

FVC, FEV₁ and FEV₁/FVC%, In Postmenopausal Women and Their Relationship with Serum Progesterone and Estrogen Level

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Background: Exacerbation of asthma associated with worsening of lung function has been reported in women after menopause. The relationship between lung function and female sex hormones has been documented in postmenopausal women. **Objective:** To observe FVC, FEV₁, FEV₁/FVC%, serum estrogen and progesterone levels in apparently healthy postmenopausal women to find out their interrelationships. **Methods:** This cross sectional study was carried out in the Department of Physiology, from 1st January 17 to 31st December 2007 in BSMMU, Dhaka. 30 postmenopausal women aged 45 to 60 years and 30 premenopausal women aged 20 to 30 years during different phases of menstrual cycle were studied. FVC, FEV₁ and FEV₁/FVC%, were measured by RMS computer based Spirometer. Estrogen and progesterone levels were estimated by Micro particle Enzyme Immunoassay (MEIA) method. Data were analyzed by Pearson's correlation coefficient test, one way ANOVA and unpaired 't' test. **Results:** The mean percentage of predicted values of FVC and FEV₁ were significantly (p<.001) lower in postmenopausal women compared to those of follicular and luteal phases of premenopausal women. Mean serum estrogen and progesterone levels were significantly lower in postmenopausal women compared to any phases of menstrual cycle of premenopausal women. In postmenopausal women, FVC, FEV₁ showed positive correlation with progesterone but negative with estrogen level. FEV₁/FVC% Showed negative correlation with both serum estrogen and progesterone level. All these correlations were statistically non significant. In premenopausal women FEV₁ and FEV₁/FVC% showed positive correlation and FVC showed negative correlation with serum estrogen level in follicular phase and FVC, FEV₁ showed positive and FEV₁/FVC% showed negative correlation with serum estrogen level in luteal phase. Again FVC, FEV₁ and FEV₁/FVC% showed positive correlation with serum progesterone level in follicular and luteal phases of menstrual cycle. **Conclusion:** The outcome of this study shows FVC, FEV₁ may be reduced in postmenopausal women which in turn may be associated with low progesterone and estrogen levels.

Key words: Menopause, Lung function, Estrogen, Progesterone.

J Bangladesh Soc Physiol. 2009 June; 4(1): 7-13

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Introduction

Menopause is the permanent cessation of menstruation resulting from the loss of follicular activity¹. A new hormonal pattern is established at menopause which is characterized by high levels of FSH, LH and very low levels of estrogen and

progesterone². In United States, 50-80% women reported that they had got menopause-related symptoms³. In addition to the recognized complications in postmenopausal women, menopause also affects the pulmonary functions associated with increased respiratory symptoms⁴. Many investigators studied lung function during

different phases of menstrual cycle. They observed that lung functions are increased during luteal phase of menstrual cycle due to high level of progesterone induced hyperventilation and bronchial relaxation⁵⁻⁶. Therefore sex hormones plays an important role in women's lung health⁷. It has also been observed that there is a close relationship between female sex hormones and lung function in postmenopausal women⁸. There is evidence that spirometric measures of lung function including FVC, FEV₁, FEV₁/FVC%, are decreased in postmenopausal women but which are increased after administration of combined hormone replacement therapy (HRT)⁹⁻¹². Again some researcher also observed that these values were significantly lower in post menopausal women compared to premenopausal women¹³. Globally postmenopausal women count was 476 million in 1990 and it was 11.9% of the total population. It is predicted that the percentage of postmenopausal women will be approximately 20% of total population by 2010. It has also been reported that there will be a dramatic increase in postmenopausal population in the developing world (because of demographic transition) and it will be approximately 1200 million (23.1% of the total population) by 2030¹⁴. Such a huge number of menopausal women will put undue pressure on existing health care services by contributing increased number of asthmatic patients and/or exacerbation of the preexisting asthma. In postmenopausal women relationship of low level of estrogen and progesterone with the changes in lung function have also been reported by some investigators of different countries¹⁰⁻¹². No data on lung function status in postmenopausal women has been published in Bangladesh. Therefore, the present study was undertaken to observe some spirometric lung function parameters in postmenopausal women to evaluate the relationship between these and serum estrogen and progesterone levels.

Methods

This cross sectional study was carried out in the Department of Physiology, from 1st January to

31st December 2007 in BSMMU, Dhaka. Protocol of this study was approved by ethical committee of department of Physiology.³⁰ apparently healthy postmenopausal women, aged 45-60 years participated in study group (group B). 30 premenopausal women, aged 20-30 years were taken in control group (group A). All the postmenopausal women were residents of different areas in Dhaka city and all the subjects for control group were selected among medical students of Ibrahim medical college. The study group subjects were assessed once and control subjects were assessed 3 times during each phase of menstrual cycle. Subjects with history of chronic obstructive lung diseases, smoking, hypertension and cardiovascular diseases, diabetes mellitus, BMI > 22.9 kg/m², menstrual abnormalities, history of hormone replacement therapy, psychiatric disorders, head trauma with concussion and alcohol user were excluded. Before examination, the aim, objectives and benefit of the study outcome were explained to all the subjects and they were encouraged for voluntary participation. Informed written consent was taken. Detail personal, medical and family history was taken. Thorough clinical examinations of each subject were done and height, weight was measured and BMI was calculated. All these information were recorded in a prefixed questionnaire. For assessing lung function, FVC, FEV₁ and FEV₁/FVC% were measured at normal room temperature by using RMS computer based Spirometer in the lung function laboratory of the department of Physiology, BSMMU. Serum estrogen and progesterone level were assessed by Micro particle Enzyme Immunoassay (MEIA) method in the laboratory of the department of Biochemistry, BSMMU. Statistical analysis was done by using SPSS windows package version 12. One way ANOVA (Post Hoc) and unpaired t' test and Pearson's correlation coefficient test was performed as applicable. This study received a research grant from university grant commission of Bangladesh. The funding source had no role in the design, conduct or reporting of the study or in the decision to submit manuscript for publication.

Results

Table I: Serum estrogen and progesterone levels in different groups (n= 60)

Groups	Subgroups	Estrogen (pgm/ml)	Progesterone (ngm/ml)
A (n=30)	A1	155.36±69.03	0.85±0.60
	A2	138.20±56.73	11.12±3.92
B (n=30)		21.93±10.46	0.20±0.15
p values			
statistical analysis			
A1 vs A2		0.204 ^{ns}	0.000***
B vs A1		0.000***	0.275 ^{ns}
B vs A2		0.000***	0.000***

One way ANOVA (Post Hoc) test was performed for comparison.

A= Premenopause (control group)

A1= follicular phase

A2= luteal phase

B= Postmenopause (study group)

***= significant at the p<0.001, n = Number of subjects, ns = not significant

Table II: Percentage of predicted values of FVC, FEV₁, FEV₁/FVC% in different groups (n=60)

Groups	FVC	FEV ₁	FEV ₁ /FVC%
B	73.78±6.98	83.34±8.66	113.11±7.41
A1	80.31±6.96	89.90±9.85	112.11±9.38
A2	112.11±9.38	92.39±8.48	110.81±8.76
Statistical analysis			
p values			
B vs A1		0.001***	0.008***
B vs A2		0.001***	0.308***

Data are expressed as mean ±SD. Figures in parentheses indicate ranges.

Statistical analysis was done by one way ANOVA (Post Hoc-LSD) test

A = Premenopause (control group)

A1 = Menstrual phase

A1 = follicular phase

A2= luteal phase

B = Postmenopause (study group)

The mean serum estrogen and progesterone level are presented in table I.

Mean serum estrogen level was significantly lower in group B compared to group A1 and A2. Again mean serum progesterone level was significantly lower in group B than that of group A2 but not than A1.

The measured values of FVC, FEV₁ and FEV₁/FVC% are expressed as percentage of their corresponding predicted value. Percentage of predicted values >80% for FVC and FEV₁ and 75% for FEV₁/FVC% were considered normal.

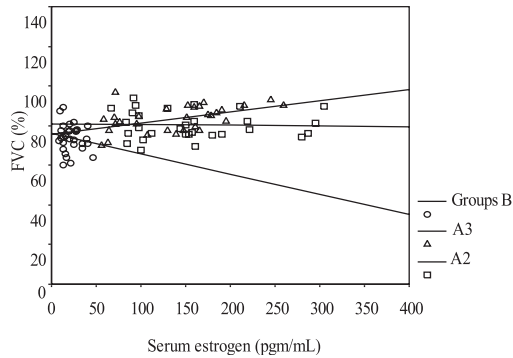
In group B the mean of percentage of predicted values of FVC and FEV₁ were significantly lower but FEV₁/FVC% was higher but nonsignificant than those of group A1 and A2. In group B mean FVC is below the lower limit of normal range. But the FEV₁ and FEV₁/FVC% were within normal range (Table II).

The correlation of FVC, FEV₁, FEV₁/FVC% with serum estrogen are shown in figure 1,2,3.

In group B, FVC, FEV₁, FEV₁/FVC% showed negative correlation with serum estrogen. But in A2, FVC, FEV₁ were positively correlated and FEV₁/FVC% was negatively correlated with estrogen. In group A1, FVC was negatively and FEV₁ and FEV₁/FVC% were positively correlated. In group B, A1 and A2 all these relationships are statistically non significant, except FVC in group A2.

The correlation of FVC, FEV₁ and FEV₁/FVC% with serum progesterone level in group B, A2 and A3 are shown in figure 4, 5, 6.

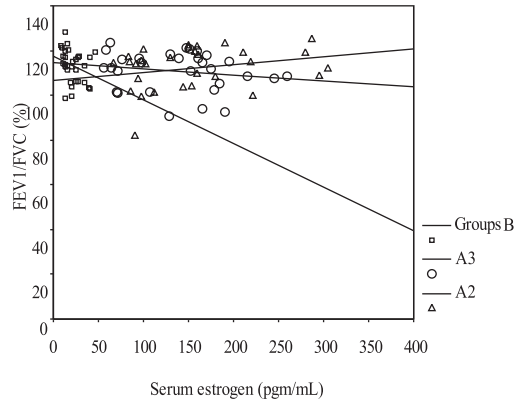
FVC and FEV₁, FEV₁/FVC% showed positive correlation with progesterone in group A1 and A2, but in group B, FVC and FEV₁ showed positive correlation FEV₁/FVC% showed negative correlation. In group B, all these relationships are statistically non significant. In group A1 and A2 the relationships are of varying significance.



(A1) $r = -0.034$, p value = 0.858
 (A2) $r = 0.494$, p value = 0.005*
 (B) $r = -0.153$, p value = 0.419

A=Premenopause (control group)
 A1=Follicular phase
 A2=Luteal phase
 B=Postmenopause (study group)

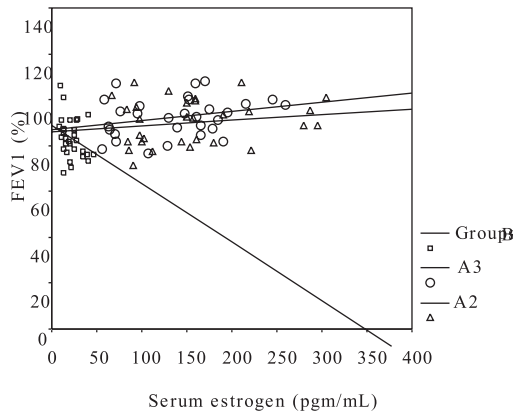
Figure 1. Correlation of serum estrogen level with percentage predicted value of FVC in different groups (n=60)



(A1) $r = 0.253$, p value = 0.177
 (A2) $r = -0.177$, p value = 0.349
 (B) $r = -0.275$, p value = 0.142

A=Premenopause (control group)
 A1=Follicular phase
 A2=Luteal phase
 B=Postmenopause (study group)

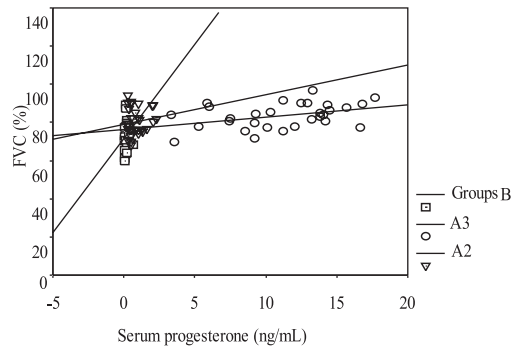
Figure 3. Correlation of serum estrogen level with percentage predicted value of FEV₁/FVC % in different groups (n=60)



(A1) $r = 0.171$, p value = 0.366
 (A2) $r = 0.266$, p value = 0.155
 (B) $r = -0.309$, p value = 0.097

A=Premenopause (control group)
 A1=Follicular phase
 A2=Luteal phase
 B=Postmenopause (study group)

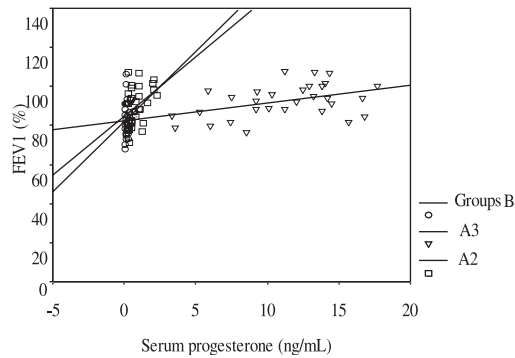
Figure 2. Correlation of serum estrogen level with percentage predicted value of FEV₁ in different groups (n=60)



(A1) $r = 0.134$, p value = 0.48
 (A2) $r = 0.398$, p value = 0.029*
 (B) $r = 0.217$, p value = 0.25

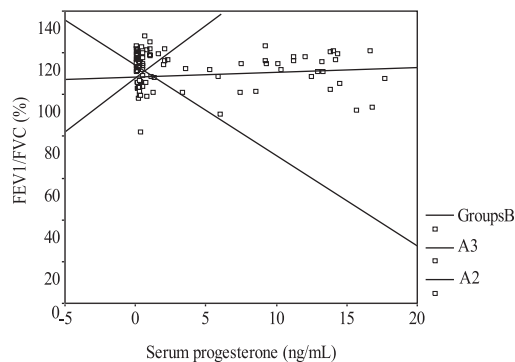
A=Premenopause (control group)
 A1=Follicular phase
 A2=Luteal phase
 B=Postmenopause (study group)

Figure 4. Correlation of serum progesterone level with percentage predicted value of FVC in different groups (n=60).



(A1) $r=0.373$, p value = 0.042*
 (A2) $r = 0.420$, p value = 0.021*
 (B) $r = 0.217$, p value = 0.502
 A=Premenopause (control group)
 A1=Follicular phase
 A2=Luteal phase
 B=Postmenopause (study group)

Figure 5. Correlation of serum progesterone level with percentage predicted value of FEV₁ in different groups (n=60)



(A1) $r=0.329$, p value = 0.076
 (A2) $r = 0.103$, p value = 0.589
 (B) $r = -0.09$, p value = 0.638
 A=Premenopause (control group)
 A1=Follicular phase
 A2=Luteal phase
 B=Postmenopause (study group)

Figure 6. Correlation of serum progesterone level with percentage predicted value of FEV₁/FVC% in different groups (n=60)

Discussion

The present study was undertaken to observe some of the spirometric lung function variables like FVC, FEV₁, FEV₁/FVC% and estrogen, progesterone level in apparently healthy post menopausal women to find out their relationship. All these parameters were also studied in premenopausal women during their different phase of menstrual cycle and compared with those of post menopausal women. To exclude the effects of age and BMI on lung function parameters the percentage of predicted values were compared between the groups.

In postmenopausal women, serum progesterone level was significantly lower compared to its value in premenopausal women during their luteal phase but though it was lower compared to that of follicular phase, but it was not significant. This finding was in agreement with some other investigators¹⁵⁻¹⁷. In postmenopausal women, serum estrogen level was significantly lower than those during both follicular and luteal phases in premenopausal women. This observation was in agreement with those¹⁸ who have demonstrated significantly lower estrogen level in postmenopausal women in comparison to that of follicular phase of menstrual cycle. However no such data is available in respect to luteal phase. In this study, the mean percentage of predicted value of FVC and FEV₁ were significantly lower in postmenopausal women than those of premenopausal women in their luteal phase and follicular phase. Similar observations were made by some other workers.⁸⁻¹³ In contrast mean percentage of predicted value of FEV₁/FVC % was higher in postmenopausal women than those of luteal phase and follicular phase in premenopausal women, but it was not statistically significant.

Further more, in post menopausal women, the mean percentage of predicted value of FVC was below but the mean FEV1 and FEV1/FVC% were within normal range.

In postmenopausal women, FVC and FEV₁ were positively correlated and FEV₁/FVC% was negatively correlated with serum progesterone level but these relationships were statistically non significant. No data is available to compare these observations. On the other hand FVC, FEV₁ and FEV₁/FVC% showed negative correlation with serum estrogen level and these were not statistically significant and no data were available to compare these observations.

However, the exact mechanisms involved for lower lung function in postmenopausal women of the present study cannot be elucidated from this type of study. According to the suggestions made by different investigators¹⁰⁻¹¹, lower percentage of predicted values of FVC and FEV₁ in postmenopausal women in comparison to premenopausal women during follicular and luteal phase are most likely due to decrease level of progesterone and estrogen as observed in this study. Reduced levels of estrogen and progesterone would cause decreased muscular strength, decreased relaxation of bronchial smooth muscle, increased compression of thoracic spine and as a result there is reduced total lung capacity. But increased value of FEV₁/FVC % in post menopausal women may be due to proportionate decrease in both FVC and FEV₁. This is further supported by less changes of percentage of predicted value of lung function parameters during follicular and luteal phases of menstrual cycle.

Conclusion

However, from the above findings it can be concluded that lung function status may be reduced in postmenopausal women. In addition these are negatively associated with low serum estrogen levels and positively associated with progesterone level.

Acknowledgements

The authors thank the participants of this study. This study was supported partly by research grant from University grant commission (UGC) of Bangladesh.

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