

Correlation of Forced Vital Capacity and Peak Expiratory Flow Rate with Serum Estrogen and Progesterone Levels in Combined Oral Contraceptive Pill (COCP) User

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Conflict of Interest: None

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Abstract:

Background: Combined oral contraceptive pill (COCP) is the most commonly used contraceptive method in Bangladesh. This COCP has some effects on different organs including the lungs. So, there may be a relationship between forced vital capacity (FVC) and peak expiratory flow rate (PEFR) with serum estrogen and progesterone levels in combined oral contraceptive pill (COCP) users.

Objective: To observe the relationship between FVC and PEFR with serum estrogen and progesterone levels in combined oral contraceptive pill users (COCP-U).

Methodology: This cross sectional study was carried out in the Department of Physiology, Sir Salimullah Medical College (SSMC), Dhaka between July 2017 and June 2018. A total of 30 apparently healthy young women, age ranged 20 to 30 years were included in this study, who were combined oral contraceptive pill users (COCP-U) for at least 6 months. Another 30 age and BMI matched combined oral contraceptive pill nonusers (COCP-NU) were also taken as control for comparison. FVC and PEFR of all the subjects were measured by using Digital Auto Spirometer (MINATO AS-507). Moreover, their serum estrogen and progesterone levels were done to observe their levels and also to observe the relationship between them if present. Statistical analysis was done by Independent 't' test and Pearson's Correlation Coefficient test.

Result: Spirometric parameters like FVC and PEFR were significantly higher in COCP-U women than those of non user women. Moreover, the mean serum estrogen and progesterone levels were also significantly higher in COCP users in comparison to those of nonusers. Here, FVC showed positive and PEFR showed negative correlation with serum estrogen level and FVC showed negative, PEFR showed positive correlation with serum progesterone level in COCP users, though the relationships were statistically non-significant.

Conclusion: The positive correlation of FVC and PEFR with serum estrogen and progesterone indicates that improvement of pulmonary function occurs in COCP-U due to its estrogen and progesterone contents, which may be by increasing the strength of the muscles along with decreased airway resistance.

Key Words:

Forced vital capacity, Peak expiratory flow rate, Estrogen, Progesterone.

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Introduction:

Contraception means prevention of conception. Contraceptive methods are preventive methods to help women avoid unwanted pregnancies.¹ Bangladesh is one of the most crowded land on earth with a population of 156.8 million² in 143,998 km² area.³ In Bangladesh the use of contraceptive methods was 3% in 1971.⁴ The contraceptive prevalence rate (CPR) has increased eightfold over last four decades to 61.2%, in 2011.⁵ In Bangladesh 61% of married women are using contraceptive methods. The most widely used method is combined oral

contraceptive pill (COCP). Among the different contraceptive methods, combined oral contraceptive pill (COCP) is about (27%).⁵

Combined oral contraceptive pill (COCP) contains levonorgestrel 150µ.gm and ethinylestradiol 30µ.gm. Levonorgestrel is a kind of progestogen. Ethinylestradiol is a synthetic form of estrogen.⁶ Estrogen has effects on all systems of the body. It helps to prepare female body for reproduction, bone growth, increases protein deposition, body metabolism, causes sodium and water retention by the kidney tubules, it causes the skin to become more vascular, soft and smooth.⁷ Oestrogen receptors are present in human respiratory muscles.^{8,9} It influences surfactant production and alveologenesis.¹⁰ Progesterone also has some important role in improvement of pulmonary function. Progesterone primarily increases ventilation during the luteal phase.¹¹ Furthermore, progesterone helps in smooth muscle relaxation and hyperventilation.¹² It has a significant bronchodilator effect.¹³

For assessment of pulmonary functions forced vital capacity (FVC) and peak expiratory flow rate (PEFR) are important parameters.⁷

Forced vital capacity (FVC) is a better indicator of respiratory muscle strength. Recently significant increase values of FVC have been found in women using COCP.^{14, 15}

Furthermore, PEFR in COCP users¹⁴ increases which may be due to decreased pulmonary airway resistance.¹⁶ Some synthetic form of progesterone causes hyperventilatory changes in COCP users.¹⁷ COCP can increase forced expiratory flow and volume from 6.5% to 15%.¹⁸

Different researchers in many countries observed the effect of COCP on pulmonary function of human being findings are not equivocal.

Prolong use of COCP may cause weight gain, thrombosis, headaches, breast tenderness etc.⁶ Some studies regarding the effect of COCP on pulmonary function has been carried out in different countries with conflicting results.^{14,19} However in our previous publication it has been shown that, there is an improvement of pulmonary function status (FVC, PEFR) in some women who used COCP for at least six months.²⁰ But the relationship between FVC and PEFR with serum estrogen and progesterone levels in these group of women were not shown in other study as well as in my previous study.²⁰ So this study has been designed to observe the correlation of FVC and PEFR with serum estrogen and progesterone levels in combined oral contraceptive pill (COCP) user.

Methods :

This cross sectional study was done in the Department of Physiology, Sir Salimullah Medical College (SSMC) from July 2017 to June 2018. Ethical permission was taken from the Institutional Ethics Committee (IEC) of SSMC. A total 30 apparently healthy women, combined oral contraceptive pill users (COCP-U) aged 20-30 years were taken as study group. They were belonged to lower socioeconomic status and were selected from Family Planning Unit of SSMC. Another 30 apparently healthy age, BMI and socioeconomic status matched combined oral contraceptive pill nonuser (COCP-NU) women were also included as control for comparison. They were selected from personal contact from different area of Dhaka city. Subjects having history of pulmonary diseases, diabetes mellitus, hypertension, angina, epilepsy, cancer, metabolic disorder, history of bleeding disorder were excluded from the study. After selection and proper counseling, the risk, benefit and procedure of the study were explained in details to each subject. They were asked to attend the Department of Physiology between 9.00 AM to 2.00 PM on the day of examination. Informed written consents were taken from them. All information about personal and medical were recorded in a pre-fixed questionnaire. After taking 5 minutes rest, for assessment of pulmonary function FVC and PEFR of all the subjects were measured by using Digital Auto Spirometer (MINATO AS-507). Then under aseptic precautions 5 ml of venous blood was collected from every subject for estimation of serum estrogen and progesterone levels. Estimation of serum estrogen and progesterone were done by chemiluminescent method²¹ in Microbiology laboratory of Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag Dhaka. Data were analyzed by Independent sample 't' test and Pearson's Collection Coefficient test as applicable.

Results :

Anthropometric data is given in Table I. All the subjects were both age and BMI matched.

Percentage of predicted value of FVC and PEFR and serum estrogen and progesterone levels shown in Table II & Table III, respectively. It has been shown that, mean percentage of predicted values of FVC and PEFR were significantly ($p < 0.001$) higher in COCP-U, than those of COCP-NU. Again, serum estrogen ($p < 0.001$) and progesterone ($p < 0.05$) levels were significantly higher in COCP-U than those of COCP-NU.

However, in this study FVC showed positive correlation

with serum estrogen in COCP-U and negative correlation with serum progesterone in COCP-U. PEFR showed negative correlation with serum estrogen in COCP-U and positive correlation with serum progesterone in COCP-U, though the relationships were statistically non-significant (Figure 1, 2, 3, 4).

Table I

<i>Age and BMI in both groups (n=60)</i>		
Parameters	Group A (n=30)	Group B (n=30)
Age (years)	24.57±1.8	25.87±2.71
BMI (kg/m ²)	21.35±1.77	21.40±1.92

Data are expressed as mean ± SD. Statistical analysis was done by independent sample t-test. Group A (Control): Combined oral contraceptive pill nonusers. Group B (Study): Combined oral contraceptive pill users n=Total number of the subject

Table II

<i>Percentage of predicted value of FVC and PEFR in both groups (n=60)</i>		
Parameters	Group A (n=30)	Group B (n=30)
FVC %	82.53±3.64	92.23±2.50***
PEFR%	73.97±5.95	81.93±5.46***

Data are expressed as mean ± SD. Statistical analysis was done by independent sample t-test. Group A (Control): Combined oral contraceptive pill nonusers. Group B (Study): Combined oral contraceptive pill users *** = Significant at p < 0.001; n =Total number of the subject

Table III

<i>Serum estrogen and progesterone levels in both groups (n=60)</i>		
Parameter	Group A (n=30)	Group B (n=30)
Serum estrogen (pg/ml)	47.04±6.72	59.52±10.42***
Serum progesterone (ng/ml)	2.37±0.66	3.32±2.34*

Data are expressed as mean ± SD. Statistical analysis was done by independent sample t-test. Group A (Control): Combined oral contraceptive pill nonusers. Group B (Study): Combined oral contraceptive pill users (***) p < 0.001, * p < 0.05), n =Total number of the subject

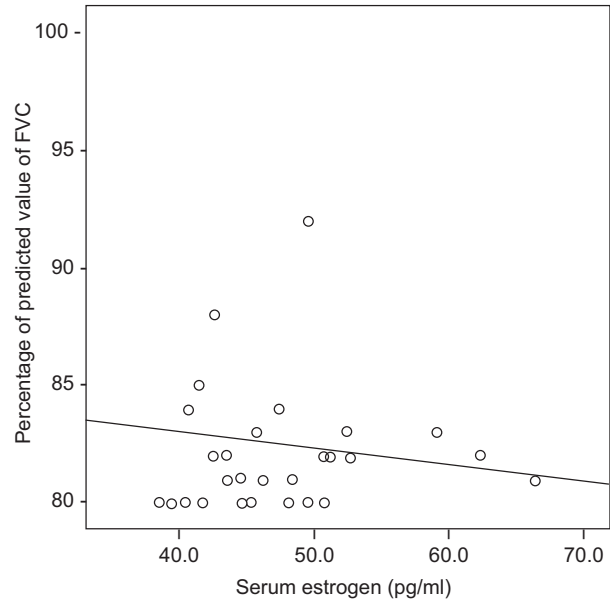


Fig-1: Correlation of percentage of predicted value of forced vital capacity (FVC) with serum estrogen level in control group (n=30)

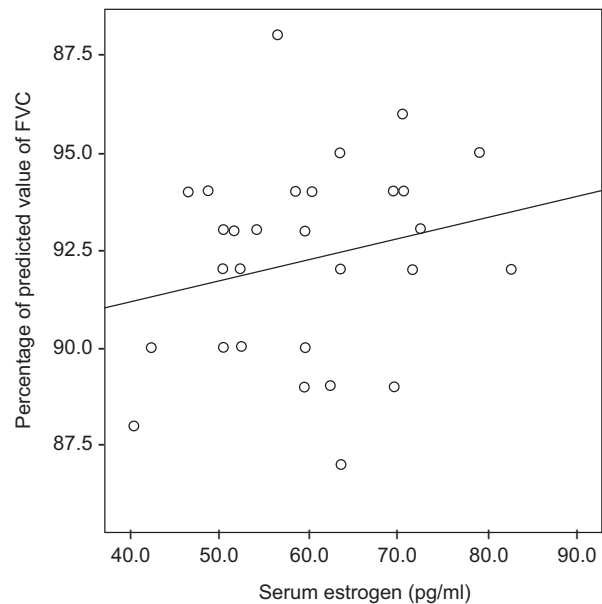


Fig-2 : Correlation of percentage of predicted value of forced vital capacity (FVC) with serum estrogen level in study group (COCP-U) (n=30)

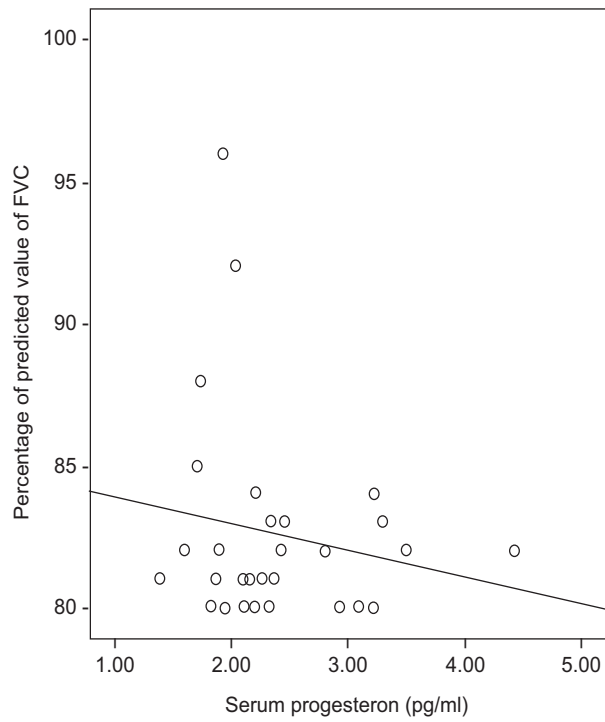


Fig.-3: Correlation of percentage of predicted value of forced vital capacity (FVC) with serum progesterone level in control group (n=30)

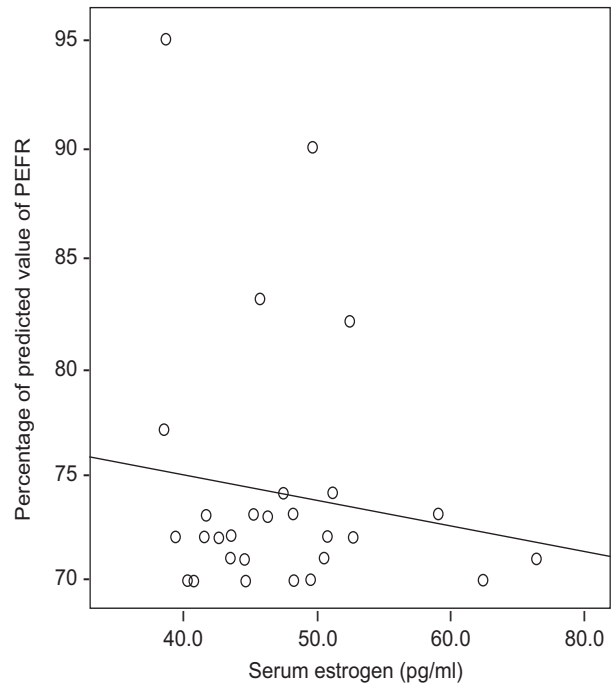


Fig.-5: Correlation of percentage of predicted value of PEFR with serum estrogen level in control group (n=30)

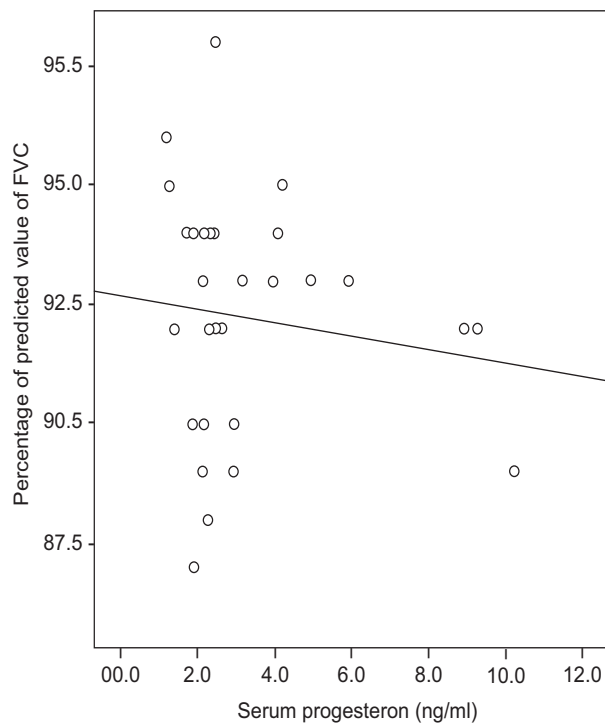


Fig.-4: Correlation of percentage of predicted value of forced vital capacity (FVC) with serum progesterone level in study group (COCP-U) (n=30)

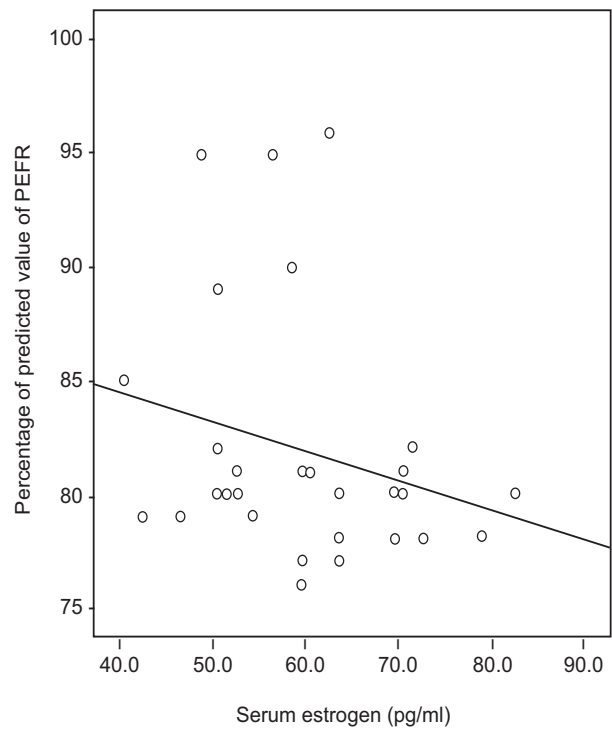


Fig.-6: Correlation of percentage of predicted value of PEFR with serum estrogen level in study group (COCP-U) (n=30)

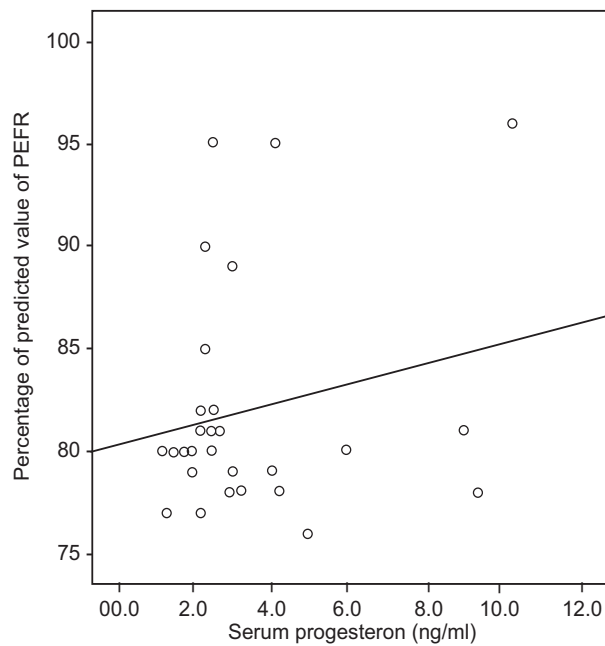


Fig.-7: Correlation of percentage of predicted value of PEFR with serum progesterone level in study group (COCP-U) ($n=30$)

Discussion :

The present study was undertaken to observe the relationship of FVC and PEFR with serum estrogen and progesterone levels in combined oral contraceptive (COCP) user. So, the pulmonary function status, like FVC and PEFR and hormonal status like serum estrogen and progesterone levels were measured in this group of women. All these pulmonary function parameters were also studied in apparently healthy age and BMI matched COCP-NU for comparison.

In this study, the value of pulmonary function parameters in healthy control group were within normal limit and were almost similar to that of various investigators from different countries.^{14,16}

Here, mean percentage of predicted values of FVC and PEFR were significantly higher in COCP-U than those of COCP-NU. Serum estrogen and progesterone concentrations were significantly higher in COCP-U than those of COCP-NU.

Improvement of pulmonary function parameters were significantly higher in COCP-U than those of COCP-NU. There are some postulated mechanism regarding these changes in lung functions of COCP-U.

Beneficial effect in pulmonary function in COCP users may be due to the effect of estrogen on strengthening respiratory muscle.^{14,22} Estrogen influences surfactant

production and alveologenesis,¹⁰ also helps to open small airways and decrease airway resistance.¹⁸ Estrogen receptors were identified in the nuclei of connective tissue and smooth muscle cells of the lung. Estrogen increases adenylyl cyclase activity which in turn results in potentiation of catecholamine induced bronchial relaxation and bronchial area widen.²³ Progesterone by activating α_2 adrenergic receptors²⁴ reduces constriction of the airways, relaxes the bronchial smooth muscle.¹³ Progesterone stimulates respiratory center through CNS steroid receptor mediated mechanism²⁵ and induces hyperventilation through both the central medullary and peripheral chemoreceptors.¹¹

Combination of estrogen and progesterone improve musculoskeletal integrity and thereby increase the total lung capacities.²⁶ Estrogen increases the number of progesterone receptors, so combined effect of estrogen and progesterone synergistically increases pulmonary function.²⁷ In the present study positive correlation of estrogen with FVC and progesterone with PEFR in COCP users, proved improvement of pulmonary function occur by increasing the strength of respiratory muscle and decreasing the airway resistance for estrogen and progesterone present in COCP.

Conclusion :

From the result of this study it may be concluded that the positive correlation of FVC and PEFR with serum estrogen and progesterone in COCP users in comparison to that of COCP nonusers. This indicates, improvement of pulmonary function occurs due to its estrogen and progesterone contents, may be by increasing the strength of the respiratory muscles along with decreasing airway resistance. However, to elucidate the mechanism of action of estrogen and progesterone on lung function, further studies are essential.

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