Effect of Treadmill Training on Premenstrual Symptoms, Hormonal and Haematological Parameters in Young Females

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ABSTRACT

Background: *The purpose of this study was to investigate the response of premenstrual symptoms, hormonal and haematological parameters to aerobic exercise in young females.* ***Methods:*** *Thirty participants aging 16-20 years and complaining from PMS were randomly assigned into two groups; control group received vitamin B6 and Ca supplements once daily and study group received the same medical treatment and participated in treadmill training three times per week for three months. Premenstrual syndrome questionnaire (MSQ), complete blood picture and hormone assays were preformed for the assessment of all participants at the starting and after the end of treatment course.* ***Results:*** *Hemoglobin, haematocrit, red cell count and platelet count were significantly increased (P<0.05), while MCV, MCH, MCHC and white blood cell count showed no significant differences (P>0.05). Also, there was significant decrease in prolactin (P=0.001), estradiol (P=0.01) and progesterone (P=0.01) levels after 3 months aerobic exercise.* ***Conclusion:*** *Aerobic exercise increases hemoglobin, haematocrit, red cell count and platelet count and decreases levels of prolactin, estradiol and progesterone resulting in improvement of fatigue, impaired concentration, confusion and most of premenstrual symptoms that affect educational performance in young females.*

Keywords: *Premenstual syndrome, aerobic exercise, hemoglobin concentration, haematocrit, prolactin, steroid hormones.*

INTRODUCTION

The menstrual cycle is a repetitive phenomenon occurring during the reproductive life of a female that involves a patterned sequence of structural, functional and hormonal changes in the reproductive system[9].

It involves complex interactions of the hypothalamus, pituitary, ovaries, uterus, prostaglandins and neuroendocrine factors. The cyclical process is regulated by complex changes in the concentrations of five hormones: gonadotropin-releasing hormone (GnRh), follicle stimulating hormone (FSH), luteinizing hormone (LH), estradiol (E2) and progesterone (P4). The interplay of these hormones is extremely complicated, with the ovarian steroid hormones exerts both negative and positive feedback effects on CNS-hypothalamic pituitary unit to influence its hormone secretion. Estradiol produces positive feedback on LH release leading to LH surge around day 14 of the cycle. Ovulation occurs approximately 12 hours after the LH surge and progesterone is secreted from the corpus luteum during the second half of the cycle (luteal phase) with a peak around 8 days after LH surge[15].

Repeated cyclical hemorrhages and variations in the estrogen and progesterone levels in the blood during menstrual cycle may affect the blood plasma volume[28]. There is a pronounced tendency toward an increase of hemoglobin together with haematocrit from the early menstrual phase until post-ovulatory period, with a subsequent decrease toward the end of the cycle[29]. This may suspect the female at her reproductive age to blood disorders such as anemia and iron deficiency which can have negative consequences on females, especially for neurocognitive outcomes[6].

Also, abnormal fluctuations in the circulating sex hormones (estrogen and progesterone levels) during the menstrual cycle may be associated with some physical and emotional symptoms[13,24]. Breast tenderness, bloating, weight gain, headache, swelling of the hands or feet and pains are main physical symptoms, while depression, angry outbursts, irritability, crying spells, anxiety, confusion, social withdrawal, poor concentration, sleep disturbance, thirst and appetite changes are common psycho-emotional and behavioral symptoms[22]. The cyclic recurrence of a combination of these symptoms during the luteal phase of the

menstrual cycle refereed as premenstrual syndrome (PMS)[3].

At least, 20% of adolescents may experience moderate-to-severe premenstrual symptoms[23]. Emerging of these symptoms during the teen years complicates the process of puberty and affects social, emotional well-being and educational performance in a negative way resulting in a poor self-steam, a sense of dissatisfaction and inadequacy[25].

Several studies had been conducted to show the effect of exercise on premenstrual symptoms using questionnaires[1,5,19,20,27]. To the authors' knowledge, no longitudinal studies have been conducted to investigate the response of prolactin and steroid hormones (E2, P4), as well as haemetological parameters to aerobic exercise in young females with PMS.

METHODS

Subjects:

Thirty young females aging 16-20 years and diagnosed with PMS participated in this study. All participants experienced regular menstrual cycle. Young females with a history of endometriosis, pelvic inflammatory diseases, any pelvic pathology, and diabetes or thyroid diseases were excluded from this study. All young females did not use oral contraceptive pills or any psychotropic agents and they did not engage in any previous regular exercise program. Both participants and parents of the participants < 18 years assigned written informed consent before starting this study and they were informed about the aims and procedures of the investigations. Participants were randomly distributed into two groups: control group received medical treatment in the form of vitamin B6 and Ca supplements once daily, while study group received the same medical treatment and engaged in a program of aerobic exercise for three months.

A full history of each participant including age, height, weight, age at menarche and length of the menstrual cycles were recorded. Pelvic ultrasonography was performed for each participant to exclude any pelvic pathology.

Premenstrual Syndrome Questionnaire (MSQ)[21] was given to each participant at two consecutive months before starting the study to confirm the diagnosis of PMS. MSQ consists of 26 symptoms, which are categorized into five subscales: PMT-A, Anxiety (behavioral changes); PMT-H, hyperhydration symptoms; PMT-C, craving manifestations; and PMT-D, characterizing depression and subscale of other symptoms. The MSQ also, measured the occurrence and severity of two menstrual pain symptoms including cramp and backache experienced during the first 2 days of the females' last menstrual period. Pre-menstrual symptoms were scaled as mild (1), moderate (2) and severe (3). Young female with PMS should experience premenstrual symptoms score at least 50% greater than postmenstrual score and rated moderate to severe impairment in one or more subscale[30]. Also, this Questionnaire was filled before and after 3 months of the study course to evaluate the effect of the treatment program.

Blood samples and Hormone assays

A 10 ml blood sample was taken from the antecubital vein with suitable vacutainers with EDTA as anticoagulant. The basal venous blood samples were obtained from all the participants in the morning between 9.00 a.m. and 11.00 a.m. after 12 hours of overnight fasting. 3 ml of each blood sample was analyzed to obtain complete blood picture. Hemoglobin, red cell count, haematocrit, merkel cell hemoglobin (MCV), mean cell hemoglobin (HCV), mean corpuscular hemoglobin concentration (MCHC), white cell count and platelet count data were obtained. 7 ml of the blood sample was allowed to clot and centrifuged at 1000 rpm for 10 min to achieve separation. The serum obtained was put into aliquots in each case, labeled and stored at – 20° C. The samples were analyzed for hormone estimation using enzyme immunoassay (EIA)[17]. Samples from all participants were run in the same assay to reduce any variance from interassay variability. These samples were taken in the luteal phase of the menstrual cycle at the day 20 of each participant before and after the treatment course.

Treatment program

Before starting the treatment program, each subject in the study group was informed about the benefits of the aerobic exercise to gain her motivation and cooperation during the treatment course. She was advised to drink plenty of fluids before and after the exercise session and wear supportive, well-fitting running or walking shoes. Treadmill protocol was modified from the method used by Allor et al.,[2]. The treadmill exercise program was started with warm up period in which each participant walked at 80 m/min at 0.0% grade for 5 min. After the walk, treadmill speed was increased to147 m/min and grade was increased gradually until reached 25% grade for 20 min. This was followed by cool down period in which the treadmill speed and grade were decreased to 2.0 miles/h and 0.0% grade during a cool down period. The participants continued the treadmill exercise program 3 days per week for 3 months.

Statistical Analyses

Data was analyzed and represented as means and standard deviations. Wilcoxon matched pairs and Mann-Whitney tests were used to compare within and between groups for non-parametric data, while paired t-test and independent t-test were used to compare within and between groups for parametric data. It was considered significant at P-value < 0.05.

RESULTS

Baseline characteristics

As shown in table 1, there were no significant differences in baseline characteristics including age, body mass index (BMI), menarche age and menstrual length between the control group and study group (P>0.05).

Table (1): Baseline characteristics of the control and study groups (Mean±SD).

Variable	Control group (N=15)	Study group(N=15)
Age (year)	18.14±1.51	17.8±1.47
BMI(Kg/m^2)	22.67±2.34	22.93±1.98
Age at menarche (year)	11.93±0.82	11.77±1.29
Menstrual length (days)	27.93±2.73	28.13±2.44

*P<0.05; **P<0.01; ***P<0.001, comparison between two groups

Effect of intervention on premenstrual symptoms

After three months of treatment, the study group showed significant post-test decrease in anxiety (behavior) score (P=0.001), craving symptoms score (P=0.002), depression score (P=0.001), hyperhydration symptoms score (P=0.001), menstrual cramps (P=0.001), backache (P=0.002) and total score (P<0.001), while for the control group, there was significant decrease in craving symptoms score (P=0.02) and no significant differences in the other subscale score, menstrual cramp, low back pain and total score, (P>0.05) (table 2). Also, results showed highly significant decrease in all post-treatment subscale symptoms scores (P<0.001) (except for craving score; P>0.05) and total score (P<0.000) of the study group when compared to the post-treatment scores of the control group.

Table (2): Comparison of PMS subscale scores and total scores at baseline and after 3 months of treatment for both groups.

	Control group (N=15)		Study group (N=15)	
Symptoms	Baseline	After 3 months	Baseline	After 3 months
Anxiety symptoms	8.66±2.84	9±2.59	9.13±2.09	5.4±1.29**
Craving symptoms	6.93±1.33	6.26±1.16*	7.6±1.99	6.13±1.3**
Depression symptoms	9.46±2.79	9.2±2.33	9.53±2.41	6±1.30**
Hyperhydration symptoms	9±1.41	9.26±1.27	9.6±1.24	6.13±1.12**
Menstrual cramps	2.8±0.41	2.8±0.41	2.73±0.59	1.46±0.51**
Menstrual backache	2.8±0.41	2.86±0.35	2.6±0.63	1.6±0.50**
Total score	52.13±7.92	51.53±7.34	54.26±7.05	37± 6.52***

*P<0.05; **P<0.01; ***P<0.001, mean values compared with baseline

Effect of intervention on haematological parameters

Results showed that 40% of the participants had hemoglobin level <12 g/dl indicating anemia. After 3 months aerobic exercise, hemoglobin, haematocrit, red cell count and platelet count were significantly increased (P=0.02; P=0.02; P=0.02; P=0.03) respectively, while other parameters MCV, HCV, MCHC and white blood cell count showed no significant differences (P>0.05) (table3). Only hemoglobin showed significant difference between the control and study group after treatment (P=0.03).

Effect of intervention on prolactin and ovarian steroid hormones

Prolactin level was significantly decreased by 58.92% (P=0.001) and also, (E2) and (P4) decreased by 23.9% (P=0.01) and 41.2% (P=0.01) respectively in the study group (table 3). Results also, showed highly significant decrease in post-treatment values of prolactin (P<0.0001), P4 (P<0.001) levels, as well as a decreasing trend in (E2) without statistical significance (P>0.05) of the study group when compared to the control group after treatment.

Table (3): Comparison of hormonal and haematological parameters at baseline and after 3 months of treatment for both groups.

Variable	Control group (N=15)		Study group (N=15)	
	Baseline	After 3 months	Baseline	After 3 months
Haematological parameters				
Hemoglobin (g/dl)	12.01±0.49	12.02±0.44	12.15±0.72	12.4±0.48*
Red cell count (millions/cmm)	4.13±0.34	4.24±0.46	4.19±0.30	4.40±0.36*
Haematocrit (vol%)	37.29±1.94	38.07±1.66	37.82±3.63	38.61±3.28*
MCV(fl)	84.40±2.89	83.73±2.55	86.13±4.58	85.6±2.23
MCH (pg)	29.33±1.39	29.40±1.29	29.67±1.91	30.07±1.16
MCHC (%)	32.40±2.16	32.87±2.10	33.93±1.1	33.47±1.68
Platelet count (Thousands/cmm)	217.3±53.57	230.7±58.27	228.9±43.91	252.9±51.14*
Hormones				
Prolactin (ng/ml)	29.21±15.76	28.73±14	30.6±18.98	12.57±4.27**
Estradiol (E2)(pg/dl)	107.3±39.49	108.7±39.22	123.1±39.85	99.33±36.33*
Progesterone (ng/ml)	10.52±5.22	11.1±5.03	9.73±5.57	5.65±2.44*

*P<0.05; **P<0.01; ***P<0.001, mean values compared with baseline

DISCUSSION

The objective of this study was to determine the effect of 3 months of treadmill training on premenstrual symptoms, hormones that may be involved in the occurrence of these symptoms and haematological parameters in young females.

The results of this study showed that B6 and ca supplementations produced improvements in some premenstrual symptoms such as appetite change, headache, fatigue, dizziness and palpitation. This was in agreement with Ghanbarid et al., who reported that ca supplements showed decreased fatigability, changes in appetite and depression in females with PMS. However, these supplements did not show any change in hormone levels and haematological parameters in the control group[10].

Exercise can significantly lower almost of premenstrual symptoms in exercising young women. It improves anxiety and depression related symptoms, carbohydrate craving symptoms, and electrolyte changes symptoms. This finding was consistent with the results of observational cross sectional studies which reported that regular exercisers had significantly lower scores on impaired concentration, negative effect, behavior changes and pain[1] and may be protected from deterioration of mood before and during menstruation[5]. It also, in line with longitudinal studies, which reported reduction in

premenstrual symptoms after 3[19] and 6[20] months of running training program. In addition, exercise showed a reduction in menstrual cramps and low back pain associated with the first two days of the menstrual period. This was in agreement with many studies which reported the beneficial effect of exercise on dysmenorrhea[11,14].

In the present study 40% of participants had hemoglobin level <12g/dl[12] indicating that young females with PMS are at greater risk of anemia. Low hemoglobin may be responsible for some symptoms associated with PMS such as fatigue, dizziness, impaired concentration and confusion that may affect educational performance of the young females. Aerobic exercise showed significant improvement in hemoglobin, hematocrit, red blood cells count and platelet count leading to reduction of the previous symptoms. These findings were consistent with Cordova et al., who found the maximal incremental exercise test significantly increased erythrocytes, haematocrit and blood hemoglobin levels in volleyball players[7] and Cho et al. who reported increased platelet counts in response to acute effect of treadmill exercise in college male students[4].

Some women with PMS have higher prolactin levels or may be abnormally sensitive to normal amount of prolactin[4]. In the present study, the prolactin level was significantly reduced in the exercising young females which may lead to relief of the physical symptoms such as breast tenderness. This was in consistent with the study which reported that prolactin-lowering agents can effectively treat premenstrual mastalgia[18].

The hypothesis of involvement of gonadal steroids in the pathophysiology of PMS is supported by the findings that symptoms are not present during non-ovulatory cycles and disappear with ovariectomy[8]. From this hypothesis, it may be suggested that reduction in the levels of estradiol and progesterone in response to exercise may be associated with the recovery of some premenstrual symptoms. This was consistent with Kossman and his colleagues who reported that aerobic exercise produced reduction in both estradiol and progesterone in premenopausal women at high risk of breast cancer[16]. Also, most recent study on rats reported decrease in estradiol and progesterone in response to high intensity exercise training[31].

Conclusion

Young females with PMS are at greater risk of anemia so, regular hemoglobin test is recommended for that population. Aerobic exercise has a very beneficial effect physiologically and psychologically for young females as it relieves premenstrual symptoms, decreases prolctin, estradiol and progesterone involved in pathophysiology of PMS and improves hemoglobin, haematocrit and red blood cell count resulting in improvement of social, emotional-wellbeing and educational performance.

REFERENCES

1- Aganoff, J.A. and Boyle, G.J.: Aerobic exercise, mood states and menstrual cycle symptoms. J Psychosom Res, 38(3): 183-192, 1994.

2- Allor, K., Pivarnik, J., Sam, L. and Perkins, M.: Treadmill economy in girls and women matched for height and weight. J Appl Phsiol, 89(2): 512-516, 2000.

3- Braverman, P.K.: Premenstrual syndrome and premenstrual dysphoricdisorder. J Pediatr Adolesc Gynecol, 20(1): 3-12, 2007.

4- Cho, H.C., Kim, J., Kim, S., Son, Y.H., Lee, N. and Jung, S.H.: The concentrations of serum, plasma and platelet BDNF are all increased by treadmill (VO2max) performance in healthy college men. NeurosciLett, 519(1): 78-83, 2012.

5- Choi, P.Y. and Salmon, P.: Symptom changes across the menstrual cycle in competitive sportswomen, exercisers and sedentary women. Br J Clin Psychol, 34 (Pt 3): 447-460, 1995.

6- Coad, J. and Conlon, C.: Iron deficiency in women: assessment, causes and consequences. Curr Opin Clin Nutr Metab Care, 14(6): 625-634, 2011.

7- Córdova, A., Sureda, A., Tur, J.A. and Pons, A.: Immune response to exercise in elite sportsmen during the competitive season. J Physiol Biochem, 66(1): 1-6, 2010.

8- Cunningham, J., Yonkers, K.A., O'Brien, S. and Eriksson, E.: Update on research and treatment of premenstrual dysphoric disorder. Harv Rev Psychiatry, 17(2): 120-137, 2009.

9- Farage, M.A., Neill, S. and MacLean, A.B.: Physiological changes associated with the

menstrual cycle: a review. Obstet Gynecol Surv , 64(1): 58-72, 2009.
10- Ghanbarid, Z., Haghollahid, F., Shariata, M., Foroshanib, A.R. and Ashrafic, M.: Effects of calcium supplement therapy in women with premenstrual syndrome. Taiwan J Obstet Gynecol , 48(2): 124-129, 2009.
11- Golub, L., Menduke, H. and Lang, W.R.: Exercise and dysmenorrhea in young teenagers: a 3-year study. Obstet Gynecol, 32: 508-511, 1968.
12- Hawkins, W.W., Speck, E. and Leonard, V.G.: Variation of the hemoglobin level with age and sex. Blood, 9(10): 999-1007, 1954.
13- Inoue, Y., Terao, T., Iwata, N., Okamoto, K., Kojima, H. and Okamoto, T.: Fluctuating serotonergic function in premenstrual dysphoric disorder and premenstrual syndrome: findings from neuroendocrine challenge tests. Psychopharmaclogy (Berl), 190(2): 213-219, 2007.
14- Israel, R.G., Sutton, M. and O'Brien, K.F.: Effects of aerobic training on primary dysmenorrhea symptomatology in college females. J Am Coll Health, 33: 241-244, 1985.
15- Kol, S. and Itskovitz-Eldor, J.: Gonadotropin-releasing hormone agonist trigger: the way to eliminate ovarian hyperstimulation syndrome-a 20-year experience. Semin Reprod Med, 28(6): 500-505, 2010.
16- Kossman, D.A., Williams, N.I., Domchek, S.M., Kurzer, M.S., Stopfer, J.E. and Schmitz, K.H.: Exercise lowers estrogen and progesterone levels in premenopausal women at high risk of breast cancer. J Appl Physiol., 111(6): 1687-1693, 2011.
17- Munro, C.J., Stabenfeldt, G.H., Cragun, J.R., Addiego, L.A., Overstreet J.W. and Lasley, B.L.: Relationship of serum estradiol and progesterone concentrations to the excretion profiles of their major urinary metabolites as measured by enzyme immunoassay and radioimmunoassay. Clin Chem, 37(6): 838-844, 1991.
18- Peters, F.: Multicentre study of gestrinone in cyclical breast pain. Lancet., 339(8787): 205-208, 1992.
19- Prior, J.C., Vigna, Y. and Alojada, N.: Conditioning exercise decreases premenstrual symptoms. A prospective controlled three month trial. Eur J Appl Physiol Occup Physiol, 55(4): 349-355, 1986.
20- Prior, J.C., Vigna, Y., Sciarretta, D., Alojado, N. and Schulzer, M.: Conditioning exercise decreases premenstrual symptoms: a prospective, controlled 6-month trial. Fertil Steril., 47(3): 402-408, 1987.
21- Prizzorno, J.R. and Murray, M.T.: Textbook of natural medicine. New York: Churcgill Livingstone, 330-331, 1999.
22- Rapkin, A.: A review of treatment of premenstrual syndrome and premenstrual dysphoric disorder. Psychoneuroendocrinology, 28 (suppl 3): 39-53, 2003.
23- Rapkin, A.J. and Mikacich, J.A.: Premenstrual syndrome in adolescents: diagnosis and treatment. Pediatr Endocrinol Rev, 3(Suppl 1): 132-137, 2006.
24- Redei, E. and Freeman, E.W.: Daily plasma estradiol and progesterone levels over the menstrual cycle and their relation to premenstrual symptoms. Psychoneuroendocrinology, 20(3): 259–267, 1995.
25- Rizk, D.E., Mosallam; M., Alyan, S. and Nagelkerke, N.: Prevalence and impact of premenstrual syndrome in adolescent schoolgirls in the United Arab Emirates. Acta Obstet Gynecol Scand, 85(5): 589-598, 2006.
26- Rocha Filho, E.A., Lima, J.C., PinhoNeto, J.S. and Montarroyos, U.: Essential fatty acids for premenstrual syndrome and their effect on prolactin and total cholesterol levels: a randomized, double blind, placebo-controlled study. Reproductive Health, 8: 2, 2011.
27- Steege, J.F. and Blumenthal, J.A.: The effects of aerobic exercise on premenstrual symptoms in middle-aged women: a preliminary study. J Psychosom Res, 37(2): 127-133, 1993.
28- Stephenson, L.A., Kolka, M.A., Francesconi, R. and Gonzalez, R.R.: Circadian variations in plasma renin activity, catecholamines and aldosterone during exercise in women. Eur J Appl Physiol Occup Physiol, 58(7): 756-764, 1989.
29- Vellar, O.D.: Changes in hemoglobin concentration and hematocrit during the menstrual cycle: A Cross-sectional Study. Acta Obstet Gynecol Scand, 53(3): 243-246, 1974.
30- Vichnin, M., Freeman, E.W., Lin, H., Hillman, J. and Bui, S.: Premenstrual syndrome (PMS) in adolescents: severity and impairment. J Pediatr Adolesc Gynecol, 19(6): 397-402, 2006.
31- Xiong, R., Ren, X., Wang, G., Chen, G., Yang, H., Yuan, Q. and Zhou, H.: High intensity training induces alteration of the ubiquitin-proteasome system gene expression profile and structural changes in the ovaries. Mol Med Report, 5(5): 1352-1356, 2012.

الملخص العربي

تأثير تمرينات المشي على السير المتحرك علي أعراض ما قبل الطمث ودلالات الهرمونية والدموية لدى السيدات الصغيرات

هدف الدراسة: تهدف هذه الدراسة إلى تقييم استجابة أعراض ما قبل الطمث وكذلك دلالات الهرمونية والدموية إلى التمرينات الهوائية لدي الفتيات الصغيرات . ولقد اشترك في هذه الدراسة ثلاثين مشاركة تتراوح أعمارهن ما بين 16 إلى 20 عاما وتعانين من متلازمة ما قبل الطمث وتم توزيعهن عشوائيا إلى مجموعتين: المجموعة الضابطة تلقت العلاج الطبي (فيتامين ب 6، كالسيوم، معادن) ومجموعه الدراسة تلقت نفس العلاج الطبي واشتركن في برنامج تدريبي بمعدل ثلاث جلسات أسبوعيا لمده ثلاث أشهر. القياسات: تم تقييم جميع المشاركات باستخدام استبيان متلازمة ما قبل الطمث، تحليل دم شامل و المقياس الهرموني في بداية الدراسة وبعد ثلاثة أشهر من العلاج . النتائج: أظهرت النتائج أن هناك زيادة ذات دلالة إحصائية في الهيموجلوبين والهيماتوكريت ومعدل الصفائح الدموية بينما لم يظهر متوسط حجم كريه الدم الحمراء ومتوسط وزن الهبموجلوبين ومتوسط تركيز الهيموجلوبين في كريات الدم الحمراء وكذلك خلايا الدم البيضاء أي اختلاف ذو دلالة إحصائية . وأيضا كان هناك نقص ذو دلالة إحصائية في كل من هرمون البرولاكتين ، الاستراديول والبروجيستيرون بعد ثلاث اشهر من ممارسة التمرينات الهوائية. الخلاصة : من هذه النتائج يمكن أن نستنتج أن ممارسة التمرينات الهوائية تؤدي إلى زيادة الهيموجلوبين، الهيماتوكريت ومعدل الصفائح الدموية وتقلل من مستويات البرولاكيتن ، الاستراديول والبروجيستيرون مما يؤدي إلى تحسين الإجهاد وقلة التركيز والارتباك ومعظم أعراض ما قبل الطمث التي تؤثر علي الأداء التعليمي لدي الفتيات الصغيرات.

الكلمات الدالة: متلازمه ما قبل الطمث، التمرينات الهوائية، الهيموجلوبين، الهيماتوكريت، البرولاكتين،هرمونات الستيرويد .