EFFECT OF POSTURE ON PULMONARY FUNCTION IN THE THIRD TRIMESTER OF PREGNANCY OF PRIMIGRAVID, NULLIPAROUS AND MULTIPAROUS WOMEN IN BENIN CITY

[1]A Omorogiuwa and [2]K Osazee

[1]Department of Physiology, School of Basic Medical Sciences, College of Medical Sciences, University of Benin City, Benin City, Nigeria

[2]Department of Obstetrics and Gynaecology, School of Medicine, College of Medical Sciences, University of Benin, Nigeria.

ABSTRACT

BACKGROUND: the advancing gravid uterus poses a limited lying down posture options in the third trimester. The supine position has been documented to have deleterious cardiovascular effect. This study is aimed at measuring pulmonary function of pregnant women in the third trimester of pregnancy with some lying down positions viz a viz parity.

MATERIALS AND METHOD: It was a cross sectional study carried out at St Philomena's Catholic Hospital. A total of 150 third trimester pregnant subjects in 5 groups of parities with 30 in each group and in different lying down were studied. Spirometric measurements of forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1) were performed in sitting position which served as the control, and the test positions were supine, left lateral and right lateral.

RESULT: FVC and FEV_1 values of all subjects in all positions studied were significantly lower than the sitting position. However, the FVC and FEV_1 of subjects in the lateral positions were significantly higher ($p < 0.05$) than the supine position across parities. There was no significant difference ($p > 0.05$) between the left lateral position and the right lateral positions. Furthermore there was an increase in FVC and FEV_1 of subjects as the parity increases across all lying down position.

CONCLUSION: Supine position in the third trimester of pregnancy has a negative effect on pulmonary function and should be discouraged; parity however has a cumulative positive effect on pulmonary function across the postures studied.

KEY WORDS: Posture, Third Trimester, Pulmonary Function, Pregnancy, Primigravid, Nulliparous, Multiparous.

Corresponding Author: DR OMOROGIUWA A.
Department of Physiology, School of Basic Medical Sciences, College of Medical Sciences, University of Benin, Benin City, Edo State, Nigeria. Tel: +2347039460340
E-mail: arthur.omorogiuwa@uniben.edu

INTRODUCTION

Pregnancy is a special state of multisystem adaptations which ultimately maintain feto-maternal homeostasis. Besides the multisystem adaptation which is usually beyond the control of pregnant women, there are varying postures a pregnant woman may adopt for comfort. Generally postures include standing, siting, lying supine, lying in the right lateral position and lying in the left lateral positions. The desired comfort of these postures to the pregnant woman may ultimately their affect their cardiopulmonary function and as such the growing fetus. Compared with the upright position, however, recumbent positions have well-documented deleterious effects on lung function, such as reduced lung volume and capacity, increased closing volume of the dependent airways, reduced flow rates, and reduced arterial saturation, The pressure caused by the intra-abdominal organ on the diaphragm is larger in the supine position than in sitting.[1] When a person is upright the vertical gravitation gradient is at the maximum, the anterior − posterior diameter of the chest wall is greater, and the compression of lung and heart is minimized.[2] Many researchers have reported significant changes in pulmonary function with positioning.[3-6] Forced vital capacity values in asthmatic subjects have been reported to be higher in standing position than in sitting position. [3] Again, vital capacity, forced vital capacity, forced expiratory volume in one second and peak expiratory flow were marginally lower in 45° rotatative prone position than in sitting and supine

position, however, this prone position is effective for coughing up secretions and endotracheal aspirates as well as the sitting position in young female subjects. [4] In the obese patients it was found that FEV1, FVC and forced expiratory flow after 50% of FVC (FEF_{50}) were significantly higher in sitting position compared standing position. On the contrary standing position have been found to have a significantly higher FVC, FEV1 AND FEV% values than in sitting, right and left lateral positions because of increased vertical thoracic diameter which ultimately increases thoracic capacity volume and lung compliance. [6] studies on pregnant women S have suggested that, in the supine position, there may be aortic compression by the enlarged uterus in late pregnancy.[7, 8] This compression can significantly affect venous return to the detriment of the developing fetus.

In pregnancy, a major factor that influences the preference for a particular posture is the gestational age. For instance in a woman in her third trimester pregnancy has a gravid uterus that is predominantly abdominal as against her first trimester counterpart that has a gravid uterus that is essentially domiciled in the pelvis. Thus a first trimester pregnant woman may not be faced with the challenge of having limited lying down options. These postures may have some effects on pulmonary function such as FVC and FEV_1 measured with the aid of a spirometer. Spirometry is an invaluable physiological test that screens the general respiratory health of an individual by measuring how best he or she inhales volume of air as a function of time. [9,10]

Parity is defined as the number of pregnancies greater than 20 weeks; it is used together with other terms to indicate more details of the woman's obstetric history.[11] A Primigravid woman is one who is getting pregnant for the first time irrespective of the gestational age. A Nulliparous pregnant woman is one who is pregnant but has had previous pregnancies which were terminated before the age of viability. A Primiparous pregnant woman is one who has had one pregnancy carried beyond the age of viability irrespective of the outcome. A para 2 and para 3 pregnant women are those who have carried two or three previous pregnancies beyond the age of viability respectively. Generally, a multiparous pregnant woman is one who has had more than one pregnancy beyond the age of viability irrespective of the outcome. Spirometric values such as FVC, FEV_1 have been reported to be dependent on parity of the subject. [12] Forced Vital Capacity (FVC), is the largest volume of air that can be expired after a maximal inspiratory effort while the fraction of the vital capacity expired during the first second of a forced expiration is referred to as FEV_1. [13]

Besides the effect the third trimester of pregnancy may have on pulmonary function, parity has been documented to have some positive respiratory influence although not in relation to posture.[12] This study is therefore aimed at assessing the effect of posture on pulmonary function in primigravid, nulliparous and multiparous pregnant women in the third trimester of pregnancy.

METHODS

Study Population

This study was carried out at St. Philomena Catholic Hospital in Benin-city. A total of 150 apparently healthy volunteer pregnant women were studied in in five groups namely, primigravida, nullipara, primipara, para 2 and para 3. FVC and FEV_1 were studied in all groups with varying postures such as sitting, supine, left lateral and right lateral positions. The sitting position for each group served as control while the supine, left lateral and right lateral positions were the test.

Each group's subjects were selected by random sampling until a total of 30 subjects per group [14]. Informed consent was taken from the subjects and Ethical clearance was obtained from the Ethics and Collaboration Committee of the Hospital.

Study setting

The study was carried out in St Philomena Catholic hospital in Benin. benin is the capital

of edo state and it is an ancient cosmopolitan city in Edo south. St Philomena Catholic Hospital is a well-known private hospital especially with regard to the practice of obstetrics and it serves as referral center for obstetrics cases.

Study Design

It was a cross sectional study done at the St. Philomena Catholic Hospital in Benin. Subjects were studied at the third trimester (36 weeks gestation) .The gestational age was determined by the booking ultra sound result of the subjects. Subjects were aged between 21-28 years. Characteristics of the subjects were obtained from the case notes of the booked ante-natal patients and the most preferred lying down position was obtained with the aid of a structured questionnaire. The sitting position for each group served as control while the supine, left lateral and right lateral positions were the test.

Inclusion criteria

Booked pregnancy after the second missed period, attend ante-natal clinic regularly, booking packed cell volume with normal limit, booking blood pressure and sugar within normal limit, and normal booking urinalysis status.

Exclusion criteria

Subjects with recent eye or abdominal surgery, history of smoking, multiple pregnancy, pregnancy resulting from assisted reproductive technique, pregnancy induced hypertension, gestational diabetes.

Measurement of Forced Vital Capacity (FVC) and Forced Expiratory Volume in One Second (FEV_1): This was done with the aid of digital Spirometer (Spirolab III, Italy) in sitting supine, left lateral and right lateral position and values were expressed in liters. [14] Each subject was instructed on the need to put on maximum effort at blowing into the instrument. They were also counseled on the possible feeling of dizziness during the respiratory function test. All tests were done between the hours of 7 to 9 am with the subjects fasting. After a test for a particular posture 30 minutes rest was allowed before a subject would embark on another posture. For each posture; sitting (sitting in a wooden chair with the trunk extended, hip and knee flexed, supine (lying on a couch in a supine position with both lower and upper limbs extended, right lateral (lying on the right hip and the right knee flexed) and left lateral (lying on the left hip and the left knee flexed), the subject was asked to hold the mouth piece around the opening of the mouth, in such way that the mouth completely goes tightly around the opening of the mouth piece to prevent leakage of air. Subject was then asked to inspire maximally and then expire forcibly at once through the mouth piece into the spirometer. Each subject was to have at least three test trials before the performance. The values for FVC as FEV_1 were copied from the screen of the spirometer and the best of three satisfactory performances was recorded.

STATISTICALANALYSIS

Results on characteristics preferred lying down position in pregnancy and lung function values of subjects were presented as mean ±S.E.M, range and percentages in tables and figures. Appropriate statistical analyses were done using ANOVA and Bonferroni post hoc test was used to test the difference between means and $p < 0.05$ were considered statistically significant.

RESULT

All subjects who volunteered for the study completed the study and the results of the subjects characteristics are shown in table1. The subjects had varying options to the most preferred mode of lying down. The supine was the least preferred across all parities, the distribution in percentages is shown in table 2. The pulmonary functions measured in this study include Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second. Pulmonary functions were measured in sitting; supine, left lateral and right lateral across all parities and the values are shown on table 3.

TABLE 1: SUBJECTS' CHARACTERISTICS IN MEAN ± S.E.M, RANGE AND PERCENTAGE

Parameters	Groups				
	Primigravida n=30	Nulliparous n=30	Para 1 n=30	Para2 n=30	Para 3 n=30
Age (Years)	21.72 ±1.82	20.11±2.51	22.52 ±2.48	24.00 ±1.71	25.11±1.99
AaM (Years)	12-13	12-13	12-13	12-13	12-13
LoMC (Days)	26-32	25- 30	26-32	25- 30	26-32
DoM (Days)	3-6	3-5	2-7	3-5	3-6
AaC	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30(100%)
UoC	30 (100%)	30(100%)	30 (100%)	30 (100%)	30 (100%)

AM (Age at Menarche), LMC (Length of Menstrual Cycle), DoM (Duration of Menstruation), AAB (Awareness about Contraceptive) UoC (Use of Contraceptive). Values are in mean ± S.E.M, range and percentage.

TABLE 2: MOST PREFERRED SLEEPING POSITIONS IN THE THIRD TRIMESTER OF PREGNANCY IN VARIOUS PARITIES

Positions	Groups				
	Primigravida n=30	Nulliparous n=30	Para 1 n=30	Para2 n=30	Para 3 n=30
Supine	6 (20.0%)	4 (13.3%)	6 (20.0%)	6 (20.0%)	4 (13.3%)
Left lateral	16 (53.3%)	20 (66.7%)	14 (46.7%)	14 (46.7%)	18 (60.0%)
Right lateral	8 (26.7%)	6 (20%)	10 (33.3%)	10 (33.3%)	8 (26.7%)

TABLE 3: COMPARISON OF FVC AND FEV_1 VALUES IN SITTING, STANDING AND SUPINE POSITIONS IN THE THIRD TRIMESTER OF PREGNANCIES OF VARIOUS PARITIES

Parities	Positions			
	Control	Test		
	Sitting	Supine	Left lateral	Right lateral
Primigravida (n=30)				
FVC (LITERS)	3.57±0.11	2.80±0.10	3.21±0.09	3.20±0.10
p-value	-	p<0.001	p<0.001	p<0.001
FEV_1(LITERS)	2.73±0.12	2.02±0.13	2.40±0.10	2.41±0.11
p-value	-	p<0.001	p<0.001	p<0.001
Nullipara (n=30)				
FVC (LITERS)	3.55±0.12	2.81±0.07	3.20±0.14	3.19±0.10
p-value		p<0.001	p<0.001	p<0.001
FEV_1 (LITERS)	2.71±0.09	2.03±0.10	2.38±0.11	2.40±0.13
p-value	-	p<0.001	p<0.001	p<0.001
Primipara (n=30)				
FVC (LITERS)	3.66±0.14	3.04±0.13	3.31±0.10	3.32±0.11
p-value	-	p<0.001	p<0.001	p<0.001
FEV_1 (LITERS)	2.84±0.13	2.33±0.11	2.69±0.13	2.68±0.13
p-value	-	p<0.001	p<0.001	p<0.001
Para 2 (n=30)				
FVC (LITERS)	3.76±0.13	3.06±0.11	3.42±0.10	3.40±0.12
p-value	-	p<0.001	p<0.001	p<0.001
FEV_1 (LITERS)	2.87±0.13	2.47±0.11	2.74±0.13	2.73±0.13
p-value	-	p<0.001	p<0.001	p<0.001
Para 3 (n=30)				
FVC (LITERS)	4.01±0.15	3.24±0.15	3.68±0.11	3.66±0.12
p-value	-	p<0.001	p<0.001	p<0.001
FEV_1 (LITERS)	3.11±0.13	2.51±0.09	2.80±0.10	2.79±0.11
p-value	-	p<0.001	p<0.001	p<0.001

FVC and FEV_1 values are in mean ± standard deviation

The post hoc test shows that within test groups, the FVC and FEV1 values of subjects when lying on the left lateral positions were significantly higher than when they adopted the supine position. The same pattern was observed for the right lateral position. There was no statistical difference (p >0.05) between the FVC and FEV1 values in the left lateral lying position and the right lateral position

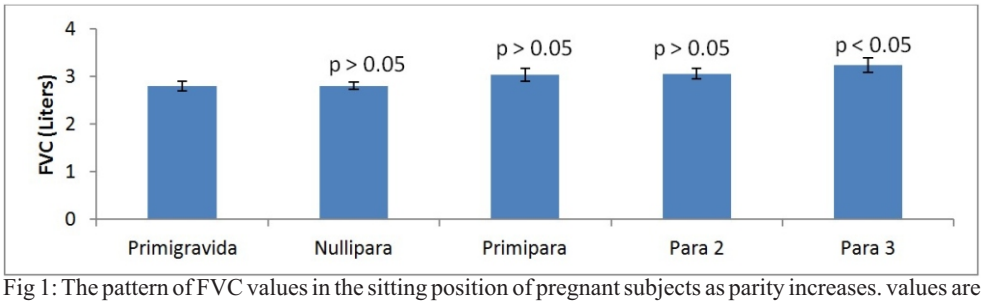

Fig 1: The pattern of FVC values in the sitting position of pregnant subjects as parity increases. values are means ± S.E.M and p < 0.05 indicates a statistically significant difference between the primigravid subjects and the other group.

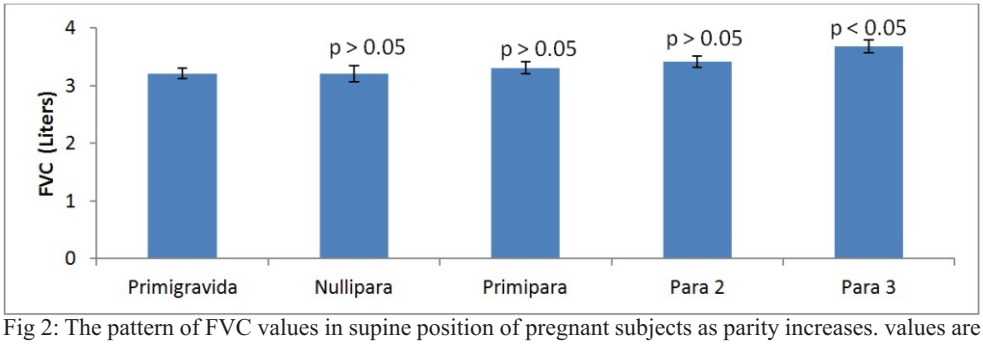

Fig 2: The pattern of FVC values in supine position of pregnant subjects as parity increases. values are means ± S.E.M and p < 0.05 indicates a statistically significant difference between the primigravid subjects and the other group.

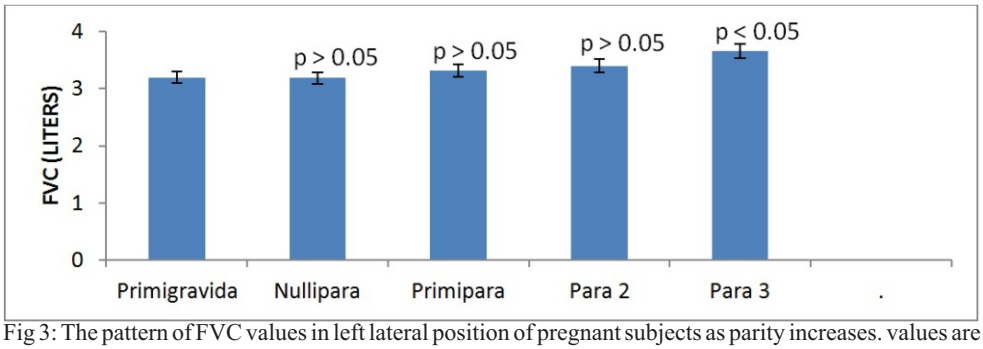

Fig 3: The pattern of FVC values in left lateral position of pregnant subjects as parity increases. values are means ± S.E.M and p < 0.05 indicates a statistically significant difference between the primigravid subjects and the other group.

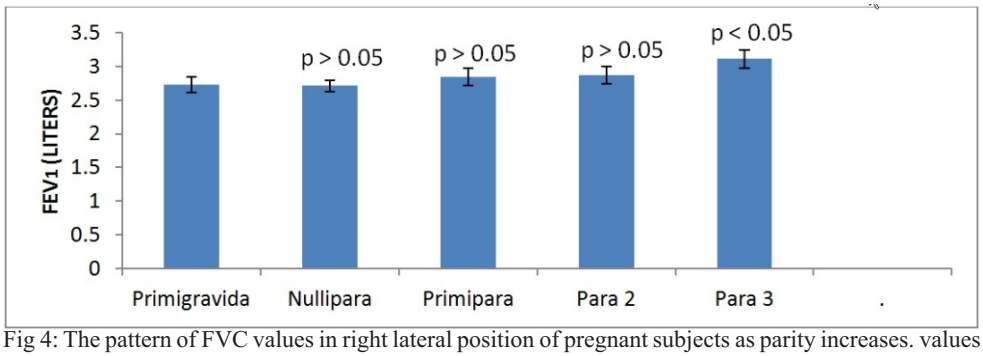

Fig 4: The pattern of FVC values in right lateral position of pregnant subjects as parity increases. values are means ± S.E.M and p < 0.05 indicates a statistically significant difference between the primigravid subjects and the other group.

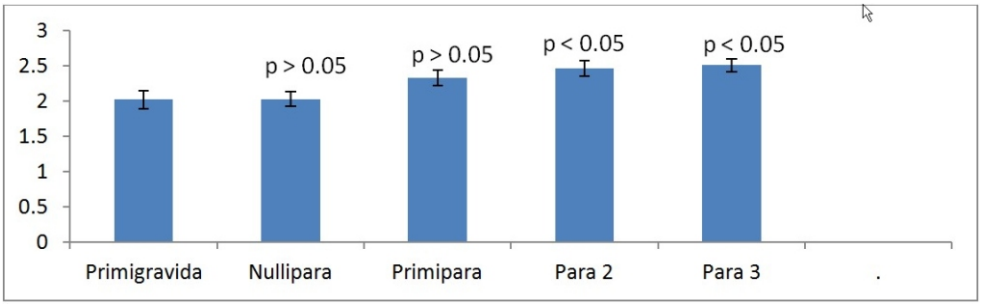

Fig 5: The pattern of FEV1 values in the sitting position of pregnant subjects as parity increases. values are means ± S.E.M and $p < 0.05$ indicates a statistically significant difference between the primigravid subjects and the other group.

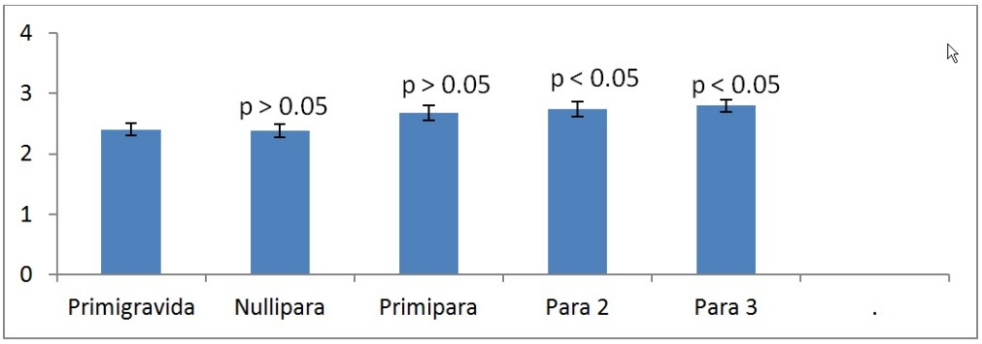

Fig 6: The pattern of FEV1 values in the supine position of pregnant subjects as parity increases. values are means ± S.E.M and $p < 0.05$ indicates a statistically significant difference between the primigravid subjects and the other group.

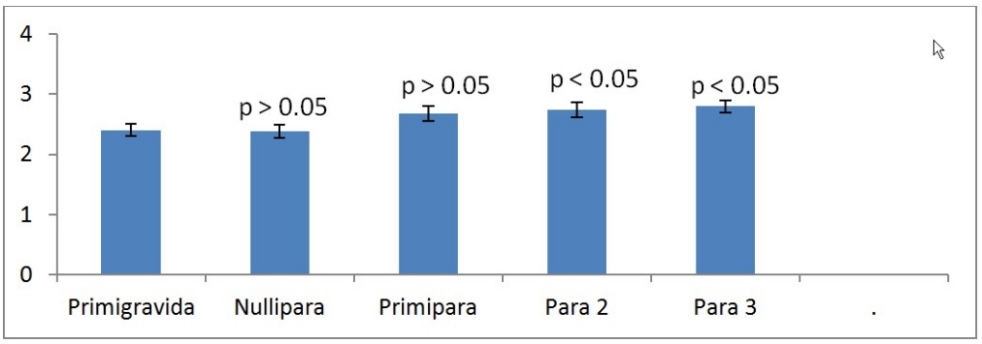

Fig 7: The pattern of FEV1 values in the left lateral position of pregnant
subjects as parity increases. values are means ± S.E.M and $p < 0.05$ indicates a statistically significant difference between the primigravid subjects and the other group.

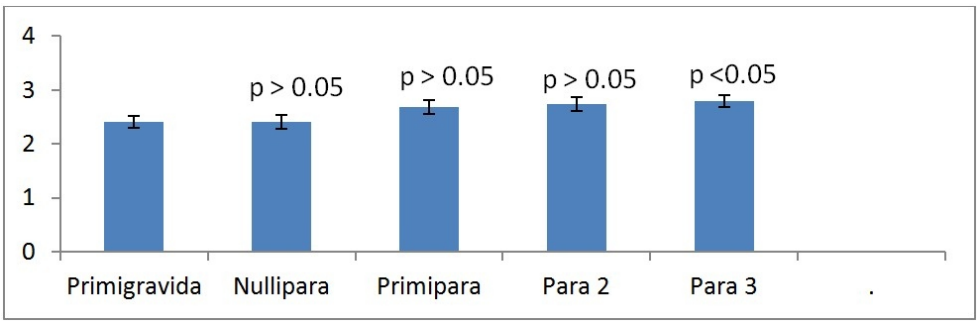

Fig 8: The pattern of FEV1 values in the right lateral position of pregnant
subjects as parity increases. Values are means ± S.E.M and $p < 0.05$ indicates a statistically significant difference between the primigravid subjects and the other group.

DISCUSSION

Cardiorespiratory activity has been shown to be heavily influenced by posture and body movement.[15] They also theorized that respiration viz a viz its sympathetic function is influenced by abnormal posture of the head and neck. Thus certain postures are favourably disposed to optimal autonomic and respiratory function. Spirometric measurements of pulmonary functions such as FVC and FEV_1 are most commonly performed in the sitting position, although the standing position is also well accepted and changes in body position can affect several measurements of pulmonary function. It is well known that FVC and VC values vary with the position of the patient upon examination.[16] The pregnant state can induce various postures depending on the one that is most convenient for the pregnant woman and these postures may vary from trimester to trimester, with the third trimester of pregnancy having the most limited lying down options. This limited posture options in the third trimester of pregnancy is traceable to the fact that the gravidly enlarged uterus is predominantly abdominal. The researches done on positional variations of spirometric FVC values revealed that FVC reduces from a sitting position to a slumped or supine position. [17- 19] Despite the fact that these studies were carried out on non-pregnant subjects, it corroborates with this study as FVC and FEV_1 was significantly lower ($p<0.05$) in the recumbent positions in all parities (table 3). Functional residual capacity which is also a parameter of pulmonary function has been studied to be found highest in the sitting position, followed by the left side lying, right side lying, half lying, slumped half lying and supine lying. [20] In pregnant subjects the effect of advancing pregnancy might be expected to increase the effects of body position on lung volume and the advancing uterus in the third trimester of pregnancy can affect the functional performance of the diaphragm which contributes a about 75% of tidal volume. The impedance on the diaphragm during the third trimester of pregnancy and the recumbent lying down positions synergize to compromise pulmonary function. However, from this study, despite the overall decrease in FVC and FEV_1 in lying down position compared to the sitting positions, lying on the lateral positions by subjects irrespective of whether left or right showed a better pulmonary function than the supine position (table 3). Thus the mechanical advantage of the oblique abdominal muscle when they contract during respiratory maneuvers was more reduced in the supine position during the third trimester of pregnancy. FVC and FEV_1 have been demonstrated to be lowest in supine position [1] because increased intra thoracic blood volume which ultimately increases airway resistance. [21,22] Furthermore, the effect of the gravid uterus in the supine position is capable of restricting thoracic compliance which ultimately affects FVC and FEV_1. Lying on the side with the hips and knees flexed has been studied to be helpful in encouraging expiratory maneuvers such as huffing and coughing. [20] Another study conducted with normal subjects showed that change in position from sitting to supine or prone resulted in significant changes in the respiratory pattern [23] and the lateral positions the lung function decreases because of lower capillary volume.[24] However, these views are at variance with a study which demonstrated that in side lying the underside of the body becomes compressed by the individual's own body weight, restricting movement of the hemi-thorax both during maximal inspiration and forced expiratory maneuver. This may explain why the maximal positive expiratory pressure (P_{Emax}) values tend to be at their lowest for side lying. [25]

Overall, high parity in this study was not associated with a decrease in lung function instead there was an increase in FVC and FEV_1 as parity increased across various postures (Figures 1-8). The increases observed were empirical at lower parities and became essentially significant at para 3 across all groups and para2 and para 3 in some cases (Figures 6, 7). However, studies have shown that lung function declines with increasing

parity in women aged greater or equal to 60years.[26] The variance of this study with their study is traceable to the age difference of 60 years in thiers and 21-28 years in our study. They opined that there would be a decrease in inspiratory muscle strength and obstructive tendency, without associated restrictive component. At younger age of pregnancy the ventilatory muscle seems to work efficiently and this is further potentiated by the cumulative effect of progesterone on pulmonary function in increasing parity. Relaxin, progesterone, and corticosteroids have positive effects on bronchodilation [27] and these substances abound in the third trimester of pregnancy. [14] Therefore the effect of parity on lung function is age dependent.

CONCLUSION:

Pregnant women in the third trimester of pregnancy should be encouraged to adopt the lateral positions of lying down for optimal pulmonary function performance. Increasing parity of pregnancy improves pulmonary function across postures.

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