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Original Article

The Effect of High Fiber Diet on Sex Hormones in Early Pubertal Obese Girls; a Randomized Crossover Clinical Trial

Zeinab Piraloo [1], Sedighe Forouhari [2], Seyede Zahra Ghaemi [3], Parisa Rostambeigy [4], Zahra Mohammadi [5], Jaleh Zolghadr [6], Seyed Shojaeddin Namazi [7], Mostafa Mohammadi [8], Moosa Salehi [9] ,Azam Jokar [10], Najaf Zare [11], Sareh Roosta [1]

1. Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
2. Infertility Research Center, Community Based Psychiatric Care Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
3. Department of Midwifery, Estahban Branch, Islamic Azad University, Estahban, Iran
4. Department of Nursing, Estahban Branch, Islamic Azad University, Estahban, Iran
5. Shahid Beheshti University of Medical Sciences, Tehran, Iran
6. Infertility Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
7. Student Research Committee, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
8. Yasuj University of Medical Sciences, Yasuj, Iran
9. Nutritional Science Center, School of Nutrition and Food , Shiraz University of Medical Sciences, Shiraz, Iran
10. Community Based Psychiatric Care Research Center, College of Nursing & Midwifery Hazrat Fatemeh(PBUH), Shiraz University of Medical Sciences, Shiraz, Iran
11. Infertility research center, Department of Biostatistics, Shiraz University of Medical Sciences, Shiraz, Iran

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Corresponding author: Sedighe Forouhari, Infertility Research Center, Community Based Psychiatric Care Research Center, Shiraz University of Medical Sciences, Shiraz, Iran, E-mail: forouharism@yahoo.com

Abstract:

Introduction: The aim of the present study was to investigate the effectiveness of high-fiber diet on sexual hormones in obese and overweight female adolescents.

Methods: This randomized crossover clinical trial was conducted among 56 obese or overweight girls in Shiraz, Iran. All subjects were randomly divided into two groups. A list containing high (25 g/day green leafy vegetables or fresh fruits) and low fiber diets were prepared for case and control groups, respectively. Each group consumed their special diet for two months. After a month of cleanup period, the intended diet was replaced between the two groups. Blood sample of participants were taken in third to fifth day of the spontaneous menstrual cycle. After the end of each step, the serum levels of SHBG, DHEA, estradiol and testosterone were measured. Data was analyzed by SPSS (V.19) using paired

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sample t-test and independent t-test. Significant level was considered below 0.05 IRCT ID; 2012120811699N1.

Results: The results showed that high-fiber diet significantly reduced the serum levels of testosterone, estradiol, and DHEA compared to low fiber diet (P = 0.0001). Nevertheless, the changes of SHBG level were not significant between the two diets (P > 0.05).

Conclusions: This study demonstrated that the use of high-fiber diet can decrease the sex hormones in adolescent girls. Consuming a high fiber diet is recommended for obese and overweight patients.

Keywords: Vegetables, Fruit, Obesity, Overweight, Gonadal Steroid Hormones, Female.

Introduction:

Overweight or obesity has led to increased prevalence of numerous diseases and disorders such as coronary and cerebrovascular diseases, type 2 diabetes mellitus, hypertension, osteoarthritis, gout, asthma and dementia (1).

Obesity is also associated with increased risk of different types of cancers such as endometrial cancer and breast cancer in postmenopausal women. Hormonal imbalance, including sex hormones and insulin can lead to obesity and raise the risk of various cancers (2).

There is strong evidence that puberty is also the leading cause of ovarian dysfunction. As well as, many investigators have demonstrated that obesity can lead to a variety of hormonal disorders such as hyperandrogenism (3).

Additionally, several studies have indicated that obesity has direct interaction with hormonal imbalance. Obesity can affect the fertility potential of women. Two different mechanisms has been reported for this effect; the first is increased androgen-estrogen conversion and the second is direct effect of obesity on estrogen circulation in human body (3, 4).

However, evidence regarding the role of diet on serum level of estrogen and androgens are inconsistent (4, 5). Few studies have shown that high fiber diet such as beans, vegetables, fruits and whole grains may be useful for treatment of metabolic, hormonal and lipid abnormalities (6). This study aimed to investigate the influence of high-fiber diet on the sex hormones in obese and overweight girls.

Methods:

This randomized cross over clinical trial was conducted in Shiraz University of Medical Sciences (SUMS). The study population consisted of all early adolescent obese girls who lived in Shiraz city from April 2012 to September 2012.

A number of 56 early adolescent girls (between 15-19 years old) with body mass index (BMI) of over 25 kg/m2 were randomly selected and assigned into two groups.

The research project protocol and the advantages and limitations of the diet described for all participants. All subjects provided informed consent, and the Study was approved by ethic committee of SUMS and registered in Iranian Clinical Trial Registry (IRCT ID; 2012120811699N1).

Exclusion criteria consisted of any medical disease including PCOS, hyperthyroidism, hypothyroidism, adrenal hyperplasia, known renal and hepatic failure, irregular menstruation, use of oral corticosteroids and tetracycline, consumption of minerals and vitamins supplements, suspected or documented pregnancy, gastrointestinal disorders, vegetarian diet or a diet containing high levels of phytoestrogens. However, they could use low amounts of acetaminophen or aspirin.

All participants started their diets 3 days before the first day of study. After 12 h fasting, participants' weight was measured with minimal clothing, and the standing height was measured without shoes. All subjects were asked to consume diets containing a mixture of 55% carbohydrates, 15% protein and 30% fat.

For the case group, a list of high-fiber diet was prepared (including lettuce, cabbage, fresh fruits and other green leafy vegetables). Case subjects were asked to consume at least one meal per day from these high-fiber foods (equaling 25 g/day).

Participants of the control group were asked not to consume the intended list of foods that contain high amounts of fiber. In the first step of study, the group A considered as experimental group and group B as control group. The diet selected for each group was asked to be used for two months. Afterwards, for a month, both groups were advised to use their usual diets (clean phase). In the second step of the study, the diet was replaced between the two groups for two months again.

During the study, participants were asked not to alter their common diets and do not use of hormonal drugs such as oral contraceptives.

At the end of each step (before study, after the first two months, after the clean phase and after the second two months) 10 ml of blood was taken from peripheral veins of the participants within the third to fifth days of the spontaneous menstrual cycle and the serum levels of sex hormone-binding globulin (SHBG), dehydroepiandrosterone (DHEA), estradiol and testosterone were measured.

Serum and plasma were separated by centrifugation for 15 minutes at 1,465 × g (3,200 rpm) and 4° C, and stored at −80°C for further analysis. Serum levels of testosterone, estradiol and DHEA were determined by radioimmunoassay using commercial reagents (Aria Farmed Company). SHBG was

measured by electroimmunoassay electrophoresis (Aria Farmed Company). Analytical sensitivity for the factors assays were: testosterone 2.5 ng/dl, estradiol 0.6 ng/dl, DHEA 6 µg/dl and SHBG 0.02 IU/l.

The analyses were performed using SPSS software version 19 and NCSS software version 11. Descriptive statistics such as mean and standard deviation were used. Paired T-test and Independent T-test were employed for continues and quantitative variables between groups. The P-value less than 0.05 were considered significant.

Results:

The mean age of participants was 16.97 ± 1.05. The age, BMI, testosterone, DHEA, SHBG and estradiol of the participants of both groups did not have significant differences before the intervention (P> 0.05). The basic characteristics of the subjects are listed in Table 1.

Table 1: Comparison of the basic characteristics of participants

Variable	Group A (mean ± S.D)	Group B (mean ± S.D)	P-Value
Age	16.78 ± 1.05	17.17 ± 1.02	NS*
DHEA (ng/ml)	189.1 ± 51.49	173.3 ± 40.6	NS
Estradiol (pg/ml)	100.2 ± 34.47	96.85 ± 21.65	NS
SHBG (nmol/l)	57.85 ± 15.96	59.49 ± 15.92	NS
Testosterone (ng/ml)	0.6 ± 0.25	0.65 ± 0.25	NS

*NS: not significant

The difference of DHEA, estradiol and testosterone levels were significant (P<0.05), but the changes of SHBG levels were not statistically significant. (P =0.86). (Table 2).

The results showed that mean reduction in group B patients were lower than group A subjects. The mean reduction of DHEA, estradiol and testosterone after the first step (Group A) were 17 ng/ml (8.99%), 20 pg/ml (19.96%) and 0.15 ng/ml (25%) and after the second step (Group B) were 42 ng/ml (23.59%), 32 pg/ml (30.47%) and 0.18 ng/ml (28/12 %), respectively.

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Table 2: Comparison of the levels of DHEA, Estradiol, SHBG and Testosterone (Mean ± S.D) in the various steps of the study

Hormone	Group	Before the first intervention	After the first intervention	After the clean phase	After the second intervention	P-Value
DHEA (ng/ml)	A	189.1 ± 51.49	172.14 ± 41.64	195.32 ± 40.91	180.61 ± 32.72	0.001
	B	173.3 ± 40.6	174.57 ± 41.73	178.11 ± 38.84	136.82 ± 32.05	
Estradiol (pg/ml)	A	100.25 ± 39.57	80.01 ± 24.08	104.32 ± 39.7	108.58 ± 39.2	0.001
	B	96.85 ± 21.65	102.48 ± 25.35	105.83 ± 27.09	84.54 ± 73.6	
SHBG (nmol/l)	A	57.85 ± 15.96	57.65 ± 16.45	58.26 ± 15.78	57.88 ± 15.26	NS*
	B	59.49 ± 15.92	59.22 ± 14.9	59.90 ± 15.30	59.54 ± 14.52	
Testosterone (ng/ml)	A	0.6 ± 0.25	0.45 ± 0.25	0.65 ± 0.2	0.61 ± 0.25	0.009
	B	0.65 ± 0.25	0.59 ± 0.24	0.64 ± 0.2	0.46 ± 0.2	

*NS: not significant

Conclusion:

To the best of our knowledge this study was the first randomized cross over clinical trial that assessed the effectiveness of high fiber diets on decreasing serum levels of sex hormones in early pubertal obese girls. Evidence have demonstrated that high fiber diets and starch-rich foods lead to slow motility of gastrointestinal tract and even delay absorption and digestion (4).

The results of cross-sectional study by Dorgan et al. indicated that energy intake in premenopausal women was inversely associated with plasma concentrations of androstenedione and DHEAS averaged across the three menstrual cycles (7).

In the similar study conducted among 286 pre-pubertal girls in which dietary fat reduced from 33% to 27% of energy per day for 7 years, the authors have concluded that by year 5, the serum levels of estrone, estrone sulfate, and E2 (estradiol) of studied population were 21–30% lower than general population with normal diets. This differences were statistically significant (8).

Another study by Rose et al (9) concluded that 30 g/d consumption of high fiber supplementations for 2 months showed significant reductions in serum estrone and estradiol. The acceptable cause for this reduction may be the effect of high fiber supplementations on the enterohepatic circulation of esterone. They also concluded that high fiber intake is related to decrease breast cancer and attributed to reduced serum estrogen concentration which is seen in these patients.

Woods et al. showed that after 21st, day dietary modification with lower fat (20%) and higher fiber (40 g/d) can result in a lowering of serum estrogens. Also, the values of serum estrogens reducing were significantly lower in non-Hispanic white than African American women (10).

In the study on 213 healthy, premenopausal women aged 20–40 years were consumed a low-fat (20%), high-fiber diet (25–30 g/d) and daily servings of fruits and vegetables for 1 year. the participants serum E2 and free E2 levels were 7–8% lower than the control group (11).

Several studies conducted by Katcher et al. (12), Mehrabani et al. (13) and Goldin et al. (14) showed that high fiber diet could decrease testosterone levels in women. These findings are in consistent with the results of the present study.

Also, the results of our study demonstrated that serum level of SHBG was not statistically different when high fiber diets are employed compared with normal diet. This finding which was consistent with other reports of several studies (4, 9, 12, 15). Nevertheless, some studies revealed that high fiber diets had significant reduction in serum concentrations of SHBG (14). On the other hand, studies have reported that the serum level of SHBG has inverse relationship with weigh and protein intake (12).

There is evidence that dietary factors including fructose, glucose, sucrose, and insulin affect SHBG expression and secretion (16, 17). The increased in SHBG levels with consumption of hypocaloric diet has been reported after a long-term period (2–7 months) (18, 19). The lack of change in SHBG after a eucaloric diet suggests that manipulating diet composition during short-term observation may not be enough to dramatically alter SHBG serum levels (12).

After more than 20 years of intervention, evidence showed that low-fat and high-fiber diets affect serum levels of E2, testosterone, SHBG, DHEA and free E2 levels among girls, premenopausal women, and postmenopausal women. However, results were not usually statistically significant, and specific hormonal changes, did not remain over time. These differences could be due to several factors including using different types and amounts of high fiber diets (4, 10, 20), racial differences (10), measuring the sex hormones during the various phases of menstrual cycle (9, 21-23), participants age (8, 9, 14), duration and population size of the study (8, 12).

A limitation of the present study is that it is not possible to determine what specific dietary component affects hormones and SHGB levels. Despite limitations, our results indicated that meal composition affects postprandial DHEA, estradiol and testosterone levels in early pubertal obese girls.

Since puberty is important period in life and affected other life periods, the relationship between diet and sex hormones in adolescents with obesity in a few studies has been investigated. We concluded that 30 g of green leafy vegetables, starch reach foods and fresh fruits can significantly decrease the sex hormones in obese and overweight patients. Based on our results and previous studies, consumption of high fiber diet is recommended at least once a day in order to prevent and decrease the prevalence of diseases which are related to low fiber intake. This matter is more important for western populations in which the subjects prefer high protein and high fat diet than high fiber dietary and face more with several cancers compared with Asian peoples (15, 24-27). In this study, we evaluated the relationship between high fiber diet and sex hormone changes and we hope this study help further projects to provide new information on the relationship between sex hormones, diet and obesity in adolescents.

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Conflicts of Interest: The authors of this article declare that they have no conflicts of interest.

References:

1. Knight JA. Diseases and disorders associated with excess body weight. Annals of Clinical & Laboratory Science. 2011;41(2):107-21.
2. Carroll K. Obesity as a risk factor for certain types of cancer. Lipids. 1998;33(11):1055-9.
3. Franks S. Adult polycystic ovary syndrome begins in childhood. Best Practice & Research Clinical Endocrinology & Metabolism. 2002;16(2):263-72.
4. Cui X, Rosner B, Willett WC, Hankinson SE. Dietary fat, fiber, and carbohydrate intake and endogenous hormone levels in premenopausal women. Hormones and Cancer. 2010;1(5):265-76.
5. Mumford SL, Schisterman EF, Siega-Riz AM, Gaskins AJ, Wactawski-Wende J, VanderWeele TJ. Effect of dietary fiber intake on lipoprotein cholesterol levels independent of estradiol in healthy premenopausal women. American journal of epidemiology. 2011;173(2):145-56.
6. De Natale C, Annuzzi G, Bozzetto L, Mazzarella R, Costabile G, Ciano O, et al. Effects of a plant-based high-carbohydrate/high-fiber diet versus high–monounsaturated fat/low-carbohydrate diet on postprandial lipids in type 2 diabetic patients. Diabetes Care. 2009;32(12):2168-73.
7. Dorgan JF, Reichman ME, Judd JT, Brown C, Longcope C, Schatzkin A, et al. Relation of energy, fat, and fiber intakes to plasma concentrations of estrogens and androgens in premenopausal women. The American journal of clinical nutrition. 1996;64(1):25-31.
8. Dorgan JF, Hunsberger SA, McMahon RP, Kwiterovich PO, Lauer RM, Van Horn L, et al. Diet and sex hormones in girls: findings from a randomized controlled clinical trial. Journal of the National Cancer Institute. 2003;95(2):132-41.
9. Rose DP, Goldman M, Connolly JM, Strong LE. High-fiber diet reduces serum estrogen concentrations in premenopausal women. The American journal of clinical nutrition. 1991;54(3):520-5

10. Woods MN, Barnett JB, Spiegelman D, Trail N, Hertzmark E, Longcope C, et al. Hormone levels during dietary changes in premenopausal African-American women. Journal of the National Cancer Institute. 1996;88(19):1369-74.
11. Gann PH, Chatterton RT, Gapstur SM, Liu K, Garside D, Giovanazzi S, et al. The effects of a low-fat/high-fiber diet on sex hormone levels and menstrual cycling in premenopausal women. Cancer. 2003;98(9):1870-9.
12. Katcher HI, Kunselman AR, Dmitrovic R, Demers LM, Gnatuk CL, Kris-Etherton PM, et al. Comparison of hormonal and metabolic markers after a high-fat, Western meal versus a low-fat, high-fiber meal in women with polycystic ovary syndrome. Fertility and sterility. 2009;91(4):1175-82.
13. Mehrabani HH, Salehpour S, Amiri Z ,Farahani SJ, Meyer BJ, Tahbaz F. Beneficial effects of a high-protein, low-glycemic-load hypocaloric diet in overweight and obese women with polycystic ovary syndrome: a randomized controlled intervention study. Journal of the American College of Nutrition. 2012;31(2):117-25.
14. Goldin BR, Woods MN, Spiegelman DL, Longcope C, Morrill-LaBrode A, Dwyer JT, et al. The effect of dietary fat and fiber on serum estrogen concentrations in premenopausal women under controlled dietary conditions. Cancer. 1994;74(S3):1125-31.
15. Bagga D, Ashley JM, Geffrey SP, Wang HJ, Barnard RJ, Korenman S, et al. Effects of a very low fat, high fiber diet on serum hormones and menstrual function implications for breast cancer prevention. Cancer. 1995;76(12):2491-6.
16. Plymate S, Matej L, Jones R, Friedl K. Inhibition of sex hormone-binding globulin production in the human hepatoma (Hep G2) cell line by insulin and prolactin. The Journal of clinical endocrinology and metabolism. 1988;67(3):460.
17. Selva DM, Hogeveen KN, Innis SM, Hammond GL. Monosaccharide-induced lipogenesis regulates the human hepatic sex hormone–binding globulin gene. Journal of Clinical Investigation. 2007;117(12):3979-87.
18. Moran LJ, Noakes M, Clifton PM, Wittert GA, Williams G, Norman RJ. Short-term meal replacements followed by dietary macronutrient restriction enhance weight loss in polycystic ovary syndrome. The American journal of clinical nutrition. 2006;84(1):77-87.
19. Moran LJ, Noakes M, Clifton PM, Tomlinson L, Norman RJ. Dietary composition in restoring reproductive and metabolic physiology in overweight women with polycystic ovary syndrome. Journal of Clinical Endocrinology & Metabolism. 2003;88(2):812-9.
20. Gaskins AJ, Mumford SL, Wactawski-Wende J, Schisterman EF. Effect of daily fiber intake on luteinizing hormone levels in reproductive-aged women. European journal of nutrition. 2012;51(2):249-53.
21. Tymchuk CN, Tessler SB, Barnard RJ. Changes in sex hormone-binding globulin, insulin, and serum lipids in postmenopausal women on a low-fat, high-fiber diet combined with exercise. Nutr Cancer 2000;38:158–62.
22. Bradlow HL, Michnovicz JJ, Halper M, Miller DG, Wong GYC, Osborne MP. Long-term responses of women to indole-3-carbinol or a high fiber diet. Cancer Epidemiol Biomarkers Prev 1994;3:591–5.
23. Longcope C, Feldman HA, McKinlay JB, Araujo AB. Diet and sex hormone-binding globulin. J Clin Endocrinol Metab 2000;85:293-296.
24. Van't Veer, P, Kolb, CM, Verhoef, P, Kok, FJ, Schouten, EG, et al.: "Dietary fiber, beta-carotene and breast cancer: results from a case- control study." Int J Cancer.1990; 45, 825-828.

25. Prentice R, Thompson D, Clifford C, Gorbach S, Goldin B, Byar D: Dietary fat reduction and plasma estradiol concentration in healthy postmenopausal women. J Natl Cancer Inst 1990;82:129–134.
26. Key, TJA, Chen, J.. Wang, DY, and Boreham, J. Sex hormones in women in rural China and in Britain. Br. J. Cancer. 1990;62: 631-636.
27. Recchione C, Venturelli E, Manzari A, Cavalleri A, Martinetti A, Secreto G. Testosterone, dihydrotestosterone, and oestradiol levels in postmenopausal breast cancer tissues. J. Steroid Biochem. Mol. Biol., 52: 541-6.