *self-efficacy*, which reflects self-perceptions of competence and the ability to resist situational temptation. TPB assumes that behavioral, normative, and control beliefs exert an influence on behavior indirectly through behavioral *intentions*, which reflect careful planning and motivation for performing the behavior in question (Ajzen, 1991).

It has been suggested that TPB's components are proximal predictors of behavioral intentions and behaviors and that other distal influences (i.e., environmental constraints) on behavior are mediated by attitudes, subjective norms, and PBC (Conner & Sparks, 2015). In sports, athletes act within an environment constrained by social forces that may influence how athletes deal with pain and injuries (Mayer & Thiel, 2016). Environments entangled with a sport ethic that advocates athletes to sacrifice for the game, take risks, and challenge limits, would encourage athletes to neglect severe injuries in order to keep playing the game (Hughes & Coakley, 1991). Within these surroundings, injured athletes can feel pressured to ignore the pain and play through injuries or risk being stigmatized as soft or malingerers (Malcolm & Sheard, 2002; Roderick, 2006). Experiencing subtle or even direct social pressure to push their bodies to the limit may thus increase athletes' intention to keep playing when an injury occurs. That is, according to Ajzen's TPB (1991), by eliciting beliefs that playing despite injury would lead to more positive than negative consequences (i.e., behavioral beliefs) and that significant others would approve of one doing so (i.e., normative beliefs) and lastly, that doing so is within one's control (i.e., control beliefs).

In line with the preceding conceptualization, playing with an injury can be seen as a goal-directed behavior rather than a reflexive one (Luszczynska & Schwarzer, 2015), which makes the role of intentionality highly relevant to the study of players' refraining from playing when injured. To better understand how intentions are shaped, several studies have employed TPB to predict a wide variety of behaviors in various contexts, including

technology acceptance (Lee, 2009), smoking initiation (Conner et al., 2006), participation in physical activity (Hagger et al., 2001), the use of dietary supplements (Barkoukis, Lazuras, Lucidi, & Tsorbatzoudis, 2015), and the use of illicit drugs (Lazuras, Barkoukis, & Tsorbatzoudis, 2015). However, there is a dearth of studies theoretically informed by TPB that focused on the intention to play when injured.

According to Armitage and Conner (2000), TPB is superior in comparison with other health behavior models and, as such, has been proven as the most prominent theory for understanding the phenomenon of playing through injuries. To improve our understanding of the relationship between the sports environment and players' intention to play through injuries, we set out to examine a multiple-mediator model linking perceived social pressure to intention to play when injured via a set of behavioral, normative, and control beliefs, while also including situational temptation to the conceptualization of control (see Figure 1). We aimed to investigate whether social pressure would be directly and indirectly (via attitudes, subjective norms, PBC avoidance, and situational temptation) related to intention to play when injured. In line with evidence presenting challenges of tapping internal and external control mechanisms related to risk behaviors (Lazuras et al., 2015), the present study will make use of avoidance in the conceptualization of PBC to explicitly tap the efficacy to avoid playing despite being injured. The sport of ice hockey was chosen because hockey players may be more prone to risk their health in the service of performance than young athletes in many other sports (K. J. Schneider et al., 2021).

Based on the existing evidence, the present study tested the following hypotheses:

- (1) Perceived social pressure is directly and positively related to intention to play when injured.

- (2) Perceived social pressure is indirectly and positively related to intention to play when injured via attitudes, subjective norms, and situational temptation, while negatively related via perceived control to avoid playing when injured (i.e., PBC avoidance).

- *Figure 1 [about here].*

Methods

Participants

Using a cross-sectional survey design, a convenience sample of participants (N = 186; 163 males, 23 females) aged 16–20 years (mean age = 17.85; standard deviation [SD] = 1.35) was recruited from 11 Norwegian junior elite clubs competing within two national ice hockey leagues (under 18 and under 20 years of age, respectively). The participants reported having had their current coach for an average of 1.61 seasons (SD = 1.47). Over one-third of the participants (N = 63) reported having played for Norway's national team (under 18 or under 20 years of age), suggesting that they were regarded as being among the most talented players in their age group. The participants also experienced varied social influences from the coach, peers, parents, and others to pursue a sporting career. Most of the participants (78%) suggested that their coaches and peers had the greatest influence on them in terms of their pursuit of a sporting career. In contrast, some participants (13%) claimed that their parents had the greatest influence on them in this regard. Only a small number of participants (9%) indicated that people other than their coaches, peers, or parents had the greatest influence on them (e.g., grandparents). The male-female ratio is representative of the sport at large, at this level, in this country.

Procedure

We recruited the study participants through a dialogue with the Norwegian Ice Hockey Association and the coaches of the respective teams. Before commencing the study, we sought ethical clearance from the University Ethics Committee of the first author's local institution. The national board of ethics and integrity in research, The Norwegian Centre for Research Data, approved the project prior to its commencement (reference number 675256). Participants read the information sheet and were informed that participation was voluntary and that their data would be treated anonymously. The participants then provided informed consent before completing the measures described below. As the survey did not disclose sensitive or stigmatizing information, the consent required only active consent from the participants. The data were collected using the digital survey tool SurveyXact (Ramboll, 2022), which stores the data on an encrypted server. The data collection took place at the end of the competitive season 2020-21, during the winter in Norway. This meant that all the teams had played over two-thirds of the season's games; thus, some players had reached 20 years of age (N = 26).

Measures

All the measures were administered in the Norwegian language, following the translation-back-translation procedure from English (Harkness, 1999).

Sociodemographic Characteristics

The participants were asked to provide their personal and social characteristics (i.e., sex, age, and structure of significant others and their influence on player's sport development) and the details of their ice hockey activities (i.e., elite level, number of years with their current coach, and national team experience).

Social Pressure

We assessed the players' perceptions of the social pressure from their sport environment for them to play when injured by adopting a single-item measure from Mayer et al. (2018, p. 145): "I am competing hurt because I feel pressured by the ones from my sporting environment" (e.g., direct pressure). The responses were recorded on a 5-point scale (1 = totally disagree; 5 = totally agree), and a higher mean score indicated a higher amount of perceived social pressure to play when injured.

Theory of Planned Behavior Scale (TPBS)

Ajzen (1991) developed TPBS to explain intentional behavior and behavior, which contains four components: *attitudes*, *subjective norms*, *PBC*, and *intention*. TPBS has been successfully used in previous studies (Barkoukis, Lazuras, Lucidi, & Tsorbatzoudis, 2015; Lazuras, Barkoukis, & Tsorbatzoudis, 2015) and has demonstrated acceptable reliability, construct, and predictive validity.

Based on Ajzen's (1991, p. 193) recommendations, attitudes toward injury were measured with the stem proposition "Playing with an injury this season is ...," followed by four semantic differential evaluative adjectives (bad/good, useless/useful, harmful/beneficial, and unethical/ethical) scored on a 7-point scale. A mean score was calculated, and higher scores reflected more positive attitudes toward playing when injured. The Omega coefficient (Hayes & Coutts, 2020) for the scale in this study was .87, indicating acceptable internal reliability (DeVellis, 2017).

Subjective norms, reflecting players' normative beliefs about other people's opinions and approval of playing when injured, were assessed with four items (e.g., "Most people who are important to me would want me to play despite being injured during this season"), scored

on a 7-point scale (1 = strongly disagree; 7 = strongly agree). A higher mean score denotes others' approval of playing when injured. Additionally, due to its conceptualization regarding how one perceives people close or important to them, a higher mean score of subjective norms might also indicate subtle pressure to play when injured. Subjective norms and social pressure may indeed have an overlap in meaning, as they both encompass aspects of social influence. Nevertheless, the two constructs differ in terms of specificity. While social pressure reflects a type of social influence in more general terms, subjective norms denote a more specific form of social influence, as indicated by the terms opinions and approval of important others. The Omega coefficient for the scale in this study was .89.

PBC concerning players' control beliefs about their perceived resources and perceived control to avoid playing when injured was assessed by three items ("How much control do you have over avoid playing despite being injured this season," "How sure are you that you can avoid playing despite being injured this season," and "How difficult is it for you to avoid playing despite being injured this season"). The responses were measured on a 7-point scale anchored completely no control/complete control, completely sure I cannot/completely sure I can, and very difficult/very easy. A higher mean score indicated higher perceived control to avoid playing when injured. The Omega coefficient for the scale in this study was .74.

Intention to play when injured was assessed with three items (e.g., "I intend to play despite being injured during this season"), scored on a 7-point scale (1 = definitely not; 7 = definitely yes). The three items assessed self-predictions, which have been proven to be more relevant to adolescents than standardized intention items used mostly for adult populations (Fishbein, 2009). Framing intention items as self-predictions is also more likely to better capture the true intentionality of playing when injured among adolescents, regardless of whether or not one is injured or never experienced being so (Gibbons et al., 1998). A higher

mean score denotes a stronger intention to play when injured. The Omega coefficient for the scale in this study was .96.

Situational Temptation

Players' ability to resist situational temptation to play despite being injured was measured using the stem proposition "How much would you be tempted to play despite being injured this season," followed by five prospective situations ("when your coach suggests so," "when you believe that most colleagues of yours play when injured," "when you were told to enhance your performance," "when you prepare for an important game," and "if you do not feel physically resilient"). The responses were recorded on a 5-point scale (1 = not at all tempted; 5 = very much tempted), and a mean score was produced, with higher scores denoting a greater temptation to play despite being injured. Conversely, a lower score would denote a higher capability to resist the temptation to play when injured. The Omega coefficient for the scale in this study was .82. This measure has been used in previous studies (Barkoukis, Lazuras, & Tsorbatzoudis, 2014; Lazuras, Barkoukis, & Tsorbatzoudis, 2015) and has shown high levels of internal-consistency reliability and adequate construct validity.

Statistical Analyses

IBM SPSS Statistics version 28.0 was used to compute the descriptive statistics, correlations, and regression. The zero-order correlation coefficient was used to investigate the relationship between the continuous variables (Field, 2018). There were no outliers and only a few missing data, as indicated by the item-level missingness, which ranged from 0 to 4.8%. The result of Little's Missing Completely at Random Test was not significant ($p = 0.266$), supporting the assumption that the missing values were missing at random. Therefore, only the values pertaining to the participants with complete data were included in the analyses. A

priori sample size calculation for multiple regression (Soper, 2018) was conducted recommending a minimum of 97 participants to reach a power level of 0.8 to detect an effect size of 0.15 at an alpha level of 0.05, with six variables.

In assessing multiple mediation, a parallel multiple-mediator model was considered the appropriate statistical method (Hayes, 2017). Hayes's (2009) PROCESS macro v4.0 (model 4) for SPSS was used to test the hypothesized multiple indirect effects. This method assesses the total and direct effects (c and c' , respectively) of an independent variable on a dependent variable after controlling for the effects of multiple mediators. In addition to the normal linear regression procedures, which assume the normality of the sampling distribution, Hayes (2009) recommended a bias-corrected bootstrapping technique for measuring indirect effects. Bootstrapping generates an empirical representation of the sampling distribution (in the current study, 10,000 samples were drawn) and estimates the indirect effects in each resampled dataset. Compared to other mediation methods, bootstrapping has been found to be more robust to non-normal distribution and tends to have greater power to detect significant effects while allowing for the control of covariates. To reveal the precise nature of the mediation, Hayes's (2009) technique produces point estimates and bias-corrected confidence intervals (CIs) for each of the hypothesized indirect effects and point estimates of the remaining direct effect. For the indirect-effect tests, the CIs that do not include zero between the lower and upper bounds (i.e., 95% CI) demonstrate significant mediation. In addition, the procedure produces point estimates and bias-corrected CIs for pairwise contrasts between specific indirect effects. Regarding contrasts, a percentile-based bootstrap CI that does not include zero indicates that one indirect effect is significantly stronger than another.

Because the participants in the current study were players from 11 different ice hockey clubs in Norway and included males and females, the possibility of clustering effects

on team level and sex existed. Thus, to account for the possible non-independence of the team and sex variables, mediation analysis was performed with the team and sex variables included as dummy variables (i.e., 10 dummy variables for team and 1 dummy variable for sex) and treated as covariates.

Results

Table 1 shows the means, SDs, and correlations of the study variables. As indicated by the mean values, the table shows that the sample of junior players reported a score below the midpoint of the scale for perceived pressure. Furthermore, the players' scores for attitudes, subjective norms, and intention were also below the respective scales' midpoints, whereas the scores for PBC avoidance and situational temptation were above the midpoint. Zero-order correlations showed that social pressure, attitudes, subjective norms, and situational temptation were positively correlated with intention to play when injured, while perceived control to avoid playing when injured (i.e., PBC avoidance) was negatively correlated. Furthermore, the relatively low correlation between social pressure and subjective norms ($r = 0.21$, $p < 0.01$) indicate that the two constructs exhibit notable differences.

Table 1 [about here].

Overall, the full multiple-mediator model explained 41% of the total variance in intention (adjusted $R^2 = 0.41$; $F(16, 160) = 7.03$; $p < 0.001$). As can be seen in Figure 2, perceived social pressure predicted intention to play when injured (i.e., total effect; unstandardized beta (b) = 1.69, 95% CI_c [0.84, 2.55], $p < 0.001$). Moreover, a higher level of perceived social pressure was associated with higher levels of attitudes ($b = 0.86$, 95% CI_{a1} [0.03, 1.70], $p < 0.05$), subjective norms ($b = 1.42$, 95% CI_{a2} [0.51, 2.33], $p < 0.01$), and

situational temptation ($b = 0.80$, 95% CI_{a4} [0.14, 1.46], $p < 0.05$). Conversely, concerning players' PBC avoidance, a higher level of perceived social pressure was related with lower levels of perceived control to avoid playing when injured ($b = -1.11$, 95% CI_{a3} [-1.74, -0.48], $p < 0.001$). Furthermore, when all the mediators were entered into the equation, attitudes ($b = 0.31$, 95% CI_{b1} [0.15, 0.48], $p < 0.001$), subjective norms ($b = 0.19$, 95% CI_{b2} [0.04, 0.34], $p < 0.05$), and situational temptation ($b = 0.27$, 95% CI_{b4} [0.09, 0.45], $p < 0.01$) stood out as independent predictors of intention, above and beyond perceived pressure, leaving PBC avoidance ($b = -0.10$, 95% CI_{b3} [-0.28, 0.08], $p = 0.28$) as a non-significant predictor. After controlling for the possible non-independence of the team and sex variables, the latter accounted for the variations in PBC, indicating differences between males and females. That is, the males had higher perceived control to avoid playing when injured compared with the females ($b = -3.40$, 95% CI [-5.86, -0.94], $p < 0.01$). A series of independent samples t-tests also supported the latter finding. There was a statistically significant difference in PBC avoidance mean scores for males and females ($M\Delta = \pm 1.03$, $t(178) = 3.33$, 95% CI [0.42, 1.64], $p < 0.001$). As indicated by Cohen's d effect size (Cohen, 1988), the magnitude of the difference in the means was medium ($d = 0.76$, 95% CI [0.30, 1.21]). Notwithstanding the difference in PBC avoidance for males and females, there were no other significant differences in the remaining study variables (e.g., social pressure, attitudes, and subjective norms).

Figure 2 [about here].

With regard to the multiple-mediator model, it was observed that the relationship between perceived social pressure and intention to play when injured was mediated by attitudes, subjective norms, and situational temptation. More specifically, a higher level of

perceived social pressure was shown to be positively related to attitudes in favor of playing when injured, as well as with others' approval and situational temptation to do so, which mediated the relationship between perceived social pressure and intention to play when injured. As for the specific indirect links (see Figure 2), attitudes ($b = 0.27$, 95% CI_{a1b1} [0.02, 0.68]), subjective norms ($b = 0.26$, 95% CI_{a2b2} [0.01, 0.68]), and situational temptation ($b = 0.22$, 95% CI_{a4b4} [0.03, 0.52]) stood out as unique mediators among all the mediators in the model. However, no significant difference between these three variables was found when their relative strengths as mediators were compared (e.g., contrasting their respective indirect contributions to the mediational model). Thus, one mediator could not be considered stronger than the other. Upon inspecting the remaining mediator in the mediational model, it was revealed that PBC avoidance had no significant mediating effect ($b = 0.11$, 95% CI_{a3b3} [-0.12, 0.39]).

Discussion

Using the TPB as a theoretical framework, the purpose of the current study was to investigate possible links between social pressure as perceived by junior ice hockey players and their intention to play while injured. This target group is of particular importance for injury prevention because it represents tomorrow's professional players in a sport associated with a high prevalence of injuries (Nordstrøm et al., 2020). Toward this end, we tested a parallel multiple-mediator model linking perceived social pressure to intention to play when injured through attitudes, subjective norms, PBC avoidance, and situational temptation.

In line with our first hypothesis, it was expected that perceived social pressure would be directly and positively related to intention to play when injured. As shown in figure 2, the direct effect of perceived environmental pressure on intention to play when injured was still present and positive after the mediating variables were added to the model. This finding

supports Ajzen's (1991) openness to the inclusion of additional predictors, as long as they capture a significant proportion of the variance in intention after the theory's current variables have been taken into account. In addition, the current study's findings seem to demonstrate the unique contribution of perceived social pressure and its potential ability to influence hockey players' intention to play when injured. Previous studies on sports injuries have shown that external influences (e.g., coaches, peers, parents) represent a set of social interactions and expectations that may increase the risk of injury among athletes (Malcom, 2006; Theberge, 2008). Such social influences incorporate expected social behaviors (e.g., displays of physical and mental toughness) that young athletes consider when they incur an injury (Malcom, 2006). Hence, athletes may be prone to conform to these expectations and learn to deal with injuries by "shaking them off" and "toughing them out" (Malcom, 2006, p. 495). Consequently, given the direct path between social pressure and intention, it is reasonable to assume that sporting culture may directly impact players' decision to play when injured, irrespective of other psychological influences on the players, such as behavioral beliefs. As indicated by the current study's results, players who perceived social pressure from their sport environment to play through injuries were more likely to report a higher level of intention to play when injured.

According to the study's second hypothesis, perceived social pressure would also be indirectly and positively related to intention to play when injured via attitudes, subjective norms, and situational temptation, while negatively related via PBC avoidance. Figure 2 shows the positive relationship between social pressure and the mediating variable attitudes, which in turn is a positive predictor of intention. In accordance with TPB, attitudes toward injury are concerned with salient behavioral beliefs that playing when injured will lead to more positive than negative consequences (Ajzen, 1991). There are similarities between the attitudes expressed by perceived social pressure in the current study and those described in

previous research (Barkoukis, Lazuras, Tsorbatzoudis, & Rodafinos, 2013), in which the influences of external factors (e.g., mastery approach) were mediated by predictors derived from TPB. The current study's results run parallel to these findings and extend the previous research by showing that attitudes toward injury operate as a mediator in the relationship between perceived social pressure and intention to play despite being injured. It appears that the presence of social pressure to play despite being injured (e.g., from the coach, peers, or parents) may relate to players' intentional behavior by shaping more favorable attitudes toward doing so. In the current study, results indicated that the higher the perceived social pressure to play through injuries, the more favorable attitudes toward injury and stronger intentions were reported by the players.

The results in Figure 2 also show a positive relationship between perceived social pressure and the mediating variable subjective norms, which is a positive predictor of intention in the next model step. According to Ajzen (1991), subjective norms refer to the perceived approval from important others to keep playing when injured. The current study finding is in line with previous research suggesting that mirroring the social norms of significant others may lead to a stronger intention to perform the behavior in question by acting on such normative beliefs (Lazuras, Barkoukis, & Tsorbatzoudis, 2015). As such, the presence of social pressure to play while injured may relate to players' intentions by eliciting beliefs that people close or important to them approve of them playing despite being injured. Notwithstanding their overlapping conceptualizations, these findings may also bring support to the rationale that subjective norms differ theoretically and methodologically from perceived social pressure in that they differ in specific connotations. That is, social pressure denotes players' perception of pressure from their sporting environment to keep playing when an injury occurs. In contrast, subjective norms reflect players' beliefs regarding significant others' opinions about playing when injured and whether they would approve of doing so.

Nevertheless, the indirect relation between social pressure and intention via subjective norms should be interpreted with caution. In the current study, results indicated that the higher perception of social pressure, the more favorable normative beliefs about others' approval of playing when injured, and stronger intentions were reported by the players.

Lastly, the current study's results also show a positive relationship between perceived social pressure and the mediating variable of situational temptation, which in turn, is a positive predictor of intention. Based on Bandura's (1982) concept of self-efficacy, situational temptation refers to the perceived ability to resist game-specific temptations to play when injured. The current study's results support the evidence presented by previous studies that situational temptation acts as a parallel mediator, next to predictors derived from TPB (Lazuras, Barkoukis, Rodafinos, & Tzorbatzoudis, 2010; Lazuras, Barkoukis, & Tzorbatzoudis, 2015). In addition, in their meta-analytic review, Blank et al. (2016) identified situational temptation as one of the most influential predictors of sport-related intentions, underlining its potential contribution next to other so-called immediate predictors of intention, such as attitudes and subjective norms. This suggests that players' intention to play when injured may not only be directly related to the perceived social pressure for them to do so; rather, perceived social pressure may also be indirectly related by eliciting a stronger temptation to engage in the game despite being injured (e.g., when the coach suggests so), in turn leading to a higher level of intention to play when injured. In the current study, results showed that the higher perception of social pressure, the more eliciting situational temptations to play despite being injured, and stronger intentions were reported by the players.

Contrary to our expectations, we did not observe a significant indirect relation between perceived social pressure and intention via perceived control to avoid playing when injured (i.e., PBC avoidance). Previous studies on risk behaviors in sports have highlighted

the unique contributions of PBC in the prediction of intention (Barkoukis, Lazuras, & Tsorbatzoudis, 2014; Barkoukis, Lazuras, Tsorbatzoudis, & Rodafinos, 2013), but few studies have supported mediation (Lazuras, Barkoukis, & Tsorbatzoudis, 2015). A possible explanation for the discrepancy between the current study's results and the earlier findings could well be that determinants of intention reflecting the players' beliefs about the ease or difficulty of avoid playing the game when injured have been shown to be less powerful than beliefs about the capacity to resist playing when injured under specific circumstances (Lazuras, Barkoukis, & Tsorbatzoudis, 2015). Collectively, our results and those of other studies (Barkoukis, Lazuras, Tsorbatzoudis, & Rodafinos, 2013) may indicate that the measurement of behavioral control concerning the behavior of avoid playing when injured could benefit from the inclusion of items that reflect self-regulatory efficacy to succumb to social pressure (or overcome them), as compared with more traditional self-efficacy items that are commonly used in most TPB studies which reflect perceived control over the difficulty or easiness to engage in a particular course of action (Conner & Sparks, 2015).

Practical Implications

Consistent with the results of previous studies (Mayer et al., 2018; S. Schneider et al., 2019; Schnell et al., 2014), the current study's results suggest that players who perceive social pressure intend to play when injured. Perceived pressure may increase players' intention to play when injured by shaping more favorable attitudes and normative beliefs toward doing so and elicit a stronger temptation to keep playing after incurring an injury. Coaches, club physicians, and other people surrounding athletes should be aware of the impact of pressure on athletes and thus help reinforce the environmental conditions that reduce it. For example, establishing cultural norms that combine to form a sports ethic that cultivates long-term perspectives on both players' careers and health can help players refrain

from playing when injured. Creating such environmental conditions may reduce the intent to play when injured by facilitating players' behavioral and normative beliefs and capability to resist the temptation to play under risk-conductive circumstances. While it is generally accepted that coaches play a key role within athletes' sports environments, our findings indicate that peers and parents also play important roles in this respect.

Limitations and Strengths

The present study was not free of limitations. First, one limitation was its cross-sectional design, which precludes precedence and causal order by referring to the strength of association between variables, as well as differences between groups and differences in the rate of occurrence in an outcome of interests (VanderWeele, 2015). Another limitation was the procedure used to account for the possible non-independence produced by team membership. Thus, for future research, a prospective design is needed to establish the directionality of the relationships between the independent variables, mediators, and outcomes. To better account for clustering effects (e.g., from groups or organizations), researchers are encouraged to use a multilevel modeling approach (Maas & Hox, 2005). Second, few females were represented in the current study's sample. However, the male and female distribution represented the status quo in Norway in this regard. Researchers will do well to replicate the current model in other sports where stereotyped expectations of masculinity and gender roles play an integral role, thus also including male and female participants. Third, due to its focus on intention to play when injured, the current study did not use any measure of actual behavior. Recent studies (Hurst et al., 2019; Kavussanu et al., 2020) have shown that indirect measures can be used efficiently when studying health-compromising behaviors. As such, hypothetical scenarios have been shown to evoke the target emotions and activate relevant social knowledge in participants by requiring judgments

on how they would be likely to feel, think, or behave in a similar situation. The underlying assumption is that this demand would activate the participants' self-concept and thus reveal their attitudes, perceived norms, and values about the behavior of interest and, in so doing, maximize predictive accuracy (Petroczi, 2016). Lastly, given the inconsistencies between players' significant others (e.g., coaches, peers, parents), future research should rely on several sources to increase the practical value of the findings.

Notwithstanding the aforementioned limitations, the current study had several strengths. Its primary strength was its formal examination that extended the TPB literature by testing a specific theory-driven model emphasizing the direct and indirect effects of distal and proximal predictors of intention to play when injured. Furthermore, the study presented an interesting development in theory-driven examinations of risk behavior in competitive sports in general. To the best of our knowledge, the current study was the first to test a multiple-mediator model linking perceived social pressure to the intentionality to play through injuries in the context of youth sports. In addition, the study had a unique sample representing the most talented players in their age group.

Conclusion

To conclude, the current study tested a multiple-mediator model and showed that perceived social pressure was directly and positively related to intention to play when injured. In addition, the relationship between the two was also indirectly and positively related via attitudes, subjective norms, and situational temptation pertaining to playing when injured; thus, no indirect negative path was identified for perceived control to avoid playing when injured. Overall, the results help highlight important psychological mechanisms underlying hockey players' decisions to play despite being injured. In particular, players that perceived social pressure from their sporting environment to play despite injury, who perceived more

positive than negative consequences of doing so (i.e., behavioral beliefs), who believed that people close or important to them approved of them doing so (i.e., normative beliefs), and who perceived game-specific temptations (i.e., control beliefs), were more likely to report a stronger intent to play the game despite being injured. Coaches and others aiming to prevent health-compromising behaviors such as playing when injured should target players' beliefs about injury and their capability to resist game-specific temptations to play under risk-conductive circumstances. Doing so may reduce players' intent to play when injured.

Disclosure Statement

The authors report there are no competing interests to declare.

Ethical approval

Ethical approval for this study was granted by the Research Ethics Committee of the Norwegian School of Sport Sciences. Participants gave informed consent to take part.

Ethical statement

This research has been carried out in accordance with the Norwegian Health Research Act, privacy legislation, and the Act on ethics and integrity in research. All participants gave informed consent to take part in this study.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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Table 1.

Descriptive statistics and correlations of the study variables

Variable	Mean (SD)	1	2	3	4	5	6	7	8
1. Social pressure	1.86 (0.99)	-							
2. Attitudes	2.51 (1.31)	0.16*	-						
3. Subjective norms	2.79 (1.45)	0.21**	0.60**	-					
4. PBC avoidance	4.69 (1.41)	-0.27**	-0.13	-0.19*	-				
5. Situational temptation	3.13 (0.88)	0.19**	0.33**	0.33**	-0.34**	-			
6. Intention	3.10 (1.82)	0.29**	0.51**	0.48**	-0.27**	0.40**	-		
7. Sex	1.12 (0.33)	0.05	0.10	0.04	-0.24**	-0.01	0.04	-	
8. Age	17.85 (1.35)	0.12	0.09	-0.01	-0.07	0.01	0.10	0.26**	-

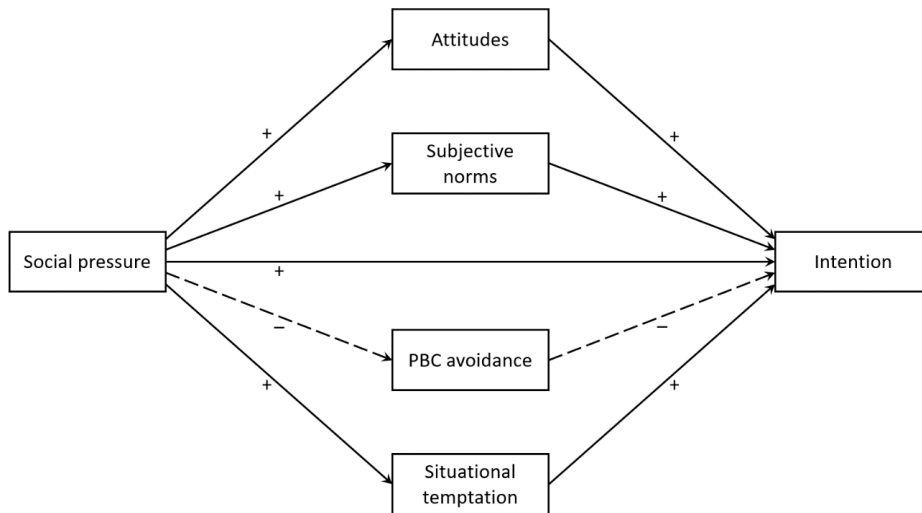
Note: Bootstrapped descriptive statistics and zero-order correlation coefficients. Due to missing data, the overall n of the sample was 177. The

possible range of responses is 1–7 for all variables except for social pressure and situational temptation (1–5, respectively). Sex was coded as 1 =

males, 2 = females. * $p < 0.05$, ** $p < 0.01$ (two-tailed).

Figure 1.

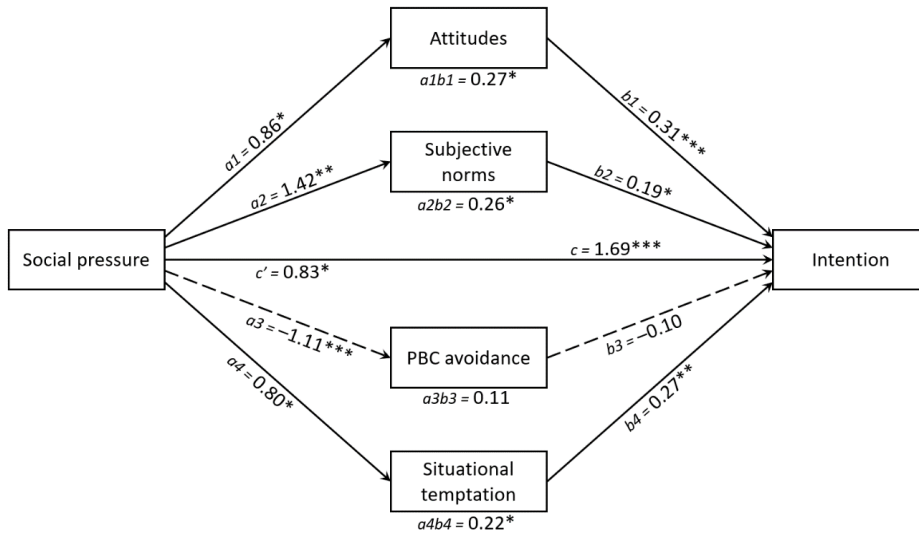
Proposed parallel multiple-mediator model of intention to play when injured.



Note: Solid lines represent positive paths and dashed lines represent negative paths.

Figure 2.

Statistical diagram of the parallel multiple-mediator model of the presumed influence on intention to play when injured.



Note: $N = 177$; The regression coefficients and the total-, direct-, and indirect-effect values are reported as unstandardized indices. Solid lines represent positive paths and dashed lines represent negative paths. For ease of presentation, the team and sex, included in the analysis as dummy variables, are not shown in the figure. $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Paper III

Kristensen, J. Å., Kavussanu, M. & Ommundsen, Y. Perceived performance climate, doping attitudes and temptation among elite youth athletes: Exploring the moderating role of perfectionistic concerns.

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Perceived performance climate, doping attitudes and temptation among elite youth athletes: Exploring the moderating role of perfectionistic concerns

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The authors report there are no competing interests to declare.

Ethical statement

Ethical approval for this study was granted by the Research Ethics Committee of the Norwegian School of Sport Sciences. Participants gave informed consent to take part.

Perceived performance climate, doping attitudes and temptation among elite youth athletes: Exploring the moderating role of perfectionistic concerns

A win-at-all-costs sports culture might enable athletes to use any means or methods necessary to succeed, and thus, drive them to use prohibited substances. In this study, we aimed to examine contextual and personal antecedents of doping temptation among adolescent athletes using an integrated model. To this end, we tested whether performance climate was directly and indirectly (via doping attitudes) related to doping temptation, and whether perfectionistic concerns moderated the indirect relationship between performance climate and doping temptation via pro-doping attitudes. The sample comprised 420 adolescent elite athletes aged 16–18 years (mean age = 16.94; standard deviation = 0.81) recruited from five Norwegian sport academy high schools. Regression analysis revealed that athletes' perceptions of a performance climate were positively related to their temptation to dope both directly and indirectly (via doping attitudes), and that the indirect relationship between performance climate and doping temptation via attitudes was stronger among athletes who were moderate or high in their perfectionistic concerns. Taken together, our findings suggest that athletes who perceive their sport environment as performance oriented and believe that the benefits of using prohibited substances outweigh the drawbacks, are more likely to be tempted to dope. Moreover, this tendency is particularly notable among athletes who are moderately or strongly concerned about making mistakes.

Keywords: Motivational climate; attitudinal; perfectionism; youth sport

Highlights:

- Performance climate is related to doping temptation both directly and indirectly via doping attitudes.
- Perfectionistic concerns moderate the indirect relationship between performance climate and doping temptation via doping attitudes.
- Perfectionistic concerns may act to facilitate temptation to dope.

Introduction

Athletes pursuing excellence in sport are often inflicted by a variety of psychological mechanisms that have been recognized to have a pervasive influence on the various ways to enhance performance (Backhouse et al., 2016). Research has advanced our understanding of potential risk factors that might lead to the experimentation and use of prohibited performance-enhancing substances in sport. It has been suggested that sporting environments characterized by a strong sense of rivalry during competitions might increase athletes' likelihood of doping (Guo et al., 2021; Kavussanu et al., 2020), and there is evidence that athletes' pro-doping attitudes play an important role in their vulnerability to dope (Lazuras et al., 2015; Madigan et al., 2016). Compared to their adult counterparts, adolescent athletes might be particularly vulnerable to health-compromising behaviors (Kristensen et al., 2022). Due to their transitional phase between childhood and adulthood, young athletes may not yet be fully aware of the possible risks and consequences of engaging in risky behaviors (Rutter, 1995). Fueled by their aspiration to enter professional sports, adolescent athletes might also be at higher risk for the hazards of doping.

During the past decades, various theoretical frameworks have been forwarded aiming to understand personal and contextual factors underlying doping behavior. In particular, research on doping has typically framed doping behavior as an conscious, reasoned, and goal-directed action determined by both personal and contextual influences (Backhouse et al., 2016). In particular, cognitive, motivational, and social-psychological influences are considered important in the formation of athletes' goal-directed intentions and behavior. Hence, identifying such factors at play is important to develop and deliver effective prevention aimed at reducing doping in youth sports (Pöppel, 2021). Therefore, the purpose of the current study was to arrive at a better

understanding of the role of the interplay between specific psychological aspects of the sporting environment and personal antecedents driving adolescent athletes' temptation to dope. Toward this end, we examined the athletes' self-reported temptation to make use of doping substances using a multi-theoretical framework in which we integrated elements from achievement goal theory (Nicholls, 1989), theory of planned behavior (Ajzen, 1991), and the conceptualization of perfectionistic concerns (Flett & Hewitt, 2014).

Perceived motivational climate

The social context within the sporting environment might enable athletes to indulge in various behaviors to better their athletic performances. According to Ames (1995), the motivational climate refers to the goals and behaviors emphasized and the salient values in the social environment created by significant others, such as coaches, peers, and parents. The significant others determine what should be considered important achievement criteria, and via their behavior they communicate what they value in a specific context and the criteria they use to evaluate success. By communicating their criteria for success, coaches play a vital role in defining and reinforcing the competitive sports' motivational climate (Ntoumanis & Biddle, 1999). Coaches create a *performance* motivational climate when they define success as winning, reward only the best performer, and place emphasis on outperforming others (Ames, 1992). On the other hand, they create a *mastery* motivational climate when they provide their athletes with opportunities and a clear rationale for improvement, while acknowledging one's feelings and effort (Hodge & Gucciardi, 2015). Athletes who perceive the motivational climate of their team as predominantly performance oriented may be more tempted to use banned substances to establish superiority over others, and thus cope with coach expectations and pressure. In contrast, a predominantly mastery oriented climate may

encourage athletes to view their achievement as a matter of individual development, take the edge of environmental pressure emphasizing social comparison standards for success, and thus help reduce athletes' temptation to make use of doping.

Previous studies have provided support for the link between the motivational climate and doping variables in sports (Allen et al., 2015; Guo et al., 2021; Kavussanu et al., 2020). For example Guo et al. (2021) reported that performance climate was positively related to doping intentions. Football players who perceived a performance motivational climate in their team were more likely to use banned substances to enhance their performance (Kavussanu et al., 2020), while Ommundsen et al. (2003) found a positive relation between young Norwegian football players' perception of a performance climate and their lack of respect for rules, officials, and social conventions. Conversely, Allen et al. (2015) found that mastery climate was negatively related to pro-doping attitudes in elite Scottish athletes, and further suggested that a mastery climate may have the potential to protect athletes from doping by eliciting a stronger belief that using a banned substance would lead to more negative than positive consequences. There is also evidence that young football players who perceived the motivational climate as predominantly mastery oriented reported more mature moral reasoning and better sportpersonship behaviors (Ommundsen et al., 2003). Hence, the quality of moral reasoning associated with a mastery oriented climate may also be considered a psychological mechanism assisting in weakening pro-doping attitudes. Taken together, previous research suggests that a coach-created performance climate is considered motivationally and behaviorally maladaptive by leading athletes to endorsing inappropriate or dysfunctional behaviors, such as doping.

Attitudes toward doping

Aside of the athletes' motivational environment, behavioral intentions, and behaviors are also known to be influenced by personal psychological factors, one being attitudes. In line with a multidimensional approach, attitudes are composed of three dimensions including cognitive, affective, and behavioral components (Kirby et al., 2016).

However, scholars disagree on their stability. Rather than being an enduring personal disposition, some researchers favor the view that attitudes are adaptive reactions to environmental demands, and that they are temporary, context-specific judgments constructed from currently accessible information (Ajzen, 1991; Schwarz, 2007).

Accordingly, Ajzen (1991) defines *attitudes* as the degree to which a person has favorable or unfavorable evaluations or appraisals of the behavior in question. For example, an athlete who believes that using prohibited substances will lead to more positive than negative consequences is expected to be more inclined to favor doping.

Several studies have confirmed a positive relationship between doping attitudes and doping behavior (e.g., Barkoukis et al., 2014; Chan et al., 2015; Lazuras et al., 2015). In a meta-analysis, Ntoumanis et al. (2014) listed attitudes toward doping as one of the strongest predictors of doping (correlation coefficient, 0.55; 95% confidence interval: 0.47–0.63). Chan et al. (2015) reported that athletes were more susceptible to dope when they believed doping to be personally beneficial. In addition, Lazuras et al. (2015) argued that attitudes toward doping have a value-expressive function that guides athletes' decision-making toward the use of a banned substance. As such, previous research suggests that permissive attitudes towards doping might drive athletes to the allure of doping. However, there is also evidence that level of perfectionistic concerns may operate to moderate the role of attitudes on athletes' decision to dope (Conner & Sparks, 2015).

Perfectionistic concerns and strivings

Perfectionism is a personality trait that seeks perfection and sets excessive standards, along with a tendency to over-evaluate one's behavior (Flett & Hewitt, 2022).

Perfectionism is best conceptualized as a multidimensional construct in which perfectionistic concerns and strivings have been identified as two higher-order dimensions of the perfectionism trait (Stoeber & Madigan, 2016). *Perfectionistic concerns* refer to athletes' concerns over making mistakes, fear of adverse reactions from others, and the consequences of failing to achieve high standards (Hill, 2016). In contrast, *perfectionistic strivings* comprise athletes' striving for flawlessness and setting unrealistically high personal standards of performance. In the context of competitive sports, athletes' perfectionism has been positively related to maladaptive as well as adaptive outcomes.

Schnell et al. (2014) found that athletes who were highly perfectionistic oriented to strive for athletic success were more willing to accept physical risks, such as continue training and competition despite being injured or experiencing illnesses. In a meta-analysis, Hill et al. (2018) reported that perfectionistic concerns were positively and consistently related to psychological maladjustments, such as fear of failure, worry, and anxiety. The same trend was also reported in research shedding light on antecedents of attitudes toward doping, in which concerns were found to be positively related to pro-doping attitudes (Hardwick et al., 2022; Wang et al., 2020). In contrast, perfectionistic strivings were unrelated to attitudes toward doping (Hardwick et al., 2022). A possible explanation for this might be the complex and ambiguous conceptualization of perfectionistic strivings, which can lead to both maladaptive and adaptive outcomes (Hill et al., 2018). That is to say, situations where athletes experience failure or commit mistakes in competition are likely to provide conditions that oppose the aspirations of

athletes with high perfectionistic strivings and/or perfectionistic concerns, and thus, exacerbates psychological maladjustments (Lizmore et al., 2017). Taken together, the body of research suggest that both dimensions of perfectionism might lead to maladaptive adjustments. However, among the two dimensions, perfectionistic concerns seem to be consistently related to maladaptive outcomes, thereby offering valuable insights into the potential risks that may facilitate doping temptation.

The present study

Extending previous literature, in this study we examined the relationship between a performance climate and doping temptation as well as whether this relationship is mediated via attitudes toward doping. We also examined the moderating role of perfectionistic concerns in the relationship between attitudes toward doping and doping temptation. Finally, considering that a mastery climate may operate in concert with a performance climate, as well as social cognitive differences between males and females, we included a mastery climate and sex as covariates (Ntoumanis & Biddle, 1999; Ntoumanis et al., 2014). Based on the existing evidence, we hypothesized that (1) performance climate would be positively related to doping temptation both directly and indirectly via doping attitudes and that (2) perfectionistic concerns would moderate the indirect relationship between performance climate and doping temptation via attitudes such that the relationship would be stronger for those with high levels of perfectionistic concerns (see Figure 1).

- *Figure 1 [about here].*

Materials and methods

Participants

Using a cross-sectional design, a sample of participants ($N = 420$) aged 16–18 years (mean age = 16.94; standard deviation [SD] = 0.81) was recruited from five Norwegian sport academy high schools that provide extracurricular, high-level training and specialization for youth athletes. Females comprised 50% ($N = 209$) of the sample and males 45% ($N = 188$), and 5% ($N = 23$) were missing. The participants represented 19 sports, with the majority competing in handball (21%), football (19%), and ice hockey (12%). They reported having participated in organized training sessions in their sport for an average of 9.67 years ($SD = 3.19$) and spent an average of 14 hours per week training in their sport. The prestigious sports academies were regulated by competitive auditions and offered both acceleration and enrichment in the chosen sport. Hence, those individuals attending these academies were among the most ambitious and talented athletes in their age group.

Procedure

The Norwegian Centre of Research Data approved the project prior to its commencement (reference number 283647). After obtaining ethical clearance from the University Ethics Committee of the first author's local institution, we recruited the study participants through a dialogue with the leaders of the specialized sporting schools and their respective coaches. Participants were first presented with information about the study, its purpose, and were informed that all data would be anonymous and confidential. After consenting, the participants completed the measures described below using the SurveyXact digital tool (Ramboll, 2023), which stores the data on an

encrypted server. The data collection took place during November and December 2022 in Norway.

Measures

All the measures were administered in the Norwegian language, following the translation-back-translation procedure from English (Harkness, 1999).

Perceived motivational climate

The participants' perceptions of the motivational climate were measured with a short version of the Perceived Motivational Climate in Sport Questionnaire (PMCSQ-2; Newton et al., 2000). Participants were asked to think about what it had usually been like on their team; seven items assessed perceived performance climate (e.g., "the coach devotes most of his/her attention to the best players"), tapping into three subscales including intra-team member rivalry, punishment for mistakes, and unequal recognitions lower-order factors, and nine items (e.g., "my coach made sure players felt successful when they improved") captured the subscales of cooperative learning, important role, and effort/improvement encompassing perceptions of a mastery climate. Participants indicated their level of agreement on a five-point scale (from 1 = strongly disagree to 5 = strongly agree). Both subscales demonstrated good internal reliability with McDonald's omega coefficient of 0.86 and 0.86 for the performance and mastery climate (Hayes & Coutts, 2020). The short version of PMCSQ-2 has also been successfully used in previous research (Appleton et al., 2016). A mean score was calculated for both performance and mastery climate subscales, with higher scores indicating stronger perceptions of performance climate or mastery climate, respectively. The same procedure was followed for all scales.

Attitudes toward doping

Based on Ajzen's (1991) guidelines, we assessed participants' attitudes toward doping by tapping into their positive and negative evaluations of doping use. WADA's (2021) definition for doping was provided, including specific examples of prohibited substances (i.e., Doping is defined as the occurrence of one or more violations of the anti-doping rules in which athletes make use of substances and/or methods included on the Prohibited List in or out of competition. Exemplars of such prohibited substances are hormones, Anabolic-androgenic steroids, and amphetamines). The measure consisted of a stem proposition ("The use of doping substances to enhance my performance this season is ...") followed by four semantic differential evaluative adjectives (bad/good, useless/useful, harmful/beneficial, and unethical/ethical) scored on a seven-point scale. To enhance the internal consistency of this measure (i.e., Omega = 0.59), one item concerning the ethical evaluation of using doping substances was removed (i.e., "The use of doping substances to enhance my performance this season is *unethical/ethical*"); thus, the index of attitudes toward doping comprised the mean score of three items. Higher scores indicated more positive attitudes toward doping use (Omega = 0.66). Acceptable values for estimating internal reliability are normally above 0.70 (DeVellis, 2017). However, according to Hair et al. (2018), values near 0.60 could be regarded as acceptable for short scales (e.g., scales with fewer than ten items).

Perfectionism

The participants' perfectionistic concerns were measured with a contextualized version of the Frost Multidimensional Perfectionism Scale-Brief (F-MPS-Brief; Burgess et al., 2016). Four items assessed perfectionistic evaluative concerns (e.g., "the fewer mistakes I make in my activity, the more people will like me") scored on a five-point scale (from 1 = totally disagree to 5 = totally agree), and higher scores denoting greater concerns

over mistakes. Although the F-MPS-Brief also includes four items assessing perfectionistic strivings (e.g., “I set higher goals for myself in my activity than most people”), this scale was not relevant to the present study as a moderator due to its unrelated relation to doping variable (Hardwick et al., 2022). Thus, only perfectionistic concerns were expected to be associated with doping temptation and therefore used in the present study ($\Omega = 0.78$).

Situational temptation

We measured situational temptation using the scale derived from Lazuras et al. (2015) which reflected the temptation to dope under specific circumstances in which athletes might get involved. Participants were asked to read the statements carefully while thinking about themselves. The stem proposition started “How much would you be tempted to use doping substances to enhance your performance this season?” followed by five prospective situations: “when your coach suggests so,” “when you believe that most colleagues of yours use doping substances,” “when you were told to enhance your performance,” “when you prepare for an important game/competition,” and “when feeling disadvantaged.” The responses were recorded on a five-point scale (from 1 = not at all tempted to 5 = very much tempted), and higher scores indicated greater temptation to dope. Conversely, a lower score denoted a higher capability to resist the temptation of using prohibited substances. This measure was used as an indicator of doping temptation and showed good internal consistency ($\Omega = 0.87$).

Data analysis

Data were analyzed using IBM SPSS Statistics version 28.0 (Armonk, NY: IBM Corp). Little’s Missing Completely at Random test identified 12 (2.9%) participants with missing data that were missing completely at random ($\chi^2 = 34.829$, $df = 48$, $p =$

0.922). Therefore, only values pertaining to the participants with complete data were included in the analyses using listwise deletion.

In assessing moderated mediation, a conditional process analysis was considered the appropriate statistical method (Hayes, 2017). We used PROCESS v4.0 for SPSS macro (model 14), which simultaneously tests performance climate's direct and indirect (via attitudes) effects on doping temptation and whether perfectionistic concerns moderate the indirect relationship. PROCESS estimates different conditional values of the moderator (i.e., perfectionistic concerns) for the indirect effect, and moderated mediation is tested at three levels of perfectionistic concerns; one SD below the mean (i.e., low), the mean (i.e., moderate), and one SD above the mean (i.e., high). If perfectionistic concerns moderate the indirect relationship of performance climate on doping temptation via attitudes, the strength and/or direction of this indirect relationship will change depending on the perfectionistic concerns score (Hayes, 2017).

Hayes (2009) recommends a bias-corrected bootstrapping technique for estimating the conditional indirect effects (in the present study, bootstrapping was set at 10,000 samples). Compared to other mediation methods, bootstrapping has been found to be more robust to non-normal distribution and tends to have greater power to detect significant effects while allowing for the control of covariates. To reveal the conditional indirect effect, PROCESS produces point estimates and bias-corrected confidence intervals (CIs) for the hypothesized conditional indirect effect and point estimates of the remaining direct effect. Conditional indirect effects that do not include zero between the lower and upper bounds (i.e., 95% CI) demonstrate significant moderated mediation. Prior to conducting the analysis, the variables were mean-centred using the statistical technique provided in SPSS, which involves converting them into z-scores. This step

was taken to enhance the interpretation of relationships between variables and reduce potential multicollinearity (Hayes, 2017).

Results

Descriptive statistics, internal consistency, and zero-order correlations

Descriptive statistics, McDonald's omega coefficients, and zero-order correlations for all measures are reported in Table 1. As indicated by the mean values, the table shows that the athletes reported scores above the scale's midpoint for performance climate and low scores for attitudes and doping temptation, whereas the score for perfectionistic concerns was above the midpoint. Zero-order correlations showed that performance climate, attitudes, and perfectionistic concerns were positively associated with doping temptation.

- Tables 1 and 2 [about here].

Main analyses

Overall, the moderated mediation model explained 20% of the total variance in doping temptation (see Table 2). As evidenced by the unstandardized regression coefficients (b), performance climate was a positive significant direct predictor of doping temptation ($b = 0.13$, 95% CI_c = 0.03 to 0.22). Attitudes ($b = 0.28$, 95% CI_{b1} = 0.17 to 0.38), perfectionistic concerns ($b = 0.11$, 95% CI_{b2} = 0.01 to 0.20), and the interaction between attitudes and perfectionistic concerns ($b = 0.14$, 95% CI_{b3} = 0.05 to 0.23) were also positive significant predictors of doping temptation. After controlling for the possible influence of mastery climate and sex, the latter accounted for the variation in attitudes toward doping, indicating differences between females and males. That is, male athletes

had more permissive attitudes toward doping compared with the females ($b = 0.52$, 95% CI = 0.34 to 0.71).

To probe the interaction, conditional indirect effects of performance climate on doping temptation (via attitudes) were tested at three levels of perfectionistic concerns; low ($W = -1.00$), moderate (0.00), and high (1.00). These tests showed that the indirect relationship of performance climate and doping temptation (via attitudes) was significant only in cases of scores for perfectionistic concerns being moderate (effect = 0.05, 95% CI = 0.02 to 0.10) and high (effect = 0.08, 95% CI = 0.01 to 0.16), but not when scores were low (effect = 0.03, 95% CI = -0.02 to 0.07). Pairwise contrasts between conditional indirect effects revealed that there were no significant differences between low, moderate, and high values. Hence, one conditional indirect effect could not be considered more substantial than the other. A visual depiction of the conditional indirect effect of performance climate on doping temptation via attitudes can be seen in figure 2. The slope of the line representing the indirect effect demonstrate how the indirect relationship between performance climate and doping temptation via attitudes changes as perfectionistic concerns change by one unit.

- *Figure 2 [about here]*.

Discussion

The purpose of the present study was to examine the role of contextual and personal antecedents on doping temptation among adolescent athletes. To do so, we used a multi-theoretical model of doping in which we integrated elements from achievement goal theory (Nicholls, 1989), theory of planned behavior (Ajzen, 1991), and the

conceptualization of perfectionistic concerns (Flett & Hewitt, 2014). We tested whether performance climate was directly and indirectly (via attitudes toward doping) related to doping temptation, and whether perfectionistic concerns moderated the attitude-doping temptation relationship. The target group of young elite athletes is of particular importance for doping prevention due to their willingness to accept and take behavioral risks in the service of attaining high level performance (Kristensen et al., 2022).

In line with our first hypothesis, performance climate was positively related to doping temptation both directly and indirectly via attitudes. Interestingly, the covariates mastery climate and sex, did not explain any variance in doping temptation. Our findings add to previous research regarding the relationship between motivational climate and doping by showing that attitudes also play a role in athletes' temptation to doping (Allen et al., 2015; Guo et al., 2021; Kavussanu et al., 2020). Our findings reveal that a performance climate may be directly related to a stronger temptation to dope as well as indirectly by shaping more favorable attitudes toward banned substances. Previous studies have also shown that performance climate positively predicts doping variables similar to doping temptation.

Our findings are in line with those of Kavussanu et al. (2020), in which athletes were more likely to use banned substances when they perceived a performance climate in their team – due to the coach's emphasis on winning at all costs. However, while providing parallel support, our findings do not directly align with the findings of Allen et al. (2015), in which performance climate was unrelated to pro-doping attitudes, whereas perceptions of a mastery climate were negatively related to pro-doping attitudes. The subtle differences in the study of Allen et al. (2015) may be explained by the relatively brief measures of performance and mastery climate subscales and the subsequently low reliability of the two scale scores. Thus, our results highlight the role

of the sporting environment in this relationship and suggest that performance climate and attitudes toward doping operate synergistically to facilitate doping.

In line with our second hypothesis, perfectionistic concerns moderated the indirect relationship between performance climate and doping temptation via attitudes. As can be seen in Figure 2, the slope of the line for the indirect effect corresponds to how much the indirect effect of performance climate on doping temptation via attitudes changes as perfectionistic concerns change by one unit. As such, the indirect relationship is larger among athletes with greater concerns over mistakes and statistically significant only among athletes who are moderate or high in their perfectionistic concerns. For athletes low in perfectionistic concerns, the indirect relationship seemed to dampen. Hence, the results indicate that athletes' overly critical evaluation of themselves might increase their risk of turning to doping. As such, perfectionistic concerns may potentially serve as a predisposing factor for doping temptation.

The current study findings add to previous research on perfectionism and doping. In a recent study, Madigan et al. (2020) examined the relationship between perfectionism and attitudes towards doping and found that perfectionistic concerns were a significant predictor of pro-doping attitudes. More specifically, Madigan and colleagues reported that athletes who exhibited a combination of high concerns and low strivings were most likely to be at risk of doping (Madigan et al., 2020). Overall, our findings indicate that athletes who perceived a predominantly performance climate seemed to report more favorable attitudes toward doping. These permissive attitudes were associated with higher temptation to dope, but more so among athletes with moderate or high concerns about making mistakes.

Implications for practice

The current study's examination of the contextual and personal antecedents associated with doping extends the doping literature and brings important theoretical and practical implications. Results suggest that athletes' perceptions of a performance climate may influence their behavioral beliefs about using banned substances and their temptation to do so. Athletes who experience a heightened pressure to win and outperform others, who believe that using banned substances would lead to more positive than negative consequences, seems more likely to be entangled with the temptation of turning to doping – more so for athletes strongly concerned about making mistakes. Coaches aiming to prevent doping need to understand their important role in influencing athletes, and in their interaction with athletes, they should downplay the importance of winning and provide opportunities to learn from mistakes. Such an approach may also enable athletes to identify with anti-doping beliefs and help them diminish their concerns about mistakes, thus protecting them from being tempted to turn to doping.

Limitations and future research

The current study has some limitations, and the following should be considered when interpreting the study findings. Firstly, the cross-sectional design precludes precedence and causal order by referring to the strength of the relationship between variables. Secondly, the reliability of the attitudes toward doping scale was somewhat low. Therefore, the findings involving this subscale should be interpreted with caution. To provide more robust evidence for causal directions, future research is recommended to use a different study design (e.g., longitudinal or experimental). Finally, to advance our understanding of adolescent athletes' doping temptation, future research should also include other personal variables (e.g., dietary supplement acceptance, moral identity,

and moral values) and investigate potential at-risk populations (e.g., athletic discipline, competition level, age group, sex).

Conclusions

We found that performance climate was positively related to doping temptation both directly and indirectly via attitudes, and the indirect relationship was stronger with higher levels of perfectionistic concerns. Overall, the results help highlight important psychosocial conditions underlying athletes' temptation to turn to doping. In particular, athletes who perceived a performance climate within their sporting environment and believed that the benefits of using prohibited substances outweighed the drawbacks, were more likely to report a stronger temptation to dope. Moreover, this relationship appeared to be more notable among athletes who were moderate or high in their perfectionistic concerns about making mistakes. These results are relevant for those aiming to prevent doping in sports and suggest that reducing a performance climate may be one target point in efforts to protect young athletes from doping temptation. Downplaying winning and punishment for mistakes and guiding athletes towards embracing "perfection in imperfection" through learning from mistakes, may be one recipe for coaches to help athletes refrain from the allure of doping.

Disclosure statement

The authors report there are no competing interests to declare.

Ethical statement

Ethical approval for this study was granted by the Research Ethics Committee of the Norwegian School of Sport Sciences. Participants gave informed consent to take part.

Data availability statement

The data supporting this study's findings are available on request from the corresponding author.

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Table 1.

Descriptive Statistics, Internal Consistency, and Zero-order Correlations (N = 408).

Variables	Mean (SD)	Omega [CI]	1.	2.	3.	4.	5.	6.
1. Performance climate	2.82 (0.87)	0.86 [0.84, 0.88]	-					
2. Attitudes	1.48 (0.89)	0.66 [0.55, 0.78]	.19**	-				
3. Perfectionistic concerns	2.81 (0.99)	0.78 [0.73, 0.81]	.33**	.16**	-			
4. Doping temptation	1.21 (0.50)	0.87 [0.75, 0.92]	.22**	.37**	.20**	-		
5. Mastery climate	3.89 (0.64)	0.86 [0.81, 0.89]	-.21**	-.03	-.08	-.01	-	
6. Sex	0.45 (0.50)	n/a	.03	.27**	.01	.02	-.08	-

Note: Bootstrapped descriptive statistics and zero-order correlation coefficients. 95% confidence intervals for closed-form McDonald's omega in brackets. The possible range of responses is 1–5 for all variables except attitudes (1–7). Sex was treated as a dummy variable and coded as 0 = females, 1 = males. ** $p < 0.01$ (two-tailed).

Table 2.

Model Coefficients for the Conditional Process Model of Performance Climate on Doping Temptation via Attitudes.

Antecedent	Attitudes (M)			Doping temptation (Y)		
	Coeff.	SE	p	Coeff.	SE	p
Performance climate (X)	<i>a</i>	0.18	<0.001	<i>c'</i>	0.13	<0.01
Attitudes (M)	—	—	—	<i>b</i> ₁	0.28	<0.001
Perfectionistic concerns (W)	—	—	—	<i>b</i> ₂	0.11	<0.03
Attitudes (M) × Perfectionistic concerns (W)	—	—	—	<i>b</i> ₃	0.14	<0.01
Mastery climate (C ₁)	0.03	0.05	<0.51	<i>b</i> ₄	0.03	<0.47
Sex (C ₂)	0.52	0.09	<0.001	<i>b</i> ₅	-0.10	<0.29
		R ² = 0.10			R ² = 0.20	
		F(3, 404) = 15.39, <i>p</i> < 0.001			F(6, 401) = 16.17, <i>p</i> < 0.001	

Note: Bootstrapped regression coefficients are reported as unstandardized.

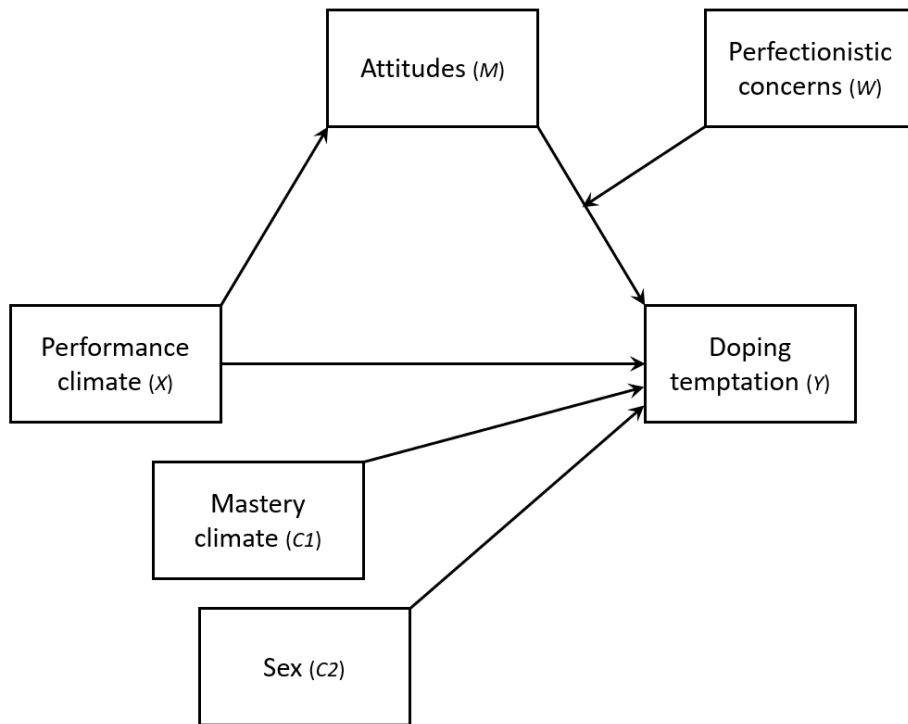


Figure 1.

Conceptual model of the moderated mediation effect of perfectionistic evaluative concerns on the indirect relationships between performance climate, attitudes, and doping temptation with covariates.

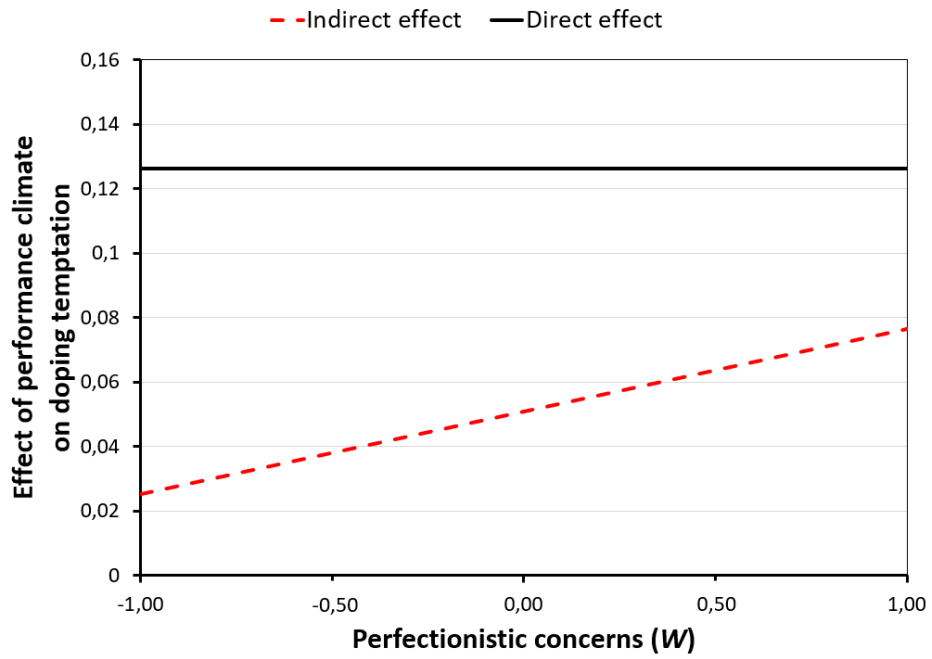


Figure 2.

A visual representation of the conditional indirect and the direct effect of performance climate on doping temptation, with the indirect effect operating through attitudes toward doping.

Paper IV

Kristensen, J. Å., Haugen, T. & Ommundsen, Y. Supplement usage and doping attitudes in elite youth sports: The mediating role of dietary supplement acceptance. Submitted to *PLOS ONE*.

Supplement usage and doping attitudes in elite youth sports: The mediating role of dietary supplement acceptance

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Running title

Supplements and doping attitudes in youth sports.

Abstract

This study investigated whether youth athletes' dietary supplement acceptance mediated the relationship between supplement use and doping attitudes. To this end, we employed a two-wave half-longitudinal design across a sports season (time point 1 [T1] to time point 2 [T2]). The sample consisted of 217 elite youth athletes (47% male; mean age = 16.98 years, standard deviation = 0.88) who competed in team sports (43%; N = 93; basketball, floorball, handball, and ice hockey) and individual sports (57%; N = 124; alpine skiing, biathlon, cross-country skiing, swimming, and tennis). The participants were recruited from eight Norwegian sport academy high schools that provide extracurricular, higher-level training and specialization for youth athletes. Results from structural equation modeling analyses indicated that dietary supplement acceptance (T2) mediated the positive relationship between supplement use (T1) and doping attitudes (T2) when accounting for prior levels of the mediator and outcome variable. These findings suggests that those who report usage of supplements at the start of the season are more likely to view them as acceptable and, in turn, report more favorable attitudes toward doping at the end of the season 6 months later. For those seeking to prevent doping in youth sports, targeting athletes' views on the acceptable use of dietary supplements may be important.

Keywords

Nutrition, performance enhancement, prohibited substances, youth sport athletes

Introduction

For decades, athletes have experimented with various ways to improve performance and recover from injury. Some means and methods are prohibited and banned in sports, collectively called doping, whereas others are considered more or less acceptable. Examples of the latter are dietary supplements, which include various products that have the premise of bringing short-term positive effects to athletes' daily business (1). However, despite the World Anti-Doping Agency's effort to develop, harmonize and coordinate anti-doping rules, athletes' use of doping is still frequently reported – also among young athletes. Due to their desire to enter professional sports and the higher stakes contingent upon their improved performance, young athletes might be particularly prone to doping behaviors (2). It has been suggested that changing athletes' attitudes toward doping may be an important strategy to combat doping by athletes (3).

A large body of literature has proposed several factors that could affect attitudes toward doping (4, 5). One of which is the use of dietary supplements, which has been suggested to elicit more permissive attitudes toward the use of banned substances (6). Recent evidence also highlights the potential importance of athletes' judgments as to whether the use of dietary supplements is acceptable (7). However, to the authors' knowledge, no research has investigated the relationship between supplement use, dietary supplement acceptance, and attitudes toward doping. Over the course of a competitive sport season, young athletes are faced with wear and tear caused by loss, injury, and stress, arguably making them more vulnerable of doping behaviors (2, 8). Hence, the current study, aimed to examine whether the acceptable use of dietary supplements mediates the supplement use and doping attitudes relationship across a sports season in youth sports.

Supplement use in sports

The use of dietary supplements is widespread in sports and often refers to a range of products that are purposefully ingested to enhance performance, promote recovery, and prevent nutrient deficiencies (9). Such products include vitamins, minerals, amino acids, enzymes, creatine, herbs, and other botanicals. In a meta-analysis, Knapik et al. (10) reported that approximately two-thirds (60%) of athletes use a dietary supplement and that the prevalence estimates may vary by elite level and sport. However, if used excessively or incorrectly, dietary supplements may also have the potential to impair athletic performance, damage health, and induce more positive attitudes toward doping (1, 11). With respect to the latter, the notion is that the use of dietary supplements could influence athletes' tendency to feel comfortable taking substances to improve performance, which may elicit more favorable attitudes toward experimenting with stronger and prohibited performance-enhancing substances.

Previous studies have provided support for the positive relationship between supplement use and attitudes toward doping (6, 12, 13). Barkoukis et al. (6) reported that users of dietary supplements held more positive attitudes toward doping compared with nonusers. This tendency was also supported by Backhouse et al. (12), who additionally found that supplement users were more in favor of competing in competitive situations that allowed doping compared with nonusers. Overall, these findings are in line with what is well-established in social cognition research (4), revealing that those who engage in the use of supplements tend to express more permissive attitudes toward the use of prohibited substances. However, such cognitive adaptation may not be fully explained by experimentation with dietary supplements. It has been suggested that judgments on the acceptable use of supplements also might play a part in doping behaviors (7).

Judging the acceptability of using of dietary supplements in sport

The mental processes by which athletes judge how acceptable it would be to use a dietary supplement are believed to be influenced by four different information cues. According to Fruchart et al. (7), the informational cues are reflecting (a) short-term success, (b) health consequences, (c) detectability – the likelihood of a positive doping test due to contamination of a banned substance, and (d) the perceived behavior of others (e.g., the coach, peers, or competitors) and whether they favor using the supplement. Rather than seeking guidance from medical staff who do not appear to be principal advisors, athletes typically rely on coaches as their primary source of information and influence (14). For example, it is possible to state that the higher the expectation for short-term success, the lesser the negative consequences for health and the more favorable the coaches' attitudes, the more likely are athletes to consider using a dietary supplement as acceptable.

Previous findings from Fruchart and colleagues (7) provide valuable insight into athletes' supplement acceptance. In general, adolescent athletes considered the use of a dietary supplement to be more acceptable compared with adult athletes. Accordingly, when the expectation for short-term success were high, the negative consequences for health were perceived as low, and the coach's attitude was favorable, adolescent athletes tended to view supplement use as acceptable. Conversely, adults judged the use of supplement as acceptable only when the negative consequences for health were low. Together, these findings highlight underlying psychological mechanisms which may regulate athletes' judgements on the acceptable use of supplements. The same mechanisms, however, is also believed to influence athletes' performance-enhancement by doping (12, 15).

The present study

Research examining dietary supplements is rich, and sufficient evidence suggests that the use is widespread in sports and that the experimentation with supplements prompt more favorable attitudes toward prohibited substances (10, 12). However, a relative dearth of research has investigated whether dietary supplement acceptance mediates the relationship between supplement use and doping attitudes across a sports season in youth sport. The current study aimed to address this knowledge gap to better understand supplement use as a potential forerunner to attitudes toward doping (16). Providing a better understanding of athletes' position regarding their dietary supplement acceptance may also be a key to prevent supplement users from turning to doping (11). Based on the existing evidence, we hypothesized that athletes' experimentation with supplements as a mean to improve performance would positively predict their dietary supplement acceptance, which in turn, would positively predict more permissive attitudes toward doping (see Figure 1).

Materials and methods

Participants

Using a half-longitudinal design, a purposive sample of participants was recruited from eight Norwegian sport academy schools that provide extracurricular, high-level training and specialization for youth athletes. A total of 598 participants completed an identical package of questionnaires at the start of the season (time point one [T1]); among these athletes, 217 continued to provide data at the end of season (time point two [T2]), reducing the final sample size to 217 participants. Females comprised 53% (N = 115) of the sample and males 47% (N = 102). The participants ranged in age between 15 and 19 years (mean age = 16.98; standard deviation [SD] = 0.88) and competed in team sports (43%; N = 93; basketball, floorball, handball, and ice hockey) and individual sports (57%; N = 124; alpine skiing,

biathlon, cross-country skiing, swimming, and tennis). The participants also reported having participated in organized training sessions in their sport for an average of 9.36 years (SD = 3.07), and most of the participants (86%) invested more than 11 hours in their sport per week. The participants were chosen because of their sports (e.g., similarities related to their physical characteristics and the period of the playing season) and their affiliation with the sport academy schools. The prestigious academies were regulated by competitive auditions and offered both acceleration and enrichment in the chosen sport. Hence, those participating in these schools could be regarded as being among the most ambitious and talented in their age group. The half-longitudinal design was employed as the minimum required to test mediation and the most feasible, requiring only two data collection time points (17).

Fig 1. The hypothesized mediation model for dietary supplement (DS) acceptance in the relationship between supplement use and doping attitudes.

Note: Time point 1 (T1) and time point 2 (T2) were separated by 6 months. Dashed lines represent the autoregressive paths.

Procedure

We recruited the study participants through dialogue with the leaders of the sport academy schools and their respective coaches. Before commencing the study, we sought ethical clearance from the University Ethics Committee of the first author's local institution. The national board of ethics and integrity in research, The Norwegian Centre of Research Data, approved the project prior to its commencement (reference No.: 571848). In collaboration with sports academy representatives, an information sheet was forwarded to the participants and their parents/legal guardians. Written informed consent was obtained from all

participants and parents of participants under 16 years of age, and their confidentiality was ensured. The data were collected using the SurveyXact digital survey tool (18), which stores the data on an encrypted server. In collaboration with the academies, the first author traveled to organize the data collection in separate activity groups, which helped monitor the data collection settings. Participants were also informed that consent could be withdrawn at any point without suffering any detrimental consequences. There were no withdrawals in the current study.

The first data collection began on September 9, 2020, coinciding with the start of the 2020–2021 sports season in Norway. A total of 668 questionnaires were distributed. However, seventy participants did not complete the survey, resulting in an 89.5% response rate ($N = 598$) at T1. We conducted the second data collection about 6 months later, on April 6, 2021, marking the end of the 2020–2021 sports season. Out of the 598 participants at T1, 36.3% ($N = 217$) continued to provide data at T2. A series of independent *t*-tests with bootstrapping was conducted to investigate whether there were any differences between the distribution of observed variables between nondropouts and dropouts at T1 during the season start. The results indicated no significant differences. However, after running a bivariate correlation analysis, some associations differed between the two groups. For those who remained in the study (i.e., nondropouts), the attitudes variable was small and medium associated with supplement use ($r = 0.24, p < 0.01$) and dietary supplement acceptance ($r = 0.41, p < 0.01$) at T1.

In contrast, for those who responded to only the first data collection at T1 (i.e., dropouts), the attitudes variable noted a nonsignificant association with supplement use ($r = 0.09, p = 0.10$) and a small association with dietary supplement acceptance ($r = 0.19, p < 0.01$) at T1. The observed *z*-value supported significant differences in associations between the two groups. Furthermore, it should be noted that the data collection took place during the

COVID-19 lockdown in Norway. During the second data collection, several academies were placed under encompassing stay-at-home orders due to COVID-19 restrictions. This resulted in limited research opportunities and a reduced sample size, primarily due to organizational challenges related to the pandemic.

Measures

All measurements were administered in Norwegian, following the translation-back-translation procedure from English (19). We then tested a pilot version of the questionnaire on three youth athletes aged 16–17 years who gave feedback on the use of language and instructions before administering the survey. Only minor changes were made.

Supplement use

In line with previous research (6), supplement use was measured with a single item (“How often do you use dietary supplements to improve your athletic performance?”). A definition derived from the 1994 Dietary Supplement Health and Education Act (20) including specific examples of supplements was provided and athletes were asked to recall their use over the last month (e.g., Dietary supplement is defined as a product taken orally that contains a dietary ingredient intended to supplement the diet and may be found in many forms such as tablets, capsules, softgels, gelcap, liquids, powders, or bars. Exemplars of dietary supplements are vitamin, protein, creatine, energy drinks). The response options reflected the frequency of supplement use to improve athletic performance and were anchored on a five-point scale, with the options “never,” “rarely,” “sometimes,” “frequently,” and “very frequently.”

The acceptable use of dietary supplements

To assess athletes' views regarding the acceptable use of dietary supplements in sports, we used a hypothetical scenario adapted from Fruchart et al. (7), with some modifications for clarity and conciseness. The scenario corresponds to an actual sports situation and emphasizes literature-based information cues on performance-enhancement in sports: (a) short-term success, (b) health consequences, (c) detectability, and (d) perceived attitudes of important others towards supplement use (e.g., the coach, peers, or competitors).

Jonas is a high-level athlete and member of a renowned national club. He decided to absorb regular doses of PERFORM, a dietary supplement that significantly increases muscular mass and vital capacity. The use of this supplement is not banned, and it is totally undetectable. In the long term, this product has no known negative effects on health. In the short term, it enhances performance and guarantees immediate success. Jonas is encouraged to use this supplement by his coach.

After reading the scenario, participants were asked, "To what extent do you think that the use of PERFORM is acceptable". The participants indicated their responses on a seven-point scale (from 1 = not at all acceptable to 7 = completely acceptable), with a higher mean score indicating a stronger acceptance of using a dietary supplement. As such, the current scenario offers insight into athletes' acceptance of "clean" performance-enhancing substances. The use of scenarios has been shown to be valid in sports contexts (13, 21).

Attitudes toward doping

Based on Ajzen's (22) recommendations, attitudes toward doping use were measured with the stem position "The use of doping substances to enhance my performance this season is ..." followed by four semantic differential evaluative adjectives (bad/good, useless/useful, harmful/beneficial, and unethical/ethical) scored on a seven-point scale. A mean score was

calculated, with higher scores reflecting more positive attitudes toward doping use. During the data collections, participants were also provided with WADA's (23) definition for doping, including exemplars of prohibited substances (i.e., Doping is defined as the occurrence of one or more violations of the anti-doping rules in which athletes make use of substances and/or methods included on the Prohibited List in or out of competition. Exemplars of such prohibited substances are hormones, Anabolic-androgenic steroids, and amphetamines). The Omega coefficients (24) for the scale in this study were 0.78 and 0.76 in the first and second waves, respectively, indicating acceptable internal reliability (25). This scale has been shown to be reliable and valid in several studies related to doping behaviors (15, 26).

Data analysis

A combination of statistical methods was used to analyze the data. IBM SPSS Statistics version 28.0 (Armonk, NY: IBM Corp) was used to compute the descriptive statistics, reliability, and correlations. There were no outliers, and missing data on observed variables ranged from 0% to 3.7%. The result of Little's test of missing completely at random was nonsignificant (chi-square = 1.42, df = 13, $p = 1.00$). Therefore, only the values pertaining to the participants with complete data were included in the analyses (listwise deletion). *Mplus* version 8.5 (27) was used to examine the final mediation model. To determine model fit, we relied on common goodness-of-fit indices, including the chi-square test, comparative fit index (CFI), Tucker–Lewis's index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). According to Geiser (28), a good fit is indicated by CFI and TLI values close to or greater than 0.90 and RMSEA and SRMR values less than 0.08. A priori power analysis for structural models was conducted (29), recommending a minimum of 140 participants to reach a power level of 0.8 to detect an anticipated effect size of 0.3 at an alpha level of 0.05, with 2 latent variables and 11 observed

variables. However, in line with Hayes's (30) critique related to the estimation of the interaction of latent variables and the sample size of the current study, which could be regarded as low for latent variables modeling ($N = 217$), manifested variables were used in the structure model to ensure sufficient statistical power (31).

We used structural equation modeling (SEM) and the maximum likelihood estimation with standard errors (ML) to test the half-longitudinal model (depicted in Figure 2). In line with Little (17), we accounted for prior levels of the mediator and outcome variables to isolate the change variance. The primary paths of interest were the relationship between the predictor and the mediator, controlling for prior levels of the mediator (path a), and the relationship between the mediator and the outcome (path b), controlling for prior levels of the outcome. Assuming stationarity, the product of ab is an estimation of mediation, which was created for the mediator (i.e., dietary supplement acceptance) using the model constraint command in *Mplus* (27). The paths of interest were also explored using a bootstrapping procedure (32). Bootstrapping generates an empirical representation of the sampling distribution (in the present study, 10,000 samples were drawn) and estimates the indirect effects in each resampled data set. Compared with other mediation methods, bootstrapping has been found to be more robust to non-normal distribution and tends to have greater power to detect significant effects while allowing for the control of covariates (33).

Given the differences in doping behaviors among females and males (5), we included sex as a covariate. As participants were recruited from eight different sport academy high schools, the possibility of clustering effects existed at the school level. Running multilevel SEM with a small number of clusters (< 30) may have led to biased estimates of the between-level standard errors and was therefore discarded (34). Thus, to handle the shared variance between the academies, we employed a method that accounts for the nested data by adjusting

standard errors and goodness-of-fit model testing (35). This was done by specifying Type = Complex in *Mplus*.

Results

Descriptive statistics and correlations

Table 1 presents descriptive statistics and correlations among all study variables for the total sample. As indicated by the mean values, at each wave, participants reported a low score for doping attitudes and a score below the midpoint for dietary supplement acceptance. The participants also reported a score below the midpoint for supplement use, indicating extensive use of supplements at season start. Prevalence estimates of the total sample showed that approximately two-thirds of participants (65%; $N = 140$) engaged in the use of supplements to improve performance. Of those, the majority reported the frequency of supplement use as rarely (51%; $N = 72$), sometimes (34%; $N = 48$), and frequently (11%; $N = 15$). Only a small number of participants indicated their use as very frequent (4%; $N = 5$). Although most participants reported supplement use, 77 (35%) respondents did not engage in such use to improve their performance (e.g., nonusers).

Furthermore, there was also a change in the respective mediator and outcome variables during the sports season. Paired sample *t*-tests revealed a statistically significant increase in the scores for dietary supplement acceptance from the season start to the season end ($M\Delta = 0.32 \pm 0.18$, $t(208) = -2.26$, $p < 0.05$, 95% CI: [-0.58, -0.04], Cohen's *d* effect size = 0.15). However, no statistically significant increase in doping attitudes was found ($M\Delta = 0.05 \pm 0.01$, $t(208) = -1.51$, $p = 0.13$, 95% CI [-0.13, 0.02], $d = 0.07$). Zero-order correlations showed that doping attitudes at the end of the sports season were positively correlated with dietary supplement acceptance (Pearson effect size correlation $r = 0.42$) and self-reported supplement use ($r = 0.37$) at the start of the season. In addition, a significant

correlation was found between doping attitudes and dietary supplement acceptance ($r = 0.47$) at the end of the season. Together, these findings suggest that athletes who frequently used supplements at the season start were more likely to view their use as acceptable and, in turn, report more favorable attitudes toward doping at the season end.

Table 1. Descriptive statistics and bivariate correlations for all variables across time (n = 209).

Variables	M (SD)	1.	2.	3.	4.	5.	6.
1. Supplement use (T1)	2.07 (1.03)	-					
2. DS acceptance (T1)	2.78 (2.01)	0.28**	-				
3. DS acceptance (T2)	3.10 (2.18)	0.32**	0.55**	-			
4. Doping attitudes (T1)	1.33 (0.68)	0.24**	0.43**	0.35**	-		
5. Doping attitudes (T2)	1.38 (0.68)	0.24**	0.44**	0.42**	0.71**	-	
6. Sex	1.53 (0.50)	-0.18**	-0.23**	-0.28**	-0.31**	-0.23**	-

Note: Bootstrapped descriptive statistics and zero-order correlations generated from the sample of 217 athletes who contributed to the first and second data collections. The possible range of responses is 1–7 for all variables except supplement use (1–5). Sex was coded as 1 = males, 2 = females. DS acceptance, Dietary supplement acceptance; T1, time point 1/season start; T2, time point 2/season end; ** $p < 0.01$ (two-tailed).

Testing the hypothesized mediation model

The main aim of the present study was to examine whether a change in dietary supplements acceptance mediates the effects of supplement use at season start on doping attitudes at the end of the sports season. The structural model generated for this purpose (see Figure 2) revealed an acceptable fit to the data $\chi^2(1) = 1.50, p = 0.22, RMSEA = 0.05, 90\% CI [0.00,$

0.20], CFI = 1, TLI = 0.98, and SRMR = 0.02. As shown in Figure 2, the use of supplements predicted the perceived acceptability of using dietary supplements at T2 ($\beta = 0.15$, 95% CI_a: 0.05, 0.25) while controlling for T1 levels of the mediator and the covariate sex ($\beta = -0.15$, 95% CI: -0.25, -0.05). Furthermore, a significant temporal link emerged between dietary supplement acceptance at T1 and doping attitudes at T2 ($\beta = 0.16$, 95% CI_b: 0.05, 0.28) while controlling for T1 levels of the outcome and sex ($\beta = 0.01$, 95% CI: -0.06, 0.08).

To probe the mediation, the product ab was created to explore how supplement use influences doping attitudes through dietary supplement acceptance. The product ab was statistically significant and different from zero ($\beta = 0.07$, 95% CI_{ab}: 0.01, 0.14), indicating that dietary supplement acceptance (i.e., the mediator) operate to facilitate the relationship between supplement use and doping attitudes. In addition, the autoregressive effects of dietary supplement acceptance ($\beta = 0.47$, 95% CI: 0.36, 0.58) and doping attitudes ($\beta = 0.62$, 95% CI: 0.51, 0.73) were sizable, suggesting reasonable stability of these constructs over time, with T1 measures being predictive of corresponding T2 levels. No significant direct path (i.e., c' path) between supplement use and doping attitudes at T2 were found ($\beta = 0.03$, 95% CI_{c'}: -0.07, 0.13). For more information related to the computer syntax [*Mplus*] for the hypothesized mediation model, please see Supplementary Material.

Fig 2. The half-longitudinal mediation model for dietary supplement (DS) acceptance in the relationship between supplement use and doping attitudes.

Note: Time point 1 (T1) and time point 2 (T2) were separated by 6 months. Dashed lines represent the autoregressive paths. For ease of presentation, only significant ($p < 0.05$) standardized parameter estimates for the structural model are presented, and the covariate sex is not shown in the diagram.

Discussion

The aim of the present study was to test a half-longitudinal mediation sequence model in which the acceptable use of dietary supplements was hypothesized to mediate the relationship between supplement use and pro-doping attitudes. Our target group of athletes is of particular importance due to two main reasons. Firstly, they serve as a stepping stone to getting into professional sports. Secondly, they have a high prevalence of supplement use, which is associated with the strive for good performance. This combination makes them more prone to the likelihood of health risks from doping (2, 10).

The results showed a mediated sequence of relations between predictor and outcome: an indirect relationship between supplement use and doping attitudes through the acceptability to use dietary supplements. As shown in Figure 2, supplement use was related to dietary supplements acceptance, which in turn, was related to pro-doping attitudes. In statistical terms, the half-longitudinal model holds promise by demonstrating that the use of supplements predicts residual changes in dietary supplement acceptance when accounting for prior levels of the mediator, and dietary supplement acceptance predicts residual changes in doping attitudes when accounting for prior levels of the outcome (17). These findings suggest that supplement use at the season start was related to higher acceptability to use dietary supplements, which in turn, was related to more favorable attitudes toward doping at the season end 6 months later.

Several studies have contributed to the doping literature and understanding of the supplement use and pro-doping attitudes relationship (6, 13). Barkoukis et al. (6) investigated the complex relationship between supplement use and doping behaviors and found that supplement users become more favorable toward doping use, prior engaging with this behavior. Additionally, Hurst et al. (13) found that supplement use could lead athletes to beliefs about their effectiveness and favor more positive attitudes toward the use of

prohibited substances – possibly due to perceived performance enhancement. Our findings add to the existing research by showing that dietary supplement acceptance mediate the relationship between supplement use and doping attitudes. It appears that experimentation with supplements aiming to improve performance may lead athletes to view dietary supplements as more acceptable, which in turn, might elicit more permissive attitudes toward experimenting with prohibited substances.

As can be seen in the path diagram (see Figure 2), the autoregressive effects of dietary supplement acceptance and doping attitudes were sizable, indicating reasonable stability of the constructs across the season (36). However, when inspecting the two autoregressive coefficients, dietary supplement acceptance appeared to be the construct that fluctuated more. While psychological constructs are often thought to be stable and enduring over time, some researchers favor the view that they are adaptive reactions to environmental demands (37, 38). According to Schwarz (38), attitudes are context-specific judgments constructed from currently accessible information. Given the varied phases encountered across a sport season, the wear and tear caused by loss, injury, and stress may influence athletes' judgments to use supplements to a greater or lesser extent (8). Consequently, in these situations, athletes may view their means as more acceptable and express more positive attitudes toward prohibited substances. Nevertheless, more knowledge of the temporal patterns of dietary supplement acceptance and doping attitudes in sports is needed (39).

Contrary to expectations, we did not observe a significant direct path between supplement use at season start and doping attitudes at season end. According to previous research (6), dietary supplement use would be expected to facilitate attitudes toward doping. However, prior research has also encountered challenges in establishing a direct path to doping attitudes (13). When residualizing the mediator and outcome variable, there is a less room left for unexplained variance by the predictor (i.e., supplement use), making significant

longitudinal links challenging to discern (40). The sizable autoregressive coefficients herein signify a relatively small amount of residual change to be predicted, which may explain the nonsignificant direct path between supplement use and doping attitudes. Hence, the absence of a direct effect of supplement use on doping attitudes underline the significance of athletes' acceptance of dietary supplements as a potential explanatory mechanism for the link between supplement use and doping attitudes.

When studying the descriptive statistics in Table 1, mean levels indicated an increase in dietary supplement acceptance and doping attitudes from season start to season end; thus, the change was more substantial in dietary supplement acceptance. Notwithstanding the small effect sizes of dietary supplement acceptance and attitudes, as indicated by Cohen's d (41), these findings suggest that participants viewed dietary supplements as more acceptable and judged the use of prohibited substances (i.e., attitudes toward doping) as more positive at the end than at the start of the season. However, due to the low mean in doping attitudes scores of the young athletes, their attitudes indicated vehement rejections of doping. The use of dietary supplements to increase the level of athletic performance in the present study sample appears to be in line with that of the general and collegiate population of similar age (10).

Methodological issues and directions for future research

Even though interesting results emerged from the present study, the following limitations should be considered when making inferences. First, we made use of a half-longitudinal design, which assumes stationarity between the mediator and outcome at additional time points and precludes directionality between variables based on a theoretical assumption (42). It would be enlightening to replicate our findings using a full longitudinal mediation model with at least three time points to estimate a more rigorously estimated indirect pathway across the time spans (17). Given the pace of change in the variables, using a sporting season would

seem reasonable. However, to detect changes in doping attitudes, allowing longer intervals accompanied by a model that bears theoretical promise could also be prudent. Second, due to the small number of clusters in the present study sample, we could not perform multilevel analyses. Therefore, future research is encouraged to approach the data analysis through multilevel SEM using a two-level rather than a traditional single-level model. Finally, the current study's data collections were performed during the COVID-19 lockdown in Norway, which dramatically reduced the sample size. Due to COVID-19 restrictions, athletes' competitive season were shortened, resulting in a reduced number of season's games. The potential impact of being in lockdown during the study could also have impacted athletes' supplement use, and potentially, their acceptability to use dietary supplements and their doping attitudes. Collecting data is never easy, and future researchers should be aware of the potential pitfalls when collecting and analyzing longitudinal data (43).

Conclusion

This study aimed to investigate the relationship between supplement use and doping attitudes in youth sports. Previous research has mainly consisted of cross-sectional investigations, including beliefs about the effectiveness of dietary supplements and psychosocial trends among supplement users and nonusers (6, 13, 16). However, to our knowledge, no previous research has examined the mediating role of dietary supplement acceptance in a prospective relation between supplement use and doping attitudes. Aiming to deal with this shortcoming, our results revealed that supplement use was related to the residual change in dietary supplement acceptance, which in turn predicted residual changes in doping attitudes. These findings indicated that when young athletes used supplements at the start of the season in an effort to improve performance, they were more likely to view the use of dietary supplements as acceptable and, in turn, to report more favorable attitudes toward doping at the end of the

season 6 months later. The results from the current study add to the existing research and underline the potential risk of experimenting with supplements. Although athletes commonly use supplements to enhance performance, frequent usage may increase the risk of developing more positive attitudes toward doping by influencing athletes' acceptance of using dietary supplements. Therefore, targeting young athletes' views on the acceptable use of dietary supplements may be important for those seeking to prevent doping – especially for those athletes who already have incorporated supplements into their daily routine.

Endnotes

The structural model was also analyzed using latent variables. In line with the reported priori power analysis, we performed the SEM analysis with 2 latent variables and 11 observed variables. However, the model did not fit the data well $\chi^2(44) = 150.88, p < 0.001$, RMSEA = 0.11, 90% CI [0.09, 0.13], CFI = 0.86, TLI = 0.79, and SRMR = 0.07. Exploring and comparing results for structural paths of the latent model and the manifested model showed that some paths estimates differed slightly. Importantly, the *b* path and *ab* product were found to be nonsignificant in the latent structural model. With these considerations in mind, as well as critique raised by Haye's (30) concerning the estimation of the interaction of latent variables and sample size of the current study, we proceeded with a structural model using manifested variables.

Competing interests

The authors have declared that no competing interests exist.

Data availability statement

The data supporting this study's findings are available without restriction.

Ethical statement

Ethical approval for this study was granted by the Research Ethics Committee of the Norwegian School of Sport Sciences. Participants provided written informed consent to take part in the study.

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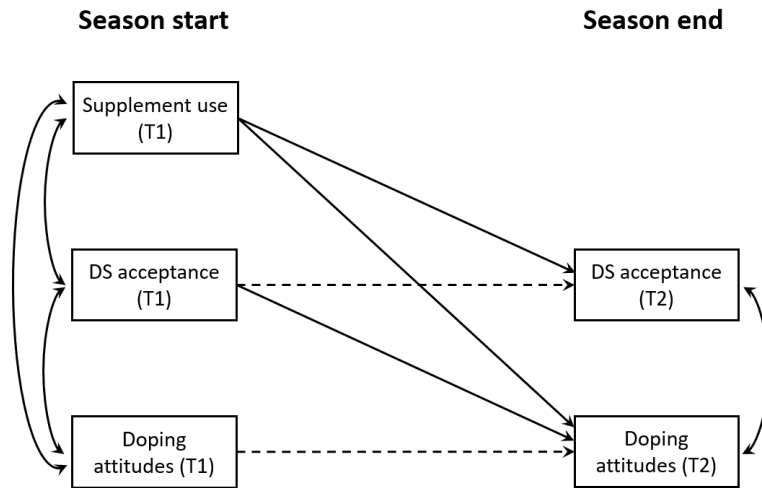


Fig 1. The hypothesized mediation model for dietary supplement (DS) acceptance in the relationship between supplement use and doping attitudes.

Note: Time point 1 (T1) and time point 2 (T2) were separated by 6 months. Dashed lines represent the autoregressive paths.

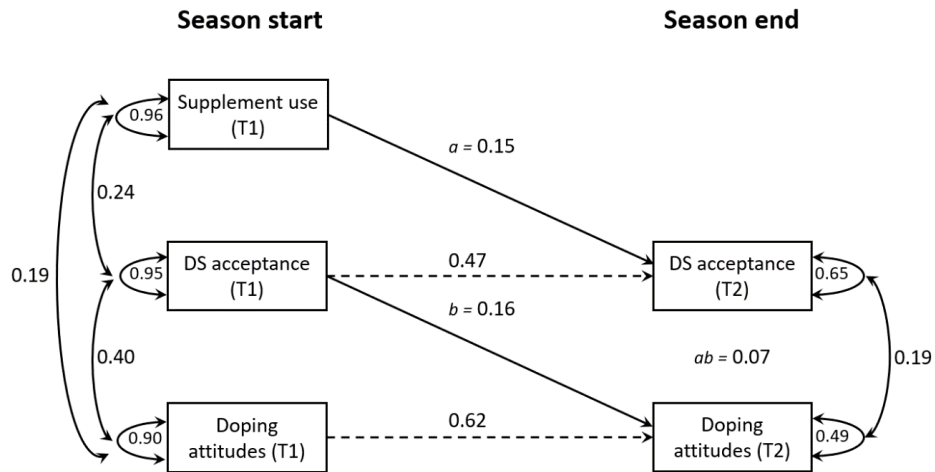


Fig 2. The half-longitudinal mediation model for dietary supplement (DS) acceptance in the relationship between supplement use and doping attitudes.

Note: Time point 1 (T1) and time point 2 (T2) were separated by 6 months. Dashed lines represent the autoregressive paths. For ease of presentation, only significant ($p < 0.05$) standardized parameter estimates for the structural model are presented, and the covariate sex is not shown in the diagram.

Appendix B: Ethical approval from the Research Ethics Committee of the Norwegian School of Sport Sciences.

Ethical approval from the Research Ethics Committee of the
Norwegian School of Sport Sciences

Application 144 – 180620 Health risk practices among ambitious Norwegian youth athletes

We refer to your application, project description, information letter, questionnaires, and the submitted notification to the Norwegian Center of Research Data (NSD).

In accordance with the guidelines for the ethical committee for human research in sports science, during the committee's meeting on June 18, 2020, the following conclusions were reached:

Assessment

The committee wishes to emphasize that consent must be explicit. This means that participants should be provided with all relevant information necessary for informed and voluntary consent. In the presented questionnaires, it is apparent that research participants will also be asked to provide assessments regarding third parties in the training environment (coaches, parents, other athletes, etc.) concerning sensitive topics such as the use of prohibited performance-enhancing substances. In the committee's view, this is relevant information that should be included in the consent forms and in the information provided to clubs/schools. The committee also deems it important that the consent forms inform about how data collection is planned to be organized, referring here to the application and what is specified regarding the use of designated locations such as classrooms or clubhouses.

Furthermore, the committee notes that for individuals under the age of 16, two consent forms must be prepared: one for the guardians and one for the participants. It is also pointed out that for participants between 16 and 19 years old, parents do not have the right to review the questionnaire in advance. The committee reminds that the supervisor should be listed as the project leader (project manager) in the relevant project's consent forms.

The committee also wishes to emphasize that the data is of sensitive nature, and confidentiality must be ensured. Therefore, the committee recommends that the project leader contacts the ICT head for an assessment of the choice of data collection system and secure storage during the project period.

Decision

Based on the provided documentation, the committee finds that the project is ethically sound and can be conducted within the framework of recognized ethical norms as laid out in the Norwegian School of Sport Sciences (NIH) guidelines. The committee has based its decision on the following conditions:

- Compliance with NSD requirements
- Updating of consent forms for participants and information letter for club/schools in accordance with the committee's comments, to be sent to the committee for information
- The ICT head performs an evaluation of data confidentiality in the project

The committee would like to emphasize that the decision is based on the presented documentation. If significant changes are made to the project that may have implications for participants' health and safety, these changes must be presented to the committee before they can be implemented.

Regards



Professor Anne Marte Pensgaard
Head of the ethics committee, Norwegian School of Sport Sciences

Appendix C: Letters of support from the Norwegian Ice Hockey Association and Anti-Doping Norway (in Norwegian)

Support letter from the Norwegian Ice Hockey Association



Oslo, 24. juni 2020

Vedr. forsknings-prosjektet: Ungdomsidretten – et sunt prestasjonsmiljø

Norges ishockeyforbund vil alltid ønske seg mest mulig kunnskap om vår idrett og våre utøvere. Når forskere ønsker å se nærmere på en utfordring innen idrett generelt, men som også berører ishockey spesielt, synes vi det er viktig å stille opp.

Utøvernes helse må alltid ha første prioritet, og undersøkelser som dette kan enten være med på å avdekke forhold som vi må løse, eller representere et potensial for å styrke helsen til våre ungdommer. NIHF ser viktigheten av begge deler.

For å oppnå dette er det vesentlig at utøverne selv bidrar med informasjon om hvordan de opplever hverdagen. Vi håper derfor både ishockeyspillere og klubber stiller seg positive til å gi sitt bidrag slik at undersøkelsen blir så bra som mulig.

Med sportslig hilsen
NORGES ISHOCKEYFORBUND

Petter Salsten
Sportssjef

Support letter from Anti-Doping Norway



Til rette vedkommende

Vår ref. 20-00235
Oslo, 27. april 2020

Sunne prestasjonsmiljøer i ungdomsidrett

Ny kunnskap er nødvendig for å videreutvikle antidopingarbeidet. For å oppnå dette, er det viktig at norske undervisnings- og forskningsinstitusjoner utfører forskning som er relevant for antidopingarbeidet, både innen idretten og i det som berører folkehelsefeltet.

I 2019 inngikk Antidoping Norge et forskningssamarbeid med Norges Idrettshøgskole knyttet til forebyggende arbeid, medikalisering og doping i ungdomsidretten. Prosjektet *Helserisikopraksis blant ungdomsutøvere* er en del av dette samarbeidet.

For å lykkes i det forebyggende antidopingarbeidet er det sentralt å ha en god forståelse av hvilke faktorer som kan bidra til dopingbruk, og hvilke faktorer som kan bidra til å beskytte mot slik atferd. Samtidig ser vi med bekymring på en medikalisering av deler av idretts- og treningskulturen. Prosjektet *Helserisikopraksis blant ungdomsutøvere* vil kunne gi nyttig kunnskap i disse problemstillingene, og blant annet bidra til å gjøre Antidoping Norges forebyggende arbeid enda mer relevant og målrettet i fremtiden.

For at forskningsresultatene skal ha en god overføringsverdi til vårt praktisk arbeid, er det viktig med representativ deltakelse og høy svarprosent. På vegne av Antidoping Norge håper jeg derfor at du ønsker å delta i denne undersøkelsen. Sammen kan vi legge til rette for en dopingfri idrett og et sunt treningsmiljø.

Med vennlig hilsen

Fredrik Lauritzen
Avdelingsleder forebygging og folkehelse
Antidoping Norge

