

# Selective Androgen Receptor Modulators (SARMs) in the World of Sports

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**Abstract** Background: The study aims to investigate the effects of selective androgen receptor modulators (SARMs) among athletes and examine the possible beneficial results and risks of these substances for the athletes' health and performance and human health in general. Nowadays, SARMs have become a focus of interest in the world of sports and medicine. Because of their anabolic action, SARMs are considered quite promising for treating several disorders including breast cancer, osteoporosis, DMD (Duchenne Muscular Dystrophy), some type of tumors, etc. As for the athletic community, SARMs are used as doping for muscle mass increasing and strengthening and pose as an alternative to other steroid-based doping with their minimum side effects. SARMs are innovative substances for athletic performance and human health. Further study on SARMs is required in order to understand the long-term effects on human health and athletic performance.

**Keywords:** SARMs, anabolic action, testosterone, doping

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## 1. Introduction

Regarding their anabolic action and therapeutic potential, selective androgen receptor modulators, SARMs, have been a focus of attention in the world of medicine [1,2,3]. The discovery of SARMs dates back to the late 1990s. These compounds affect the androgen receptors in muscles and bones. SARMs are assumed to have a curative influence on certain disorders and diseases such as tumors, Alzheimer's Disease, breast cancer, osteoporosis, etc. Several studies have been conducted on selective androgen receptor modulators and their effect on the human body. However, SARMs' true potential and risks are not fully understood nor studied [4,5,6,7,8,9].

One reason the discovery of SARMs has considered such an important development is that they have the potential to pose as an alternative cure instead of testosterone. Testosterone is used commonly in the medical area for its therapeutic effects, yet this treatment offers many possible side effects. Most of these side effects are caused by steroids. SARMs on the other hand, are free of steroid-based side effects [10,11].

World Anti-Doping Agency (WADA) has banned certain anabolic compounds that help athletes to improve their performance. Even though the use of SARMs is quite promising in terms of their therapeutic effects, these

molecules are also used as doping by athletes. Therefore, the World Anti-Doping Agency has prohibited SARMs in 2008. There is an ongoing debate on SARMs about whether they are safe for the athlete's health. Even though there is no conclusion on the issue, these substances can be obtained easily [12,13].

### 1.1. SARMs and Testosterone

SARMs is not an innovation only in the world of medicine but also in the world of sports as well. Doping use is quite common in the competitive field. Yet, doping especially those with steroids that are used for a long period bring along possible side effects. SARMs, on the other side, are free of some of the steroid-based health issues such as sexual dysfunction, hypogonadism, testicular atrophy, arrhythmia, hypertension, certain heart-related disorders, mental and behavior disorders, etc. [14,15,16]. In fact, according to some researches, SARM RAD140 is argued to have a beneficial influence on the nervous system [17].

And also, a recent study indicates that hormone treatment with testosterone may cause problems with the prostate and cardiovascular system [18].

### 1.2. Therapeutic Promise of SARMs

#### 1.2.1. Osteoporosis

As recent studies on animals indicate SARMs are

likely to positively affect muscles and bones. This provides a basis for SARMs' potential curative effect on osteoporosis [19,20,21,22]. Today, there are already existing antiresorptive therapies for osteoporosis. This method restrains further damage in bones. However, it cannot increase bone mass.

### 1.2.2. Muscle-wasting Disorders

Skeletal muscle wasting is a life-impacting disorder, especially for people who are over 40 years old. According to the data, people lose 1% of the muscle in their bodies every year [23]. Each year more and more adults are affected by this disorder and it causes serious impairments in the quality of life. This disorder may appear as the body ages or because of cancer [24,25]. Androgens are critical substances that have the potential to increase muscle mass. Therefore, they are quite promising for curing muscle wasting disorder [7,26].

### 1.2.3. Duchenne Muscular Dystrophy (DMD)

Duchenne Muscular Dystrophy is a health disorder that appears degeneration in muscles. This is a rare disorder that is caused by a genetic mutation in the DMD gene [27]. Its target group is young males. Because of the weakness in muscles, patients with DMD experience problems with their heart and lung muscles. This leads to heart failures and shorter life expectancy [28,29].

### 1.2.4. Breast Cancer

Androgens are known to increase the health risk for prostate cancer. However, studies suggest that androgens and SARMs may be used in the treatment of breast cancer [7].

### 1.2.5. Sexual Medicine

Sexual functions are influenced by androgens. This is valid both for females and males because of androgen receptors [30,31,32]. According to several types of research, SARM may be used to increase sexual urges [33].

### 1.2.6. Alzheimer's Disease

According to a study by Akite et al. [34], SARMs' androgenic effects increase neprilysin activity and is promising in the treatment of Alzheimer's [7].

### 1.2.7. Risks of SARMs in the Athletic World

SARMs are currently a focus of interest, particularly in the athletic community. With their anabolic effects and minimal side effects, SARM poses as a new type of doping alternative for athletes. SARM is a significant doping potential for increasing and strengthening muscle mass, especially for bodybuilders [35]. WADA has prohibited the use of SARMs to avoid unfair competition. But it is known that doping substances are common among athletes. Even though SARMs are quite common and easily accessed in the online markets, it is a fact that SARMs are not FDA approved [32]. Their safety is still debatable.

## 2. Discussion

It was conducted on mice to analyze how androgen receptor agonists influence bone mass. SARMs were one of the compounds that were used in animal subjects and it was concluded that SARMs restrain the loss of bone mass and increase the mineral amount in bones in animal trials [36].

SARMs are assumed to be promising in the treatment of DMD. One research used GLPG0492 type of SARM on a trial with mice that have DMD mutation. SARM was used as a treatment method. The researchers observed an increase in muscle mass and improvement in muscular function. Even though this study does not suggest SARM as a certain cure for DMD, it offers a therapy method that may be improved and further used [37].

One study investigated the relationship between bones and SARM. The type of SARM used in the study is LGD-4033. The research was conducted with a group of young males in 21 days. The subjects received SARM or a placebo. Those who were treated with SARM had more lean body mass at the end of the study. Besides, their leg strength was also observed to have increased [38].

In one study, SARM MK-773 was used. The study consisted of 170 females over age 65. While half the subject group received MK-773, the others received a placebo instead. At the end of the research, females who received SARM MK-773 have more lean body mass compared to before [39].

In several studies that were conducted on mice, different types of SARMs such as S-23, S-24, S-27 were found out to positively affect sexual motivation. Also, the myometrial thickness was observed to have increased with the use of different types of SARMs [33].

In their research, Nejishima et al. questioned how Benign Prostatic Hyperplasia can be cured using SARM S-40542 or flutamide. Weight of prostate lowered as a result of both of the substances. However, Levator ani muscle, FSH, LH, etc. were less affected by SARM. The study suggests that SARMs, with their ability to avoid side effects, may be quite promising for the therapy of BPH [40].

It was investigated the relationship between SARMs and Alzheimer's disease; SARM NEP28 was used in the research. According to the results, neprilysin activity scaled up, androgenic effects were observed to have decreased [34].

## 3. Conclusion

Selective Androgen Receptor Modulators have become a focus of interest in the world of sports and medicine. Because of their anabolic action, SARMs are considered quite promising for treating several disorders including breast cancer, osteoporosis, DMD, tumors, etc. As for the athletic community, SARMs are used as doping for muscle mass increasing and strengthening. SARMs, which are banned by WADA, pose as an alternative to other steroid-based doping with their minimum side effects. SARMs are innovative substances for

athletic performance and human health. However, even though many studies indicate promising therapeutic results, SARMS are not proved to be safe either. Further study on SARMS is required to understand the long-term effects on human health and athletic performance.

## Conflict of Interest

No declared.

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