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Research Article

EFFECT OF FLAXSEED SUPPLEMENTATION ON HORMONE PROFILE IN WOMEN WITH PCOS

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ABSTRACT
Poly Cystic Ovarian Syndrome (PCOS) is a hormone disorder that affects women in the reproductive ages. Women with PCOS have difficulty in reproduction and usually have high levels of androgen hormones levels (e.g., testosterone) from the Ovary and Adrenal Gland. Androgen overproduction often results from overproduction of Luteinizing hormone (LH). In India, the prevalence of PCOS ranges from 4-10% and goes even as high as 26%. Diet and exercise is preferred treatment for PCOS management to normalize serum androgens and restore reproductive function. PCOS patients are also advised a diet rich in fiber and lignans. Flaxseeds are a good source of omega-3 fatty acid, fiber and lignans and can help manage symptoms of PCOS. The objective of the present study was to assess the effects of flaxseed on hormone profile (LH, FSH and Testosterone levels) of women with PCOS. Forty women suffering from PCOS (18-40 years) were selected purposively for the study. Blood samples were analysed at baseline and after 3 months of supplementation with 30gm of flaxseed per day. The parameters studied were LH, FSH and Testosterone, Height, Weight and Body Mass Index (BMI) which were estimated at pre and post intervention. The results of the study indicate a reduction in the mean LH levels and BMI was significant at 0.01% & 0.05% respectively where as a non- significant reduction in the mean Testosterone, FSH levels and weight of women with PCOS from pre to post intervention was observed. Supplementing the diet with 30gms of flaxseed per day for 3 months brings about an improvement in the BMI and LH levels of women with PCOS.

Keywords: *Flaxseed, PCOS, Hormone (LH, FSH & Testosterone), BMI, Weight, Omega -3 Fatty Acids*

INTRODUCTION
Polycystic Ovary Syndrome (PCOS) is the most common endocrinopathy in women of reproductive age. It is prevalent in 5 -15% of women in United States and goes to as high as 33% in UK (Fakhoury *et al*. 2012, Ganie and Karla, 2011 and Hart *et al.*, 2004). Research has been conducted to assess the prevalence of Polycystic Ovary on ultra-sound examination in the general female population of reproductive age (Dasgupta and Reddy, 2008). The prevalence of PCOS in Indian women ranges from 4-10% and goes even as high as 26% (Nidhi *et al.*, 2011). Women having cysts in their ovaries have difficulty becoming pregnant (i.e. are infertile) and may have high levels of androgens (male hormone) specifically testosterone from the Ovary and Adrenal Gland. Increased testosterone levels are responsible for the symptoms of PCOS. PCOS can affect other organ systems like the brain, pancreas, liver, muscle, blood vasculature and fat (NIH, 2012). The clinical systems of PCOS include menstrual dysfunction, hirsutism, acne, alopecia, obesity, infertility, and a high rate of miscarriage *(Eid et al., 2005).* The endocrine abnormalities of PCOS include high serum androgen concentrations, increased mean serum concentrations of Luteinizing Hormone (LH), normal or low levels of Follicle-Stimulating Hormone (FSH), elevated LH/FSH ratios and hyperinsulinemia. The diagnosis of PCOS is not based on pathologic changes in the ovaries or plasma hormone disturbances. Clinical diagnosis based on the coexistence of chronic anovulation and varying degrees of hirsutism (Carr *et al.*, 1998). PCOS is also associated with an increased risk of type II diabetes, gestational diabetes, stroke, hyperlipidemia, coronary artery disease and endometrial carcinoma (*Eid et al 2005)*.

According to the symptoms, three diagnosis criteria were given by different societies or institutes (Table -1) (Carlos *et al.*, 2012).

Table 1: Diagnostic Criteria for PCOS

NIH Criteria (1990)	Rotterdam Criteria (2003)	AES Criteria (2006)
All three of the following • clinical or biochemical evidence of hyperandrogenism • oligomenorrhea and/or anovulation • exclusion of other disorders	At least two of the following • clinical and/or biochemical signs of hyper androgenism • oligomenorrhea and/or anovulation • polycystic ovaries	All three of the following • hyperandrogenism (clinical or biochemical) • ovarian dysfunction (oligomenorrhea or anovulation and/or polycystic ovarian morphology) • exclusion of other androgen excess or related diseases
	PCOS can be assesed only after the exclusion of related diseases (e.g., severe insulin resistance, androgen-secreting neoplasms, Cushing's syndrome, hyperprolactinemia and thyroid abnormalities).	PCOS is predominantly a disorder of androgen excess

NIH *= National Institute of Health*
Rotterdam *= European Society for Human Reproduction and Embryology and the American Society for Reproductive Medicine*
AES *= Androgen Excess Society*

Etiology of PCOS is unclear. But according to some studies the causes of PCOS develop on overproduction of androgens (e.g., testosterone) by the ovaries, which is a consequence of overproduction of LH. When insulin levels in the blood are high enough, the ovary can be stimulated to produce more testosterone. Hence, the combination of having ovaries that are responsive to insulin and hyperinsulinemia can result in the overproduction of testosterone. Research indicates that 35-50% of women with PCOS are obese. Obesity has consistently been shown to increase the prevalence of hirsuitism and anovulation when compared to lean women suffering from PCOS (Pettigrew *et al.,* 1997).
Lifestyle modification on diet and exercise is the first-line treatment for PCOS management with the primary goal to normalize serum androgens and restore reproductive function (Moren *et al.,* 2004). Some research has shown that weight loss of 5–10% of overweight PCOS women via energy restriction can reduce circulating insulin levels, hyperandrogenism (Hoeger *et al.,* 2006), improve menstrual cyclicity (Crosignani *et al.,* 2003), improve fertility and decrease heart disease risk factors (Moran *et al.,* 2003). It is suggested that the primary determinant underlying many of these reported weight reduction benefits is the accompanying reduction in circulating insulin concentrations (Norman *et al.,* 2002). PCOS patients are also advised a diet rich in fiber and lignans. Flax seed is a very good source of omega-3 fatty acid, fiber and lignans. Omega-3 Fatty acids helps to reduce inflammation and normalize heartbeat. The amino acids found in flaxseed, can help to lower blood pressure. 1.8 gm of omega-3 fatty acids are found in each table spoon (15gm) of ground flaxseed. Lignans are phytoestrogens, plant estrogens that can affect hormonal imbalances in Polycystic Ovarian Syndrome (Thomas *et al.,* 2012). Insulin resistance and hormonal imbalances of estrogen and testosterone are connected. Lignans, in botanical form can reduce testosterone levels. The flax seeds also help with eliminating breast-tenderness (one manifestation of premenstrual syndrome) that may occur post-ovulation. Flaxseed commonly contains 0.96-3.15 µmol. lignans/gm seed (Thompson *et al.,* 1991).

Objective

This study was conducted to assess the effects of flaxseed supplementation on Hormone profile (LH, FSH and Testosterone levels) of women having PCOS.

MATERIALS AND METHODS

For this study, a total of 40 women suffering from PCOS, fulfilling the inclusion criteria, were selected purposively from Department of Gynaecology, Government Hospital, Jaipur, India. Blood samples were analysed at baseline and after 3 months of supplementation with 30gm of flaxseed per day.

***Inclusion Criteria*:** Women with hyperandrogenism (Increased testosterone levels / facial hirsutism), menstrual irregularity, presence of PCOS confirmed by ultrasound (USG), willing to participate in the study and residents of Jaipur city only, were selected.

***Intervention and Assessments*:** The subjects were given 30gm of whole flaxseed /day for a period of 3 months. The parameters studied were Height, Weight, BMI, LH, FSH and Testosterone levels, which were estimated at pre and post intervention. Blood sample was taken and analysis done using Auto analyser in a diagnostic laboratory. Blood samples for analysis were withdrawn between Day 1 and 5 of the period. The ethics committee clearance was taken for conducting the present study. Informed consent was taken from the participants. The researcher was in constant touch with the subjects either through follow up visit of the subjects to the hospital or telephonically, to ensure compliance.

RESULTS AND DISCUSSION

The mean age of the respondents was 23.6 ± 5.12 years. The increasing problem of PCOS is commonly seen in the child bearing age group of 15 to 30 years. PCOS may come at a younger age in girls who develop early pubarche and thelarche. Therefore, young females have to be made more aware about PCOS (Bronstein *et al.*, 2011).

Flaxseed Supplementation and Hormone profile

The results of the present research indicate that there was a statistically significant reduction ($p<0.01$) in the mean LH levels and an improvement in the mean FSH levels of the subjects after intervention with flaxseed (Table No.2; Figure No. 1). A non significant reduction was observed in the serum testosterone levels and FSH levels of the respondents (Table No.2; Figure No. 2).

Table 2: Mean Difference in Hormone Profile and BMI of the respondents receiving flaxseed supplementation from Pre to post intervention

S. No.	Variables	Mean Difference (From Pre to post intervention)
1	Testosterone (ngm/dl)	- 5.39 ns
2	LH (mIU/ml)	- 2.17**
3	FSH (mIU/ml)	- 0.10 ns
4	BMI	- 0.30*
5	Weight (kg)	- 0.69 ns

*ns = Non Significant ; *p < 0.05 ; ** p < 0.01*

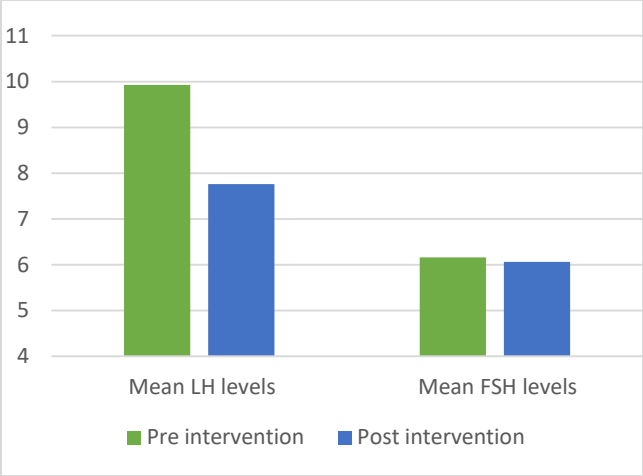

Figure No.1: **Comparison of Mean LH and FSH levels of respondents from Pre to Post Intervention**

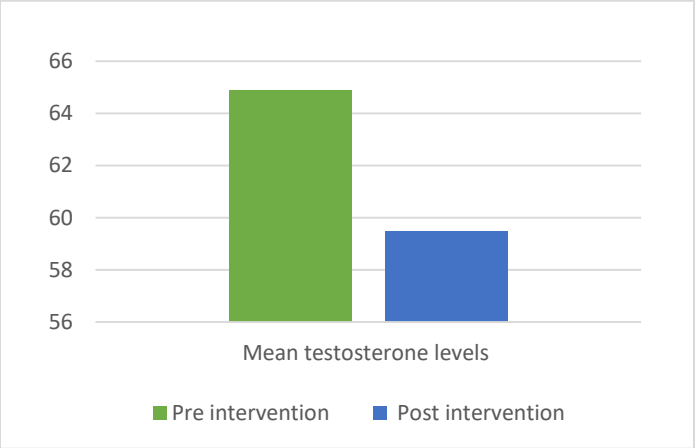

Figure No.2: Comparison of Mean Testosterone levels of respondents from Pre to Post Intervention

Flaxseed Supplementation and BMI

The Mean Body Mass Index of the subjects reduced significantly ($p< 0.01$). This could be attributed to a non- significant reduction in weight of the subjects as a result of Flaxseed supplementation (Table No.1).

Discussion

PCOS is a common gynecological endocrinopathy (Kauffman *et al.,* 2008; Azziz *et al.,* 2004). Women suffering from PCOS are more vulnerable to reproductive problems including infertility, endometrial cancer, late menopause (Navaratnarajah *et al.,* 2008; Balen *et al.,* 1995). They are at increased risk of metabolic aberrations, including insulin resistance, type 2 diabetes mellitus, dyslipidemia and heart diseases (Christakou *et al.,* 2008; Talbott *et al.,* 2004). Research indicates that intake of high lignan foods may cause binding of testosterone in the enterohepatic circulation and result in subsequent excretion (Adlercreutz *et al.,* 1987).

Flaxseed, a food renowned for its omega-3 fatty acid content, is one of the richest sources of dietary lignan also, having levels that are 800-fold more as compared to other foods (Thompson *et al.,* 1995). These lignans have the potential to reduce the excess testosterone which play a vital role in the development of PCOS. Over the last few years, diets abundant in fiber have been shown to influence the hormonal milieu (Monroe *et al.,* 2007; Adlercreutz *et al.,* 1987) and may be beneficial in the management of PCOS. The findings of the present study are in accordance with the research conducted by Fatima et al., (2015) and Nowak *et al.,* (2007) who have concluded that flaxseed supplementation is effective in reducing the LH levels. LH plays an important role in androgen production by theca cells and in PCOS high levels of androgen hormones (e.g., testosterone) from the Ovary and Adrenal gland, results in infertility. FSH is responsible for aromatization of these androgens to oestradiol by granulosa cells (Bart *et al.,* 1997).The high levels of androgen in PCOS causes increase in the number of immature follicles. Flax seed helps to decrease serum androgen levels (Sturgeon *et al.,* 2008). Other studies suggest that consumption of omega-3 fatty acids results in a decrease in testosterone concentration after 2 months trial. This decrease can be due to the effect of omega-3 on LH levels (Forouhi *et al.,* 2015; Nadjarzadeh *et al.,* 2013). Bioavailable testosterone concentrations were significantly decreased by PUFA supplementation than after placebo intake ($P<0.05$), whereas there was a non-significant reduction in total-testosterone . No significant effects in concentrations of other reproductive hormones (LH and FSH) were observed (Phelan *et al.,* 2011)

Thus, flaxseed supplementation may be elemental in improving the Hormone levels of women with PCOS.

Flaxseed Supplementation and BMI

Obesity is a major factor that worsens PCOS. Flax seed fiber improves satiety and decreases hunger (Ibrugger *et al.*, 2012). Pineda *et al.*, (2011) studied the effect of an intake of 30 gm/day of powdered flaxseed on body weight, BMI and the dietary intake of 10 individuals with excess weight over 2 months. The changes in the body fat percentage were widely variable (40% of subjects gained weight, of these, 50% decreased fat percentage, 25% showed no change in the percentage and 25% had combined weight and fat gain). It was suggested that the intake of flaxseed supplementation without a decreased energy intake or an increase in physical activity does not lead to weight loss in individuals with excess weight. Decrease in body weight helps to improve menstrual function and fertility (Fatima *et al.*, 2015). Supplementation with 3.5 g/day fish oil for 6 weeks in patients with PCOS did not significantly change in body weight, BMI, and WC as compared to control group (Vargas *et al.*, 2011). Fish oil intake reduced BMI, WC and Waist to Hip Ratio in women with type 2 diabetes in comparison to the placebo group (Hajianfer *et al.*, 2011). Khani *et al.*, (2017) show that many anthropometric parameters did not significantly change after the study, but BMI in omega-3 group was significantly reduced after treatment in comparison to control group.

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