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Prevalence and Risk Factors Associated with Anabolic-androgenic Steroid Use: A Cross-sectional Study among Gym Users in Riyadh, Saudi Arabia

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ABSTRACT

Objectives: Anabolic-androgenic steroids (AAS) have been used internationally for enhancing physical appearance and performance despite their significant side effects. We sought to identify the prevalence of AAS use and its different risk factors among gym users in Riyadh, Saudi Arabia. ***Methods***: A cross-sectional survey was distributed among gym users across 20 gyms in Riyadh. The cluster sampling technique was used to represent the four regions of Riyadh (North, South, East, and West). Univariate and multivariate analyses were performed to identify the factors associated with AAS. ***Results:*** Out of 482 participants, 29.3% reported using AAS. The mean age of the study participants was 27.2±6.9 years, 61.0% were single, 67.1% were educated, 35.5% were government employees, and 31.1% were students. The use of AAS was more prevalent among gym members who practiced weightlifting (45.5%), were employed in the private sector (35.8%), and aged > 25 years old (53.3%). Multiple logistic regression showed that the most significant factors associated with the use of AAS among gym members were: weightlifting, using supplementary vitamins or minerals, following special diets, knowing individuals who used AAS, and being offered AAS. ***Conclusions:*** Our study provides clear evidence that the lifetime prevalence of AAS use is high among male gym members in Riyadh with modifiable risk factors. The results could help public health policymakers to take the necessary measures to alleviate the potential negative implications of AAS use at the community level.

Anabolic-androgenic steroids (AAS) are synthetic derivatives of testosterone, which is the primary sex hormone in males. The effects of testosterone on the human body can be divided into two main categories: androgenic and anabolic.[1] The androgenic effects are those associated with male sexual characteristics, such as the deepening of the voice, body hair growth, and the development and growth of male testes and external genitalia as well as male accessory reproductive glands (seminal vesicles, prostate, and bulbourethral glands). The anabolic effects are responsible for protein building in bone and muscles that leads to the linear growth of bone and the increase of muscle mass.[1] Moreover, testosterone was found to influence muscle performance by increasing maximal voluntary strength and power.[2,3]

AAS were developed to minimize the androgenic effects of testosterone and maximize the anabolic ones promoting the growth of skeletal muscles.[4,5] They can be used therapeutically to restore muscle mass in the treatment of cachexia associated with severe burns, renal failure, and AIDS. Also, they are used as hormonal replacements in men with

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hypogonadism or low circulating testosterone levels.[1,6] Although AAS are relatively safe when used for medical indications, they have some serious side effects that can affect different body organs.[1] These include cardiac side effects such as an increased risk for myocardial infarction, stroke, left ventricular hypertrophy, and sudden cardiac death. Hepatic side effects include bile canal obstruction and increased risk for hepatic tumors. AAS can also affect fertility by causing decreased levels of testosterone and testicular atrophy in men and amenorrhea in women. Some psychiatric side effects include irritability, hypomania, increased aggression, and hostility. Other side effects are breast atrophy in women and gynecomastia in men.[1]

Despite these significant side effects, AAS have been internationally used without medical prescriptions by professional and non-professional athletes to improve their performance and physical appearance.[7,8] Professional athletes started to use AAS in the 1950s, and the first athletes to use them were weightlifters.[9] After that, AAS use quickly spreads among athletes practicing sports that depend on muscle strength and speed of recovery, such as bodybuilding competitions and track and field events. In the 1980s, western culture was increasingly focusing on male muscularity, leading to the spread of AAS use from the domain of professional athletes to the general population.[10] Currently, studies show that AAS use is common worldwide,[11-20] and four out of five AAS users are non-athletes who are using these medications for cosmetic purposes.[11]

The use of AAS for nonmedical purposes was reported to be "a serious widespread public health problem" in a global systemic review published in 2014.[12] A study conducted in the UK in 2005 found that AAS use was common among recreational gym users with 70% reporting AAS use and 65.8% reporting to currently still use it.[13] Another study on 1802 fitness-center visitors in Germany found that 13.5% of the participants used AAS at some point in time.[14] Among Brazilian bodybuilders, the frequency of AAS use was 20.6%; 98.1% were young men, and 49.5% trained for more than four years.[15] In a cross-sectional study in Iran, the prevalence of AAS use was 28.8%, with a significant association between AAS use and the duration of exercise.[16] Other factors associated with AAS use include a lower level of education,[21] history of illegal drug abuse,[22] and body image concerns.[23]

In the Middle East, despite the low number of studies, AAS use for recreational reasons appears to be common. An Iraqi study conducted on 3200 participants reported 1.3% of lifetime prevalence of AAS use.[17] In the UAE, a study published in 2008 reported a prevalence of 22% among gym users with AAS use that is significantly higher among weightlifters and bodybuilders.[18] Another study in Kuwait showed a similar prevalence with AAS users of 22.7%. Surprisingly, only a small number of participants (6.8%) in that study believed that AAS use could cause significant health problems.[19] In Saudi Arabia, a recent study in the western province of Riyadh reported a percentage of 24.5% of AAS users among 400 male gym attendees from 10 different fitness centers. The level of awareness regarding AAS was also low among those study participants.[20] This finding is concurrent with a recent study that was conducted by us in Riyadh, in which participants reported a low level of awareness regarding the side effects of AAS use.[24]

Although AAS use is relatively common in the Middle East, data about the prevalence and risk factors of AAS use is still considered to be lacking in Saudi Arabia. Identifying the risk factors of AAS use will help in the development of effective evidence-based interventional strategies to control the abuse of AAS among targeted high-risk populations. Thus, this study aims to identify the prevalence of AAS use among gym attendees in Riyadh, Saudi Arabia as well as to identify the different risk factors associated with high prevalence.

METHODS

This cross-sectional study was conducted on gym users in Riyadh, the capital city of Saudi Arabia. All healthy male adults (18–55 years) who were attending any type of gym facility, including hotels, social clubs, and commercial clubs, during the study period and were able and willing to give a voluntary consent were included in this study. Individuals who attended a selected gym were approached on a randomly selected day. The objectives of the study were explained to all participants by our research team. Any person who used AAS because of health problems was excluded from the study.

The sample size needed for this study, which was calculated using Raosoft software, was 264 subjects with a statistical significance level of 95% (an error

margin of 5%), and 95% confidence interval (CI) ± 5% marginal errors. We used an expected prevalence of AAS use of 22.0% based on the results of previous similar studies to calculate this sample size. We anticipated a non-response rate of 25.0% (264 × 0.25 = 66), so the final total sample size would be 264 + 66 = 330. Additionally, sampling errors of approximately 1.5 were expected using a cluster sampling technique. Therefore, the final sample size was multiplied by 1.5 (330 × 1.5) equaling 495, which was rounded up to 500 participants.

The study was approved by the Institutional Review Board Committee of the King Abdullah International Medical Research Center with protocol number RC15/125/R. In addition, we sought administrative permission from the Saudi General Authority for Sport to conduct this study and from the gym owners to distribute the questionnaire. Informed written consent was obtained from all participants, and all responses were anonymous. Participants' names were not recorded, and data remained confidential to protect privacy; data were not used for purposes outside the study objectives.

Data were collected using a cluster sampling technique from March to October 2016. A list of all gym centers in Riyadh was obtained from the General Authority of Sports Welfare, and the number of gyms according to the list was 187 across four geographical areas of the city (North, South, East, and West). Five-hundred gym members were randomly selected from the four geographical regions representing the proportion of gym facilities in each area. We expected to have 30 individuals per gym (cluster). Therefore, the above number (500) was divided for each area to obtain the required number of clusters (or gyms). The data were collected using a self-administered questionnaire, the contents of which were obtained and modified after reviewing the literature.[7,8,11–29] In addition to basic demographics, the questionnaire included questions on exercise patterns, the use of nutritional supplements, and the use of any narcotic or psychiatric drugs. The questionnaire was pilot-tested to ensure its validity, reliability, and clarity. The feedback received from the pilot study was taken into consideration in the creation of a final version of the questionnaire.

Data entry and analysis were performed using the SPSS Statistics (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). After cleaning the data, the descriptive statistics (frequencies, percentages, means, and standard deviations) were carried out to the sample's sociodemographic characteristics, and the prevalence of AAS use among gym users was calculated. Chi-square test followed by logistic regression was used to test the association between the respondents' sociodemographic characteristics, and to identify the independent factors associated with the prevalence of AAS among gym users. An alpha level of < 5% was used to determine statistical significance.

RESULTS

A total of 500 questionnaires were distributed among gym users across 20 gyms in Riyadh; 482 (96.4%) gym users agreed to participate in the study. The mean age of the study participants was 27.2±6.9 years. Most participants were single (61.0%), government employees (35.5%), and had a degree or diploma (62.7%). The most common reason for visiting the gym among our subjects was professional training (54.6%), and most visited daily (57.3%) staying for 30–60 minutes (42.7%). A total of 141 participants (29.3%) reported using steroids [Table 1].

When compared to non-steroid users, those who used were older ($t = 2.06$, $p = 0.040$). Another significant association was detected between the type of sport that the participant usually practices and the use of AAS with 45.5% of AAS users practicing weightlifting compared to only 28.1% of non-users ($\chi^2 = 14.49$, $p = 0.001$). No statistically significant associations were detected between other sociodemographic characteristics and the use of AAS [Table 2].

Among the study variables selected to assess an association with the binary outcome variable 'AAS use (yes/no)', the following study variables were significantly associated with the use of AAS: (i) age, (ii) type of work, (iii) type of sport, (iv) awareness that AAS are used for bodybuilding, (v) use of supplementary vitamins, minerals, or special diet, (vi) knowing anyone using AAS, (vii) being offered AAS, (viii) ever using narcotics or psychoactive drugs, and (ix) the use of narcotic or psychoactive drugs in the past 30 days. The odds of using AAS were significantly higher among gym members aged > 25 years compared to gym members aged ≤ 25 years. Moreover, the odds of using AAS were

Table 1: Characteristics of study subjects (N = 482).

Characteristics	n (%)
Have you ever used anabolic steroids?	
Yes	141 (29.3)
No	341 (70.7)
Age, mean ± SD, years	27.2 ± 6.9
Marital status	
Single	294 (61.0)
Married	182 (37.8)
Divorced	6 (1.2)
Occupation	
Student	150 (31.1)
Private employee	134 (27.8)
Government employee	171 (35.5)
Retired	4 (0.8)
Other	23 (4.8)
Monthly income (Saudi Riyals)	
< 5000	203 (42.1)
5000–9999	156 (32.4)
10 000–14 999	76 (15.8)
> 15 000	47 (9.8)
Education level	
Illiterate	6 (1.2)
Primary	6 (1.2)
Intermediate	11 (2.3)
Secondary	136 (28.2)
Degree or diploma	302 (62.7)
Higher education (Masters or PhD)	21 (4.4)
Nationality	
Saudi	408 (84.6)
Non-Saudi	74 (15.4)
Area of residence in Riyadh	
East	81 (16.8)
West	167 (34.6)
North	126 (26.1)
South	108 (22.4)
Reason for gym use	
Medical	50 (10.4)
Work	14 (2.9)
Recreational	155 (32.2)
Professional training	263 (54.6)
How often do you visit the gym?	
Once per week	25 (5.2)
Twice per week	31 (6.4)
Three or more times per week	150 (31.1)
Daily	276 (57.3)
How long do you stay at the gym when visiting?	
< 30 minutes	25 (5.2)
30–60 minutes	206 (42.7)
> 1 hour–2 hours	197 (40.9)
> 2 hours	54 (11.2)
What sport do you usually practice?	
Aerobic	283 (58.7)
Weightlifting	162 (33.6)
Other	37 (7.7)

SD: standard deviation

2.25-times higher among those who are employed in the private sector compared to students. Gym members who practiced weightlifting had odds of using AAS that were 2.29-times higher compared to those who practiced aerobic sports. Those who had heard about AAS had 2.03-times higher odds compared to those who never did. Also, gym users who had prior knowledge regarding the use of AAS in bodybuilding were 2.13-times more likely to use AAS compared to participants who are unaware of its use in bodybuilding. The odds of using AAS is 7.60-times higher among gym members who use supplementary vitamins, minerals, or special diets compared to those who do not use these supplements.

Our results show that the odds of using AAS is 9.94-times higher among gym members who know someone using AAS and 4.53-times higher among gym members who have been offered AAS, compared to those who did not know anyone that uses these drugs and were not offered them to use, respectively. The use of narcotics or psychoactive drugs was found to be significantly associated with the use of AAS among gym members, where the odds of AAS use were 1.98-times and 2.04-times higher among gym members who had used narcotics or psychoactive drugs, respectively, and particularly among those who used these drugs in the past 30 days, compared with gym members who were never exposed to psychoactive drugs [Table 3].

Multivariable binary logistic regression was used to identify the independent variables associated with the use of AAS including the significant variables found in the bivariate analysis. A model including the variables: (i) type of sport (aerobic, weightlifting, or none), (ii) use of supplementary vitamins, minerals, or special diet (yes/no), (iii) knowing someone using AAS (yes/no), and (iv) being offered AAS (yes/no) against a model with only a constant was statistically significant. This set of variables differentiate between gym users who did and did not use AAS ($\chi^2 = 175.28$; df = 21; $p < 0.0001$). The adjusted odds ratios of these four variables indicate a highly significant association with the use of AAS [Table 3]. The validation was carried out using the classification table, which summarized the observed group and predicted group classification. The overall prediction success rate was 82.3% (65.0% for the use of AAS and 89.3% for non-use). The receiver operating characteristic (ROC) curve analysis for assessing predictive probabilities provided an area under the ROC curve value of 0.88

Table 2: Differences between users and non-users of anabolic-androgenic steroids (AAS).

Variables	Ever used AAS?		*p*-value
	Yes, n (%)	No, n (%)	
Age, mean ± SD, years	28.3 ± 5.8	26.8 ± 7.4	0.040
Marital status			
Single	84 (62.7)	195 (60.2)	0.425
Married	47 (35.1)	126 (38.9)	
Divorced	3 (2.2)	3 (0.9)	
Occupation			
Student	30 (22.4)	114 (35.2)	0.051
Private employee	48 (35.8)	81 (25.0)	
Government employee	47 (35.1)	112 (34.6)	
Retired/unemployed	9 (6.7)	17 (5.2)	
Monthly income (Saudi Riyals)			
< 5000	51 (38.1)	139 (42.9)	0.671
5000–9999	50 (37.3)	102 (31.5)	
10 000–14 999	20 (14.9)	51 (15.7)	
> 15 000	13 (9.7)	32 (9.9)	
Education level			
Illiterate, primary, and intermediate	8 (6.0)	14 (4.3)	0.853
Completed secondary school	36 (26.9)	88 (27.2)	
Degree or diploma	83 (61.9)	208 (64.2)	
Higher education (Masters or Ph.D.)	7 (5.2)	14 (4.3)	
Nationality			
Saudi	111 (82.8)	276 (85.2)	0.527
Non-Saudi	23 (17.2)	48 (14.8)	
Area of residence in Riyadh			
East	22 (16.4)	58 (17.9)	0.582
West	49 (36.6)	112 (34.6)	
North	29 (21.6)	86 (26.5)	
South	34 (25.4)	68 (21.0)	
Where do you practice your sport?			
Social club	36 (26.9)	83 (25.6)	0.399
Private club	63 (47.0)	136 (42.0)	
Commercial club	35 (26.1)	105 (32.4)	
Reason for gym use			
Medical	11 (8.2)	34 (10.5)	0.054
Work	5 (3.7)	9 (2.8)	
Recreational	32 (23.9)	115 (35.5)	
Professional training	86 (64.2)	166 (51.2)	
How often do you visit the gym?			
Once per week	7 (5.2)	18 (5.6)	0.362
Twice per week	7 (5.2)	24 (7.4)	
Three or more times per week	35 (26.1)	105 (32.4)	
Daily	85 (63.4)	177 (54.6)	
How long do you stay at the gym when visiting?			
< 30 minutes	6 (4.5)	19 (5.9)	0.781
30–60 minutes	57 (42.5)	140 (43.2)	
> 1 hour–2 hours	58 (43.3)	127 (39.2)	
> 2 hours	13 (9.7)	38 (11.7)	
What type of sport do you usually practice?			
Aerobic	61 (45.5)	208 (64.2)	0.001
Weightlifting	61 (45.5)	91 (28.1)	
Other	12 (9.0)	25 (7.7)	

SD: standard deviation.

Table 3: Multiple logistic regression analysis for users of anabolic-androgenic steroids.

Variables	Univariate analysis			Multivariate analysis		
	Unadjusted OR	*p*-value	95% CI	Adjusted OR	*p*-value	95% CI
Age groups, years						
≤ 25	1.0 (ref.)	-	-	1.0 (ref.)	-	-
> 25	1.60	0.025	(1.06, 2.41)	1.04	0.906	(0.54, 2.02)
Occupation						
Student	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Private employee	2.25	0.003	(1.31, 3.86)	2.14	0.069	(0.94, 4.84)
Government employee	1.60	0.083	(0.94, 2.70)	2.16	0.064	(0.96, 4.87)
Retired	1.27	0.840	(0.13, 12.62)	3.52	0.478	(0.11, 114.01)
Other	2.17	0.112	(0.83, 5.66)	3.45	0.074	(0.88, 13.45)
What type of sport do you usually practice?						
Aerobic	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Weightlifting	2.29	< 0.0001	(1.48, 3.52)	1.93	0.044	(1.02, 3.67)
Other	1.64	0.195	(0.78, 3.45)	2.46	0.096	(0.85, 7.10)
Have you heard about anabolic steroids (anabolic hormones)?						
Yes	2.03	0.001	(1.35, 3.07)	0.92	0.844	(0.42, 2.02)
No	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Are you aware that anabolic steroids are being used in bodybuilding?						
Yes	2.13	0.001	(1.36, 3.33)	0.83	0.671	(0.36, 1.93)
No	1.80	0.087	(0.92, 3.53)	1.17	0.738	(0.45, 3.03)
I don't know	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Have you ever used supplementary vitamins, minerals, or special diet?						
Yes	7.60	< 0.0001	(4.65, 12.41)	7.80	< 0.0001	(4.05, 15.03)
No	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Do you know anyone using anabolic steroids?						
Yes	9.94	< 0.0001	(5.86, 16.86)	7.51	< 0.0001	(3.78, 14.1)
No	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Did anyone ever ask you to take anabolic steroids?						
Yes	4.53	< 0.0001	(2.94, 7.01)	2.26	< 0.008	(1.23, 4.15)
No	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Did you ever use any narcotic or psychiatric drug?						
Yes	1.98	0.034	(1.05, 3.74)	1.19	0.712	(0.47, 3.05)
No	1.0 (ref.)	-	-	1.0 (ref.)	-	-
Have you used any narcotic or psychiatric drugs in the past 30 days						
Yes	2.04	0.052	(0.99, 5.80)	1.75	0.379	(0.50, 6.11)
No	1.0 (ref.)	-	-	1.0 (ref.)	-	-

OR: odds ratio; CI: confidence interval.

(95% CI: 0.79–0.95), indicating that the final model classified the group of AAS users significantly better than by chance.

DISCUSSION

The prevalence of AAS use among our study participants was 29.3%. This prevalence is higher than that reported in other Middle Eastern countries, including Jordan (26%)[25], Kuwait (22.7%),[19] UAE (22%),[18] and Iraq (1.3%).[17] However, the prevalence in this study is consistent with that reported in a previous study which was conducted in three gyms in Riyadh with 30.5% of participants reported using AAS.[26] The majority of AAS users in the study belonged to the 25–29 years age group,[26] which is also consistent with this study in which the use of AAS was significantly higher among gym members aged > 25 years. Similarly, the mean age of AAS users in Jordan was 28 years old,[25] and the majority of AAS users in a Kuwaiti study were 20–29 years.[19] Taking into account the results of our study and previous studies, people aged between 24–29 years appear to be a risky group for using AAS in Middle Eastern

countries. Thus, preventive and awareness programs targeting this age group should be considered in the future.

In contrast to previous studies,[15,21,22] our study proves that there is no association between AAS use and the level of education. This could be because most participants in this study had a degree or diploma (62.7%). However, an association between the type of work and AAS use was found, with employees in the private sector 2.25 times more likely to use AAS than students. The higher income of employees in the private sector in comparison to students could explain this. Another reason could be the more pressing need of privately employed individuals to maintain a better figure, and their financial ability to afford AAS compared to government employees. In contrast, another study reported that the majority of AAS users were government employees.[20] This difference could be attributed to the differences in the methodology of gym sampling between the two studies, which could affect the cohort of AAS users.

Regarding the type of exercise, 45.5% of AAS users in our study practiced weightlifting. This is consistent with a previous study in the UAE, which showed a statistically significantly higher prevalence of AAS use among weightlifters.[18] Weightlifters are known to be the first athletes that used AAS.[9] This could be due to the greater muscle cross-sectional area that is considered advantageous when lifting heavy objects and could be achieved using AAS.[30] In a study among 231 young male weightlifters in the USA, 12% reported the use of AAS, and 81% met the criteria for current or past AAS dependence.[31] The link between AAS use and weightlifting was also reported in other studies.[27,28,31] With the continuing practice of using AAS among weightlifters, it seems necessary to study and develop programs directed towards reducing AAS use among this group.

In this study, using narcotics or psychiatric drugs in the past 30 days was significantly associated with the use of AAS. It could be assumed from this finding that AAS users tend to use/abuse other substances. This assumption, although it should be further studied, could be confirmed by the findings of previous studies. In a German study, AAS use showed a significant association with the use of cocaine and general illicit drugs.[14] Another study in Sweden reported a strong association between AAS use and a history of illegal drug use and the misuse of prescription drugs.[22] Polysubstance use among AAS users was also reported to be frequent in another study from Sweden.[29] Thus, using AAS could be a risk factor for the nonmedical use of other substances or vice versa. In this study, supplementary vitamins were also associated with the use of AAS, and this finding was consistent with a previous study in Riyadh in which 47.9% of participants reported using nutritional supplements.[32] The use of daily supplements was associated with AAS use in another study in Brazil.[15]

In this study, gym members who knew someone using AAS had 9.94-times higher odds of using them themselves compared to others, and those who were offered AAS had odds that are 4.53-times higher. An Iranian study reported a similar finding with AAS being suggested mostly from peers (43.1%) and coaches (36.1%).[16] In a previous study that we conducted in Riyadh, 38.8% of participants reported obtaining AAS from their coaches, and 35.7% from friends who use AAS.[24] It appears that gym coaches are a major source for obtaining AAS. Awareness programs targeting gym coaches may help in reducing the prevalence of AAS.

Some of the limitations of this study include: 1) the use of a self-administered questionnaire could result in self-reporting bias; 2) our study was performed in only one city (Riyadh), which has unique social and financial demographics; and 3) only male gym members were included. Hence, our results cannot be generalized to the rest of the country/region or women. Additionally, 4) we did not measure serum AAS levels in this study to confirm AAS use; and 5) did not assess whether AAS use was more prevalent in specific gyms or in particular sociodemographic characteristics of the members of these gyms. We believe that these limitations could be addressed in future studies.

CONCLUSION

The results of this study provide clear evidence that the lifetime prevalence of AAS use is high among male gym members in Riyadh. Therefore, there is a strong need for health policy reforms to reduce the rise of AAS use among young adults. These reforms could be directed towards improving education and awareness of the short- and long-term adverse effects of AAS among gym attendees, especially those who are single, employed in the private sector, with a low level of education, have friends who use AAS, were

offered AAS, and use psychoactive medications. We believe that strict criminalizing policies should be exhibited towards the smuggling, handling, and trading of AAS in gyms. There have been growing efforts in Saudi Arabia towards combating illicit substance abuse. However, the results of this study indicate that AAS should be included in these efforts. Public health awareness campaigns in schools, colleges, and workplaces, in addition to the limitation of access as well as improvement of knowledge regarding the health implications of AAS use, could all be important approaches towards reducing AAS use in Saudi Arabia in particular, and in the Middle East in general. Future epidemiological studies could include other regions of Saudi Arabia in addition to studies probing the correlation between sports injuries and the use of AAS as well as, investigating the dose-response relationship associated with AAS use and its adverse health effects in addition to the possible pharmacotherapeutic interventions to combat it.

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