**A systematic review of the use of Androgenic Anabolic Steroids (AAS) and their possible side effects in the Arab countries**

**ABSTRACT**

**Background:** The use of Androgenic Anabolic Steroids (AAS) has gained significant attention in public health, due to its rising prevalence and associated possible health risks. This systematic review aims to elucidate the prevalence, motivations, awareness, and health implications of AAS use in the Arab world.

**Methods:** Adhering to PRISMA-2020 guidelines, we conducted a comprehensive search across several databases, including Web of Science, Scopus, and PubMed. We used a set of related keywords to capture a diverse range of relevant studies. We applied a prespecified set of inclusion and exclusion criteria to the retrieved records and selected the appropriate studies through a two-phased screening process. After the final inclusion of the studies, we extracted the relevant data and narratively presented the results.

**Results:** A total of 17 studies with a total number of 10,948 participants, the selected studies were from Saudi Arabia, Egypt, and Kuwait. These studies indicated a high prevalence of AAS use, particularly among male gym attendees, with significant variations across countries. A common motivation for AAS use is the enhancement of physical appearance. Alarmingly, there is a substantial gap in the awareness of its health risks. Most users rely on non-scientific sources for information.

**Conclusion:** This review underscores the urgent need for comprehensive public health strategies including targeted health education and support systems, to address the widespread and risky use of ASS in the Arab world. It also highlights the necessity for future longitudinal studies to understand the long-term impact of AAS use.

**Keywords:** Androgenic Anabolic Steroids, AAS, Systematic Review, Arab World, Prevalence, Health Risks.

**INTRODUCTION**

**I-1- Definition of Androgenic Anabolic Steroids:**

Androgenic Anabolic Steroids (AAS) can be defined as any synthetic derivatives of testosterone hormone that have strong and powerful anabolic actions and relatively weak androgenic actions or effects (***Alsaeed and Alabkal, 2015)***. AAS molecules enter the human cells and bind to androgen receptors, which are present in various tissues throughout the body, these androgenic receptors are part of the endocrine system and play a crucial and important role in regulating the effects of the testosterone hormone ***(Reyes-Vallejo, 2020)***.

The term "anabolic" refers to the promotion of tissue growth, particularly in skeletal muscles. One of the primary anabolic effects of AAS is the stimulation of protein and collagen synthesis within muscle cells  ***(Kicman, 2008)***. ]This leads to an increase in the production of proteins and amino acids, particularly those involved in muscle growth and muscle repair ***(Hartgens and Kuipers, 2004)***. AAS also improves nitrogen balance in the body, which has a positive effect on nitrogen concentration within the body as it is a critical component of amino acids synthesis, and acts as the building block of protein formation when the body is in a state of positive nitrogen balance, this indicates that the body is in an anabolic state, that in turns favoring muscle growth and repair (***Van-Wayjen, 1993***

**1-2: Historical overview of AAS**

The development of synthetic Anabolic steroids dates back to the early 20th century when scientists began experimenting with modifying the structure of natural testosterone hormones. In the 1930s, German chemists synthesized the first AAS compounds *(Kanayama and Pope, 2017)*. AAS gained some popularity during World War II when they were administered to soldiers and prisoners of war to help them control their muscle wasting and to improve their overall health and performance during war, this use provided early insights into the possible useful anabolic effects of these compounds. In the post-war years, AAS started gaining attention among athletes and bodybuilders, particularly weightlifters and track-and-field athletes. Some athletes believed that AAS could enhance their performance, despite there being limited awareness of their potential side effects (***Usman, et al, 2015)***

After this, AAS continued to be prescribed medically in various countries throughout the 1950s and 1960s for a range of conditions, But their use and prescription was generally limited to clinical settings and under the supervision of specialized healthcare professionals. The turning point for its abuse came in the 1960s and 1970s when AAS began to gain widespread popularity among sport clubs bodybuilders and fitness enthusiasts. Athletes and bodybuilders believed that these drugs could help them build their muscle mass and enhance their physical appearance and their performance in various sports competitions ***(Nelson et al., 2022)***.

**1-3: Reasons for using AAS in sports**

AAS is used in huge amounts by bodybuilders and in certain types of sports, to increase body mass, and can be used also even by non-professional and noncompetitor bodybuilders for the same purposes without proper knowledge of its adverse effects. AAS usually helps the overgrowth of cells and enhances the anabolic pathways (Usman, et al, 2015).

As the use of AAS expanded beyond medical settings, concerns grew about their safety and potential health risks, this led to increased Strick regulations and classifications of AAS as controlled substances in Many countries ***(Albano et al., 2021)***. Today, anabolic steroid abuse represents a serious public health problem and is increasing rapidly in all countries either developed or developing, with a very limited lack of knowledge about its possible side effects, as 80% of the users don’t seek medical advice from a specialized health care practitioners before its use, even though over 90% are aware of its potential health risks ***(AbouZeid, 2020)***. The reasons that the consumers mentioned for its use include: to have a good shape 84%, to be stronger 54%, or to improve their health and fitness 14% ***(AbouZeid, 2020)***.

Both synthetic anabolic steroid hormones plus some nutritional supplements currently are widely and extensively used in adolescents in both sexes, males and females, athletes, bodybuilders, or any people who exercise, these substances are used for different reasons. First to increase their muscle bulk and make their muscle stronger, to increase their abilities, and to improve their look, the main action of these substances is enhancing cellular growth by stimulating the pathways of all anabolic processes **(Khokah YY, 2018),** some of these substances may be synthesized and developed in the laboratory which is usually referred as Anabolic steroids, these anabolic steroids are nutritional supplements which are concentrated and special formulas of food staffs, including certain and specific types of vitamins and some minerals that can be used to avoid the occurrence of certain diseases or to improve the health status and the general performance of the peoples who use them **(Yarasheski et, al, 1993)**

**1-4: Testosterone as anabolic steroid.**

Testosterone hormone is a form of anabolic-androgenic steroid, that interacts mainly with androgen receptors (AR) in the skeletal muscle whereas the more potent form called dihydrotestosterone (DHT), acts primarily within the sex-linked tissues with a secondary role in the skeletal muscle ***(Kraemer et al., 2020)***. The skeletal muscle amount of DHT has been related to more muscle strength and power ***(Pollanen et al., 2015)***, It was found that hormonal replacement by 5a-reductase inhibitors like dutasteride or finasteride may produce similar effects in lean tissue mass and enhance more muscle strength ***(Bhasin et al., 2012 and Borst et al., 2015)***. It is sometimes unclear if DHT is more anabolic in skeletal muscle than testosterone or not. Furthermore, testosterone can perform multiple functions as ergogenic, and strong anabolic, with anti-catabolic actions to muscles leading to increased muscle mass, strength, power, endurance, and hypertrophy, which usually occurs in a dose-dependent relationship ***(Kraemer et al., 2017)***.

Testosterone hormone structure is a C-19 steroid, present in two forms free (unbound) and unfree that are usually bound to plasma proteins. Approximately, more than 38% of testosterone is found bound to albumin, the major binding protein to testosterone is sex hormone binding globulin (SHBG), which can bind up to 60 percent of testosterone ***(Rannevik et al., 1995)***. The remaining percent of testosterone is left unbound in the plasma. Based on the free hormone hypothesis, the unbound form of testosterone binds to the androgen receptor to produce and elicit the physiological response, where it is converted by the 5α-reductase enzyme to the more active DHT ***(Marshall-Gradisnik et al., 2009)***.

The physiological effects of AAS depend on its specific molecule, as its modifications to other forms as esters may contribute to more variations in its binding to certain receptors or steroid enzymes that can affect the metabolism ***(Creutzberg and Schools, 1999)***.



**Figure (1). The chemical structure of testosterone and its common derivates adapted from *(Kuhn, 2002)*.**

Furthermore, the mechanism of physiological actions of any form of AAS is usually similar to other steroid hormones, which is based on the binds of the hormone to an androgen receptor which is an intracellular protein in the target tissues (Figure 2), this binding forms an androgen receptor complex within the nucleus of the cell ***(Nieschlag and Behre, 2012)***. The AR is a nuclear receptor that can be organized into different domains, two domains, a central and highly conserved cysteine-rich DNA-binding, and a C-terminal ligand binding domain ***(Miller and Auchus, 2011)***.

When the testosterone hormone binds to cell surface receptors, it rapidly increases the concentration of intracellular free Ca2+ ***(Benten et al., (1999)***, furthermore the presence of receptors of testosterone in the T cell membranes may support evidence that many cell membranes may be associated with receptors for steroid hormones ***(Marshall-Gradisnik et al., 2009)***. This data can support findings that the lymphocytes may contain testosterone receptors in their plasma membranes, with the evidence that, there is a novel testosterone signaling pathway that involves Ca2+ as an intracellular mediator ***(Hurd, 2006)***. From the above scenario, we can conclude that AAS can have both short and long-duration physiological effects.

Athletes usually use supraphysiologic doses of AAS to obtain the maximum response on their muscle mass and performance, in this situation these high doses may saturate the androgen receptor, which can lead to down-regulation of the androgen receptors ***(Nieschlag and Behre, 2012)***. Furthermore, the aromatase enzyme which is an intracellular enzyme that can convert high doses of AAS into estrogen, which can competitively bind to the estrogen receptors and then migrate to the cell nucleus to form estrogen receptor complexes ***(Hurd, 2006)***.

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**Figure (2): Molecular mechanism of androgenic anabolic steroid [145].**

**1-5: Prevalence of AAS use in Arab Countries**

In the United States of America (USA), more than 20% of athletes use AAS ***(Alsaeed and Alabkal, 2015)***. Studies on the prevalence of its use in the Arab Countries, Middle East, and North Africa (MENA) region are scarce and very limited and scarce  ***(Abd El-Raouf and Araby, 2022)***. It is estimated that more than 22 % of gym users in the United Arab Emirates (UAE) ***(Al-Falasi et al., 2009)***, and more than 13 % of Iranian youth bodybuilders ***(Bahrke et al., 1998***. While, it was about 28% of the gym users in Riyadh, Saudi Arabia. ***(Alhekail et al., 2018)***.

Furthermore, many studies reported a very low level of knowledge about the harmful side effects of using AAS among the Arab populations, as more than 70% of the participants in two different studies have a low level of knowledge of the possible side effects of these products on their health ***(Al-Falasi et al., 2009*** ***& Althobiti et al., 2018)***.

**1-6: Detection of AAS doping.**

The most important anabolic hormones that are extensively used in sports include insulin, testosterone, and growth hormones. The usage of AAS may be suspected by clinical signs such as acne, sexual dysfunction and muscle development, gynecomastia in males, and androgenetic alopecia in addition to hirsutism in females) also, laboratory investigations such as gonadotropins suppression, elevated levels of testosterone in addition to low levels of HDL cholesterol) ***(García-Arnésa and García-Casares, 2022)***. A vital step was taken by the World Anti-Doping Agency in 2009 which forbids the athlete from consuming prohibited substances ***(Anawalt et al., 2018)***. Also, another method for detecting doping is The testosterone: epitestosterone ratio (its normal value is 1:1), and when it is more than 6:1 this indicates exogenous administration, but the testosterone: epitestosterone ratio is not accurate in cases of women and therefore, other detection methods like bioassays and mass spectrometry (which are easier and more economical) are required ***(Robinson et al., 2017)***.

In addition, these can be used as regards doping with indirect androgens ***(García-Arnésa and García-Casares, 2022)***:

**1)** Testosterone precursors such as dehydroepiandrosterone and androstenedione.

**2)** Gonadotropins.

**3)** Estrogen receptor antagonists and aromatase inhibitors.

**1-7: Possible Side Effects of AAS Use**

 The most important side effects and symptoms that can occur because of using AAS are atrophic testicles, infertility, gynecomastia, and erectile dysfunction, these side effects are more prominent in users for the longest duration ***(AbouZeid, 2020)***, Also AAS can have irreversible side effects, including liver tumors, increased blood pressure, Dyslipidemia in the form of increase low-density lipoprotein (LDL), and decreased the beneficial high-density lipoprotein (HDL), and may be linked with certain types of tremors ***(Nakhaee et al., 2013)***.In the Arab countries and the Middle East, the use and abuse of AAS in age groups the populations has become a very serious health issue and there is limited data and information about the reasons for using such products, also there are limited studies and data about the prevalence of its use in different age groups ***(Allafi et al., 2018)***.

Based on the above data, we design this systematic review to detect the prevalence and magnitude of using AAS in different countries of the Arab regions and spotlight the potential health hazards and side effects of using these products.

**2- Aims and Hypothesis**

The research aims to outline the magnitude and prevalence of the use of AAS in Arab countries and to spotlight the possible side effects of its use on the different categories of Arab countries that their populations use such products. We conducted this study because the high rate of use and abuse of AAS has dramatically increased all over the world among all age groups. The rationale of our study is that currently in Arab countries there is very little data about the magnitude and the actual percentage of users in the Arab population.

1. **Methodology**

We followed the Preferred Reporting Items of Systematic Reviews and Meta-analysis (PRISMA-2020) during the preparation of this manuscript ***(Page et al., 2021)***. The study was conducted and carried out with a guide of the recommendations mentioned in the Cochrane Handbook that deals with the systematic reviews of interventions. ***Higgins and Green, 2008)***. This passed through 5 main steps until we finished the research (starting by searching through various databases, then a meticulous screening of the search results, then a data extraction process followed by data analysis, and finally writing the results and the paper).

## 3.1. Search Strategies

We searched the following databases: Web of Science database, the Scopus database, and PubMed. For conducting a comprehensive search over this topic, we used a set of related keywords including: (Androgenic Anabolic, and Steroids OR testosterone). By incorporating a combination of specific and broad terms related to AAS, the search aimed to capture a diverse range of relevant studies.

## 3.2. Inclusion Criteria used

Inclusion criteria: the following research and papers were included in the study

* Population: Adolescents (from 11 to 18 years and Adults (>18 years) in both sex
* Intervention: Any form of androgenic anabolic steroids with any dose or regimen.
* Comparator: any other supplements or no comparator at all.
* Study design: Cross-sectional studies, controlled clinical trials either randomized or non-randomized.
* Outcomes: Efficacy in terms of physical performance, strength, and any reported side effects

**3-3-: Exclusion criteria: the following research and papers were excluded from the study**

* Scientific papers published in conferences
* Scientific comments, editorial letters, and uncompleted review papers.
* Scientific data in book chapters.
* Papers and articles with overlapped sets of data.
* Any articles published in non-English language
* Research based on Animal studies

## 3.4. Selection of Studies

The process of data screening was carried out after the search results had been finished, all articles and included research passed through two main stages of meticulous screening. The first dealt with a screening of the title and the abstract of the research by reviewing them in all included papers as a preliminary screening, then articles that passed this stage underwent the advanced full-text screening in the second stage in which all selected papers were reviewed thoroughly for eligibility when we obtained the full-text files for all investigations.

## 3.5. Data Extraction

This step is carried out after finishing the screening. For each of the included studies, we extract the following data: Study ID (last name of the first author), Publication year, Publication journal, Study design, City/Region, Country, Sample size (number of participants), Inclusion criteria, exclusion criteria, Main findings, Conclusion, basic socio-demographic data including Participants age, Gender, Residence, and the prevalence of steroids use among participants. The results extracted from the included studies are presented and discussed narratively and through tables.

**3-6: Statistical analysis**

According to the type of data, for quantitative continuous data, we calculated the mean difference (MD) and its relative 95% confidence interval (CI), while for qualitative dichotomous outcomes, the risk ratio (RR) and its 95% CI, were estimated. For data analysis, we used the Review Manager Software (RevMan 5 | Cochrane Community,” n.d.). The Mantel-Haenszel Method was used for analysis of categorical data while the Inverse Variance Method was used for analysis of the continuous data. The inconsistency across various research was detected by two methods: The I-squared test (I2) and the P-value of the Chi-square test **(Higgins,** Thompson, Deeks, & Altman, 2003).

According to the Cochrane Handbook, any values of I2 >50% and P values less than 0.1 were considered significant indicators of heterogeneity (Higgins & Green, 2008). Furthermore, we used a fixed-effects model to assess the homogeneous data, and a random-effects model to examine the heterogeneous data

**3-7: Quality Assessment:**

This is a very crucial step in the study in which we assessed the risk of bias among the included studies, by using Cochrane’s risk of bias tool that is used for randomized clinical trials (Green et al., 2011). Which can predict the likelihood of bias, this Cochrane tool considers the following factors in the studies:

1. The Patient randomization process if present,
2. Allocation concealment,
3. level of blinding of the study participants (single or double-blinding)
4. Attrition or dropout bias, which deals with reporting all outcomes specified in the protocol,
5. Selection bias,
6. Blinding of outcome assessors to prevent over- and/or under-estimation of outcome values,
7. Any other forms of methodological bias

**3-8: Schedule and timetable of the study:**

**The study was conducted through the following timetable**

* Searching Databases and screening the results take one month.
* Screening the results takes two months
* Data extraction takes two months
* Data analysis takes two months
* Quality Assessment takes two months
* Statistical analysis of the data takes 2 months
* Writing the article takes two months
* However, the time may vary according to the device and supervisor ranging from six to nine months

|  |
| --- |
| ***Activity*** |
| **September 2023**  | **October** **2023** | **November** **2023**  | **December** **2023** | **January** **2024**  | **February** **2024** |
| Searching Databases |  |  |  |  |  |  |
| Screening the results  |  |  |  |  |  |  |
| ***Data extraction***  |  |  |  |  |  |  |
| ***Data Analysis***  |  |  |  |  |  |  |
| ***Quality assessment***  |  |  |  |  |  |  |
| ***Statistical analysis***  |  |  |  |  |  |  |
| **Research article design and writing** |  |  |  |  |  |  |

# Figure 3. Timetable

# 4- RESULTS

## 4- 1. Search results

Our search process yielded 256 records from PubMed, 1535 records from the Web of Science core collection, and another 115 records from Scopus (**Figure 4**). These 1906 records were imported to Endnote software to automatically recognize and remove duplicates. 175 records were identified and subsequently deleted. The remaining 1731 results were then screened for eligibility based on the title and abstract. We removed 1706 results in this phase. The full text of the remaining 25 studies was obtained for the second stage of the screening based on the full manuscript. Finally, 17 studies were included in this review as they met the inclusion criteria.

**Figure 4**: PRISMA flow diagram showing the details of the study selection process.

## 4.2. Description of the Included Studies

We included 17 cross-sectional studies with a total number of 10,948 participants in the present systematic review. The basic characteristics of these studies are shown in **Table 1**. The publication year span is 14 years starting from 2008 until 2022. As shown in **table 1**, 9 out of these 17 studies were conducted in Saudi Arabia ***(Alhekail et al., 2018)***, ***(Jabari et al., 2016)*** ***&*** ***(Albaker et al., 2021)***, 2 in Egypt ***(AbouZeid, 2020)***, ***(Abd El-Raouf and Araby, 2022)***, 2 in Kuwait ***(Alsaeed and Alabkal, 2015)*** ***&*** ***(Allafi et al., 2018)***, 2 in Iraq ***(Ahmed et al., 2021) &*** ***(Challab et al., 2023)***, 1 in Jordan ***(Tahtamouni et al., 2008)***, and 1 in the United Arab Emirates ***(Al-Falasi et al., 2009)***.

**Table 1**: Basic characteristics of the included studies.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study ID | Publication Journal | Publication Year | Study Design | City/Region | Country | Sample Size |
| Tahtamouni 2008 | European Journal of Public Health | 2008 | Cross-sectional study | Zarqa | Jordan | 657 individuals (503 collegiate students and 154 athletes)  |
| Jabari 2008 | Electronic Physician | 2008 | Cross-sectional study | Riyadh | Saudi Arabia | 600 athletes |
| Al-Falasi 2008 | The Open Sports Medicine Journal | 2008 | Cross-sectional analytical study | Al-Ain District | United Arab Emirates | 154 participants |
| Alsaeed 2015 | Substance Abuse Treatment, Prevention, and Policy  | 2015 | Cross-sectional survey | Kuwait | Kuwait | 194 participants |
| Bahri 2017 | Tropical Journal of Pharmaceutical Research | 2017 | Observational cross-sectional survey | Jazan | Saudi Arabia | 465 participants |
| Al Nozha 2017 | Annals of Saudi Medicine | 2017 | Cross-sectional study | Madinah | Saudi Arabia | 316 participants |
| Authority 2018  | Mater Sociomed | 2018 | Cross-sectional study | Multiple cities | Saudi Arabia | 4860 participants |
| Allafi 2018 | Science & Sports | 2018 | Observational cross-sectional survey  | Kuwait | Kuwait | 150 participants |
| Alhekail 2018 | International Journal of Pharmaceutical Research & Allied Sciences | 2018 | Cross-sectional study | Riyadh | Saudi Arabia | 185 participants |
| Albishi 2018 | Electronic Physician  | 2018 | Cross-sectional survey  | The western province of Riyadh | Saudi Arabia | 363 participants (400 approached) |
| Alharbi 2019 | Saudi Pharmaceutical Journal | 2019 | Cross-sectional survey | Riyadh | Saudi Arabia | 482 participants |
| Ahmed 2019 | Journal of Microscopy and Ultrastructure | 2019 | Cross-sectional observational survey | Jeddah | Saudi Arabia | 300 participants |
| Ahmed 2020 | Zanco Journal of Medical Sciences | 2020 | Cross-sectional study  | Erbil  | Iraq | 400 participants |
| AbouZeid 2020 | Kidney International Reports | 2020 | Cross-sectional observational survey | Not specified | Egypt | 1000 athletes surveyed, 480 admitted to anabolic steroid abuse |
| Albaker 2021 | Medicine | 2021 | Cross-sectional study  | Eastern Province | Saudi Arabia | 541 participants |
| Challab 2022 | Ibn Al-Haitham Journal for Pure and Applied Sciences  | 2022 | Cross-sectional questionnaire study | Baghdad | Iraq | 81 participants |
| Abdel-raouf 2022 | Egyptian Journal of Community Medicine | 2022 | Cross-sectional study | Benha and Shebin Al-Kom Cities | Egypt | 200 participants |

## 4.3. Main results from the included studies

Because of the heterogeneity of the included studies, we narratively presented the results. For the sake of organization and simplicity, tables were used to organize the extracted results. **Table 2** describes the baseline characteristics of the participants regarding their number, Age, Gender, Residence, and the prevalence of steroid abuse among them.

**Table 2**: Baseline characteristics of the participants

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Study ID | Sample Size | Age | Gender | Residency | Prevalence of Steroid Abuse |
| Tahtamouni 2008 | 657 individuals (503 collegiate students and 154 athletes)  | The mean age of student users was 19.9 years, and athlete users was 28 years.  | Majority male (specific numbers not provided) | Various cities in Jordan | 4.2% among students and 26% among athletes. |
| Jabari 2008 | 600 athletes | 15-49 years, with a majority in the 25-29 age group | All male | Riyadh, Saudi Arabia | 30.5% of athletes |
| Al-Falasi 2008 | 154 participants | Predominantly 21-29 years | Male | Al-Ain City, UAE | 22% of gym users |
| Alsaeed 2015 | 194 participants | Predominantly in the 19–25 years age group | Male | Kuwait | 22.7% of participants |
| Bahri 2017 | 465 participants | Predominantly 20-34 years | Male | Not specified | 31.0% of participants |
| Al Nozha 2017 | 316 participants | 18-35 years | Male | Madinah, Saudi Arabia | 70% of participants |
| Allafi 2018 | 150 participants | The majority between 18—and 29 years | Male | Urban and rural areas of Kuwait | 22.7% of participants |
| Althobiti 2018  | 4860 participants | Mean age 28.6 years | Male | Various regions of Saudi Arabia | 9.8% of gym participants |
| Alhekail 2018 | 185 participants | The majority are between 20 and 25 years | Male | Riyadh, Saudi Arabia | 39% among participants |
| Albishi 2018 | 363 participants (400 approached) | The majority are between 26 and 33 years  | Male | Riyadh, Saudi Arabia | 24.5% of participants |
| Alharbi 2019 | 482 participants | Mean age 27.2 years | Male | Riyadh | 29.3% among gym users |
| Ahmed 2019 | 300 participants | Mean age 30.66 years | 59.7% female, 40.3% male  | Not specified | 4.7% among participants |
| AbouZeid 2020 | 1000 athletes surveyed, 480 admitted to anabolic steroid abuse | Not specified | Not specified | Not specified | 48% among athletes |
| Ahmed 2020 | 400 participants | Mean age 27.8 years | Male | Not specified | 26.3% of participants |
| Albaker 2021 | 541 participants | The majority are between 21 and 30 years | Male | Eastern Province, Saudi Arabia | 21.3% among gym users |
| Abdel-Raouf 2022 | 200 participants | Not specified | Not specified | Not specified | 18% of gym attendees |
| Challab 2022 | 81 participants | Average 29.0 years | Male | Not specified | High among the study participants |

**Table 3**: Main results from the included studies.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Study ID | Sample Size | Inclusion Criteria | Exclusion Criteria | Main Findings | Conclusion |
| Tahtamouni 2008 | 657 individuals (503 collegiate students and 154 athletes)  | Jordanian collegiate students and bodybuilding athletes | Not explicitly mentioned | Among collegiate students, 4.2% were current anabolic-androgenic steroids (AAS) users, and among athletes, this percentage rose to 26%. Key reasons for AAS use were to improve athletic performance and physical appearance.  | AAS abuse is emerging as a public health concern in Jordan, necessitating educational programs to raise awareness about the negative effects of AAS. |
| Jabari 2008 | 600 athletes | Athletes visiting gymnasiums in Riyadh | Not explicitly mentioned | The prevalence of anabolic androgenic steroid (AAS) use among athletes was 30.5%. Most users were in the age group of 25-29 years.  | High prevalence of AAS use among athletes in Riyadh, with most users lacking knowledge about the adverse effects of AAS. |
| Al-Falasi 2008 | 154 participants | Gym users in Al-Ain city | Not explicitly mentioned | A high prevalence (22%) of anabolic steroids (AS) use among gym users; misinformation and lack of awareness about AS risks.  | Need for public awareness programs on AS risks; high AS misuse in gym users.  |
| Alsaeed 2015 | 194 participants | Male fitness center attendees | Not specified | 22.7% of participants used anabolic androgenic steroids (AAS), with the highest occurrence (46.8%) in the 19–25 age group. Many users believed in the necessity of AAS for an optimal muscular body and had inadequate knowledge of potential health harms. | High prevalence of AAS use and significant misconceptions about its safety among fitness center attendees. |
| Bahri 2017 | 465 participants | Male bodybuilders visiting gyms  | Not explicitly mentioned | High prevalence (31.0%) of AAS use among male bodybuilders; lack of awareness about AAS side effects  | Urgent need for health education to increase awareness of AAS side effects  |
| Al Nozha 2017 | 316 participants | Young adult male gym users, aged 18-35  | Gym users who participated in national or international sports competitions | High prevalence (70%) of performance-enhancing agents (PEAs) use; limited knowledge about negative health consequences of PEAs. | Widespread misuse of PEAs with low awareness about potential serious health risks. |
| Allafi 2018 | 150 participants | Kuwaiti males visiting gyms | Not specified | 22.7% prevalence of anabolic hormones use among participants; growth hormone, testosterone, and Deca-Durabolin were most commonly used; side effects reported included depression, aggressive behavior, and sexual problems.  | High prevalence of anabolic hormone use; the need for health education on AH use among youths.  |
| Althobiti 2018  | 4860 participants | Male gym participants | Incomplete survey responses | 9.8% prevalence of AAS use among gym participants; the majority obtained AAS information from friends, and gym trainers were a primary source of AAS substances  | High prevalence of AAS use, associated with risky habits like smoking and growth hormone abuse; participants showed inadequate knowledge of potential AAS complications |
| Alhekail 2018 | 185 participants | Male gym users including medical students | Not explicitly mentioned | 39% of gym users reported using protein supplements, with "Whey" protein being the most common. There was no significant difference in protein use between medical students and the general population.  | High usage of protein supplements among gym goers; no significant difference in knowledge about protein supplements between medical students and the general population.  |
| Albishi 2018 | 363 participants (400 approached) | Male gymnasts over 18 years old attending selected gyms  | Younger than 18 years, female, professional athletes, or multiple registrations in study centers | 24.5% of gymnasts were AAS users; the most common AAS type was testosterone, obtained mainly through online shopping and gym coaches. There was a lack of awareness about AAS among both users and non-users.  | High prevalence of AAS use among gymnasts in Riyadh, with low levels of awareness about AAS and its adverse effects, highlighting the need for educational programs. |
| Alharbi 2019 | 482 participants | Male gym users | Not explicitly stated | 29.3% of gym users reported AAS use. Knowledge about AAS and its side effects was limited among participants. Attitudes towards AAS were varied, with many acknowledging both the perceived benefits and risks.  | A significant proportion of gym users in Riyadh use AAS with limited awareness of potential side effects, indicating a need for better education and policy measures |
| Ahmed 2019 | 300 participants | Adult gym users, both male and female | Under 18 years old, physical or mental conditions preventing questionnaire completion | Low prevalence of anabolic-androgenic steroid (AAS) use (4.7%) with poor knowledge regarding AAS among the population; no significant correlation between AAS use and gender, exercise, or energy drink consumption.  | Need for national awareness programs on AAS use and side effects due to poor knowledge among the population. |
| AbouZeid 2020 | 1000 athletes surveyed, 480 admitted to anabolic steroid abuse | Athletes from health clubs in Egypt | Non-anabolic steroid users, athletes with chronic diseases or comorbidities  | 48% prevalence of anabolic steroid abuse among athletes, with testosterone being the most used substance. High awareness of health risks but prevalent side effects.  | The study underscores the significant issue of anabolic steroid abuse among Egyptian athletes and calls for more targeted health interventions.  |
| Ahmed 2020 | 400 participants | Gym users in Erbil city | Less than six weeks of gym use  | 26.3% prevalence of anabolic-androgenic steroid use among gym users; misinformation and risky behavior associated with steroid use; trainers as the main source of recommendation.  | High prevalence of steroid use among gym goers, demonstrating the need for public health awareness and intervention. |
| Albaker 2021 | 541 participants | Male gym users | Not specifically mentioned | 21.3% prevalence of AAS use; the highest prevalence in the 26–30 age group (31.9%). Users had inadequate knowledge of AAS side effects.  | High AAS use among gym goers, with limited awareness of its risks, emphasizes the need for targeted health education. |
| Abdel-Raouf 2022 | 200 participants | Gymnasium attendees | Not specified | 18% of the study group used anabolic steroids, either alone or with nutrient supplements. 31.6% of total anabolic supplement users and about a third were unaware of the possible side effects. | High prevalence of anabolic steroids use among gym attendees, with a significant portion lacking awareness of side effects. |
| Challab 2022 | 81 participants | Male, >18 years, healthy bodybuilder using the gym | Female gender, Age under 18 years | Significant use of anabolic androgenic steroids (AAS) among gym users; lack of knowledge about AAS's side effects. | High prevalence of AAS use among male gym goers; need for improved health policies and awareness about AAS abuse |

## 4.4. Prevalence of AAS Use in the Arab World

The studies consistently report a high prevalence of AAS use among gym attendees. For instance, in Saudi Arabia ***(Alharbi et al., 2019)***, the prevalence was noted at 29.3% among gym users in Riyadh. Similarly, in Kuwait ***(Alsaeed and Alabkal, 2015)***, 22.7% of male fitness center attendees reported using AAS. Notably, a significant portion of AAS users is found in the younger demographic. In the Al Nozha 2017 study from Saudi Arabia ***(Al Nozha and Elshatarat, 2017)***, a staggering 70% of young adult male gym users aged 18-35 were found to use performance-enhancing agents, including AAS. There are variations in the prevalence rates across different countries in the Arab world. For example, the prevalence in Iraq ***(Ahmed et al., 2021)*** was reported at 26.3%, while in Egypt ***(AbouZeid, 2020)***, it was significantly higher at 48%.

## 4.5. Reasons Behind Usage

The motivation for AAS use often comes from the desire of bodybuilders and gym users or any athletes to go to sports clubs, to improve their physical appearance, increase their muscle bulk and mass, and enhance their performance in sports clubs and national and international competitions. The studies also indicate a cultural trend among the users about valuing muscular physique and body image, with gym trainers frequently being a primary source of AAS abuse among adolescents and young adults (as seen in Althobiti 2018).

## 4.6. Awareness and Knowledge About ASS Use among Users

A recurring theme in the included studies is the general lack of basic knowledge and awareness together with misconception and misinformation about the side effects and risks of AAS use. For example, the study by Althobiti 2018 in Saudi Arabia found that gym participants had inadequate knowledge about potential AAS complications, despite a prevalence rate of 9.8%.

Many users of ASS perceive steroids as safe and very effective and rapid method of increasing muscle bulk and mass without understanding the potential short and long-term health implications. The study in Kuwait by Alsaeed 2015 reported a 22.7% prevalence of AAS use among their population, with many users believing in the necessity of AAS for optimal muscular development. Regarding the main source of information for use and side effects of AAS, The studies reveal that gym-goers often rely on their peers, trainers, and internet sources for information their knowledge and information, which always be not correct and not accurate or based mainly on personal experience and has no any scientific background.

Even among users who are aware of the possible health risks and bad side effects that can occur when using such products, their knowledge does not necessarily prevent or minimize their use, which indicates a great gap between the level of knowledge and awareness of the users and their behavior change toward refusing using such products, as seen in the study by Ahmed, 2020 in Iraq, where 26.3% of gym users reported AAS use.

Finally, cultural, and social factors play a significant role in the perception and use of AAS in Arab Countries, The emphasis on physical appearance and muscular physique in Arab cultures can influence attitudes toward AAS use, as highlighted in several of these studies.

## 4.7. Health Risks and Side Effects Reported

One of the consistent findings across these studies is the association of steroid use with various physical health risks and side effects, these include hormonal imbalances, liver damage, cardiovascular issues, and increased risk of infectious diseases due to needle sharing. Additionally, several studies reported mild and serious psychological disturbances and side effects associated with AAS use, these include mood swings, aggressive behavior, depression, and dependency which may have a very negative impact on the behavior of AAS users in their communities and with their friends, peers, and families. The study in Kuwait ***(Alsaeed and Alabkal, 2015)***, particularly noted depression and aggressive behavior as common among AAS users.

# 5- DISCUSSION

The systematic review presented in this study provides a comprehensive analysis of the prevalence, motivations, knowledge, and health implications of AAS use in the Arab world. Our review revealed a high prevalence of AAS use among gym attendees, with notable variations across different countries, this widespread use of AAS is often motivated by the desires of the users to enhance their physical appearance and performance in their community while improving their body image and view. A striking aspect of our findings is the general lack of knowledge and awareness of the possible side effects and bad health consequences of using such products, together with high levels of misinformation and misconceptions about AAS health risks and benefits. It was surprising that despite some users being aware of the possible side effects and bad health risks associated with AAS use, this knowledge and awareness does not necessarily prevent their usage or their recommendation of its use to their peers and friends, this gap between their awareness and their behavior highlights the need for more effective educational campaigns and interventions that address not only the dissemination of information but also address the importance of behavioral therapy and tactics which is a science and should not be ignored or neglected to control. The reliance on peers, trainers, and online sources for information about steroids, often unscientific and inaccurate, underscores the necessity for accessible, reliable, and scientifically grounded educational resources.

The health risks associated with AAS use, as evidenced in our review, are significant. These findings are consistent with the literature on steroid abuse ***(Horwitz et al., 2019)*** & ***Nelson et al., (2022)*** and point to the urgent need for effective strategies to mitigate these risks AAS use can lead to an increased risk of cardiovascular problems such as high blood pressure, heart attacks, and strokes. AAS can negatively affect lipid profiles by lowering "good" HDL cholesterol and increasing "bad" LDL cholesterol levels. Liver damage, especially from certain oral AAS in high doses or prolonged use, can lead to severe hepatic cirrhosis and even liver tumors. Kidney problems are another concern as AAS use can stress the kidneys, potentially resulting in damage or dysfunction. Additionally, AAS disrupts the body's natural hormonal balance, causing hormonal imbalances, infertility, and testicular atrophy in males, while some users may develop gynecomastia due to increased estrogen levels. ***(Bates et al., 2019)***.

AAS use is also associated with severe acne, mood swings, mental health issues, addiction, legal consequences, social stigma, and dependency, leading to withdrawal symptoms upon discontinuation. Furthermore, long-term AAS use has been linked to an increased risk of cancers, hair loss, and masculinizing effects in women, emphasizing the need for informed decision-making, medical supervision, and adherence to legal regulations to protect one's health and overall well-being. ***(Chang et al., 2018)***.

One of the factors that may influence the AAS abuse is the legal status which varies from one Arab country to another, reflecting different approaches to their regulation and availability across the region. In the United Arab Emirates (UAE), the sale and possession of AAS are subject to strict regulations. AAS are classified as controlled substances, making their importation, distribution, and possession without a valid prescription illegal. Violating AAS laws in the UAE can lead to severe penalties, including fines and imprisonment. Similarly, Saudi Arabia maintains stringent regulations concerning AAS. The sale, possession, and use of AAS without a prescription are strictly prohibited, and individuals found in violation of these laws may face legal consequences, such as fines and imprisonment. ***(Nelson et al., 2022)***

Egypt has established regulations to control the sale and distribution of AAS. These substances can only be legally obtained through prescriptions issued by licensed healthcare providers. The sale and possession of AAS without a prescription may lead to legal penalties. Lebanon takes a relatively more lenient stance on AAS compared to some other Arab countries. While AAS are prescription medications, they can sometimes be found in pharmacies without strict enforcement of regulations. Consequently, the sale and non-medical use of AAS may not consistently result in legal consequences. In contrast, Qatar has stringent laws in place regarding AAS. The possession, sale, and use of AAS without a prescription are illegal activities. Violators may face legal action, including fines and imprisonment. ***(Horwitz et al., 2019)***

A significant portion of AAS use in the Arab regions occurs through the black market. This involves the illegal sale and distribution of AAS without a prescription. Users often purchase AAS from underground sources, unregulated sellers, or gyms. These sources may sell counterfeit or substandard products, posing significant health risks. Moreover, the internet has become a global marketplace for AAS. Users in Arab countries can access AAS through online sources, including websites, forums, and social media platforms. These sources often offer a wide range of AAS products, making it convenient for users to acquire them anonymously. ***(Althobiti et al., 2018)***

In many Arab societies, the perception of an ideal male body is often associated with physical strength, muscularity, and virility. Men are expected to exhibit physical prowess and be the protectors of their families. This cultural ideal can drive some individuals to use AAS to achieve a more muscular and imposing physique, aligning with societal expectations of masculinity. Additionally, Arab communities often emphasize the importance of social harmony and conformity. Peer pressure to conform to established beauty standards and masculine/feminine ideals can drive individuals to use AAS to fit in or gain social acceptance within their communities. Moreover, Arab media, like elsewhere, often portrays idealized body images for both men and women. These images can contribute to unrealistic beauty standards and may encourage AAS use among those striving to attain these ideals. Finally, some individuals may view AAS use to improve overall health and well-being, believing that a more muscular or toned physique equates to better physical and mental health. ***(Alsaeed and Alabkal, 2015)***

While our review provides valuable insights, it is not without limitations. The biggest limitation is the exclusive inclusion of cross-sectional studies and the obvious lack of longitudinal studies. Longitudinal studies could provide more insights into the long-term effects of steroids. That’s why we think that future research in this area should focus on longitudinal study designs to better understand these aspects. Additionally, the heterogeneity of studies, differences in methodologies, and variations in reporting standards across different countries may affect the generalizability of our findings.

Another noticeable limitation is the focus on male participants and ignoring the female population in the context of AAS use and its effects. Only one study out of the 17 included studies involved female participants while the remaining 16 studies were conducted exclusively on males. This gender bias in research creates a significant gap in our understanding of the impact of AAS on women. This disproportion highlights a critical area for future research. This is especially important because women could face unique health risks from AAS use, such as disruptions in menstrual cycles, changes in secondary sexual characteristics, and increased risk of certain cancers. Without adequate research, these risks remain poorly understood. ***(Al Nozha and Elshatarat, 2017)***,

This important deficiency in our research is not different from the existing literature on this topic. A notable gender disparity exists in AAS research, with the majority of studies focusing exclusively on male participants. Historically, AAS use has been associated primarily with male bodybuilders and athletes. This stereotype may have discouraged researchers from including women in their studies, as AAS use among females was less common and less visible. Some researchers may be hesitant to include female participants in AAS studies due to ethical concerns about potential harm. There is a concern that women could face unique and potentially more severe health risks from AAS use, such as disruptions in menstrual cycles, virilization (development of male secondary sexual characteristics), and increased risk of certain cancers.

Finally, we would like to emphasize that healthcare systems and providers are crucial in addressing AAS use. Healthcare providers should be trained to identify signs and symptoms of AAS use in patients. These may include rapid muscle gain, mood swings, acne, gynecomastia, and unexplained changes in behavior or physical appearance. They also should assess an individual's risk factors for AAS use, such as body image dissatisfaction, pressure to conform to societal ideals, and previous substance abuse issues.

Additionally, healthcare providers should be knowledgeable about AAS-related health issues, including the physical and psychological risks. They can offer evidence-based information to individuals who are considering AAS use or who are already using AAS. They also should emphasize the potential health consequences of AAS use, including cardiovascular problems, liver damage, hormonal imbalances, and mental health issues. They can also explain that the pursuit of physical appearance goals through AAS can have serious and even life-threatening repercussions.

Moreover, Counseling and support are essential components of healthcare systems' response to AAS use. Healthcare providers should offer individualized counseling and support to those struggling with AAS use, addressing underlying psychological factors like body dysmorphic disorder and low self-esteem.

For individuals who may not be ready to quit AAS use immediately, healthcare providers can implement harm-reduction strategies. This includes regular health check-ups to monitor physical well-being, tracking blood markers for early detection of health problems, and offering guidance on safer AAS practices.

When faced with individuals experiencing mental health issues due to AAS use, healthcare providers can refer them to mental health professionals skilled in treating substance use disorders and related psychological conditions. This ensures that the individual receives comprehensive care tailored to their specific needs.

In cases of AAS dependence or addiction, healthcare providers have the option to refer individuals to addiction specialists or substance abuse treatment programs. These specialized services can provide the necessary support for recovery and rehabilitation.

Monitoring and follow-up are crucial aspects of healthcare intervention. Healthcare providers should conduct long-term health monitoring, especially for those who have used AAS and may have experienced adverse effects. Regular follow-up appointments enable early detection and timely intervention for any health issues that may arise.

6- **CONCLUSION AND RECOMMENDATIONS**

In conclusion, the use of AAS in the Arab world is a significant public health concern, characterized by high prevalence rates and a worrying lack of accurate knowledge about its risks. This review underscores the need for comprehensive public health strategies that include education, regulation, and support systems to address this growing issue. It is imperative to bridge the gap between awareness and behavior change and to combat the cultural and social factors that contribute to steroid abuse. This demands a synchronized effort from healthcare providers, educators, policymakers, and the broader community to implement evidence-based educational initiatives, enforce robust regulations, and establish a network of support systems. Only through a collective endeavor can the Arab world hope to safeguard the health and overall well-being of its populace and mitigate the far-reaching consequences of AAS misuse on individual lives and society as a whole.

**List of Abbreviations**

|  |  |
| --- | --- |
| **AAS** | Anabolic Androgenic Steroids |
| **AR** | Androgen receptors  |
| **DHT** | Dihydrotestosterone  |
| **LDL** | Low-Density Lipoprotein  |
| **HDL** | High-Density Lipoprotein  |
| **MENA** | Middle East, and North Africa; |
| **PRISMA** | Preferred Reporting Items for Systematic Reviews and Meta-Analysis |
| **SHBG** | sex hormone binding globulin |
| **UAE** | United Arab Emirates  |
| **USA** | United States of America  |

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