European Journal of Sport Science

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tejs20

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To cite this article: Andrea Ballesio, Mariacarolina Vacca, Valeria Bacaro, Adriano Benazzi, Paola De Bartolo, Fabio Alivernini, Fabio Lucidi, Caterina Lombardo & Chiara Baglioni (2021): Psychological correlates of insomnia in professional soccer players: An exploratory study, European Journal of Sport Science, DOI: 10.1080/17461391.2021.1892197

To link to this article: https://doi.org/10.1080/17461391.2021.1892197

Published online: 23 Mar 2021.

EUROPEAN JOURNAL OF SPORT SCIENCE
https://doi.org/10.1080/17461391.2021.1892197

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Psychological correlates of insomnia in professional soccer players: An exploratory study

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ABSTRACT
Sleep promotes health, well-being, recovery and athletic performance. As a consequence, sleep problems in athletes may have detrimental effects. Previous investigations showed that professional athletes often reported to suffer of poor sleep quality and insomnia (e.g. difficulties falling asleep and/or maintaining sleep). However, psychological variables exacerbating and maintaining insomnia in professional athletes as well as its mechanistic pathways are still largely unknown. Available literature mostly focused on effects of sport-related variables, such as evening training and stimulant consumption on athletes' sleep. Instead, the contribution of cognitive and emotional variables globally associated with insomnia in athletes in clinical models has been largely neglected. To address these limitations, this study explored the associations between emotional experience, pre-sleep arousal, pre-sleep worry and rumination and insomnia severity in a sample of 210 (25.93 ± 6.68 years) male professional soccer players. Bivariate correlations, multiple regression, and structural equation modelling with manifest variables (path analysis) were computed. Results showed that insomnia severity was associated with stimulants consumption, pre-sleep arousal, negative emotions, positive emotions, and pre-sleep worry/rumination (all $p < .05$). Path analysis showed that relationship between stimulant consumption, emotional experience, worry/rumination and insomnia was mediated by pre-sleep arousal ($p < .05$). Our results suggest that preventive and interventional studies in professional soccer players would benefit from considering global cognitive-emotional variables as targets of interventions.

KEYWORDS
Exercise; health; performance

Highlights

- Insomnia was associated with greater stimulants consumption, pre-sleep arousal, negative emotions, pre-sleep worry/rumination, and lower positive emotions.
- Path analysis showed that pre-sleep arousal mediated the relationship between stimulant consumption, emotional experience, worry/rumination and insomnia severity.
- Cognitive-emotional and behavioural factors as well as sport-related variables were important predictors of insomnia in professional soccer players.

Sleep is essential for human health and athletic performance (Nèdèlec, Halson, Abaidia, Ahmaidi, & Dupont, 2015). However, studies involving actigraphic measures in professional athletes report on average sleep efficiency of 80% (Gupta, Morgan, & Gilchrist, 2017), indicating poor sleep quality. Evidence on sleep duration is mixed. For instance, according to Gupta et al. (2017), sleep duration of professional athletes is in line with the international recommendations, i.e. 7.5 h, while a recent systematic review and meta-analysis showed that athletes are often unable to achieve more than 7 h of sleep per night and sleep efficiency ≥85% during nights before training and/or competition (Roberts, Teo, & Warmington, 2019). Furthermore, around 80% of professional athletes complain of insomnia symptoms in the pre-competition period (Silva & Paiva, 2016), with several stressors potentially exacerbating and maintaining players' sleep problems, including the habits of performing at night and subsequent incongruency between performance and circadian rhythms (Nèdèlec et al., 2015).

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Insomnia, in both its acute and chronic manifestations, is a disabling condition associated with fatigue, mood instability, cognitive impairments and high economic costs and it is defined as the presence of a disturbance of nocturnal sleep and related daytime impairment that has to occur at least three nights a week over a period of three months (American Academy of Sleep Medicine, 2014). Insomnia symptoms as measured by self-reported questionnaires are complained by up to 70% of professional athletes and are common in both individuals and team sports (Silva & Paiva, 2016; Gupta et al., 2017).

As stated above, previous studies mainly focused on sport-related behavioural predictors of insomnia that could affect sleep quality and quantity. Less is known about global behavioural, cognitive and emotional factors in professional football players which are considered as predisposing and/or maintaining factors on insomnia in influential psychophysiological models (e.g. Espie, Broomfield, MacMahon, Macphee, & Taylor, 2006; Harvey, 2002; Perlis, Giles, Mendelson, Bootzin, & Wyatt, 1997).

Particularly, according to cognitive models of insomnia (e.g. Espie et al., 2006; Harvey, 2002), emotional reactivity and negatively toned cognitive activity (e.g. pre-sleep rumination and worry) would perpetuate insomnia via the increase of pre-sleep psychophysiological arousal (i.e. increase in autonomic activity). Similarly, the concept of pre-sleep arousal as a perpetuating factor of insomnia is present in the neurocognitive model of insomnia by Perlis et al. (1997), where attention is given to pre-sleep cortical arousal as the strongest perpetuating factor of the disorder. Notably, these factors may be particularly relevant for professional athletes. For instance, athlete often experience performance worries (Oudejans, Kuipers, Kooijman, & Bakker, 2011), which may increase cognitive and psychophysiological arousal which may, in turn, inhibit sleep (Harvey, 2002). In a cross-sectional study conducted in a sample of 283 elite Australian athletes emerged that difficulty falling asleep due to competition-related thoughts and due to nervousness was the mostly complained sleep problem (Juliff, Halson, & Peiffer, 2015). However, the different associations between pre-sleep worry about life events and performance-related worry and sleep are still unknown. Moreover, professional athletes often report increased negative emotions (Onate, 2019) which may contribute to poor sleep (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010).

Considering the previous evidence, the aim of the present study is twofold. First, we aim to explore the potential behavioural (e.g. stimulants consumption, naps, and late-night training), cognitive (e.g. rumination/worry, pre-sleep cognitive arousal) and emotional (e.g. positive and negative emotional experience) perpetuating factors of insomnia symptoms in a sample of professional male soccer players. Second, based on aforementioned literature on insomnia in elite athletes and global psychophysiological models of clinical insomnia, we aim to explore whether behavioural (stimulants consumption, naps and late-night training) and cognitive-emotional factors (rumination/worry, emotional experience) may predict insomnia through the mediation of pre-sleep arousal. Professional soccer players have been previously detected as at risk for disturbed sleep. For instance, Khalladi et al. (2019) recently found that 68.5% and 27% of Qatar Stars League soccer players complained poor sleep quality and insomnia symptoms, respectively. We hypothesised that significant relationships between behavioural, cognitive and emotional factors and insomnia would be found. Specifically, we hypothesised that insomnia would be positively associated with negative emotions, pre-sleep arousal, stimulants consumption, late evening training and daytime napping, and negatively associated with positive emotions. Moreover, we hypothesised that the associations between insomnia and emotional experience, pre-sleep worry and rumination, stimulants consumption, late evening training and daytime napping would be mediated the effect of pre-sleep arousal.

Materials and methods

Participants

A convenient sample of 210 unselected male soccer players (25.93 ± 6.68 years) of Italian serie A, B, C and D category was recruited from the Italian Association of Soccer Players "Associazione Italiana Calciatori, AIC". Potential participants were informed by a legal representative of the AIC about the ongoing study and completed an informed consent sheet before being enrolled in the study.

Procedure

This was an observational study with a cross-sectional design. Participants were recruited from April to June 2019. Questionnaires were completed in group sessions right after training using tablets and smartphone and administered through the platform SurveyMonkey (http://surveymonkey.com). SurveyMonkey is an electronic survey administration system that is increasingly being used in social science research (Massat, McKay, & Moses, 2009). Privacy of the participants is guaranteed as the system generates a personal code for each completer respecting the agreement of the Helsinki

Declaration. Questionnaire took about 30 min to be completed. The scoring of the questionnaire was performed by the first and the third authors. The study was approved by the Ethics Committee of the Faculty of Educational Science, University of Rome "G. Marconi"- Telematic.

Measures

Insomnia symptoms. The Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001) is a brief self-report instrument measuring the severity of night-time and daytime symptoms of insomnia in the previous two weeks. Scores range from 0 (insomnia absent) to 28 (very severe insomnia), with 7 as the cut-off for identifying individuals with subthreshold insomnia and 14 individuals with clinical insomnia. This instrument was previously used to assess insomnia symptoms in elite athletes (e.g. Kahallidi et al., 2019). Cronbach's alpha of the ISI in our sample was .77.

Pre-sleep arousal. The Pre-Sleep Arousal Scale (PSAS; Nicassio, Mendlowitz, Fussell, & Petras, 1985) is a 16-item items each rated on a five-point scale assessing pre-sleep symptoms of arousal. Eight items evaluate cognitive arousal (e.g. "Being mentally alert, active") and eight evaluate somatic arousal (e.g. "Heart racing, pounding, or beating irregularly"), with higher scores indicating higher pre-sleep arousal. Cronbach's alpha of the PSAS in our sample was .85.

Emotional experience. The Positive Affect Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) is a widely used self-report questionnaire assessing negative (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid) and positive emotions (interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, active). Participants were asked to rate the intensity of twenty emotions in the previous months. By summing the scores of positive and negative emotions separately, the PANAS allows to obtain two subscales: PANAS-negative emotions and PANAS-positive emotions. Cronbach's alpha of the PANAS in our sample was .87 for the positive emotions subscale and .84 for the negative emotions subscale.

Pre-sleep worry and rumination. To assess the presence of pre-sleep worry and rumination we administered two items of the Athlete Sleep Behavior Questionnaire (ASBQ, Driller, Mah, & Halson, 2018) that assessed sleep habits and behaviour in athletes. The first item ("I think, plan and worry about issues not related to my sport when I am in bed") aimed to assess pre-sleep general worry and rumination; the second item ("I think, plan and worry about my sporting performance when I am in bed") aimed to assess sport-related pre-sleep worry and rumination. Participants were asked to rate each item on a five-points scale ranging from 0 = Never to 5 = Always.

Sport-related factors. To assess the role of specific sport-related factors previously evidenced as risk factors for athletes' insomnia and professional football players (e.g. stimulants consumption, late-night training, napping, Gupta et al., 2017; Nèdèlec et al., 2015), participants were asked to answer the following items adapted from the ASBQ (Driller et al., 2018):

(1) Daytime nap: "I take afternoon naps lasting two or more hours";
(2) Stimulants: "I use stimulants when I train/compete (e.g. caffeine)";
(3) Night-time training: "I exercise (train or compete) late at night (after 7pm)".

Participants were asked to rate each item on a five-point scale ranging from 0 = Never to 5 = Always. Moreover, to quantify the amount of training in the previous month, participants were asked to indicate the number of hours spent per week to train or compete in the last month.

Data analysis

Statistical analysis was computed using IBM SPSS 24 and Mplus software version 8.2 (Muthén & Muthén, 1998–2017). Data were checked for normal distribution (skew absolute value < 2 and kurtosis absolute value <7; Chou & Bentler, 1995). Descriptive analysis of the sample was performed, and all values were reported as means and standard deviations.

Aim 1: sport-related and psychological predictors of insomnia

To achieve this aim, bivariate correlation and multiple regression analyses were computed. In the regression model, scores on the ISI were considered the dependent variable and sport-related factors, positive and negative emotions, sport-related and general worry/rumination, and cognitive and somatic pre-sleep arousal were considered as predictors.

Aim 2: the mediating role of pre-sleep arousal – path analysis

To achieve this aim, a path analysis was computed with bootstrapping of 5000 with 95% biased corrected percentile was applied (Kline, 2011). Stimulants consumption, daytime napping, late-night training, sport-related worry/rumination, general worry/rumination, positive and negative emotions were considered as predictors; pre-sleep arousal was considered the mediator and insomnia severity the outcome. Goodness of fit was assessed using the following indices: chi square test (χ^2), Confirmatory Fit Index (CFI), Tucker–Lewis index (TLI), Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) (Barbeau, Boileau, Sarr, & Smith, 2019). A non-significant χ^2 value ($p > .05$) is indicative of a good fit. For CFI and TLI, values close to 1.00 indicate a goodfit of model. A RMSEA and SRMR values < .08 represent an acceptable good model fit (Mulaik et al., 1989).

Results

Description of the sample

Descriptive values of the sample are reported in Table 1. Mean scores on ISI were 6.10 ± 3.73. Sixty-eight participants (32.38) reported subclinical symptoms of insomnia (ISI score = 7–13) and 9 participants (4.28%) reported symptoms of clinical insomnia (ISI score ≥14). Moreover, participants reported having spent on average 12.80 ± 12.38 h training and competing in the month prior to assessment.

Aim 1: sport-related and psychological predictors of insomnia

Bivariate correlations

Results from bivariate correlations are reported in Table 2. Results showed that insomnia severity (ISI) was significantly associated with stimulants consumption ($r = .16$, $p = .02$), pre-sleep arousal ($r = .54$, $p < .01$), negative emotions ($r = .47$, $p < .01$), positive emotions ($r = -.21$, $p < .01$), sport-related pre-sleep worry/rumination ($r = .18$, $p = .01$) and general pre-sleep worry/rumination ($r = .33$, $p < .01$). ISI scores did not correlate with napping ($r = -.09$, $p = .18$), night-time training ($r = .03$, $p = .66$), and the mean training time in the previous month ($r = -.03$, $p = .58$).

Table 1. Descriptive statistics of the sample.

	Mean	SD
Age	25.93	6.68
PSAS	11.56	3.39
ISI	6.09	3.73
PANAS-P	34.71	6.05
PANAS-N	20.52	6.34
Nap	2.07	0.97
Stimulant use	2.8	1.31
Late training	1.55	1.18
Worry/rumination (sport)	3.2	0.95
Worry/rumination (general)	3.28	0.91

Note: ISI = Insomnia Severity Index; PANAS-P = Positive Affect Negative Affect Schedule-Positive; PANAS-N = Positive Affect Negative Affect Schedule-Negative; PSAS = Pre-Sleep Arousal Scale.

Regression analysis

As displayed in Table 3, results showed that the model was significant ($F_{(1,209)} = 14.60$, $p < .01$), with ISI significantly predicted by high pre-sleep arousal ($\beta = .348$, $t = 4.33$, $p < .01$), high negative emotions ($\beta = .186$, $t = 2.51$, $p = .01$), and low positive emotions ($\beta = -.162$, $t = -2.76$, $p < .01$).

Aim 2: the mediating role of pre-sleep arousal – path analysis

The path analysis indicated significant effect of stimulant consumption ($\beta = .127$, $p < .01$), sport-related worry/rumination ($\beta = .117$, $p < .05$), general worry/rumination ($\beta = .231$, $p < .001$) and negative emotions ($\beta = .532$, $p < .001$), on pre-sleep arousal. A significant pathway of .42 ($p < .001$) from pre-sleep arousal to mean scores at ISI was also indicated. However, since the goodness of fit indices indicated poor fit for this model, with the exception of acceptable values of many indices (a CFI value of .93, a TLI value of .85, and a SRMR value of .05), modification indices (MI) were examined to improve the model. The inspection of the modification indices suggested an improved model fit for the additional path from positive emotions to ISI (MI = 9.41) and form negative emotions to ISI (MI = 7.29). Since these patterns were theoretically plausible (Baglioni et al., 2010), a revised model including the suggested paths was tested. The final model, displayed graphically in Figure 1, showed an improvement all fit indices ($\chi^2 = 8.728$, df = 5, $p > .05$; CFI = 0.98; TLI = 0.95; RMSEA = .06; [95% CI 0.000–0.124]; SRMR = 0.03). Significant direct effects were found between positive and negative emotions and ISI ($\beta = -0.159$, $p < .01$; $\beta = 0.173$, $p < .05$, respectively). Mediational analysis showed a significant indirect effect of stimulant consumption ($\beta = 0.053$, $p < .05$, 95%CI = 0.007–0.100), sport-related worry/rumination ($\beta = 0.049$, $p < .05$, 95% CI = 0.00–0.098), general worry/rumination ($\beta = 0.097$, $p < .01$, 95%CI = 0.031–0.163) and negative emotions ($\beta = 0.223$, $p < .001$, 95%CI = 0.141–0.306) on ISI through pre-sleep arousal.

Discussion

The first aim of this study was to explore the role of sport-related and traditional psychological correlates of insomnia in a sample of professional soccer players. We hypothesised that insomnia would be positively associated with negative emotions, pre-sleep worry and rumination, pre-sleep arousal, stimulants consumption, late evening training and daytime napping and negatively associated with positive emotions. Our

Table 2. Bivariate correlations between main study variables.

		ISI	PANAS-P	PANAS-N	PSAS	NAP	Stimulants use	Late night training	Worry/ rumination (sport)	Worry/ rumination
ISI	Pearson's *r*	1.000	−0.212**	0.466**	0.540**	−0.094	0.163*	0.03	0.177*	0.332**
	p		0.002	0.000	0.000	0.177	0.018	0.666	0.010	0.000
PANAS-P	Pearson's *r*	−0.212**	1.000	−0.155*	−0.063	−0.011	0.074	0.043	0.141	−0.031
	p	0.002		0.025	0.365	0.876	0.285	0.533	0.042	0.659
PANAS-N	Pearson's *r*	0.466**	−0.155*	1.000	0.640**	−0.009	0.047	0.081	0.256**	0.292**
	p	0.000	0.025		0.000	0.901	0.496	0.240	0.000	0.000
PSAS	Pearson's *r*	0.540**	−0.063	0.640**	1.000	0.040	0.158	0.094	0.364**	0.460**
	p	0.000	0.365	0.000		0.575	0.022*	0.175	0.000	0.000
NAP	Pearson's *r*	−0.094	−0.011	−0.009	0.040	1.000	0.012	−0.051	0.067	−0.023
	p	0.177	0.876	0.901	0.575		0.862	0.462	0.337	0.742
Stimulants use	Pearson's *r*	0.163*	0.074	0.047	0.158	0.012	1.000	−0.048	−0.053	0.059
	p	0.018	0.285	0.496	0.022*	0.862		0.493	0.447	0.396
Late night training	Pearson's *r*	0.03	0.043	0.081	0.094	−0.051	−0.048	1.000	0.023	0.084
	p	0.666	0.533	0.24	0.175	0.462	0.493		0.738	0.228
Worry/ rumination (sport)	Peason's *r*	0.177*	0.141*	0.256**	0.364**	0.067	−0.053	0.023	1.000	0.513**
	p	0.010	0.420	0.000	0.000	0.337	0.447	0.738		0.000
Worry/ rumination (general)	Pearson's *r*	0.332**	−0.031	0.292**	0.460**	−0.023	0.059	0.084	0.513**	1.000
	p	0.000	0.659	0.000	0.000	0.742	0.396	0.228	0.000	

Note: ISI = Insomnia Severity Index; PANAS-*P* = Positive Affect Negative Affect Schedule-Positive; PANAS-N = Positive Affect Negative Affect Schedule-Negative; PSAS = Pre-Sleep Arousal Scale.

predictions were partially confirmed by results. Specifically, correlation analysis showed that the only sport-related factor associated with insomnia was the consumption of stimulants (caffeine, nicotine, chocolate). This result confirms previous finding on the effects of nutritional intervention for sleep problems in elite athletes (for a review, see Halson, 2014).

Moreover, echoing robust findings from clinical insomnia research (e.g. Lancee, Eisma, van Zanten, & Topper, 2017), results of correlation analysis showed that insomnia in professional players was significantly associated with high levels of pre-sleep arousal with moderate to large effect sizes, low positive emotion and high negative emotion with small effect sizes; additionally, insomnia was significantly associated with both sport-related and general worry and rumination with small effect sizes.

In regression analysis we explored the specific contribution of cognitive and emotional variables globally involved in psychophysiological models to explain insomnia, e.g. arousal, emotion, perseverative thinking (Espie et al., 2006; Harvey, 2002; Perlis et al., 1997) and sport-related factors (stimulant consumption) on insomnia severity. Results showed that insomnia was significantly predicted by high pre-sleep arousal and negative emotion and low positive emotion. These results are consistent with previously cited influential models on the conceptualisation of insomnia (Espie et al., 2006; Harvey, 2002; Perlis et al., 1997; Spielman, Caruso, & Glovinsky, 1987). For instance, according to Espie et al. (2006), insomnia would be exacerbated and maintained by the difficulty in lowering the levels of arousal at bedtime, resulting in the difficulty falling asleep and maintaining sleep. Also, our results are consistent with the conceptualisation of negative emotion as factors involved in the development of insomnia (e.g. Harvey, 2002). Furthermore, results from the present study suggest the view of positive emotions as protective factors for insomnia (e.g. Baglioni et al., 2010). This result is partially in contrast with Espie's model of insomnia (2006), in which it is theorised that emotional reactivity of both positive and emotional valence would be a trigger of insomnia via the activation of sympathetic nervous system. However, our results are in line with previous empirical findings contrasting Espie's model and suggesting a protective role of positive emotional experience on insomnia (e.g. Ong, Kim, Young, & Steptoe, 2017).

The second aim of this study was to explore the role of pre-sleep arousal in the relationship between behavioural and psychological variables and insomnia. Specifically, we hypothesised that the associations between insomnia and emotional experience, pre-sleep worry and rumination, stimulants consumption, late evening

Table 3. Hierarchical multiple regression analysis with insomnia severity (ISI) as outcome as sport-related factors and cognitive emotional factors as predictors.

	B	SE	*β*	*t*	Sign	Tolerance	VIF
Constant	0.902	1.715		0.526	0.599		
Daytime nap	−0.300	0.217	−0.078	−1.380	0.169	0.985	1.016
Stimulant use	0.295	0.165	0.103	1.786	0.076	0.939	1.065
Late training	−0.061	0180	−0.019	−0.340	0.734	0.976	1.024
Pre-sleep arousal (PSAS)	0.151	0.035	0.348	4.331	0.000*	0.487	2.052
Positive emotions (PANAS-P)	−0.100	0.036	−0.162	−2.763	0.006*	0.918	1.089
Negative emotions (PANAS-N)	0.109	0.044	0.186	2.508	0.013	0.574	1.742
Worry/rumination (sport)	−0.097	0.270	−0.025	−0.360	0.720	0.662	1.510
Worry/rumination (general)	0.493	0.288	0.120	1.711	0.089	0.641	1.560
$R^2 = 0.368$, $F = 14.606$, df = 1, 209, $p = 0.000$							

Note: ISI = Insomnia Severity Index; PANAS-P = Positive Affect Negative Affect Schedule-Positive; PANAS-N = Positive Affect Negative Affect Schedule-Negative; PSAS = Pre-Sleep Arousal Scale.

training and daytime napping would be mediated the effect of pre-sleep arousal. Again, our predictions were partially confirmed by results, as path analysis showed that stimulant consumption, worry/rumination, and negative emotion predict insomnia through the mediation effect of increased pre-sleep arousal.

This result is consistent with the neurocognitive model of insomnia proposed by Perlis et al. (1997) according to which pre-sleep cortical hyperarousal would be the strongest perpetuating factor of insomnia. Moreover, these results are consistent with Harvey's model of insomnia (2002), according to which excessive worry and rumination during both day and night would trigger psychophysiological arousal and determine emotional distress, which, in turn, would inhibit sleep. In addition, results of path analysis are consistent with recent meta-analytic evidence showing that increased negatively-toned cognitive activity such as that

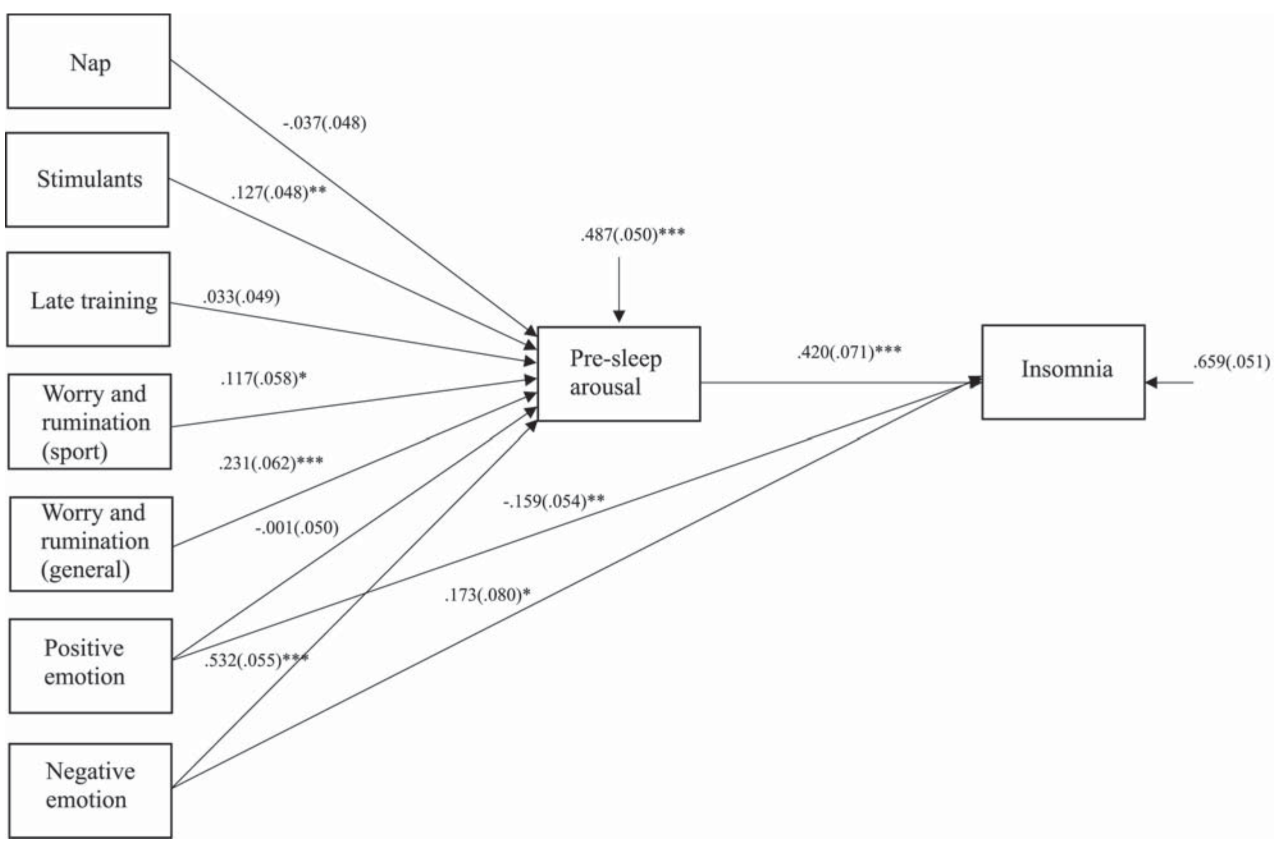

Figure 1. Final tested model. Mediational analysis showed a significant indirect effect of stimulant consumption, sport-related worry and rumination, general worry and rumination and negative emotions on insomnia severity through pre-sleep arousal. *Note:* Standardised regression coefficients and p values are displayed. Fit indices: $\chi^2 = 8.728$, df = 5, p > .05; CFI = 0.98; TLI = 0.95; RMSEA = 0.06; [90% CI 0.000–0.124]; SRMR = 0.03. *p* value legend: *** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$. Residual variances and associated standard errors are reported for the mediator (pre-sleep arousal) and the outcome (insomnia).

experienced in rumination and worry, is longitudinally related to abnormal autonomic function (i.e. higher systolic and diastolic blood pressure and heart rate and lower heart rate variability, Ottaviani et al., 2016).

Practical implications

Insomnia in professional athletes may have further functional implications (Leger, Metlaine, & Choudat, 2005). For instance, experiencing insomnia at night may result in daytime motor lapses during training or competitions (Nishida & Walker, 2007). Also, it is well-known that sleep disruption is associated with proinflammatory processes involved in post-match fatigue feelings and in post-training muscle damage repair (Nèdèlec et al., 2015). Finally, many sports require the execution of complex goal-directed actions such as modulating running speed and direction, jumping and dribbling which involve intact complex cognitive functions such as concentration and executive functions which are instead impacted in insomnia (e.g. Ballesio, Aquino, Ferlazzo, Kyle, & Lombardo, 2019). Therefore, insomnia in soccer players may result in degraded performance due to impaired motor and executive functioning. Several practical implications can be translated from our preliminary findings. Above all, the screening of insomnia symptoms and arousal should be implemented in professional soccer with standardised diagnostic tools (e.g. ISI, Bastien et al., 2001; Kahallidi et al., 2019) in order to detect cases that might benefit behavioural sleep interventions. In fact, a number of promoting interventions have been developed over the last years to improve sleep quality in the context of elite sport. Notably, these interventions are mostly focused on the principles of sleep hygiene as core strategy (Vitale, La Torre, Banfi, & Bonato, 2019). Specifically, these programmes focused on reducing factors that could inhibit sleep, such as daytime stimulant avoidance or in promoting power naps (e.g. O'Donnell, Beaven, & Driller, 2018). Surprisingly, evidence-based psychological techniques to treat insomnia such as cognitive behavioural therapy for insomnia (CBT-I, Riemann et al., 2017), are rarely integrated in these interventions. CBT-I is a structured program that targets to modify dysfunctional beliefs and behaviours that perpetuate or worsen sleep problems. Particularly, CBT-I is a multicomponent treatment consisting of behavioural strategies such stimulus control therapy and sleep restriction therapy aimed at increasing sleep pressure and sleep-inducing routines, cognitive strategies such as cognitive restructuring of dysfunctional sleep-related thoughts as well as psychoeducation/sleep hygiene strategies (e.g. healthy practices that may promote or inhibit sleep) and relaxation training aimed at reducing somatic tension or intrusive thoughts at bedtime (see Riemann et al., 2017 for a review). Importantly, while sleep hygiene may be effective in improving sleep quality in non-clinical samples by promoting healthy sleep habits, this has been associated with limited efficacy in reducing insomnia severity and improving daytime functioning when compared to other components of CBT-I (Ballesio et al., 2018; Mitchell, Bisdounis, Ballesio, Omlin, & Kyle, 2019). Therefore, if replicated with appropriate longitudinal designs, our results would suggest the potential need to develop and test the feasibility of standard CBT-I techniques in professional athletes with insomnia.

Limitations

This study encompasses a number of limitations that should be acknowledged. Initially, as the first study exploring the relationships between cognitive-emotional processes and insomnia in this population we used an observational cross-sectional design; however, future studies are encouraged to employ longitudinal design or ecological momentary assessment to better elucidate the direction of the relationships under study. Moreover, our study did not include a control group of non-athletes, or athletes of different disciplines (Vitale, Banfi, Sias, & La Torre, 2019). We included only self-report measures of insomnia and cognitive-emotional variables; however, the involvement of physiological measures of sleep (e.g. actigraphy, polysomnography), as well as of pre-sleep cognitive and somatic arousal (e.g. cognitive tasks, heart rate variability or skin conductance) may further advance the knowledge in the field and is therefore strongly encouraged. Related to this, we specifically assessed pre-sleep arousal and missed to consider the role of dispositional/trait arousal which may equally play a role in athletes' insomnia. Furthermore, the role of potential confounding factors remains unexplored and should be examined in future research. For instance, circadian preferences, i.e. chronotypes, may play a role in influencing athletes' sleep schedule and performance (e.g. Vitale & Weydahl, 2017) and it is well-known that evening types individuals are at higher risk of developing insomnia symptoms and poor mental health (e.g. Sheaves et al., 2016). Similarly, we included the ISI as likely the most widely used self-reported measure to assess insomnia symptoms (Bastien et al., 2001). However, further instruments detecting other dimensions of sleep health (e.g. Buysse, 2014) may be included in future studies assessing the psychological predictors of sleep in professional athletes. Moreover, we considered daytime napping, stimulant consumption and late evening training as putative sport-related perpetuating factors of insomnia in soccer players. However, it should be noted that these factors are not of soccer-specific sleep challenges per se, as they are common habits in other populations. Future observational studies are needed to elucidate soccer-specific sleep challenges and test mechanistic pathways in relation to insomnia symptoms. Finally, we included a convenience sample of professional football players; future studies including more rigorous inclusion/exclusion criteria and selecting participants on the basis on power analysis may reduce the risk of selection bias.

Conclusions

Insomnia is a severe and chronic condition that may have several detrimental effects on players' health and performance, including daytime sleepiness and fatigue that may potentially result in motor lapses, and altered post-training muscle damage repair. We showed that several behavioural and psychological variables such as stimulants consumption, abnormal emotional experience and pre-sleep worry/rumination may be associated with insomnia symptoms in professional soccer players. Notably, in line with influential clinical models on insomnia, we showed that pre-sleep arousal may be a key mechanism explaining the effects of such variables in perpetuating insomnia. If confirmed in larger groups with longitudinal designs, these results would suggest adopting non-pharmacological interventions such as CBT-I with such variables as treatment target.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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