# Effect of Anabolic-Androgenic Steroids on Semen Parameters and Serum Hormonal Levels in Iraqi Male Bodybuilders

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**Abstract**

**Aim:** This research aims at studying the influence of administration of anabolic androgenic steroids on the male reproductive health.

**Materials and Methods:** Twenty four male bodybuilders were included in the study. The history of Anabolic Androgenic Steroids administration (AAS group) was recorded for 16 subjects (age =21±1.6 years), while 8 subjects exercised only without AAS use (age =21.2±0.8 years) and served as control group. All subjects of AAS group were asked to cease using AAS before being enrolled in the study. A sheet containing a detailed questionnaire was completed for each subject. Subjects of both groups were asked to visit the clinic (subsequent visits) for clinical evaluation of their health together with semen analysis. Blood was collected to determine serum hormonal changes.

**Results:** Semen analysis results indicated that, the use of AAS resulted in the impairment of spermatogenesis. Thus, sperm concentration and total sperm count increased significantly ($P < 0.05$) within both AAS and control groups during the period of cessation, however, these parameters remained significantly low ($P<0.05$) in AAS group in comparison with the control group. Sperm agglutination increased significantly within AAS group ($P<0.05$). Both sperm agglutination and round cells increased significantly ($P<0.05$) in AAS group as compared with the control group. Likewise gonadotropins: Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH) increased significantly ($P<0.05$) in AAS group, 12 weeks after the cessation of AAS as compared to baseline. Although prolactin level was within the normal range in AAS group, it was significantly low ($P<0.05$) in AAS group as compared to the control.

**Conclusion:** These findings collectively indicated that, the use of AAS drugs have an ill effect on the general health of the users in addition to a profound effect on the reproductive functions. This study has also opened the road for further studies in Iraq concerned with the abuse of anabolic steroids which may constitute on the long run a major source of health and social problems.

**Keywords:** Anabolic-Androgenic Steroids Abuse, Male Infertility, Semen Analysis.

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## Introduction

The use of drugs to enhance strength and endurance of human being has been observed for thousands of years. In the present time, a variety of drugs, such as anabolic steroids are used for improving athletic performance and appearance. [1]

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Anabolic Androgenic Steroids (AAS) have been used by athletes since the early fifties of the last century [2] with a tremendous increase in the use since then. [3] As time passed by, problems emerged worldwide due to the abuse of these drugs. A large number of young adolescents abuse AAS to improve their physical fitness and appearance especially in the developed countries.[4] Also, it has been found that athletes involved in recreational and minor-league sports outnumber top-level competitive athletes in the abuse of AAS. [5] Nevertheless, AAS are one of the main health-related problems in organized sports due to their availability and low price. The medical and scientific community doubt any real beneficial effects achieved from the use of steroids. [6] This controversy is added to another point concerning the side effects of these drugs on athletes' health. [7]

AAS have profound effects on male endocrinological and reproductive systems, including lowered male fertility which has been found to be reversible. Also, cases of sustained hypogonadotrophic hypogonadism may be induced by steroid abuse. [8, 9] Prolonged abuses may, however, produce transient testicular impairment, observed as lowered steroidogenesis with normal gonadotrophin stimulus. [8, 10]

In Iraq, although there are indications that AAS are used by athletes, but as far as the authors know it is not documented. Therefore, there is a real need for conducting a pre- liminary study to investigate the effects of abuse of these drugs on the male reproductive health in an effort to pave the way for studies in the future to quantitate the size of this problem in Iraq and to organize an effective educational program about the damaging effects these drugs might have on the health of the users.

## Materials and Methods

This study was carried out in the Institute of Embryo Research and Infertility Treatment, Al-Nahrain University, Baghdad, Iraq. A total of 24 healthy, single, non-obese men with a bodyweight ranging from 57-85 kg were recruited to participate in this study. All were involved in a bodybuilding training program. Their age ranged from 15-28 years. They were recruited through an advertisement fixed in the gymnasium asking bodybuilders to contact the authors to participate in a medical scheme designed to freely check the reproductive health of those who are using anabolic steroids.

The participating 24 male bodybuilders were divided into two groups: **Group I,** included 16 subjects who were taking AAS during their bodybuilding program to increase their muscle mass and physical appearance (AAS group). **Group II,** included 8 subjects who exercised only without AAS use (control group).

All subjects of group I have been using these drugs independently prior to their involvement in the study and the authors had no role in encouraging AAS administration. It is important to indicate that subjects of group I were asked to stop AAS use before being enrolled in the study. All subjects of both groups were asked for subsequent visits during which clinical evaluation, besides, semen analysis and serum hormonal changes were evaluated. A sheet containing a questionnaire concerning medical, sexual and training history of all participants was used. Also, information about anabolic-androgenic steroids used was taken. The study design was reviewed and approved by Ethics Committee, Al-Nahrain University.

### Laboratory Tests

To secure against any sexual activity of the subject whether through masturbation or illegal sexual contact prior to semen collection, the subjects were instructed to strictly avoid these activities for 3 to 7 days (abstinence period). Initiation of collection started immediately after cessation of ASS administration (base-line), subsequent samples were taken after 6 weeks (sample 2) and 12 weeks (sample 3) of AAS cessation.

The semen samples were obtained by masturbation done in a private room. Semen

analyses were carried out according to WHO guidelines. [11, 12]

A sample of venous blood was drawn and serum was separated by centrifugation of clotted blood and aliquots stored at-20C [13] for hormonal assay. The blood was drawn immediately after AAS cessation (sample1) as a baseline reading and at 12 weeks after cessation (sample2). Serum concentration of FSH, LH, prolactin and total testosterone was determined in the hormonal assay laboratory of the institute using Addendum-mini VIDAS apparatus (VIDAS12 model, Biomerieux company, France), through an enzyme linked fluorescent assay (ELFA) technique.

## Drugs (AAS)

Anabolic-androgenic steroids used by the participants involved in this study are shown in table (1):

***Table (1): Anabolic Androgenic Steroids (AAS) used by AAS group.***

| *Chemical Name* | *Trade Name* |
|---|---|
| ***a-Oral*** | |
| ***Methandienone or (Methandrostenolone)*** | *Anabol® 5 mg (the British Dispensary (L.P.) O.,LTD.,Thailand)* |
| | *Bionabol® 5mg (Balkanpharma®)* |
| ***b-Injectable*** | |
| ***Nandrolone Decanoate*** | *Nandrolne Decanoate 25mg (I.P.D.I.C. Rasht-Iran)* |
| | *Deca-Vinone® 50 mg (Hikma pharmaceuticals, Amman-Jordan)* |
| | *Deca-Durabolin® 50 mg (N.V. Organon Oss Holland)* |
| | *Nandrolone Decanoate 25mg/50mg Panther, (London) LTD.* |
| ***Testosterone Enanthate*** | *Testosterone Enanthate 250 mg (Aburaihan Laboratories Tehran-Iran)* |

## Statistical Analysis

Computerized statistical analysis was performed using SPSS-10 (Statistical Package of Social Science), version 10. Excel program was used for figures. Distribution percentages were done. The values for each variable expressed as mean ± Standard Error of Mean (SEM). One-way and two-way Analysis of Variance (ANOVA) test were used to assess the significance of statistical differences in the mean within each group and between different groups (AAS and control groups). Probabilities of less than 0.05 were regarded as statistically significant ($P<0.05$), while P value more than 0.05 was regarded as statistically not significant ($P>0.05$).

## Results

### Changes in Semen Analysis

The majority of semen samples had normal whitish-opaque color. There was a significant increase in the liquefaction time within the same group for both AAS and control groups ($P<0.05$). The mean values of semen volume for both groups were within normal range with a mean value of 4.6±1.3 ml.

The baseline readings of AAS group after cessation of AAS administration revealed that, of the sixteen body builders, one had azoospermia, five had oligozoospermia ranging between 2 to 7.6 x $10^6$ sperm/ml and one had mild oligozoospermia ($16x10^6$ sperm/ml), while the baseline readings of the control group were of range between 22 to 51 $x10^6$ sperm/ml. Comparison of both groups indicated that the mean baseline sperm concentration of AAS group was slightly smaller than that found in the control group (26.4 ± 7.2 vs. 31.8± 3.2). Moreover, there was a significant increase in sperm concentration within both AAS and control groups ($P<0.05$) during the period of AAS cessation but still sperm concentration of the AAS group was found to be significantly low as compared to that of the control group ($P<0.05$).

Concerning total sperm count, a significant intragroup increase was detected for both AAS and control groups ($P<0.05$) but still it was significantly low in the AAS group as compared with the control group ($P<0.05$). There was no

significant difference in sperm motility percentages within each group and between the two groups.

The percentage of normal sperm morphology was found to be within normal limits (>50%) in both groups. Although the percentages of normal sperms have increased during the period of AAS cessation in both AAS and control groups, this increase was not significant (P>0.05).

The percentages of agglutinated sperm increased significantly during the period of cessation in AAS group and in comparison with the control group (P<0.05). Round cells count increased during withdrawal period but this increase did not reach significance. However, in comparison with the control group, round cells increased significantly (P<0.05).

**Reproductive Hormonal Changes**

Although the mean baseline serum concentrations of FSH, LH and testosterone were found to be within normal limits for both groups, it was obvious that the baseline readings of the AAS group were lower than the control group. Serum concentration of prolactin was within normal value in the AAS group but it increased to 32.2 ± 8.4 ng/ ml in the control group (Figure 1).

Serum concentration of both FSH and LH increased significantly after 12 weeks of AAS cessation in AAS group (P<0.05), while prolactin and testosterone levels were not changed significantly after 12 weeks of AAS cessation (Figures 1 and 2).

Comparing the readings of AAS group with those of the control group, there was a significantly low serum concentration of prolactin (P<0.05). However, there was no significant difference in FSH, LH and testosterone concentrations (P>0.05, Figures 1and 2).

***Table (2): Changes in different semen parameters in AAS and control groups during follow up period.***

| *Semen Parameter* | *Normal Values* | *AAS Group* | | | *Control Group* | | |
|---|---|---|---|---|---|---|---|
| | | *Baseline ( n=16)* | *6 weeks ( n=5)* | *12 weeks ( n=7)* | *Baseline ( n=8)* | *6 weeks ( n=4)* | *12 weeks (n=0)?* |
| *Liquefaction (min.)* | 15-30 min. | 31.6±3.4 | 46±8.7 | 35.7±3.4 * | 32.5±3.3 | 41.3±3.7* | - |
| *Volume (ml)* | ≥ 2ml | 3.3±0.4 | 2.8±0.4 | 3±0.4 | 3.8±0.7 | 4.6±1.3 | - |
| *Sperm concentration (million/ml)* | ≥ 20 m/ml | 26.4±7.2 | 38.4±9.9 | 48.6±6.4 *+ | 31.8±3.2 | 50.5±11.7* | - |
| *Total sperm count (million/ejaculate)* | ≥ 40 m/eja. | 86.6±27.1 | 103.7±24.9 | 145.1±28.8*+ | 121.1±23.1 | 217.8±52.9* | - |
| *Sperm motility % grade (a+b)* | ≥ 50% | 37±5.4 | 30.4±3.1 | 35.8±2.7 | 36.8±7.2 | 33.1±4.9 | - |
| *Normal sperm morphology %* | ≥ 50% | 61.9±5.3 | 74±5.4 | 73.5±2.6 | 71.8±5.1 | 74±3.4 | - |
| *Sperm agglutination %* | 5% | 2.5±0.9 | 13.8±4.1 | 7.1±2.2 * ++ | 8.5±2.4 | 5.3±1.7 | - |
| *Round cells (million/ml)* | ≤5 m/ml | 6.2±0.8 | 9.4±2.8 | 7.8±2.4 ++ | 4.9±1.2 | 2.7±0.5 | - |

**** Significant increase between the readings of the same group (P< 0.05).***
***+ Significantly low mean difference in comparison with the mean difference of the control group (P< 0.05).***
***++ Significantly high mean difference in comparison with the mean difference of the control group (P<0.05).***
***Values are means ± SEM.***
***n.: Number of subjects.***
***? No readings were possible because the subjects didn't come.***

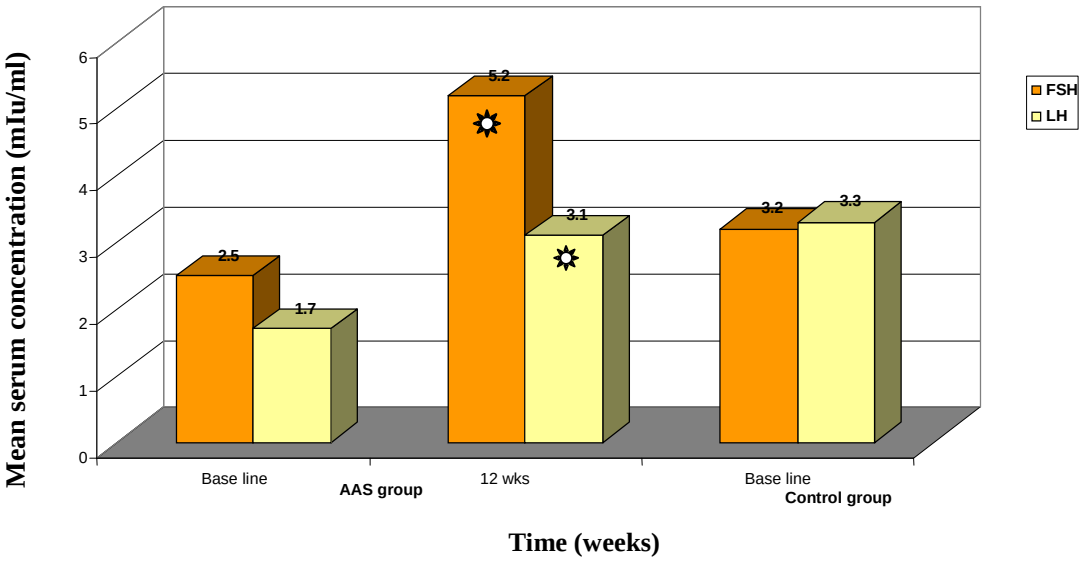


***Figure (1): Changes in serum concentration of FSH and LH in AAS and control groups.***

***✡Significant increase after 12 weeks of AAS cesstion as compared with base line (P< 0.05).***
***N.V.: FSH = 1.7-12 mIu/ml, LH=1.1-7 mIu/ml***

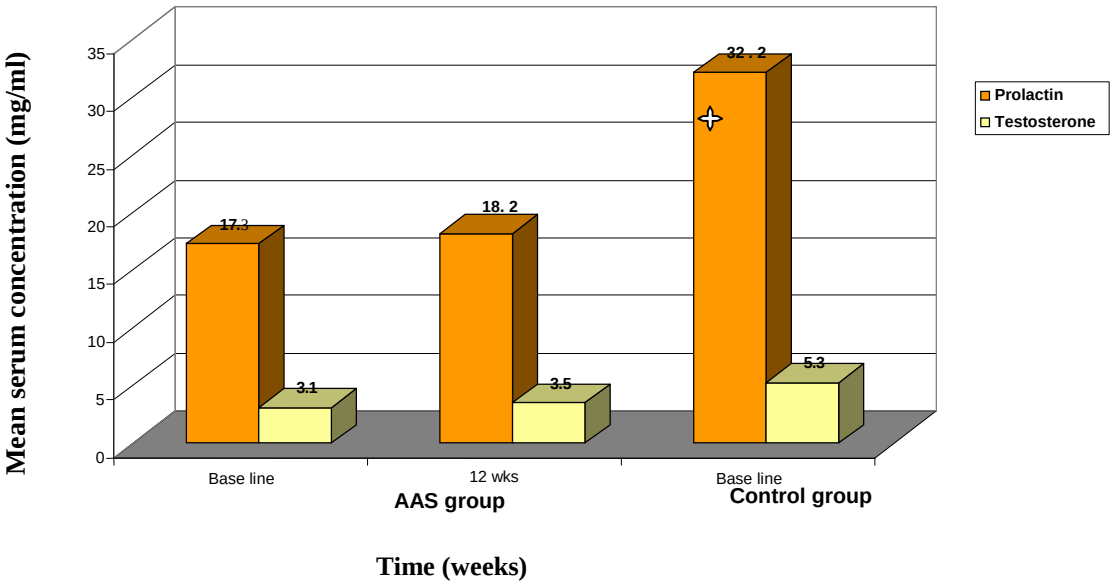


***Figure (2): Changes in serum concentration of prolactin and testosterone in AAS and control group.***
***✧Significantly different in comparison with the mean difference of the AAS group(P<0.05)***
***N.V. : Prolactin = 1.5-19 ng/ml, Testosterone = 3-10.6 ng/ml***

**Discussion**

The present study is the first of its kind in Iraq to investigate some ill effect of using AAS on the general health of users on one hand, on the other hand on their reproductive functions which constitute the most important aim of this pioneer study. The most important problem that faced the authors is the absence of understanding the volunteer system in the Iraqi community in addition to the absence of basic necessary cooperation of the subjects whom the authors have persuaded to participate in the study to come for checking according to the plan of the study. These factors have reduced the number of the subjects who have been included in the study as compared to the initial number.

Many adverse effects on the reproductive functions of AAS users have been recorded. Mild oligozoospermia and even azoospermia which may have been induced by AAS use due to reversible hypogonadotropic hypogonadism. [14-16] Moderate oligozoospermia in the present study was observed 8 weeks after drug administration while it has been shown that azoospermia may have been observed 7 weeks after anabolic steroid use. [17] Recovery of sperm production in AAS users needed 6 weeks in some subjects to return to normal concentration while, in others, it needed 12 weeks after AAS cessation. However, sperm concentration had returned to normal within a period ranged from 8 weeks to 30 weeks after the cessation of treatment with anabolic steroid. [17] Also, it was indicated that the recovery of sperm concentration to normal had been achieved after 6 months of AAS cessation. [16, 18] These differences in recovery period are probably due to different doses and durations of AAS used in different studies, besides different sources of drug manufacturing.

Concerning sperm motility, it was sustained below normal value during the follow up period (12 weeks) in both groups despite cessation of AAS use while percentages of morphologically normal sperm were within normal. However, sperm motility and normality returned to normal after the cessation of anabolic steroid administration within a period ranging from 8 up to 30 weeks. [17] Some authors have found that the percentages of normal sperm significantly reduced in AAS users [16, 19] a result which contradicts with our result. Concerning sperm agglutination in the present study, a significant increase in the percentage of agglutinated sperm was obtained after the cessation of drugs in AAS group and as compared to the control group. No reports concerned with the percentage of agglutinated sperm in AAS users were found in available literatures to compare these results with. Also, high concentration of round cells in the semen of AAS users as compared to the control group was detected and this may indicate genitourinary infection since sperm agglutination may follow genitourinary infections and high concentration of round cells in the semen. [20] Genitourinary infections are known to be associated with positive history of illegal sexual contact which has been found to be high among AAS users (68.75%).

Although spermatogenesis was recovered by the subjects during the period of AAS cessation, still serum FSH and LH did not reach normal levels in some subjects. This long lasting suppression of gonadotropins may be explained on the ground that AAS use for a relatively long period of time has disturbed feedback steroidal control on hypothalamic pituitary axis for gonadotropin release by inhibiting the pulsatile release of these hormones which, in turn, leads to a decline in testicular testosterone. [21] Serum testosterone levels in the present study contradict with other studies since several authors found that the levels of this hormone returned to normal values 24 weeks after AAS cessation which indicates prolonged impairment of testicular function. [8,16,17] Concerning serum prolactin, it was unchanged significantly after cessation of AAS as this was the finding after the treatment of five volunteers with AAS. [17] Moreover, mean serum prolactin concentration was low in AAS group as compared to the control group in which it was elevated above normal level (32.2$\pm$ 8.4 ng/ml) and this is consistent with a study done which reflected the association between the empirical use of ASS and individual's reproductive health.[19]

The elevated prolactin level in the control group may be attributed to the physiological effect of exercise and both physical and emotional stress which are known to increase serum prolactin level. [22, 23]

## Conclusion

Anabolic androgenic steroids abuse results in impaired spermatogenesis (mainly sperm count) due to hypogonadotropic hypogonadism which may have resulted from the chronic negative feedback inhibition of these exogenous steroids at the level of hypothalamus with subsequent suppression of gonadotropins.

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# تأثير الستيرويدات البنائية الذكرية على نوعية النطف ومستويات الهرمونات في مصل الدم لبنائّي الأجسام في العراق

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**الملخص**

**الهدف:** أجريت هذه الدر اسه لبحث تأثير تناول الستيرويدات البنائية الذكريه على الصحة الانجابية للرجل.

**الطرق:** شملت الدراسة أربعة وعشرين شاباً من بنائّي الأجسام الذين تطوعوا للمشاركة في البحث. تم تسجيل مجموعة بنائي الأجسام الذين استخدموا الستيرويدات البنائية (المجموعة الاولى) وكان عددهم ستة عشر شابا (21± 1.6سنة) حيث تم الاتفاق مع كل شاب في المجموعة على إيقاف استعمال هذه الأدوية قبل الانخراط في الدراسة، بينما شملت المجموعة الثانية ثمانية شبان من بنائي الأجسام الذين لم يستخدموا هذه الأدوية مطلقا (21,2± .08سنة). أخذت استبانة تفصيلية عن كل شخص وتم الاتفاق على زيارات متكررة كل ستة اسابيع لغرض اجراء الفحص السريري وفحص السائل المنوي وتحديد التغيرات الهرمونيه في مصل الدم. تم مقارنة التغيرات الحاصلة للمتغيرات التي تضمنتها الدراسة ضمن المجموعة الواحدة ومقارنة هذه التغيرات بين المجموعتين أيضا.

**النتائج:** وجد أن 50% من الأشخاص الذين استعملوا الستيرويدات البنائيه كانت أعمارهم تتراوح بين 20الى 24سنه. لقد أظهرت نتائج فحوصات السائل المنوي وجود خلل في عملية إنتاج النطف حيث حصلت زيادة معنوية في عدد النطف في المللتر الواحد وكذلك في العدد الكلي للنطف خلال فترة المتابعة البالغة ثلاثة اشهر في المجموعتين ($p<0.05$)عند مقارنة الستة اسابيع الاولى مع الثانية، لكن هذه المعايير بقيت اقل بشكل معنوي في المجموعة الاولى إذا ما قورنت بالمجموعة الثانية. لقد لوحظ أن نسبة تلاصق (تلازن) النطف و عدد الخلايا الكروية قد ازدادت بشكل معنوي ($p<0.05$) في المجموعة الاولى مقارنة مع المجموعة الثانية ($p<0.05$). ازدادت تراكيز الهرمون المحفز للجُريب (FSH) والهرمون اللوتيني (LH) معنويا ($P<0.05$) في المجموعة الاولى بعد ثلاثة اشهر من التوقف عن استعمال الستيرويدات البنائية. لقد كانت تراكيز هرمون البرولاكتين ضمن المستوى الطبيعي في المجموعة الاولى بينما أظهر مستواه انخفاضا معنويا في هذه المجموعة مقارنة بالمجموعة الثانية.

**الاستنتاج:** ان نتائج هذه الدراسة بمجموعها تشير الى التاثيرات الجانبية المرتبطة باستعمال الستيرويدات البنائية على الصحة العامة اضافة الى التاثيرات السلبية على الوظائف الانجابية. ان هذه الدراسه تضاف الى الدراسات الاخرى لمعرفة مساوئ استخدام الستيرويدات البنائية والذي قد يشكل على المدى البعيد مصدرا رئيسيا للكثير من المشاكل الاجتماعية و الصحية.

**الكلمات الدالة:** مساوئ استخدام الستيرويدات البنائية الذكرية، العقم الذكري، تحليل المني.