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Metacognitive Skills Approach to Achieve Performance: Is There Any Moderating Role of Performance-Enhancing Drugs?

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Abstract Athletes' on-field performance is an amalgamation of their off-the-field activities as millions of dollars get invested into sports science to help them effectuate their performance, strength, and conditioning. Athletes have to go through a plethora of obstacles to effectuate athletic ranking, financial benefits, and sponsors availability while balancing their personal and professional lives. Such generic challenges can propel them to resort to unethical practices to survive in the competitive environment. Ostensibly, athletes have started consuming prohibited substances to boost their performance. Theoretical implications of performance-enhancing drugs have been drawn explicitly for enhancing performance but moderating effects of the latter have not been reflected between metacognition and performance. Thus, this article documents the relationship between metacognition and performance among professional athletes (N =304) with attention to the moderating role of performance-enhancing drugs through hierarchical regression analysis. Results allowed for the complete acceptance of steroids as a significant moderator but to a lesser extent. The implications suggest that interventions, which can enhance the performance of the athletes, should be developed, so athletes do not fall prey to the utilization of performance-enhancing drugs. Also, a mixed-method study design could be the future scope of the study as it compensates for the losses served by either of the methods. The study made recommendations and drew suggestions for future research.

Keywords Metacognition, Performance, Performance-Enhancing Drugs, Athletes

1. Introduction

An intriguing quote by Usain Bolt [1] pointed that "You have to get to the worst to get better." The quote explains the obstacles an athlete faces before reaching their performance benchmark [2-8]. Athletes are required to put up an excellent performance for reputation, job, ranking etc. Performance is influenced by physical and cognitive abilities such as attention, focus and meta-imagery across sports. Hence, researcher [9] encapsulated the amalgamation of physical [10, 11] and mental skills for performance excellence. Indispensable nature of sport psychology and its interventions [12, 13] have improvised the performance of athletes by focusing on meta-attention, metacognition [14, 15] as the latter is powerful and robust [16].

However, for many professional athletes in developing countries, the target is to achieve a medal along with a reputed job and set goals for higher levels such as Asians, commonwealth games or the Olympics. But this might

propel athletes to resort to unfair practices such as doping to boost performance. However, it is not encouraged and in the present study; it has been studied as a moderator between metacognition and performance assuming that athletes who use metacognitive skills will not be engaging in doping to achieve performance.

1.1. Metacognition and Performance

Predictably, the goal of an Indian athlete is to deliver stupendous performance at the Nationals/ Asian level. It becomes arduous to focus when there are multiple obstacles such as injury [17, 18]. This hinders an athlete to "*refocus*" [19]. In addition, it also depends on the "cognitive processing of a performer". Performance can be effectuated [20] with better metacognition intervention strategies which are the ability to recognize one's state of mind [21]. Metacognition has the strength to make an athlete aware of his/her cognitive and emotional processes [22, 23]. For example, Neeraj Chopra's self-talk before his Tokyo Olympics, as reported by [24].

"How can I do it better? What should be the movement of my glutes? What if I block this way?"

A study on players was conducted, where researchers found if players were given mental skills training [25-28] and they were asked to focus on being aware and mindful, as a consequence, they had better performance delivered in the future along with reducing the self-assessment errors such as irrational beliefs and rumination etc. One of the researchers [29] reported female and male elite athletes used motor cognition while practicing their drills which helped them in their performance.

Elite athletes not only perform movement but also engage in planning, reflection and metacognition [30-32]. Metacognition is an expertise that can help athletes achieve standard performance while arousing [33] an athlete to deviate from any distraction by self-regulatory process and monitoring. Besides mental training, athletes need explosive strength, endurance and stamina to outperform their competitors. That can be achieved through proper diet, supplements, sleep etc. However, resorting to other methods for boosting performance and confidence [34, 35] has grown among athletes.

1.2. Performance-Enhancing Drugs

The empirical theoretical framework supports the link between psychological variables such as perfectionism, task-orientated attitude and motives for PEDs [36]. World Anti-Doping Program [37] analysed 278,047 samples of athletes, where 57% were violations, across 83 sports, comprising 77% males and 23% females, with bodybuilding and athletics on the top two [38-41]. Thus, there is a need to understand why these substances are being consumed despite of deleterious consequences [42-51], though some studies have pointed out beneficial effects of steroids [52, 53].

1.3. PEDs and Metacognition

Also, considering the study by [54] which elucidates the metacognitive approach to doping, and previous research which has established an inconsistent relationship between metacognition and performance, this article harps on the understanding that if steroids would explain a better relationship between metacognition and performance. The purpose of the study is to examine the moderating role of performance-enhancing drugs between metacognition and performance (Figure 1.)

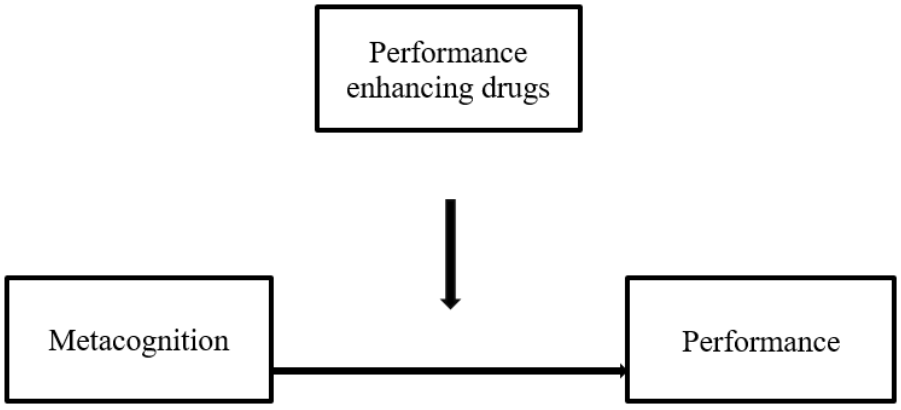

Figure 1. (Hypothesized moderation model)

2. Methods

2.1. Participants

The initial sample consisted of 498 professional athletes who have been practicing for the past 10 years and playing at national and international level. They ranged from 18 to 25 years old. A priori analysis had been conducted to find the appropriate sample size. However, with the use of the G*Power program with a significance level of α=.05 and a power of .80. [55], only 304 responses were generated from the athletes across different sports (track and field, swimming, and shooting) among which 202 were male athletes and 102 were female athletes.

2.2. Measures

2.2.1. Metacognition Self-Assessment Scale (MSAS)

Metacognition Self-Assessment Scale (MSAS) was developed by [56] and includes 18 items used as a self-report measure. MSAS is scored using a five-point Likert scale. This scale measures five elements namely: 1) monitoring; 2) differentiation; 3) integration; 4) decentration and 5) mastery. Exploratory factor analysis was carried out by using Principal Axis Factoring and Promax rotation on a sample of 304 athletes. Bartlett's Test of Sphericity was carried out to assess whether the data obtained from the target population are suitable for factor analysis. The result indicates that the correlation matrix obtained from the sample was not an identity matrix and was found to be significant ($p<0.01$). In addition, the sampling adequacy was examined through Kaiser-Meyer-Olkin (KMO) measure (0.91), which was well above the recommended level (0.6). All 18 statements had high pattern coefficients of more than 0.36 and were above the 0.30 level. Further, to check the reliability of the scale Cronbach's Alpha, McDonald's omega coefficients were assessed ($\alpha = .87$, $\omega = .87$) and were satisfactory.

2.2.2. Athlete's Subjective Performance Scale (ASPS)

To evaluate the satisfaction among athletes, Athlete Subjective Performance Scale (ASPS) has been developed by [57]. This scale measures six items about the performance satisfaction of athletes along with an extended one-item scale. Exploratory factor analysis was carried out by using Principal Axis Factoring and Promax rotation on a sample of 304 athletes. The purpose of this measure is to understand general performance, team contribution and personal ability. Although the scale was developed for team sports, with the permission of the author, 2nd and 4th items had been removed in order to use it on individual sports.

Bartlett's Test of Sphericity was carried out to assess whether the data obtained from the target population are suitable for factor analysis. The result indicates that the correlation matrix obtained from the sample was not an identity matrix and was found to be significant ($p<0.01$). In addition, the sampling adequacy was examined through Kaiser-Meyer-Olkin (KMO) measure (0.73), which was well above the recommended level (0.6). All six statements had high pattern coefficients of more than 0.48 and were above the 0.30 level. Further, to check the reliability of the scale Cronbach's Alpha, McDonald's omega coefficients were assessed ($\alpha = .80$, $\omega = .80$) and were satisfactory.

2.2.3. Performance enhancement drugs (PEDs)

As the usage of PED's is taken as a moderator between the antecedent (metacognition) and the outcome variable (performance), and the response is in 'yes or no' format, categorical moderation analysis was carried out. Moreover, the questions about PEDs were asked in the form of close-ended questions which were "Do you have any knowledge regarding the performance-enhancing drugs", "Have you taken any performance boosting substances in sports?" The usage of PEDs was dummy-coded, no responses as 1 and yes responses as 2.

2.3. Procedure

The permission from ethical committee board at the university had been granted, after which data collection was started. Data collection took place from Dec'21 to April'22 in offline and online modes from professional athletes who have been part of National and Asian championships. Participation was solicited. The researchers sent a pre-modification message online which comprised the purpose and intention of the study. Respondents were apprised that their responses would be kept esoteric without any violation of their confidentiality. Besides the online survey, the authors of the paper also went to stadiums and gyms for a larger sample size for better generalizability. Coaches and the Sports Authority of India administration staff were aware of the research objective and asked their athletes to participate in the survey once they explained the ethical considerations such as confidentiality, anonymity and voluntary participation.

2.4. Transparency and Openness

Readers will have the required information from this research article as the data provided in the manuscript are authentic and genuine. If any further information is required, then the primary author of the research paper can be contacted.

2.5. Analytic Strategy

As part of the analysis, the data screening process has been completed. After screening of data, significant outliers have been deleted. Assumptions of normality have been assessed with a Q-Q plot, Histogram and Z score of Skewness and Kurtosis. Linear regression has been performed to know the moderating effect of using Performance-enhancing drugs between predictive and criterion variables.

3. Results

Analyses were carried out by using IBM SPSS AMOS 21 statistical software studying moderating effect of performance-enhancing drugs between metacognition and athlete's subjective performance. Simple linear regression was carried out between metacognition and athlete's subjective performance to investigate whether the measures of metacognition (predictor variables) significantly predict athletes' subjective performance (criterion variable). The results in Table 2 show that coefficient of determination $(R)^2$ was 0.12, indicating 12% of the variance in athlete's subjective performance. In addition, the standard error of the estimate was found to be 8.82 and standardized beta was .34 ($p<0.01$).

Table 1 shows the descriptive data for the participants. Out of 304 participants, there were 202 male athletes, which was 66.4 percent of the total sample, whereas females were 102 with a percentage of 33.6. On the other hand, 97 (31.9 %) athletes reported the intake of PEDs for enhancing their performance while 207 (68.1 %) athletes denied the intake of PEDs for enhancing their sports performance.

Table 1. Profile of the participants

	Sample with incidents (N=304)	
	N	Percentage
Gender		
Male	202	66.4
Female	102	33.6
No PEDs used	207	68.1
Yes PEDs used	97	31.9

Source: own elaboration

Table 2. Model Summary of measures of Metacognition and Athlete's Subjective Performance (N=304)

Parameters	R^2	SE	β	T	P
Athlete's Subjective Performance	.12	8.82	.34	6.43	.000**

** p< 0.01
Predictors: Metacognition

Further, Table 3 shows the regression weights of metacognition and athlete's subjective performance of participants who have never used PEDs. The estimate was .16 with a standard error of .05 and the standardized beta was .22 with a t-value of 3.37 which was significant at $p<0.01$. Whereas, Table 4 shows the regression weights of metacognition and subjective performance of athletes who have used PEDs for enhancing their performance. The estimate was .38 with a standard error of .06 and the standardized beta was .52 with a t-value of 6.12 which was significant at $p<0.01$. The moderating role of PEDs usage about metacognition and athlete's subjective performance was analysed by comparing the critical ratios for differences between PED users and non-users. This value was found to be 2.68, which was more than the z value of 1.96 (5% level of significance), and this indicates a statistically significant difference between the PEDs users and non-users. Hence, the findings have shown that PED usage moderated the positive relationship between metacognition and athlete's subjective performance so that the relationship was stronger for PED users ($\beta=.52$, $P<0.01$) than for non-users ($\beta=.22$, $P<0.01$).

Table 3. Regression Weights of Metacognition and Athlete's Subjective Performance (No PED's Used, N=207)

Parameters	Estimate	SE	β	T	P
Athlete's Subjective Performance	.16	.05	.22	3.37	.000**

** p< 0.01
Predictors: Metacognition

Table 4. Regression Weights of Metacognition and Athlete's Subjective Performance (Yes PED's Used, N=97)

Parameters	Estimate	SE	β	T	P
Athlete's Subjective Performance	.38	.06	.52	6.12	.000**

** p< 0.01
Predictors: Metacognition

4. Discussion

In the present research, the proposition stating that there would not be any moderating effect of utilization of performance-enhancing drugs on the relationship between metacognition and performance among professional athletes was refuted. As an existing relationship exists between metacognition and doping, hence in the present study, performance-enhancing drugs were used as moderators with the possible chances of PEDs not acting as a moderator and athletes won't be using them to boost their performance. But results came out to be contradictory. Possible reasons for rejecting the hypothesis could be the psychological effects of PEDs leading to increasing stamina among athletes and further increasing their performance through better awareness of their skills when they performed any drill. One of the researchers [58] found the usage of steroids had proliferated widely among sports aces. Rice and his colleagues gave their findings that utilization of the steroids helps them to deal with overwhelming stress.

Another study also examined and concluded that professional athletes indulging in disrupted eating patterns for better performance may impact them psychologically, however, intake of anabolic androgenic substances helps in performance satisfaction. Undeniably, the intake of steroids leads to aggression, which benefited professional athletes thus increasing their competitive spirit.

More importantly, although this present research does not promote utilization of steroids, it can provide

knowledge regarding utilization of metacognitive skills which can help athletes reach above and beyond targets thus achieving performance satisfaction.

Considering the implications, metacognitive skills having a positive influence on performance is pretty evident. For example, it has been shown in the research that athletes possessing metacognitive skills are likely to perform better, also it goes congruent with metacognitive proficiency found in elite performers therefore easily effectuating performance goals. Besides, this research has also delineated steroids impact to lesser extent between metacognitive skills and performance satisfaction among professional athletes. However, this proposition can be challenged due to the risks involved in the intake of anabolic steroids. Thus, the intake of steroids by athletes should not be promoted.

If athletic coaches contribute to fostering metacognitive skills among professional athletes by keeping short sessions of awareness after their drill practice, professional athletes can perform better in any sport. Sometimes, athletes are not aware of their mental skills, for which sessions or classes can be given periodically by coaches to elucidate the setbacks of the lack of metacognitive skills.

One of the limitations of the study was the application of cross-sectional data, but longitudinal design could be used for future to understand causal relationships. Secondly, the role of mediating variables can also be considered in the future such as resilience etc. Third, also, data was collected online. Also, there are certain factors such as perfectionism which might engage an athlete in doping have not been discussed [59].

In the future, mixed method approach could be used to conduct thematic analysis and interview for knowing if athletes engage in self-talk for better metacognitive strategies such as regulation and monitoring, which goes in line with prior research. Steroid intake is not advocated however. Awareness can be created by sports officials' team to control the usage which has proliferated as per WADA [60-64] reports highlighting more than 2Lacs violations.

To summarise, our findings provide results that metacognition skills play an important role in performance [65, 66]. Also, this study does not promote the usage of doping.

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The author(s) of this present article do not have conflicts of interest with this research.

Conflicts of Interest

There are no financial/academic/personal/political conflicts of interest between the authors.

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