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## The effect of abdominal exercises without breath-holding on haemodynamics in post-natal period

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### Abstract

**Objective:** The objective of this study is to compare the haemodynamic parameters [Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Blood Pressure, Rate Pressure Product] during the early postnatal period and the later postnatal period, with abdominal exercises and to record the magnitude of variations in the haemodynamic parameters between the three abdominal exercises in the postnatal period.

**Methodology:** 30 postnatal primi para women who had undergone full term normal delivery without any complications during labour/delivery and who did not have any diastasis recti were selected for this study. These women received three types of abdominal exercises and the changes in haemodynamics were recorded on the 3<sup>rd</sup> and 30<sup>th</sup> postnatal day.

**Result:** Results of the study showed statistically that all the haemodynamic parameters were elevated following each of the three abdominal exercises. It occurred in both the 3<sup>rd</sup> and 30<sup>th</sup> post natal day. The elevations seen in the haemodynamic parameters were comparatively more for the straight partial sit up (SPSU) exercise and oblique partial sit up exercise (OPSU) than the pelvic tilting exercises. The post exercise recovery was comparatively earlier for pelvic tilting exercise than the SPSU and OPSU exercises. The exercise recovery was faster in the 30<sup>th</sup> postnatal day in comparison with the 3<sup>rd</sup> postnatal day. There is significant decrease in the mean scores of RPE scale from the 3<sup>rd</sup> postnatal day to the 30<sup>th</sup> postnatal day from  $10.37 \pm 0.93$  to  $6.33 \pm 0.48$  following the pelvic tilting exercises,  $12.10 \pm 0.99$  to  $10.67 \pm 0.88$  following the straight partial sit up exercises (SPSU) and  $13.13 \pm 0.78$  to  $11.03 \pm 1.13$  following the oblique partial sit up exercises (OPSU).

**Conclusion:** The study shows that though there is a significant rise in the haemodynamic parameters following the abdominal exercises in both 3<sup>rd</sup> and 30<sup>th</sup> postnatal day, all these haemodynamic parameters [Blood Pressure, Heart Rate, Mean Blood Pressure, Rate Pressure Product] returned to baseline within few minutes of post exercise, thus making it safe to prescribe abdominal exercises from early postnatal period. Anyways since rate of perceived exertion (RPE) was higher in 3<sup>rd</sup> post natal day in comparison with 30<sup>th</sup> postnatal day, the intensity of exercise should be lesser in 3<sup>rd</sup> postnatal day than 30<sup>th</sup> postnatal day.

**Keywords:** Abdominal exercises, blood pressure, heart rate, mean blood pressure, rate pressure product, post natal period

### 1. Introduction

The term childbearing year (CBY) is used by physiotherapist and others for many decades. Noble defined it as 'the time from conception through postpartum adjustment'. The simplistic view of the CBY can be seen as four trimesters-nine months pregnancy plus first three months after the birth of the baby [1]. Many of the physiologic and morphologic changes of pregnancy persists 4 to 6 weeks postpartum [2].

The physiological and endocrinal changes that occur during pregnancy may predispose woman to spinal instability and hence back pain. This takes months to resolve as the hormone relaxin, continues to circulate in the blood for 12 to 20 weeks postpartum resulting in hypermobility and hence segmental instability [3]. The aetiology behind back pain could be both biomechanical and/or hormonal factors. The prevalence of back pain in 2 to 18 months postpartum is 2% to 65% [4]. As low back pain persists postnatally it is important to establish some of the causative factors for this continuing pain [3].

Mechanically, the structure of abdominal muscles, including transverse abdominis alters during pregnancy. This has significant implications for their functions and thus stability of the spine [5].

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Evidence suggests that exercises designed to improve strength or endurance of internal oblique and transverse abdominal muscles are beneficial for individuals with low back pain because they stabilize the lumbar spine [6].

Almost all the abdominal exercise researches have focussed primarily on the electromyographic and biomechanical aspects of abdominal exercise. Very few studies have examined the haemodynamic parameters before or after abdominal exercise. It is likely that heart rate and blood pressure changes are present during abdominal exercise because large muscle co-contractions are involved [7]. Consequently, it is of clinical importance to determine the haemodynamic response to common abdominal exercises prescribed in the postnatal period. This would be of particular importance since abdominal strengthening is the integral part of the postnatal program. The abdominal strengthening can be started within 24 hours of delivery to maintain the tone and to strengthen the deconditioned muscles in the postnatal period [8].

The pre pregnancy exercise routines may be resumed gradually as soon as it is medically safe. Having undergone training, resumption of activities should be gradual [2]. The cardiovascular and haemodynamic changes persist for approximately four weeks post-delivery and remain a significant factor during post-partum exercise [3].

Determining the haemodynamic responses to common abdominal exercise prescribed from the early post natal period helps a physiotherapist to make decisions regarding the appropriateness of the abdominal exercise prescription not only on the biomechanical basis but also based on haemodynamic basis [9].

In advising woman on the continuation of exercise in the postnatal period, the persistent musculoskeletal and cardiovascular changes need to be considered. The cardiovascular and haemodynamic changes persist for approximately four weeks post-delivery and remain significant factor during postpartum exercise [10].

The need for guidelines for the exercise during pregnancy and the postpartum period was stimulated during the early 1980's, when active women of the 'baby boom' generation became interested as to whether it was safe to continue their active life styles during pregnancy and the postnatal period [9]. Exercise in the postpartum period is the key to rapid and maximum muscle function and restoration of mother's health [8].

## 2. Materials and methods

The purpose of the study is to compare and record the variations in haemodynamic parameters like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Rate Pressure Product (RPP) and Rate of perceived exertion (RPE) during the early post natal period (3<sup>rd</sup> postnatal day) and the later postnatal period (30<sup>th</sup> postnatal day) with various abdominal exercises. The haemodynamic parameters were recorded with

- Heart Rate Monitor
- Aneroid Sphygmomanometer.
- Mean arterial pressure(MAP) was calculated using the formula  $DBP + 1/3(SBP - DBP)$
- Rate Pressure Product(RPP) was calculated using formula  $HR \times SBP / 100$
- Rate of perceived exertion(RPE) was recorded with Borg's category ratio scale

## 2.1 Intervention

To assess these changes 30 postnatal primipara subjects in the age group of 20-35 years were selected as sample for the study. All the subjects had undergone full term normal delivery and without Diastasis Recti. Any postnatal women with complications during pregnancy, labour or delivery are excluded from the study.

30 subjects were selected by purposive sampling at Kempegowda Institute of Medical Science and Research Centre, Bangalore.

All the 30 postnatal women received three types of abdominal exercises to investigate the changes in haemodynamic at 3<sup>rd</sup> and 30<sup>th</sup> postnatal day.

Single group pretest-posttest design was used.

The three abdominal muscle activation exercises used in the study are:

- Pelvic tilting exercise
- Straight Partial Sit-Up exercise(SPSU)
- Oblique Partial Sit-Up exercise(OPSU)



Fig 1: Pelvic Tilting Exercise.



Fig 2: Straight Partial Sit up exercise.



Fig 3: Oblique Partial sit up exercise.

The abdominal exercises were asked to be performed by the subject. The base line haemodynamic parameters were recorded, after which the subject is asked to perform abdominal activation exercises, followed by recording each minute in the post exercise recovery period for a total of 10 minutes for each of the 3 abdominal exercises.

The total of 3 sets of abdominal exercises with continuous 4 repetitions for each set and position held for 3 seconds considered as 1 repetition was performed. The subjects were asked to grade their perceived exercise effort following the abdominal exercise by using Borg’s scale of RPE.

This study was conducted on the same group of subjects both

on the 3rd and 30th postnatal day. While performing all the 3 abdominal exercises emphasis is to be given on performing the exercises with expiration implying without breath holding.

### 3. Results & discussion

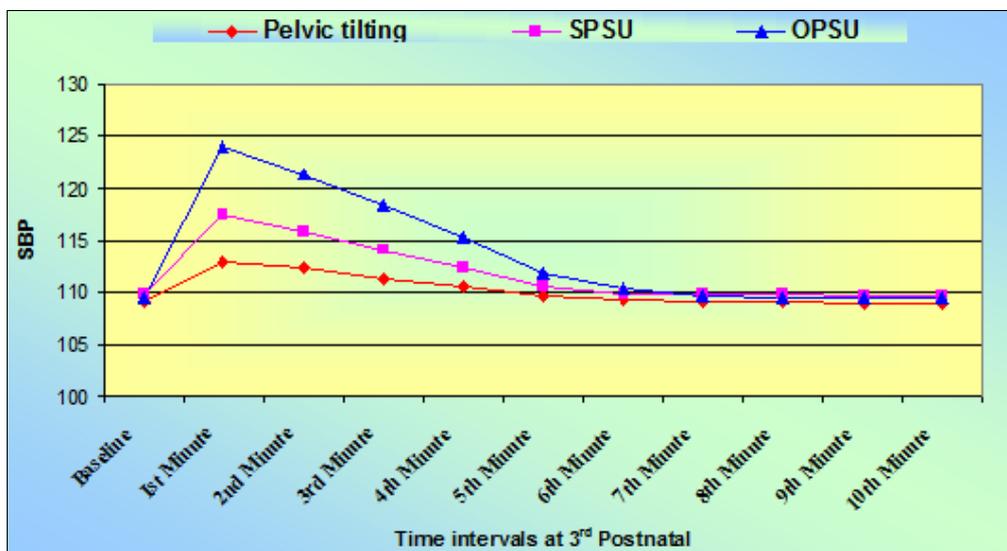
#### 3.1 Statistical Methods

1. Repeated Measures of Anova.
2. Wilcoxon Signed Rank Test

#### 3.2 The recorded data on the 3rd and 30th postnatal day are mentioned below

**Table 1:** Effect of Abdominal exercises on Systolic Blood Pressure at 3<sup>rd</sup> postnatal day

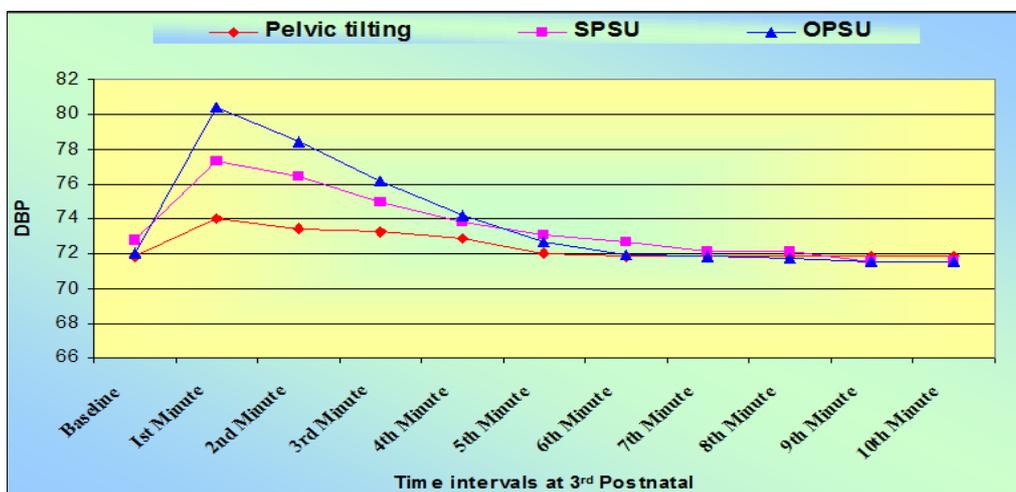
	Pelvic Tilt	SPSU	OPSU
Baseline	109.13±6.36	109.80±5.69	109.53±6.10
1 <sup>st</sup> Minute	112.94±5.71	117.47±5.20	124.07±3.58
Recovery	109.27±6.49(6 <sup>th</sup> minute)	109.93±5.67(6 <sup>th</sup> minute)	109.73±5.98(7 <sup>th</sup> minute)
Significance	F=85.021 P<0.01	F=207.566 P<0.01	F=103.383 P<0.01



**Fig 4:** Effect of Pelvic tilting, SPSU and OPSU on SBP at 3<sup>rd</sup> postnatal day

**Table 2:** Effect of Abdominal exercises on Diastolic Blood Pressure at 3<sup>rd</sup> postnatal day

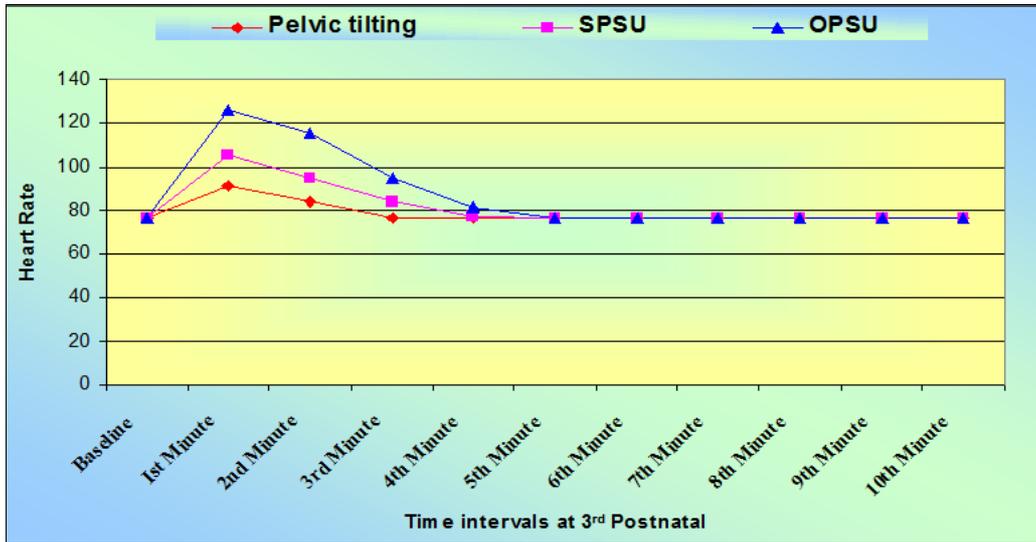
	Pelvic Tilt	SPSU	OPSU
Baseline	71.87±2.40	72.80±2.66	72.07±2.07
1 <sup>st</sup> Minute	74.00±2.46	77.33±2.19	80.40±1.52
Recovery	72.07±2.55(5 <sup>th</sup> minute)	72.67±2.54(6 <sup>th</sup> minute)	71.93±2.06(6 <sup>th</sup> minute)
Significance	F=11.263 P<0.01	F=86.705 P<0.01	F=156.832 P<0.01



**Fig 5:** Effect of Pelvic tilting, SPSU and OPSU on DBP at 3<sup>rd</sup> postnatal day

**Table 3:** Effect of Abdominal exercises on Heart Rate at 3<sup>rd</sup> postnatal day

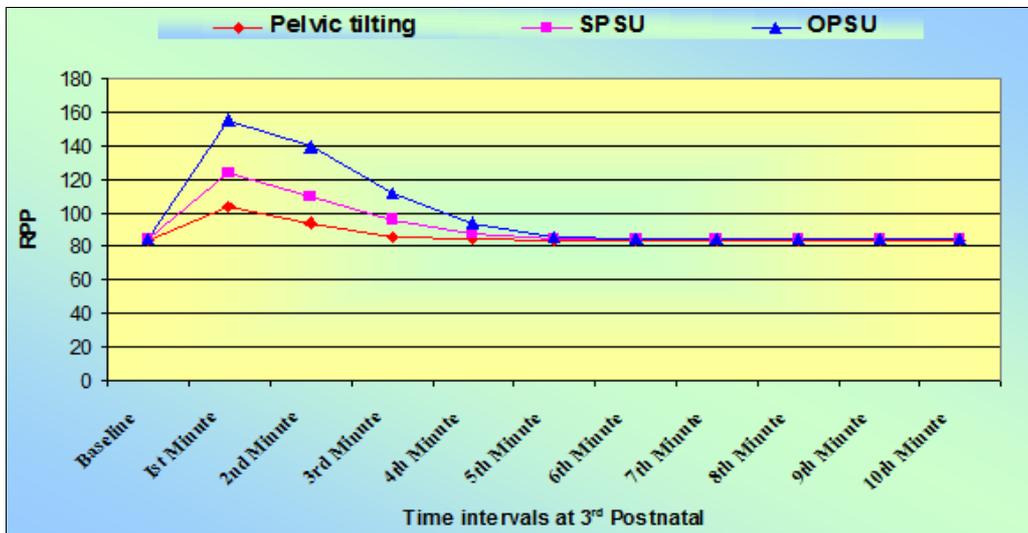
	Pelvic Tilt	SPSU	OPSU
Baseline	76.93±4.05	76.93±3.20	76.87±3.23
1 <sup>st</sup> Minute	91.60±2.50	105.60±2.01	125.70±2.73
Recovery	77.00±3.90 (3 <sup>rd</sup> minute)	77.77±4.86(4 <sup>th</sup> minute)	76.87±3.12 (5 <sup>th</sup> minute)
Significance	F=161.335 P<0.01	F=415.634 P<0.01	F=1353.669 P<0.01



**Fig 6:** Effect of Pelvic tilting, SPSU and OPSU on HR at 3<sup>rd</sup> postnatal day

**Table 4:** Effect of Abdominal exercises on Rate Pressure Product at 3<sup>rd</sup> postnatal day

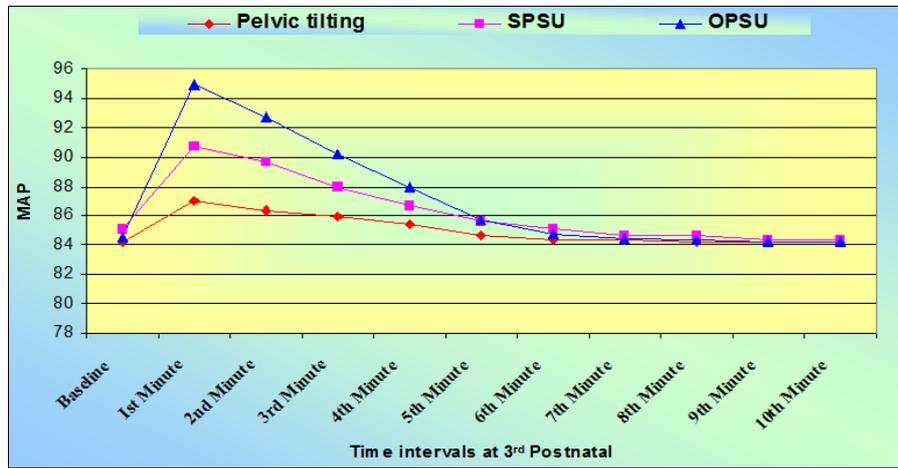
	Pelvic Tilt	SPSU	OPSU
Baseline	84.00±7.09	84.47±5.59	84.21±6.06
1 <sup>st</sup> Minute	103.46±6.19	124.03±5.71	155.76±5.72
Recovery	84.45±6.83(4 <sup>th</sup> minute)	87.47±7.67 (4 <sup>th</sup> minute)	84.37±6.00 (7 <sup>th</sup> minute)
Significance	F=207.823 P<0.01	F=591.204 P<0.01	F=1199.532 P<0.01



**Fig 7:** Effect of Pelvic tilting, SPSU and OPSU on RPP at 3<sup>rd</sup> postnatal day

**Table 5:** Effect of Abdominal exercises on Mean Arterial Pressure at 3<sup>rd</sup> postnatal day

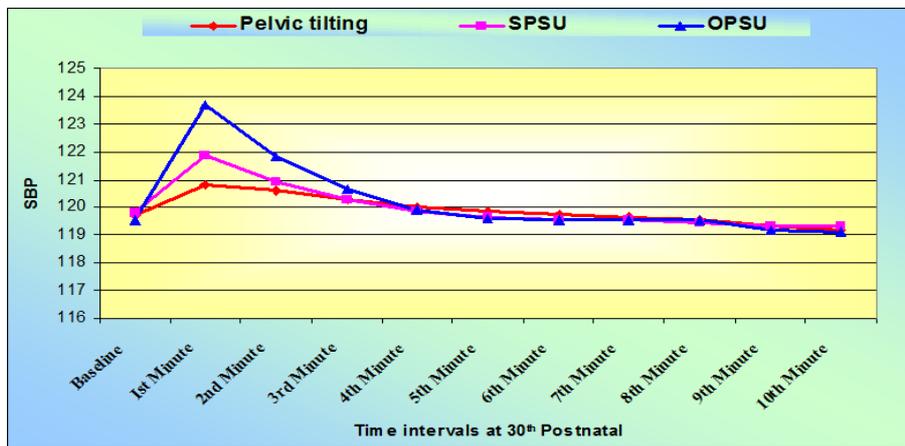
	Pelvic Tilt	SPSU	OPSU
Baseline	84.29±3.09	85.13±2.93	84.56±2.74
1 <sup>st</sup> Minute	86.98±3.12	90.71±2.82	94.96±1.82
Recovery	84.33±3.07 (6 <sup>th</sup> minute)	85.09±2.83 (6 <sup>th</sup> minute)	84.76±2.71 (6 <sup>th</sup> minute)
Significance	F=40.644 P<0.01	F=224.661 P<0.01	F=219.479 P<0.01



**Fig 8:** Effect of Pelvic tilting, SPSU and OPSU on MAP at 3<sup>rd</sup> postnatal day

**Table 6:** Effect of Abdominal exercises on Systolic Blood Pressure at 30<sup>th</sup> postnatal day

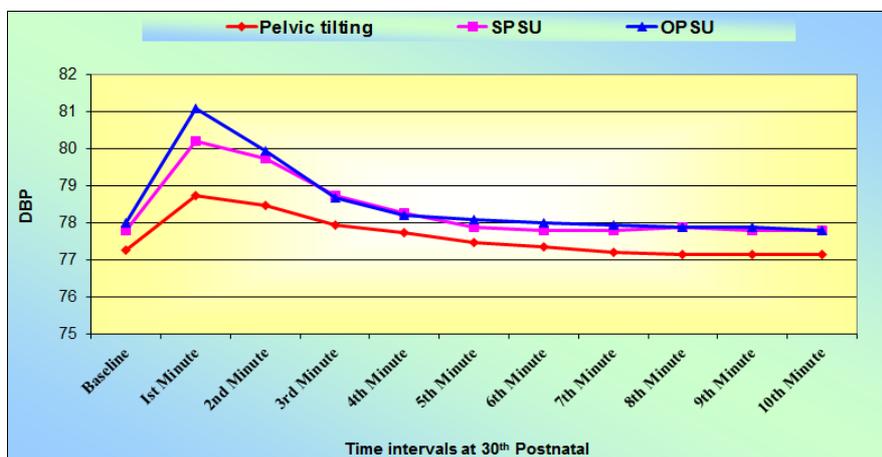
	Pelvic Tilt	SPSU	OPSU
Baseline	119.73±2.45	119.80±1.77	119.53±1.9
1 <sup>st</sup> Minute	120.80±2.61	121.87±2.34	123.67±1.90
Recovery	119.87±2.52 (5 <sup>th</sup> minute)	119.67±1.40 (5 <sup>th</sup> minute)	119.60±2.06 (5 <sup>th</sup> minute)
Significance	F=18.572 P<0.01	F=24.627 P<0.01	F=65.349 P<0.01



**Fig 9:** Effect of Pelvic tilting, SPSU and OPSU on SBP at 30<sup>th</sup> postnatal day

**Table 6:** Effect of Abdominal exercises on Diastolic Blood Pressure at 30<sup>th</sup> postnatal day

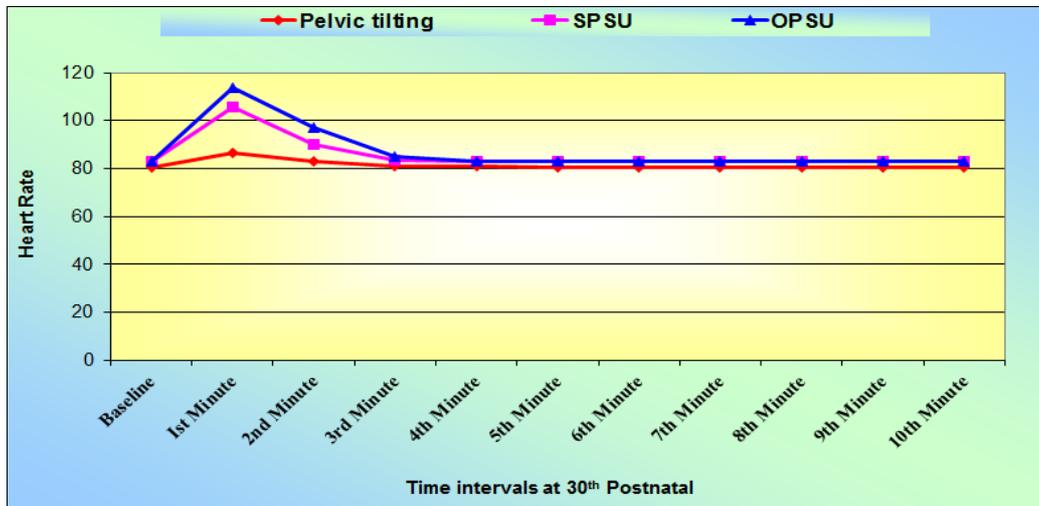
	Pelvic Tilt	SPSU	OPSU
Baseline	77.27±3.13	77.80±2.59	78.00±2.35
1 <sup>st</sup> Minute	78.73±3.17	80.20±1.99	81.07±1.80
Recovery	77.47±3.01 (5 <sup>th</sup> minute)	77.87±2.52(5 <sup>th</sup> minute)	78.07±2.32(5 <sup>th</sup> minute)
Significance	F=20.225 P<0.01	F=24.742 P<0.01	F=39.522 P<0.01



**Fig 10:** Effect of Pelvic tilting, SPSU and OPSU on DBP at 30<sup>th</sup> postnatal day

**Table 7:** Effect of Abdominal exercises on Heart Rate at 30<sup>th</sup> postnatal day

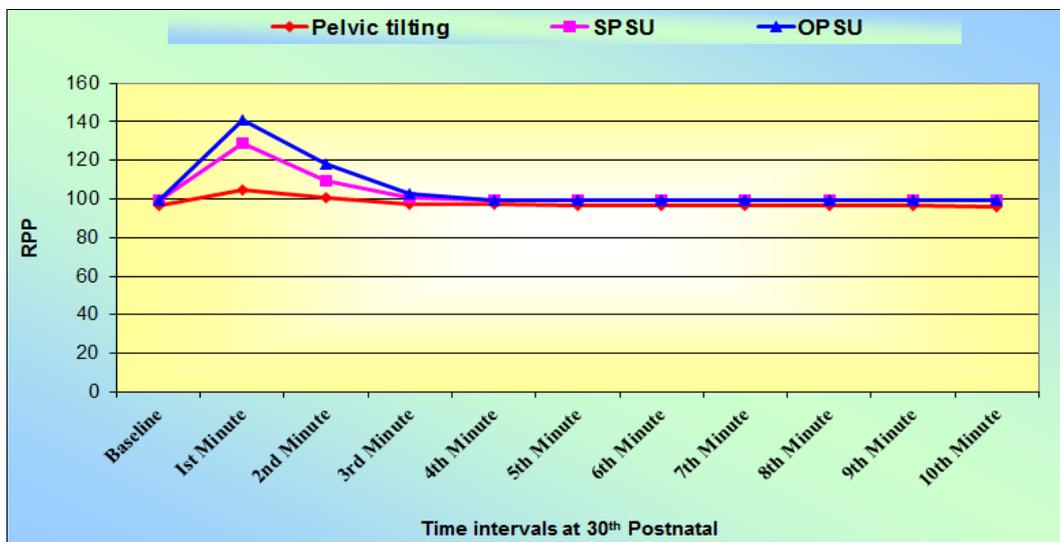
	Pelvic Tilt	SPSU	OPSU
Baseline	80.77±4.01	82.97±3.84	83.10±3.90
1 <sup>st</sup> Minute	86.37±4.15	105.80±4.41	113.90±7.28
Recovery	81.07±3.82(3 <sup>rd</sup> minute)	83.60±3.84(3 <sup>rd</sup> minute)	83.07±3.88 (4 <sup>th</sup> minute)
Significance	F=60.830 P<0.01	F=375.351 P<0.01	F=172.631 P<0.01



**Fig 10:** Effect of Pelvic tilting, SPSU and OPSU on HR at 30<sup>th</sup> postnatal day

**Table 8:** Effect of Abdominal exercises on Rate Pressure Product at 30<sup>th</sup> postnatal day

	Pelvic Tilt	SPSU	OPSU
Baseline	96.72±5.43	99.41±5.16	99.35±5.39
1 <sup>st</sup> Minute	104.38±6.37	128.93±5.76	99.35±5.39
Recovery	96.83±5.56 (5 <sup>th</sup> minute)	99.50±5.07 (4 <sup>th</sup> minute)	99.41±5.43 (5 <sup>th</sup> minute)
Significance	F=75.752 P<0.01	F=400.571 P<0.01	F=183.387 P<0.01



**Fig 11:** Effect of Pelvic tilting, SPSU and OPSU on RPP at 30<sup>th</sup> postnatal day

**Table 9:** Effect of Abdominal exercises on Mean Arterial Pressure at 30<sup>th</sup> postnatal day

	Pelvic Tilt	SPSU	OPSU
Baseline	91.42±2.68	91.80±2.00	91.84±1.93
1 <sup>st</sup> Minute	92.76±2.80	94.09±1.78	95.27±1.48
Recovery	91.60±2.64 (5 <sup>th</sup> minute)	91.80±1.92 (5 <sup>th</sup> minute)	91.91±1.92 (5 <sup>th</sup> minute)
Significance	F=31.655 P<0.01	F=35.792 P<0.01	F=64.480 P<0.01

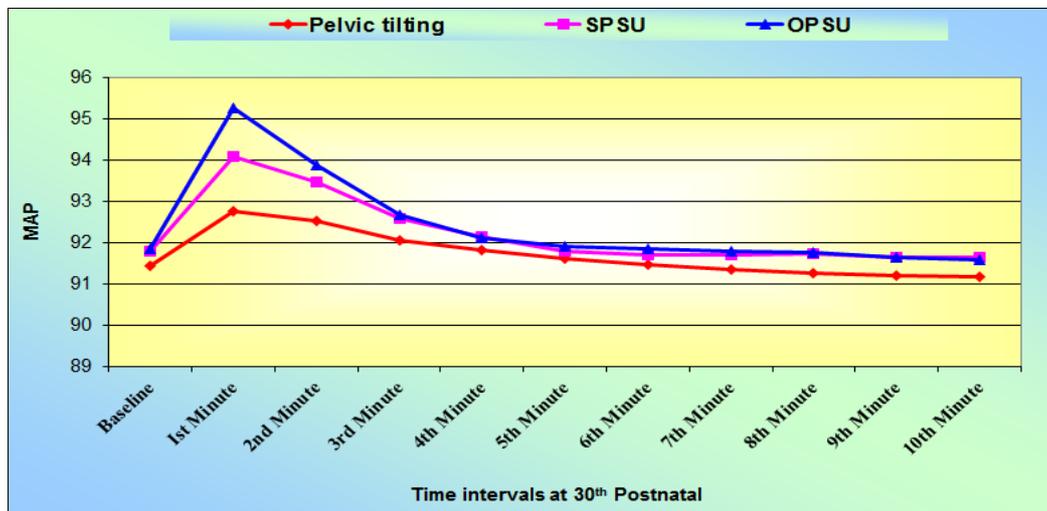


Fig 12: Effect of Pelvic tilting, SPSU and OPSU on MAP at 30<sup>th</sup> postnatal day

Table 10: Rate of Perceived Exertion

	3 <sup>rd</sup> Day Postnatal	30 <sup>th</sup> Day Postnatal	Significance*
Pelvic Tilting	10.37±0.93	6.33±0.48	0.01
SPSU	12.10±0.99	10.67±0.88	0.01
OPSU	13.13±0.78	11.03±1.13	0.01
Repeated measures of ANOVA	F=159.865 P<0.01	F=377.180 P<0.01	—

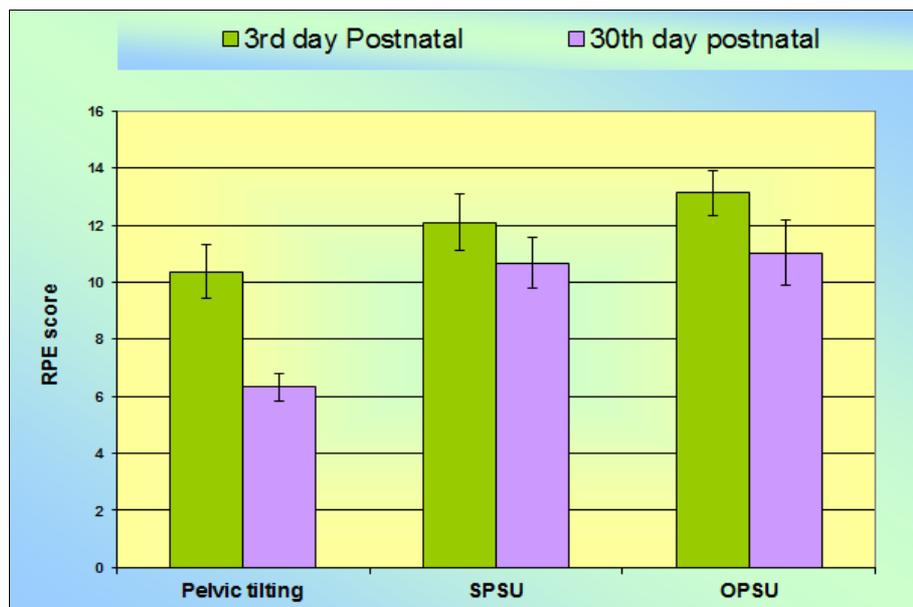


Fig 13: Rate of Perceived Exertion

### Effects of haemodynamic parameters following abdominal exercise

The results showed that all the haemodynamic parameters were elevated following each of the three abdominal exercises. It occurred in both in the 3<sup>rd</sup> and 30<sup>th</sup> post natal day. The elevations seen in the haemodynamic parameters were comparatively more for the straight partial sit up (SPSU) exercise and oblique partial sit up exercise (OPSU) than the pelvic tilting exercises.

### The Post Exercise Recovery

The study showed that the post exercise responses to the acute haemodynamic parameters following the abdominal exercises were varying for each of the exercises. The post exercise recovery was comparatively earlier for pelvic tilting exercise than the SPSU and OPSU exercises

The exercise recovery was faster in the 30<sup>th</sup> postnatal day in

comparison with the 3<sup>rd</sup> postnatal day. This may be due to the fact that the various cardiovascular changes and haemodynamic changes occurring during pregnancy recover by 4 weeks in the postpartum period.

### Rate of Perceived Exertion (RPE)

There is significant decrease in the mean scores of RPE scale from the 3<sup>rd</sup> postnatal day to the 30<sup>th</sup> postnatal day from 10.37±0.93 to 6.33±0.48 following the pelvic tilting exercises, 12.10±0.99 to 10.67±0.88 following the straight partial sit up exercises (SPSU) and 13.13±0.78 to 11.03±1.13 following the oblique partial sit up exercises (OPSU)

These results of perception of exertion is higher in the early postnatal period could be due to various emotional and physical factors associated with post-delivery and by 30<sup>th</sup> postnatal day the most of these psychological and musculoskeletal changes come back to near normal.

#### 4. Conclusion

In advising woman on continuation of exercise in the postnatal period, the persistent musculoskeletal and cardiovascular changes need to be considered. The cardiovascular and haemodynamic changes persist for approximately 4 weeks post-delivery remain a significant factor during postnatal exercise.

The haemodynamic parameters variations following abdominal exercises are similar in the early and late postnatal period. The raised haemodynamic parameters fall to the baseline in the post exercise recovery period which took slightly longer time in the early postnatal period than the late postnatal period. Also showed that rate of perceived exertion was higher in the 3rd postnatal day in comparison with the 30th postnatal day.

Therefore the intensity and repetition of the exercise is to be limited in the early postnatal period and progressed slowly and gradually. Especially oblique partial sit up (OPSU) exercise should be started with lesser intensity compared to pelvic tilting exercise and straight partial sit up exercise (SPSU).

To have true aerobic conditioning, the heart rate should fall within the target zone. The recommended target zone in pregnancy and until 12 weeks postpartum is 60% to 70% of the safe, maximum, attainable heart rate. To determine the safe heart rate, the formula is 220-age multiplied by 60% to 70% of heart rate. To prescribe the exercise intensity the heart rate data and rate of perceived exertion (RPE) can be utilized in order to make postnatal exercise program effective and safe.

In summary, the results of the study showed that raised haemodynamic parameters [Blood Pressure, Heart Rate, Mean Blood Pressure, Rate Pressure Product] fall to the baseline in the post exercise recovery period which took slightly longer time in the early postnatal period(3rd postnatal day) than the later postnatal period(30th postnatal day). Also the rate of perceived exertion (RPE) was higher in the 3rd postnatal day in comparison with the 30th postnatal day.

This exercise program which is significantly effective in restoring functions in postnatal period can be concluded to be safe as it is within normal haemodynamic parameters.

#### 5. References

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