

ALTERNATIVES FOR FORCED VITAL CAPACITY (FVC) AND FEV1% DURING PREGNANCY: PRELIMINARY STUDY IN WESTERN GUJARAT

Geetanjali Purohit*, J M Harsoda**

*Associate Professor, **Prof. & Head, Department of Physiology, SBKS Medical Institute & Research Center, SVDU, Vadodara, Gujarat

Background & Objectives: Asian countries need to set their own standards and reference values for spirometry. ATS considered FEV1% as gold standards and recommend 70% of FEV1% as the cut-off. Poor subjective efforts, frustration, time taken and complications as syncope associated with forced spirometry inspires researchers to find out the surrogate of FVC and FEV1%. Present study was aimed to study the forced spirometry during three trimesters of pregnancy with non-pregnant as control group to compare the values of FVC and FEV1% with FEV6 and FEV1/FEV6 in three trimesters of pregnancy and non-pregnant females.

Methods: Total 400 participants (100 in each trimester and 100 non pregnant control) attending antenatal clinic of Obstetrics and Gynaecology Department. Dhiraj General Hospital, SVDU were studied for FVC, FEV1, FEV6, FEV1% and FEV1/FEV6 using Digital spirometer (SpiroWin+). ANOVA, Student's t-test and Mann Whitney test were used for statistical analysis. **Results:** The values of FVC and FEV6 in all three trimesters of pregnancy were within physiological limit and insignificantly different. Difference for FVC (1.910 ± 0.35 vs 1.952 ± 0.44) and FEV6 (1.619 ± 0.40 vs 1.567 ± 0.34) were observed to be insignificant ($p > 0.05$) when compared for pregnant and non-pregnant groups. FEV1% and FEV1/FEV6 for all the groups were comparable and well above the 70%. Mann Whitney test for comparison of FVC with FEV6 and FEV1/FVC with FEV1/FEV6 insignificant variations within the trimesters. **Conclusion:** FEV6 can be effectively used in place of FVC in evaluation of lung function test, since the values are highly correlative at all the levels. Compared with measurements of FVC, using FEV6 reduces the test time, frustration and may reduce the complication as syncope during the test which is a common observation in pregnant female, specifically last trimester. Thus time to rethink for a change.

Key words: ATS, Gold standard, FEV6, FEV1/FEV6

Author for correspondence: Dr. Geetanjali Purohit, Associate Professor, Department of Physiology, SBKS MI & RC, SVDU, Vadodara, Gujarat. E-mail-purohit85geet@gmail.com

Introduction:

American Thoracic Society (ATS) considered FEV1% as gold standards and recommend 70% of FEV1% as the cutoff.¹ Community based studies in lower socioeconomic class are comparatively overdue in India to set-up a base to new reference values for PFT for Indian rural pregnant female. Poor subjective efforts, reluctance, frustration, time taken and complications as syncope associated with forced spirometry inspires researchers to find out the surrogate of FVC and FEV1%.²

Performing the FVC manoeuvre, the entire exhalation time can be prolonged and technically demanding in patients with severe airflow limitation, FEV6 as a surrogate for the FVC has recently been found to be admissible in nonpregnant clinical settings.^{3,4} Present study started with a research question that "Is the values of FEV6 and FVC comparable to each other for all the three trimesters of pregnancy and in non pregnant control?" and similarly can the value of

FEV1/FEV6 be used for clinical purpose instead of the values of FEV1/FVC?

Study was aimed to study the forced spirometry during three trimesters of pregnancy with non-pregnant as control group with an objective to compare the values of FVC and FEV1% with FEV6 and FEV1/FEV6 in three trimesters of pregnancy and non-pregnant females.

Material and Methods:

After Ethical approval from HRRP committee (SVIEC/ON/MEDI/PhD/1202), longitudinal cross sectional descriptive study was conducted in the Department of Physiology jointly with department of Obstetrics and Gynaecology, Dhiraj Hospital, Vadodara. Total 400 females were studied included 300 pregnant and 100 non-pregnant controls. All women were explained the purpose and importance of the study. Only those who were motivated enough to give their consent and volunteered were recruited for the study. Pregnant women attending the antenatal clinic during morning hours (9.00 AM-1.00 PM) were selected

for the study. Determination of different trimester was based on subject's statement of last menstrual phase (LMP) and confirmed by the USG. The pregnant women were studied thrice during the course of the pregnancy and were studied as follows.⁵

I trimester- 4-12 wk

II trimester-13-24 wk

III trimester- 26-40 wk

The control group was studied once. After informed consent and information about the study the participants were invited to the respiratory laboratory set up in the Department of OBG, Dhiraj Hospital. The experiment was started with Trail and training of instrument which also include rest and measurement of anthropometric parameters followed by FVC manoeuvre (as per ATS guidelines)

Results:

The value of FVC and FEV6 in all three trimesters of pregnancy was within physiological limit insignificantly different within the trimesters (Table-1). Mean difference for FVC, FEV6 and FEV1 were observed to be insignificant ($p>0.05$) when compared for pregnant and non-pregnant groups respectively (Table-2).

FEV1% (87.62 ± 8.29 , 89.33 ± 8.69 , 89.14 ± 6.89 in I, II and III Tm respectively; $p>0.05$) and FEV1/FEV6 (86.52 ± 7.239 , 87.23 ± 6.89 , 82.14 ± 7.79 in I, II and III Tm respectively; $p>0.05$) for all the groups were comparable and well above the 70% (Table-1).

Table-3 showed the Mann-Whitney U inferential statistics for FEV6 versus FVC and FEV1/FEV6 versus FEV1/FVC

Table-3 Mann-Whitney U inferential statistics of FEV6 versus FVC and FEV1/FEV6 versus FEV1/FVC

	N	FVC vs FEV6 (p value)	FEV1/FVC vs FEV1/FEV6 (p value)
Control	100	0.344	0.677
I TM	100	0.433	0.744
II TM	100	0.333	0.644
III TM	100	0.876	0.0632

Table 1: Forced Vital Capacity, Forced expiratory volumes and Flow rates in all three trimesters of pregnant female and analysis

Variable		I TM	II TM	III TM	Analysis
FVC	M	1.958	1.911	1.862	$p>0.05$,
	SD	0.36	0.31	0.37	NS
FEV1	M	1.71	1.69	1.660	$p>0.05$,
	SD	0.35	0.31	0.35	NS
FEV1%	M	87.62	89.33	89.14	$p>0.05$,
	SD	8.29	8.69	6.89	NS
FEV6	M	1.592	1.628	1.614	$p>0.05$,
	SD	0.614	0.80	0.57	NS
FEV1/ FEV6	M	86.52	87.23	82.14	$p>0.05$,
	SD	7.239	6.89	7.79	NS

Table 2: Comparison of Forced Vital Capacity, Forced expiratory volumes and Flow rates in pregnant and nonpregnant females

Parameter	P (N=300)	NP (N=100)	Analysis
FVC	1.910 ± 0.35	1.952 ± 0.44	0.2263
FEV1	1.686 ± 0.338	1.60 ± 0.35	0.10177
FEV1%	88.69 ± 7.79	82.62 ± 7.22	$5E-06^{**}$
FEV6	1.619 ± 0.4	1.567 ± 0.34	0.3456
FEV1/FEV6	85.29 ± 6.69	80.23 ± 7.23	0.0267^*

Discussion:

Table-1 represents the mean values of FVC, FEV1, FEV1/FVC, FEV6 and the FEV1/FEV6 in all three trimesters and their statistical analysis. All the values difference was found to be statistically insignificant during pregnancy (ANOVA; $p<0.05$). Table-2 showed that the mean difference of FVC, FEV1, FEV1/FVC, FEV6 and the FEV1/FEV6 was insignificant except FEV1% and FEV1/FEV6 when compared to nonpregnant control (t test; $p<0.05$). Table 3 showed the Mann-Whitney U inferential statistics of FEV6 versus FVC and FEV1/FEV6 versus FEV1/FVC. The analysis found that except for III trimester the difference is insignificant and the values are comparable.

In present study FEV6 with FVC, both values found to be similar. Recent Studies suggested that FEV6 is an accurate, reliable alternative to FVC for diagnosing airway obstruction and reasonably comparable for the spirometric diagnosis of restriction.⁶

FEV6 is more reproducible and less physically demanding for patients. FVC always require patient effort and cooperation; the effort to reach FVC is especially difficult for some patients or some of the challenging conditions like compromised pregnancy. The standard FVC also has the problem of being dependent on expiratory time (FET) in individuals with airway obstruction and in healthy individuals as they age.³

Hankinson (1999) published reference values including predicted values for FEV6 and FEV1/FEV6.⁷ Above findings makes it possible to compare FEV6 with FVC, both values found to be similar. Although author exclude the participants those put less effort during forced spirometry, but in compromised condition FEV6 can be used as a surrogate of FVC. In addition, FEV6 has the practical advantages of simplifying testing procedures, reducing test variability, and possibly improving accuracy in the diagnosis of airway obstruction.

Descriptive cross-sectional study carried out among 200 pregnant women 100 nonpregnant control reported in 2014 found that FEV6 requires a short exhalation time and can effectively be used in place of FVC in evaluation of lung function test during pregnancy. The FEV1/FEV6 may be applied as a proxy for FEV1/FVC in pregnant and nonpregnant women.³ Systematic review for the sensitivity, specificity, and other measures of accuracy of FEV1/FEV6 in the diagnosis of airway obstruction published in 2009 found that FEV1/FEV6 is a sensitive and specific test for the diagnosis of airway obstruction. FEV1/FEV6 can be used as a valid alternative for FEV1% in the diagnosis of airway obstruction.⁸

Conclusion:

FEV6 can be effectively used in place of FVC in evaluation of lung function test, since there values are highly correlative at all the levels. Compared with measurements of FVC, using FEV6 reduces the test time, frustration and may reduce the complication as syncope during the test which is a common observation in pregnant female, specifically last trimester. Thus time to rethink for a change.

Acknowledgment:

I acknowledge my Guide Dr J M Harsoda, Prof. & Head, Physiology and Dr T.K. Das, Ex. Professor,

Physiology, SBKS MIRC for his valuable ideas and guidance. I am also thankful to the participants and department of ObGy, Dhiraj hospital for their support.

References:

1. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi R et al. Interpretative strategies for lung function tests. *Eur Respir J* 2005; 26: 948–968.
2. Coper BG. An update on contraindications for lung function testing. *Thorax* 2011;66:714-723
3. Nwagha U, Iyare E, Anyaehie U, et al. Forced Expiratory Volume in 6s (FEV6) and FEV1/FEV6 Values as a Viable Alternative for Forced Vital Capacity (FVC) and FEV1/FVC Values During Pregnancy in South East Nigeria: A Preliminary Study. *Annals of Medical and Health Sciences Research*. 2014;4(4):516-521.
4. Enright RL, Connett JE, Bailey WC. The FEV₁/FEV₆ predicts lung function decline in adult smokers. *Respir Med*. 2002;96:444–9.
5. Das TK, Jana H. Maternal airways function during normal pregnancy. *Indian J Med Sci*. 1991 Oct;45(10):265-8.
6. Swanney MP, Jenson RL, Crichto DA, Beckert LE, Cardno LA, Crapo RO. FEV6 Is an Acceptable Surrogate for FVC in the Spirometric Diagnosis of Airway Obstruction and Restriction. *Am J Respir Crit Care Med* 2000;162. 917–19.
7. Hankinson, JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general US population. *Am. J. Respir. Crit. Care Med*. 1999;159:179–187.
8. Jing JY, Huang TC, Cui W, Xu F, Shen HH. Should FEV1/FEV6 replace FEV1/FVC ratio to detect airway obstruction? A meta-analysis. *Chest* 2009 Apr;135(4):991-998.

Disclosure: No conflicts of interest, financial, or otherwise are declared by authors