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RESEARCH ARTICLE

BIOPSYCHOSOCIAL ANALYSIS OF IMAGERY IN ELITE ATHLETES

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ABSTRACT

Purpose: The aim of this study was to examine the relationships between elite athletes' imagery abilities and their body awareness, plank stance duration, psychological and social skills.
Material and Methods: The study included 53 healthy elite athletes (female:32, male:21). The imagery abilities of the athletes were evaluated using the Movement Imagery Questionnaire-3. A Body Awareness Questionnaire was used for body awareness assessment. Plank stance duration, psychological and social skill levels were evaluated using Sport Specific Core Muscle Strength and Stability Plank Test, Athletic Psychological Skills Inventory and Social Skills Inventory, respectively.
Results: External and kinesthetic imagery was found to correlate with body awareness (r=0.33, p=0.02; r=0.39, p<0.01). There was a relationship between these imagery abilities and the prediction of body responses (r=0.31, p=0.03; r=0.38, p<0.01) and sleep-wake cycle (r=0.38, p<0.01; r=0.37, p<0.01) sub-dimensions of body awareness. Kinesthetic imagery also was associated with changes in paying attention to changes and reactions in the body process (r=0.30, p=0.03) sub-dimension. There was no relationship between imagery and other parameters (p>0.05).
Conclusion: The external and kinesthetic imagery ability of elite athletes is related to the body awareness level. It should be considered in terms of holistic approach in the performance and rehabilitation processes of the athletes.

Keywords: athletes, imagery, awareness, psychological, social

INTRODUCTION

Motor imagery is central to cognition, perception, action, and emotion and is expressed as thinking mentally without actively performing a task (1,2). This action can be visually focused using an internal and external perspective, or it could be performed kinesthetically, focusing on the feeling of movement (3). According to functional magnetic resonance images, brain activation occurs during imagery actions, and this activation is higher during dynamic tasks rather than static tasks (4). Since dynamic activities are frequently included in sportive tasks, motor imagery has been studied in terms of rehabilitation and performance of athletes, especially in the last decade. Motor imagery combined with action observation increases muscle strength and reduces fear of re-injury, pain perception, and adverse effects on neuromuscular function due to activity restrictions (5-8).Motor imagery is important in terms of sportive performance parameters such as strength, power, reaction time and coordination (9,10). It improves performance, and this improvement is faster in athletes with good motor imagery ability (11). In terms of the effects of imagery on functional outcomes such as strength performance, individuals' imagery ability, motivation, and self-efficacy are important as well as imagery type (5). Activation of brain parts during imagery is affected by different variables, such as the type of imagined movement, the instructions given, and the visual or kinesthetic type of motor imagery (1). In this context, it is necessary to evaluate the imagery ability of athletes holistically from a biopsychosocial perspective.

Body awareness is the concept of operating mechanisms to continuously monitor, update and provide feedback on the information acquired about the position and movement of one's body in space. It is also the primary process that integrates information for perception, decision-making, and action, managing accurate body information for control of movements (12). Movement harmony is one of the key themes for understanding body awareness. Mental awareness works simultaneously with movement harmony (13). Therefore, kinesthetic perception is an important component of body awareness. In motor imagery, the kinesthetic imagery parameter operates in parallel with these processes. Revealing the place of body awareness in imagery could be explanatory, especially in the processes of developing kinesthetic perception in athletes, but, this relationship has yet to be examined in the literature. Despite the available evidence in the literature on imagery, there is a need for a biopsychosocial examination of imagery, especially in elite athletes. Relational examinations of body awareness, muscle strength, and psychosocial-based indicators with imagination can guide clinicians and trainers in terms of rehabilitation and performance-oriented approaches to elite athletes. In this context, the primary aim of this study was to biopsychosocial examine the relationships between the internal visual, external visual, and kinesthetic imagery abilities of elite athletes and their body awareness levels, plank stance duration, psychological skills, and social control levels. The secondary aim was to compare these imagery parameters of the athletes by gender and previous injury history.

MATERIAL AND METHODS

Participant

All the athletes registered in the center were invited to the research, and all the athletes were informed about the research. Elite athletes who could communicate verbally and in writing were included in the study. Those with orthopedic, neurological, or congenital problems, those who have had an injury or illness in the last two weeks, those who use drugs continuously, those who have systemic diseases such as diabetes, epilepsy, and asthma, and those who have mental and psychiatric problems were excluded. Athletes who met the required criteria and accepted the research invitation read and signed the informed consent form. Permission was obtained from the parents of the athletes under the age of 18.

Procedures

In addition to the imagery abilities of the athletes, their body awareness levels, plank stance duration, psychological and social skill levels were evaluated.

Movement Imagery Questionnaire-3

The questionnaire developed by Williams et al. (14) was used to determine the imagery abilities of athletes (internal consistency coefficient: 0.87). The four different movements in the questionnaire were explained to the athletes in order and they were asked to perform them actively once. They were then asked to imagine each movement from an internal perspective (internal visual imagery), external perspective (external visual imagery), and feeling (kinesthetic imagery). These mental tasks were scored on a seven-point Likert (1: Very hard to see/feel; 7: Very easy to see/feel). The average score of the responses in the four actions was calculated for each imagery type. The Turkish validity and reliability of the questionnaire was carried out by Dilek et al. (15).

Body Awareness Questionnaire

The questionnaire developed by Shields et al. (16) consists of 18 items (Cronbach's alpha: 0.917). In this questionnaire, which aims to determine the normal or abnormal sensitivity level of body composition, there are Likert type scoring from 1 to 7. The questionnaire is evaluated over four sub-dimensions: paying attention to changes and reactions in the body process, prediction of body responses, sleep-wake cycle, and prediction at the onset of disease. A higher score indicates better body awareness. Turkish validity and reliability were conducted by Karaca and Bayar (17).

Sport Specific Core Muscle Strength and Stability Plank Test

This test, developed by Mackenzie (18), was used to evaluate plank stance duration. Athletes were allowed to try once before the assessment to learn the test. Athletes were asked to perform the following task, respectively. The time the athlete was able to hold the position was recorded. The Turkish validity and reliability (95%, 0.94-0.99%) of the test was carried out by Tong et al. (19),

Stage 1: Immediately after the athlete took the prone plank position, the chronometer was started, and the athlete was asked to maintain this position for 60 seconds.

Stage 2: The athlete was asked to wait 15 seconds by extending his right arm.

Stage 3: The athlete was asked to bring his right arm to the starting position, extend his left arm and wait for 15 seconds.

Stage 4: The athlete was asked to bring his left arm to the starting position, extend his right leg and wait for 15 seconds.

Stage 5: The athlete was asked to bring his right leg to the starting position, extend his left leg and wait for 15 seconds.

Stage 6: The athlete was asked to extend his left leg and right arm simultaneously and wait for 15 seconds.

Stage 7: The athlete was asked to bring his left leg and right arm to the starting position, extend his right leg and left arm and wait for 15 seconds.

Table 1. Descriptive characteristics of the athletes

Parameter		N (%)
Gender	Female	32 (60)
	Male	21 (40)
Sports branch	Wrestle	12 (23)
	Athletics	11 (21)
	Boxing	10 (19)
	Curling	10 (19)
	Karate	5 (9)
	Swimming	3 (5)
	Shooting	2 (4)
Education level	High school	30 (57)
	Associate degree	2 (4)
	Undergraduate	21 (39)
Dominant hand	Right	48 (91)
	Left	5 (9)
Dominant foot	Right	46 (87)
	Left	7 (13)
Sleep duration (hours)	4-6	3 (5)
	6-8	31 (59)
	8-10	17 (32)
	10-12	2 (4)
Weekly sleep quality	Very poor	3 (6)
	Poor	5 (9)
	Moderate	23 (43)
	Good	12 (23)
	Very good	10 (19)
Previous injury history	Yes	18 (34)
	No	35 (66)

Stage 8: The athlete was asked to come to the starting position and wait 30 seconds.

Athletic Psychological Skills Inventory

This scale (internal consistency coefficient 0.85), developed by Smith et al. (20) and validated in Turkish by Erhan et al. (21), was used to determine the psychological skill levels of athletes. The scale, which consists of 28 items and seven sub-dimensions, is scored with a four-point Likert scale according to the expressions "rarely", "sometimes," "often" and "almost always." Items 3, 7, 10, 12, 19, and 23 of the scale are reverse scored.

Social Skills Inventory

The inventory developed by Riggio (22) consists of 90 items. It has six sub-dimensions, each consisting of 15 items: emotional expressivity, emotional sensitivity, emotional control, social expressivity, social sensitivity, and social control. Within the scope of this study, the social control sub-dimension, which measures social role-playing and the ability of the individual to reveal himself socially, was used (internal consistency coefficient 0.81). The inventory has a five-point Likert-type response. Turkish validity and reliability were conducted by Yüksel (23).

Statistical analysis

Data were analyzed using Statistical Package for Social Science (SPSS) 22.0. Whether the data showed normal distribution was evaluated using histogram, coefficient of variation, Kurtosis value, Skewness value, Detrended plot graph, and Shapiro-Wilks test. Since the imagery data did not show a normal distribution, the Spearman correlation coefficient was used in the correlation analysis. The Mann-Whitney U test was used to compare imagery between groups regarding gender and previous injury history. Evaluation of data 95% confidence interval was used. Statistically, results of less than 0.05 were

Table 2. Imagery and biopsychosocial parameters of athletes

Parameter		Mean±SD
Imagery	Internal visual imagery	5.89±0.96
	External visual imagery	5.74±0.88
	Kinesthetic imagery	5.46±1.06
Body Awareness	Pay attention to changes and reactions in the body process	30.50±5.72
	Prediction of body responses	35.09±7.56
	Sleep-wake cycle	32.39±7.35
	Prediction at the onset of disease	19.24±3.84
	Total score	91.33±16.74
Psychological skill level	Coping with difficulties	6.75±2.47
	Being open to learning	9.22±1.92
	Concentration	6.88±2.01
	Confidence and success motivation	9.05±1.88
	Goal setting and mental preparation	7.88±2.21
	Ability to perform well under pressure	5.32±3.04
	Getting rid of worries	5.77±2.23
	Total score	50.90±9.30
Social skill level		54.05±8.34
Plank stance duration (sec)		55.33±19.31

SD: Standart deviation, sec: second

accepted as an indication of a significant difference (24). According to the post hoc power analysis performed at the end of the study with GPower 3.1.2 (Heinrich-Heine-Universität Düsseldorf, Germany), the power (1-β) of the study with a moderate effect size was calculated as 0.87 (N=53, α=0.05).

Ethical Consideration

The research protocol was approved by Karadeniz Technical University Faculty of Medicine Scientific Research Ethics Committee (Date: 27.09.2021; Decision number: 25).

RESULTS

The mean age, height, and body weight of the athletes were 18.13±1.60 years, 168.86±9.18 cm, and 63.79±15.39 kg, respectively. The weekly average of the training sessions was 6.96±2.16, and the weekly average duration of the training sessions was 17.56±6.67 hours. The descriptive characteristics of the athletes are shown in Table 1.

The external visual imagery was associated with the prediction of body responses (r=0.31, p=0.03) and sleep-wake cycle (r=0.38, p<0.01) sub-dimensions as well as the total score of the body awareness (r=0.33, p=0.02). This imagery ability also correlated with the getting rid of worries sub-dimension of psychological skill level (r=0.31, p=0,03). Kinesthetic imagery had a significant relationship with all sub-dimensions and the total score of the body awareness questionnaire, except for the prediction at the onset of the disease sub-dimension (p<0.05). There was no correlation between imagery and other parameters in the study (p>0.05) (Table 3).

In comparison between genders, internal visual imagery (female: 5.88 ±1.08; men: 5.90 ±0.75), external visual imagery (female: 5.88 ±1.08; men: 5.53 ±0.95), and kinesthetic imagery (female: 5.70 ±0.81; male: 5.10 ±1.30) did not show a significant difference (p>0.05).

There was no significant difference between the internal visual imagery (with injury: 6.01±0.96, without

Table 3. Relationships between imagery and biopsychosocial parameters

	Parameter	Internal visual imagery	External visual imagery	Kinesthetic imagery
Body Awareness	Pay attention to changes and reactions in the body process	r=0.19 p=0.18	r=0.23 p=0.10	**r=0.30 p=0.03**
	Prediction of body responses	r=0.21 p=0.13	**r=0.31 p=0.03**	**r=0.38 p<0.01**
	Sleep-wake cycle	r=0.25 p=0.07	**r=0.38 p<0.01**	**r=0.37 p<0.01**
	Prediction at the onset of disease	r=0.20 p=0.15	r=0.08 p=0.55	r=0.20 p=0.15
	Total score	r=0.24 p=0.09	**r=0.33 p=0.02**	**r=0.39 p<0.01**
Psychological skill level	Coping with difficulties	r=0.08 p=0.56	r=-0.06 p=0.66	r=0.24 p=0.08
	Being open to learning	r=-0.05 p=0.72	r=-0.16 p=0.27	r=-0.20 p=0.16
	Concentration	r=0.06 p=0.66	r=0.10 p=0.47	r=0.22 p=0.11
	Confidence and success motivation	r=0.12 p=0.39	r=-0.14 p=0.31	r=0.12 p=0.40
	Goal setting and mental preparation	r=-0.03 p=0.83	r=0.09 p=0.50	r=0.27 p=0.06
	Ability to perform well under pressure	r<0.01 p=0.99	r=0.09 p=0.53	r=0.08 p=0.56
	Getting rid of worries	r=-0.22 p=0.11	**r=-0.31 p=0.03**	r=-0.19 p=0.18
	Total score	r=0.05 p=0.74	r=-0.07 p=0.60	r=0.17 p=0.23
Social skill level		r=0.11 p=0.42	r=0.11 p=0.42	r=-0.11 p=0.43
Plank stance duration (sec)		r=0.03 p=0.83	r=0.03 p=0.83	r=0.02 p=0.90

r:spearman correlation test

injury: 5.82±0.96) and kinesthetic imagery (with injury: 5.59±1.12, without injury: 5.40±1.04) abilities of the athletes with and without a history of injury (p>0.05). External visual imagery ability was significantly higher in favor of athletes with a history of injury (with: 6.04±1.01, without: 5.59±0.78) (p=0.03)..

DISCUSSION

In the study, it was revealed that external visual imagery and kinesthetic imagery were positively related to body awareness in elite athletes, but the imagery was not related to psychosocial skill level, plank stance duration, and social control level. In addition, imagery was not related to gender. Athletes with a history of injury had a better level of external imagery than those who did not.

The positive relationship between motor imagery and body awareness may be due to some similar properties of these two parameters. For example, just like the interoceptive and exteroceptive parts of body awareness, motor imagery has internal and external visual imagery parts. Moreover, previous studies in the literature show that motor imagery can be effective in terms of body awareness, body image and body schema (25,26). Similar to the positive effects of motor imagery training on athlete performance, body awareness is also moderately positively correlated with performance emotional status (11,27). These results support the relationship between motor imagery and body awareness in the current study. However, it needs to be explained that body awareness is related to external and kinesthetic imageries but not to internal imagery. These parts of motor imagery show different effects in improving performance for complex sports skills (28). Internal imagery tends to be more self-focused and independent of the sport type. External imagery involves the visualization of others and the environment. It is important in terms of adapting to the rapidly changing dynamics in branches such as karate, which are described as open sports (29). The significant relationship between external visual/kinesthetic imagery and body awareness in our study may be due to most of the athletes included doing open sports. This result suggests that body awareness is more related to exteroceptive inputs. External factors such as sports grounds, equipment used, light, and ventilation can affect both motor imagery and body awareness. More research is needed.

Motor imagery is an appropriate tool for maintaining and increasing physical performance capacity among professional athletes (30). Dhouibi et al. (31) revealed that sports and physical activity positively affect internal and external motor imagery (31). Although it is known that imagery training increases muscle strength, the relationship between imagery ability and muscle strength has yet to be clearly demonstrated. In our study, it was found that imagery was not associated with plank time. There is a need for branch-specific studies with large samples.

Injury may affect the imagery ability due to negative consequences such as fear of re-injury, anxiety, and depression. To reduce these effects, psychological skills such as imagery and awareness are recommended (32,33). In our study, external visual imagery ability was higher in athletes with a history of injury. This can be caused by athletes' self-protection behaviors and kinesiophobia. This situation may also reflect the awareness of the athletes against external stimuli in terms of preventing re-injury. Finding a significant relationship between body awareness and external imagery also supports this result.

From a psychosocial perspective, imagery is effective on emotional state, self-confidence, emotional self-regulation, depression, and social anxiety levels. (34-36). In our study, unlike these parameters, the relationship between imagery and psychological skill was examined. A relationship was found between the psychological skill parameters of imagery and the sub-dimension of getting rid of worries. This relationship may be since the imagery ability is related to emotional parameters rather than psychological skills.

Strengths and Limitations

The strength of this study is to investigate the relationships between imagery, which has an important place in the rehabilitation and performance of elite athletes, and biopsychosocial parameters. The limitation of the study is that some results cannot be discussed sufficiently due to the limited number of studies related to the aim of the study.

CONCLUSION

As a result, there are positive relationships between external visual/kinesthetic imagery ability and body awareness in elite athletes. Revealing this relationship is important in terms of the holistic perspective of imagery in athletes. There is a need for branch-specific examination of imagery in future studies with large sample sizes.

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