Rational Use of Anabolic Steroids Among Athletes in the Province of Basra, Iraq

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Abstract

Anabolic steroids are commonly used among athletes and gym trainers all over the world. they have an anabolic characteristic that helps build muscles for an aesthetic purpose or is used for other desired medical or non-medical purposes. Anabolic steroids also can have harmful effects on those who overuse or abuse them. The present study aims to find the relationship between the overuse or abuse of anabolic steroids and the possible adverse outcome which may appear during or after the time course of the administration. An online and on-paper survey was used targeting multiple gym centres in the province of Basra asking people there whether or not they use Anabolic steroids, the doses, and the route of administration as well as the harmful effects and complications. A software program for statistical analysis was used afterwards to determine the final result and conclusion. Around 55.3% of those who filled out the survey form confirmed their frequent use of Anabolic steroids and around 82.6% (from the total number who used the anabolic steroids) experienced at least one or more Anabolic steroids complications as a result of overuse and abuse. Anabolic steroids are commonly used among athletes and young men in the city of Basra and many of them used anabolic steroids without consulting a physician. Some of them showed serious complications after overusing and abusing anabolic steroids and the majority of them did not seek medical support afterward.

Keywords: anabolic steroids, athletes, adverse effects, Basra

الاستخدام الرشيد للستيرويدات البنائية بين الرياضيين في محافظة البصرة، العراق

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الخلاصة

تُستخدم الستيرويدات الابتنائية بشكل شائع بين الرياضيين ومدربي الصالة الرياضية في جميع أنحاء العالم. لديهم خاصية الابتنائية التي تساعد على بناء العضلات لغرض جمالي أو يتم استخدامها لأغراض طبية أو غير طبية أخرى مرغوبة. يمكن أن يكون للستيرويدات الابتنائية أيضًا آثار ضارة على أولئك الذين يفرطون في استخدامها أو يسيئون استخدامها. تهدف الدراسة الحالية إلى إيجاد العلاقة بين الإفراط في استخدام الستيرويدات الابتنائية أو إساءة استخدامها والنتائج السلبية المحتملة التي قد تظهر أثناء أو بعد فترة تناول الدواء. تم استخدام استبيان إلكتروني وورقي يستهدف مراكز رياضية متعددة في محافظة البصرة لسؤال الأشخاص هناك عما إذا كانوا يستخدمون الستيرويدات الابتنائية أم لا، والجرعات، وطريقة تناولها، بالإضافة إلى الآثار الضارة والمضاعفات. تم استخدام برنامج حاسوبي للتحليل الإحصائي بعد ذلك لتحديد النتيجة النهائية والاستنتاج. أكد حوالي 55.3% ممن ملأوا استمارة الاستبيان استخدامهم المتكرر للستيرويدات الابتنائية، وحوالي 82.6% (من إجمالي عدد الذين استخدموا الستيرويدات الابتنائية) تعرضوا لمضاعفات واحدة أو أكثر على الأقل من الستيرويدات الابتنائية نتيجة الإفراط في الاستخدام وإساءة الاستخدام. الستيرويدات البنائية شائعة الاستخدام بين الرياضيين والشباب في مدينة البصرة، وكثيرون منهم يستخدمون الستيرويدات البنائية دون استشارة الطبيب. وقد أظهر بعضهم مضاعفات خطيرة بعد الإفراط في استخدام المنشطات الابتنائية وتعاطيها، ولم يطلب غالبيتهم الدعم الطبي بعد ذلك.

الكلمات المفتاحية: المنشطات, الرياضيين, الآثار الضارة, البصرة.

Introduction

Anabolic steroids (AS) are man-made substances that have a similar structure to testosterone, a hormone naturally produced in the body. These steroids bind to androgen receptors and can result in anabolic effects, which promote muscle growth, and androgenic effects, which enhance masculine characteristics **1**. Testosterone, a hormone essential for various bodily functions, is produced within the body through a process known as biosynthesis. This biosynthesis occurs primarily in the Leydig cells found in the testicles and adrenal glands in males, while in females, it takes place in the adrenal glands and ovaries. During this process, cholesterol serves as the precursor molecule from which testosterone is synthesized **1**.

In men, estrogen has an impact on reproductive health. It can affect sex drive, the ability to achieve an erection, and sperm production. Elevated levels of estrogen in the blood can lead to infertility and erectile dysfunction. Additionally, excessive levels of estrogen may result in gynecomastia, which is the enlargement of breast tissue in males **2**.

The effects of AS are mediated through their binding to androgen receptors in various tissues throughout the body **3.** Testosterone, the primary AS, exerts its actions through multiple mechanisms. Firstly, it binds to the androgen receptor to exert its androgenic activity. Secondly, in certain target tissues such as the male urogenital tract, skin, liver, and sebaceous glands, it undergoes 5α reduction to form dihydrotestosterone (DHT), which also acts on the androgen receptor **3.** Lastly, testosterone can be converted to estradiol through aromatization, resulting in estrogenic activities. However, these latter two actions are typically undesired in anabolic drugs due to the negative side effects associated with them. The binding of testosterone to androgen receptors leads to an increase in protein synthesis and a decrease in protein breakdown, contributing to an overall enhancement in muscle mass and strength. Furthermore, AS can stimulate the production of red blood cells, which can improve endurance and oxygen delivery to the muscles **4**.

Androgen receptors function as nuclear receptors that regulate gene expression in response to androgen stimulation. When AS binds to these receptors, it can activate or suppress specific genes involved in muscle growth, bone density, and other physiological processes **5**

AS has various physiological effects on the body, with one of the primary effects being the enhancement of muscle mass and strength by enhancing protein synthesis and reducing muscle tissue breakdown. This can result in faster recovery after intense exercise which explains their frequent use among athletes and bodybuilders. Additionally, AS can contribute to increased bone density, potentially reducing the risk of osteoporosis and fractures 5.AS can stimulate the production of red blood cells, which improves oxygen delivery to muscles and can be beneficial in treating conditions such as anaemia **6.**

However, the use of AS can also have negative consequences on the body. The endocrine system, specifically the hypothalamic-pituitary-gonadal axis, can be negatively affected by AS **7.** In men, they can suppress the natural production of testosterone, leading to testicular atrophy, infertility, baldness, gynecomastia, prostatic hypertrophy, and low sperm counts resulting in sterility **8.** Effect of androgenic AS on sperm quality and serum hormone levels in adult male bodybuilders. Women may experience menstrual irregularities and masculinizing effects, such as the growth of facial hair and deepening of the voice and breast atrophy **9.** Acne, hair loss, and mood changes can occur in both men and women as a result of AS use **9.**

Furthermore, AS can increase the risk of cardiovascular diseases, elevate blood pressure and cause myocardial hypertrophy. Additionally, they can disrupt cholesterol levels, leading to a higher susceptibility to atherosclerosis **10.** This is due to their ability to elevate LDL (or "bad") cholesterol levels and decrease HDL (or "good") cholesterol levels, leading to the accumulation of plaque in the arteries **10.** The liver and kidneys can also be adversely affected by AS use, as these organs are responsible for metabolizing the steroids. High doses of AS can cause liver damage and potentially even liver cancer, while long-term use can result in kidney damage. teens exhibit stunted growth (when high hormone levels from steroids signal to the body to stop bone growth too early)
stunted height (if teens use steroids before their growth spurt) **10.**

The use of AS has been linked to various psychological complications. One common complication is the development of mood disorders, including depression and anxiety. This is of particular concern for individuals involved in bodybuilding or sports, as these conditions can negatively impact training and performance **11.** Substance use disorders, including addiction to AS, are also observed among users. Dependence on these drugs can lead to withdrawal symptoms upon discontinuation,

and individuals may engage in other forms of substance abuse or risky behaviours while under their influence **12.** Cognitive changes, such as attention deficits, memory problems, and impaired executive functioning, have also been associated with AS use. These effects may be more pronounced in younger individuals whose brains are still developing and may be more vulnerable to the drug's impact **13.** Lastly, AS use has been linked to an increased risk of suicidal thoughts and suicide attempts. This risk may be higher in individuals with pre-existing mental health issues or a history of substance abuse **13.**

Methodology:

The present study, a survey is done among bodybuilders and athletes in the province of Basra. People who are frequently going to the gym filled out an online and paper questionnaire. The questionnaire was done in private and anonymous settings, using (Yes/No questions, Multiple choice questions, checkbox questions, and short answer form questions) people filled out the form within a cumulative period of two months providing information about their (Age, sex, frequency of visiting the gym, the purpose of using AS in the gym, the person who recommended AS for them, the type of AS is used, the dose and route of administration, the complications and adverse effects of AS used, whether they continued using AS or not after the complications, and whether or not the sought medical consultation or advice afterwards). ***Questioner format used in the study is listed below;***

استمارة بحث بخصوص استعمال المنشطات الستيرودية و أثرها على الرياضيين في البصرة

العمر*

☐ اقل 15 سنة
☐ 15-18
☐ 19-24
☐ 25-30
☐ اكثر من 30 سنة

الحالة الاجتماعية*

☐ متزوج
☐ اعزب
☐ مقبل على الزواج

المستوى الوظيفي*

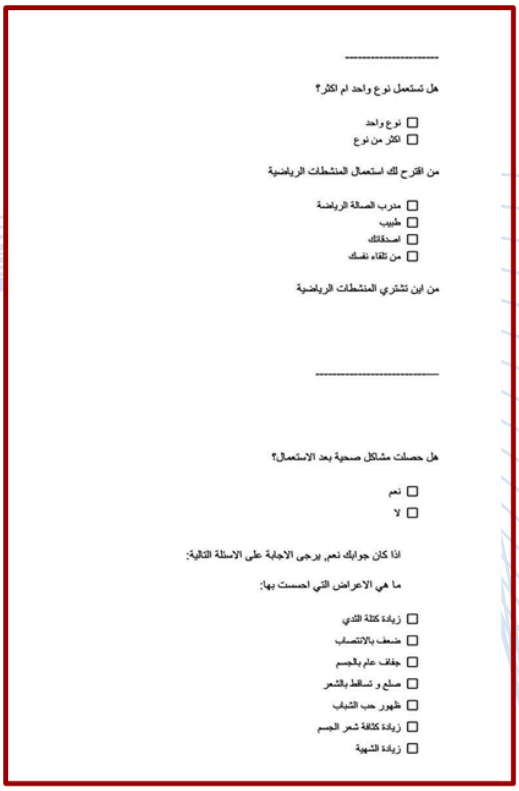
☐ طالب
☐ موظف
☐ عاطل عن العمل

الوزن*

☐ Kg 50-60
☐ 60-70
☐ 70-80
☐ 80-90
☐ 90-100
☐ اكثر من 100

في اي عمر بدأت الذهاب للنادي الرياضي؟*

☐ اقل 15 سنة
☐ 15-18
☐ 19-24
☐ 25-30



هل تستعمل نوع واحد ام اكثر؟

☐ نوع واحد
☐ اكثر من نوع

من اقترح لك استعمال المنشطات الرياضية

☐ مدرب الصالة الرياضية
☐ طبيب
☐ اصدقائك
☐ من تلقاء نفسك

من اين تشتري المنشطات الرياضية

هل حصلت مشاكل صحية بعد الاستعمال؟

☐ نعم
☐ لا

اذا كان جوابك نعم, يرجى الاجابة على الاسئلة التالية:

ما هي الاعراض التي احسست بها:

☐ زيادة كتلة الثدي
☐ ضعف بالانتصاب
☐ جفاف عام بالجسم
☐ صلع و تساقط بالشعر
☐ ظهور حب الشباب
☐ زيادة كثافة شعر الجسم
☐ زيادة الشهية

Statistical analysis

Data were gathered and analyzed using the statistical package for social science (SPSS) program version 25. For continuous variables, data were expressed as N% and as frequencies and percentages for categorical variables.

The chi-square test was used to establish the link. Frequency tables and chart bars were used to illustrate the results, and P<0.05 consider a significant association.

Results and Discussion:

Use of anabolic steroids:

Table 1 and **Figure 1** illustrate that 177 participants have involved in the study, and only 98 athletes (55.3%) used AS at some period throughout their lives, which divided into two groups first group (43.9%) of AS users used a single type of AS, while the second group (56.1%) use a combination of different AS, furthermore, 79 (44.6%) athletes from the total number of participant (177) deny the use of AS.

			types of anabolics			Total
			not used	single type	combination	
use of anabolics	yes	Count	0	43	55	98
		% Within the use of anabolics	0.0%	43.9%	56.1%	100.0%
	no	Count	79	0	0	79
		% Within the use of anabolics	100.0%	0.0%	0.0%	100.0%
Total		Count	79	43	55	177
		% Within the use of anabolics	44.6%	24.3%	31.1%	100.0%

Table 1: Summary of the participant in the questioner

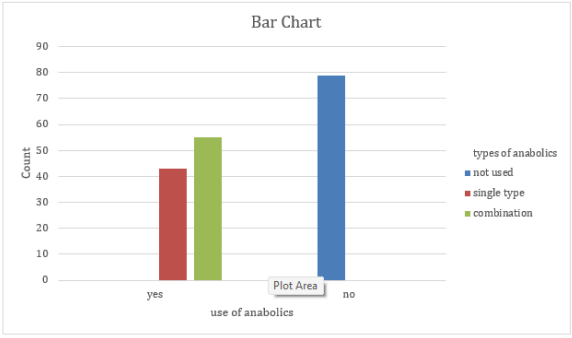


Figure1: Bar chart for the participants in the questioner

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	177.000[a]	2	0.000
Likelihood Ratio	243.331	2	0.000
Linear-by-Linear Association	143.514	1	0.000
N of Valid Cases	177		

Table 2: chi-Square tests for the use of AS

According to Table 2, there were a very significant association 177.000a with P<0.0001 for the abuse of AS among athletes in Basra, this indicates that according to the data provided above, many people who are frequent to the gym use anabolic steroids either for aesthetic purposes or for other purposes.

The person who gave the advice:

According to **Table 3** around 38.8% of people who started using AS were recommended to use them by their friends, while 58.2% of them were advised to use them by their gym trainers, few of them 2.0% received advice from their doctors, and only 1.0% of them received that advice from other sources.

			who gives the advice?					Total
			no one	friends	gym trainer	doctor	other	
use of anabolics	yes	Count	0	38	57	2	1	98
		% within the use of anabolics	0.0%	38.8%	58.2%	2.0%	1.0%	100.0%
	no	Count	79	0	0	0	0	79
		% within the use of anabolics	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total		Count	79	38	57	2	1	177
		% within the use of anabolics	44.6%	21.5%	32.2%	1.1%	0.6%	100.0%

Table 3 Who advises the athletes?

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	177.000[a]	4	0.000
Likelihood Ratio	243.331	4	0.000
Linear-by-Linear Association	138.644	1	0.000
N of Valid Cases	177		

Table: 4 chi-square for the advice

Moreover, table 4 shows that there was a strong association between the use of AS and advice given by gym trainers and friends 177.000a with P < 0.0001 (This result indicates that many people who filled out the survey form reported that using AS was recommended to them by gym trainers mainly as part of the training course without medical recommendations).

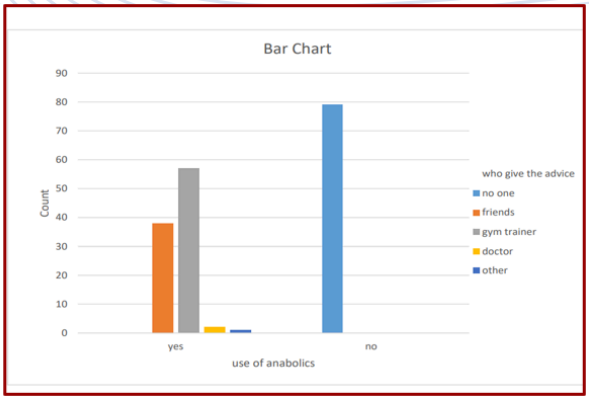


Figure 2 bar chart for the advice given to the athletes

This result indicates that many people who filled out the survey form reported that using AS was recommended to them by gym trainers mainly as part of the training course without medical recommendations.

Problems and complications that were experienced:

			problems									Total
			mood	alopecia	dehydration	erectile dysfunction	angry	kidney problem	liver problem	fertility	none	
use of anabolics	Yes	Count	12	18	7	13	6	12	2	11	17	98
		% within the use of anabolics	12.2%	18.4%	7.1%	13.3%	6.1%	12.2%	2.0%	11.2%	17.3%	100.0%
	no	Count	4	0	0	0	2	0	0	0	73	79
		% within the use of anabolics	5.1%	0.0%	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%	92.4%	100.0%
Total		Count	16	18	7	13	8	12	2	11	90	177
		% within the use of anabolics	9.0%	10.2%	4.0%	7.3%	4.5%	6.8%	1.1%	6.2%	50.8%	100.0%

Table 5: Problems and complications that were experienced

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	102.992[a]	8	0.000
Likelihood Ratio	129.109	8	0.000
Linear-by-Linear Association	61.977	1	0.000

Table 6: Chi-square for the problem associated with the use of AS

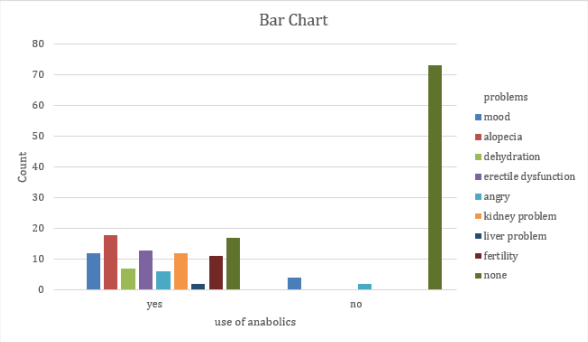


Figure 3 bar chart for the possible problems associated with the use of AS

Mood Swing

According to **Table 5,** approximately 12.2% of individuals who have used anabolic steroids (AS) have reported experiencing mood swings with a strong association of 102.992a and P< 0.0001. The underlying pharmacological explanation for this issue involves the hormone dopamine. Androgen receptors, which are affected by AS, are widely distributed in the brain, with a particular concentration in the amygdala, where the fight-or-flight response is generated. In vitro, studies have shown that testosterone, a component of AS, exhibits neurotoxic effects, and similar findings have been observed in studies conducted on mice

Use of AS can result in the :

Downregulation of dopamine receptor levels, specifically the D1 and D2 receptors. This downregulation may impact the brain's response to dopamine, which is associated with feelings of happiness **14**

D**ownregulation of Serotonin Receptors** Serotonin receptors, which play a role in regulating mood, may also be affected by AS use **14**. Downregulation of these receptors can disrupt serotonin signaling and contribute to mood instability.

Upregulation of Dopamine Transporters AS use can lead to an increase in dopamine transporter activity. Dopamine transporters are responsible for removing dopamine from the brain. Elevated levels of dopamine transporters can result in decreased dopamine availability and further contribute to mood fluctuations **15.**

Dopamine and serotonin, both hormones involved in mood regulation, being affected by anabolic steroids can explain the mood swings issues associated with their use. It is important to note that individual responses to AS can vary, and the impact on mood may be influenced by factors such as dosage, duration of use, and individual susceptibility. Consulting with a healthcare professional is crucial for individuals considering AS use or experiencing mood-related problems associated with their use. Happiness Role of Dopamine and Serotonin on Mood and Negative Emotions **16.**

Alopecia

Table 5 shows that approximately 18.4% of individuals who have used AS developed alopecia with a strong association between the use of AS and hair loss 102.992a and P< 0.0001, specifically (androgenic alopecia). When anabolic steroids are used, they can increase the levels of testosterone and its byproduct, dihydrotestosterone (DHT), in the body **17.** Elevated levels of DHT are the cause behind alopecia as it causes hair follicles to become more sensitive. The DHT attaches to your hair follicles and over time causes the hair follicle to degrade thereby producing weaker or thinner hair. Eventually, your hair follicles will stop producing new hair. Steroids can both accelerate male pattern baldness or cause it in people who aren't genetically predisposed to the condition 13, **18.**

Dehydration

From **Table 5** about 7.1% complained of dehydration with a strong association between the use of AS and the need for fluids 102.992a and P< 0.0001.

AS themselves do not directly cause dehydration, they can indirectly contribute to it through various mechanisms: Increased perspiration: Anabolic steroids can raise body temperature and metabolic rate, leading to increased sweating. Enhanced urine production: Steroids can impact kidney function and cause an increase in urine production **19**. Electrolyte imbalances: Prolonged use of anabolic steroids can disrupt the balance of electrolytes, such as sodium and potassium, in the body. Imbalances in electrolytes can impair the body's ability to retain water and maintain optimal hydration **10, 20**. Dehydration affects muscle tissue directly by reducing its elasticity and impairing its ability to contract and relax efficiently. Inadequate fluid intake can lead to decreased blood volume and oxygen supply to the muscles, potentially resulting in muscle fatigue, soreness, or pain, which contributed to muscle spasms associated with AS use **21.**

Erectile dysfunction

Table 5 illustrated that approximately 13.3% of participants reported experiencing erectile dysfunction with a strong association between the use of AS and erectile dysfunction 102.992a and P< 0.0001and testicular shrinkage as a result of regularly and heavily using anabolic steroids (AS) over an extended period. The impact of AS on sexual performance can be significant **22.**

Anabolic steroids can cause erectile dysfunction by influencing the action of the enzyme aromatase, which converts testosterone into estrogen **23.** This leads to elevated levels of estrogen in the body. While a certain level of estrogen is necessary for male sexual function, the imbalance caused by high doses of steroids and the testosterone/estrogen ratio can result in sexual dysfunction, including erectile dysfunction.

Furthermore, when individuals discontinue the use of steroids, their body takes time to resume normal testosterone production 6. During this period, testosterone concentrations remain low, which can contribute to problems such as erectile dysfunction **24.**

Kidney problems:

According to **Table 5**, (12.2%) of them reported that they suffered from kidney problems after using AS. Anabolic-androgenic steroids can affect the kidney in different aspects. They can induce or aggravate acute kidney injury, chronic kidney disease, and glomerular toxicity. These adverse effects are mediated through pathways such as stimulating the renin-angiotensin-aldosterone system, enhancing the production of endothelin, producing reactive oxygen species, over-expression of pro-fibrotic and pro-apoptotic mediators (e.g., TGF-β1), as well as inflammatory cytokines (e.g., TNF-α, IL-1b, and IL-6) **25.**

Although GH may affect the kidney in different aspects, such as size, glomerular filtration rate, and tubule functions, either directly or indirectly, there is no conclusive clinical evidence about its detrimental effects on the kidney in athletes and bodybuilders. Consequences of long-term use of AS are acute kidney injury, chronic kidney injury, and glomerular toxicity **26**.

Liver problems:

Only 2% of people who used AS according to the study mentioned that they experienced liver problems while and after using AS. Anabolic-androgenic steroids can affect the kidney in different aspects. They can induce or aggravate acute kidney injury, chronic kidney disease, and glomerular toxicity **27.** These adverse effects are mediated through pathways such as stimulating the renin-angiotensin-aldosterone system, enhancing the production of endothelin, producing reactive oxygen species, over-expression of pro-fibrotic and pro-apoptotic mediators (e.g., TGF-β1), as well as inflammatory cytokines (e.g., TNF-α, IL-1b, and IL-6) **28.** Although GH may affect the kidney in different aspects, such as size, glomerular filtration rate, and tubule functions, either directly or indirectly, there is no conclusive clinical evidence about its detrimental effects on the kidney in athletes and bodybuilders **29, 30.**

Consequences of long-term use of AS are acute kidney injury, chronic kidney injury, and glomerular toxicity **31.**

Anger and Aggression:

Referring to **Table 5**, 6.1% of them reported feeling angry and aggressive during and after the period of using AS. Roid Rage": The term "roid rage" is often used colloquially to describe intense, unpredictable outbursts of aggression associated with anabolic steroid use. However, the occurrence and extent of "roid rage" are debated in the scientific community **13, 32**. Some studies suggest that individuals using high doses of steroids may experience mood swings, irritability, and increased aggression, but it is unclear whether these effects are solely due to the steroids or influenced by other factors such as pre-existing mental health conditions or individual personality traits **33**.

Two pathways are thought to be involved in AAS-induced behavioural disorders. Direct pathway via the amygdala-fugal pathway, which connects the central nucleus of the amygdala to the brainstem, is involved in cognitive-emotive and homeostatic processes. The latter is modified by chronic AAS use, which subsequently leads to increased anxiety. Indirect pathways via the serotonergic, dopaminergic, and glutamatergic signals which are modified by AAS abuse in the later-anterior hypothalamus and can mediate the aggressive behaviour **34.**

Seeking medical consultations

			consultation		Total
			yes	no	
use of anabolics	yes	Count	27	71	98
		% Within the use of anabolics	27.6%	72.4%	100.0%
	no	Count	1	78	79
		% Within the use of anabolics	1.3%	98.7%	100.0%
Total		Count	28	149	177
		% Within the use of anabolics	15.8%	84.2%	100.0%

Table 7: Medical consultation for the abuser of AS

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	22.694[a]	1	0.000		
Continuity Correction	20.763	1	0.000		
Likelihood Ratio	28.473	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-Linear Association	22.565	1	0.000		
N of Valid Cases	177				

Table 8: Chi-square for medical consultation

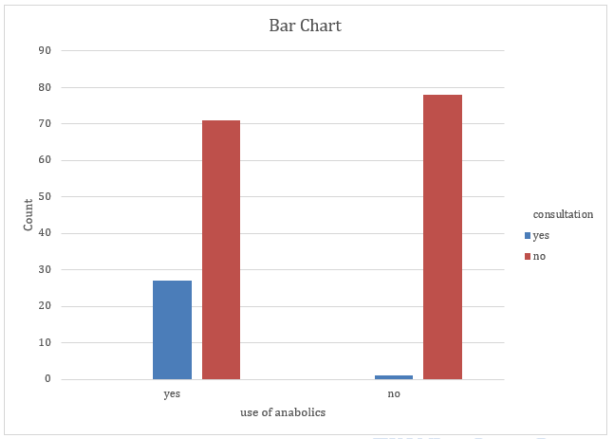


Figure 4 Bar chart for medical consultation for the abuser of AS

Table 7, 8, and Figure 4 shows that there was a strong association for ignoring a medical consultation regarding the problems associated with abuse of AS 72.4% with chi-square value 22.694a and P <0.0001 (This result indicated that many men who experienced minor or serious adverse effects and complications never sought medical consultation or medical support).

Conclusions

Anabolic steroids are commonly used among athletes and young men in the city of Basra and many of them used anabolic steroids without consulting a physician. Some of them showed serious complications after overusing and abusing anabolic steroids and the majority of them did not seek medical support afterward.

Recommendations

1-Health programmes or advice should be performed regarding the rational use of anabolic steroids.

2-Routine monitoring of gyms should be carried out to check the contents of anabolic steroids and the rational use and whether prescribed under the supervision of medical staff or not.

References

1.Ni Z. Testosterone biosensor in sports doping. Revista Brasileira de Medicina do Esporte. 2023; 29: e2022_0442.

2. Jett S, Schelbaum E, Jang G, et al. Ovarian steroid hormones: A long overlooked but critical contributor to brain aging and Alzheimer's disease. Frontiers in Aging Neuroscience. 2022; 14: 948219.

3. Park J, Mcllvain V, Rosenberg J, Donovan L, Desai P and Kim JY. The mechanisms of anabolic steroids, selective androgen receptor modulators and myostatin inhibitors. The Korean Journal of Sports Medicine. 2022; 40: 67-85.

4. Yan S, Chen J, Lyu L, et al. Molecular characterization and expression patterns of nuclear androgen receptors in the ovoviviparous black rockfish Sebastes schlegelii. Aquaculture and Fisheries. 2022; 7: 454-61.

5. Choupani E, Gomari MM, Zanganeh S, et al. Newly developed targeted therapies against the androgen receptor in triple-negative breast cancer: A review. Pharmacological reviews. 2023; 75: 309-27.

6. García-Arnés J and García-Casares N. Doping and sports endocrinology: anabolic-androgenic steroids. Revista Clínica Española (English Edition). 2022.

7. Biswas D, Brar T, Beniwal A, Jamwal AS, Saran B and Seth AK. Effect of Anabolic Steroids Abuse in Gym Visitors.

8. Joury A, Alshehri M, Li LZ and Rezan T. Androgenic steroids dysregulation and the risk of coronary artery disease. Expert Review of Cardiovascular Therapy. 2022; 20: 343-9.

9. Khalaf MM and Wali JK. Study the Effect of the Anabolic Androgen Methandrostenolone on Some Physiological Parameters in Local Male Rabbits. Pakistan Journal of Medical & Health Sciences. 2022; 16: 674-.

10. Skoupá K, Šťastný K and Sládek Z. Anabolic Steroids in Fattening Food-Producing Animals—A Review. Animals. 2022; 12: 2115.

11. Gawash A, Zia H and Lo D. Body dysmorphic-induced Androgenic Anabolic Steroids usage and its association with mental health outcomes. medRxiv. 2023: 2023.01. 14.23284562.

12. Althobaiti YS, Alzahrani MS, Alhumayani SM, Assiry SA, Aljuaid HF and Algarni MA. Potential Association between the Use of Anabolic Steroids and COVID-19 Infection. Healthcare. MDPI, 2022, p. 196.

13. Nelson BS, Hildebrandt T and Wallisch P. Anabolic–androgenic steroid use is associated with psychopathy, risk-taking, anger, and physical problems. Scientific reports. 2022; 12: 1-10.

14. Arvelo JAF. Effects of Anabolic Steroids and Cocaine on the Brain Reward Circuit and Reproductive System of Male Rats. University of Puerto Rico Medical Sciences (Puerto Rico), 2022.

15. Penna D, Raony Í, Jardim-Messeder D, dos Santos-Rodrigues A and Pandolfo P. Adenosine receptors participate in anabolic-androgenic steroid-induced changes on risk assessment/anxiety-like behaviors in male and female rats. Physiology & Behavior. 2023; 261: 114071.

16. Alisauskiene R, Johnsen E, Gjestad R, et al. Does drug use affect the efficacy of amisulpride, aripiprazole and olanzapine in patients with schizophrenia spectrum disorders? Results from a pragmatic, randomised study. General Hospital Psychiatry. 2023; 83: 185-93.

17. Corona G, Rastrelli G, Marchiani S, et al. Consequences of anabolic-androgenic steroid abuse in males; sexual and reproductive perspective. The World Journal of Men's Health. 2022; 40: 165.

18. Shah T and Lieman HJ. Managing the PCOS-Related Symptoms of Hirsutism, Acne, and Female Pattern Hair Loss. Polycystic Ovary Syndrome: Current and Emerging Concepts. Springer, 2022, p. 205-31.

19. Yazdan MMS, Kumar R and Leung SW. The environmental and health impacts of steroids and hormones in wastewater effluent, as well as existing removal technologies: a review. Ecologies. 2022; 3: 206-24.
20. Tzankova D, Mateeva A, Mitkov J, Peikova L and Georgieva M. Development and validation of RP-HPLC method for analytical characterization of the anabolic steroid Methenolone acetate in food supplements. Pharmacia. 2022; 69: 151-5.
21. Shimko KM, O'Brien JW, Li J, et al. In-sewer stability assessment of anabolic steroids and selective androgen receptor modulators. Environmental Science & Technology. 2022; 56: 1627-38.
22. de Ronde W and Smit DL. Anabolic–androgenic steroid abuse and testicular function in men; recent insights. Current Opinion in Pharmacology. 2022; 67: 102318.
23. Desai A, Yassin M, Cayetano A, Tharakan T, Jayasena CN and Minhas S. Understanding and managing the suppression of spermatogenesis caused by testosterone replacement therapy (TRT) and anabolic–androgenic steroids (AAS). Therapeutic Advances in Urology. 2022; 14: 17562872221105017.
24. Creciun M. Anabolic-androgenic steroids and male reproductive health. MedEspera. 2022, p. 383-.
25. Slee A and Reid J. Disease-related malnutrition in chronic kidney disease. Current Opinion in Clinical Nutrition and Metabolic Care. 2022; 25: 136-41.
26. Ginsberg C and Ix JH. Diagnosis and management of osteoporosis in advanced kidney disease: a review. American Journal of Kidney Diseases. 2022; 79: 427-36.
27. Mohammed ZS and Hossain AO. Study the Effects of Anadrol Overdose on Liver Function in Male Rats. Iraqi Journal of Pharmaceutical Sciences (P-ISSN 1683-3597 E-ISSN 2521-3512). 2022; 31: 65-71.
28. Sami Z and Obaid A. Study the Effects of Anadrol Overdose on Liver Function in Male Rats.
29. Alves AS, Perdigão S, Morais S, Sousa C and Salvador F. Androgenic-Anabolic Steroids: From the Gym to Drug-Induced Liver Injury. Cureus. 2022; 14.
30. Ghani JM, ALzahid JM and Hammod HJ. Evaluation of the dainabol effect on the liver in albino male rats. AIP Conference Proceedings. AIP Publishing LLC, 2022, p. 020041.
31. Nordman JC. Anger management: Mechanisms of glutamate receptor-mediated synaptic plasticity underlying animal aggression. The international journal of biochemistry & cell biology. 2022; 142: 106120.

32. de Rezende LA, Pereira JET, Pereira EJ, et al. IMPACTS OF ANABOLIC ANDROGENIC STEROID USE BY YOUNG ADULTS. CIPEEX. 2022; 3: 1-.

33. Mahmoudi E, Nakhostin-Ansari A, Ranjbar M and Memari AH. Are all types of empathy associated with lower aggression in athletes? A cross-sectional study on Iranian athletes. BMC psychology. 2022; 10: 276.

34. Nordman JC. Anger management: Mechanisms of glutamate receptor-mediated synaptic plasticity underlying animal aggression. The international journal of biochemistry & cell biology. 2022; 142: 106120.