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Immediate Effect of Four-Square Breathing and Progressive Muscle Relaxation on Lactation among Postnatal Mothers:A Randomized Controlled Trial

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Abstract

Background: The release of milk when the nipple areola is stimulated is called "Let down reflex". Immediately after labor, mothers will be under immense stress because of which let down reflex will be affected leading to reduced milk volume. Studies have shown that milk ejection or synthesis can be improved by different relaxation techniques, but there are no studies to show immediate effect of Four-Square Breathing (FSB) and Progressive Muscle Relaxation (PMR) on lactation.

Research Aim: The study evaluates the immediate effect of Four-Square Breathing and Progressive Muscle Relaxation on lactation among postnatal mothers.

Method: In this single blinded parallel randomized control trial, 90 participants were selected based on the inclusion criteria and were randomized by sequential numbered, opaque, sealed envelope method into experimental and control group. Experimental group received 20 rounds of FSB, along with PMR in the mornings and afternoon of Day 1, 2 and 3 with patient education on breastfeeding techniques. Control group received only breastfeeding education. The outcome measures used were United Nation Children Fund's (UNICEF) breastfeeding assessment tool and test weighing (ml) of the baby.

Result: 45 subjects in each group were analyzed. Breastfeeding assessment tool suggests increase in frequency and volume of feed in experimental group ($p< 0.05$) when compared to control group. Experimental group showed greater difference ($p < 0.05$) in weight when compared to control group. No participant was harmed in this study.

Conclusion: Four-Square Breathing and Progressive Muscle Relaxation is effective in improving lactation among postnatal mothers immediately after labor.

Key words: Four-Square Breathing, Progressive Muscle Relaxation, Lactation, Postnatal, c, test weighing method

Introduction

Human milk is an idiosyncratic biological fluid containing nutrition and bioactive components with numerous short- and long-term benefits for both the infant and the mother. Breastfeeding reduces the risk of ovarian and breast cancer in the mother and morbidity and mortality in the infant.[1] A recent study conducted in 2021 has shown that if breastfeeding is increased by 50% worldwide, that could save the life of >800000 young children and prevent >20000 maternal deaths from breast cancer annually. [2]

Four-Square breathing (FSB) exercise is a relatively new technique where postnatal mothers are asked to breathe-in to a count of 4, hold breath for 4 seconds, breathe out slowly to a count of four, and ask not to inhale for another four seconds. This cycle is repeated as instructed.[3]

Progressive Muscle Relaxation (PMR) is a widely used technique that involves tense-release of a major muscle group to reduce the responsiveness to stress, reduce skeletal muscle contraction and reduce pain sensation.[4]

Breastfeeding not only depends on the milk production and release, but also on the proper attachment of the baby and most importantly, the baby should have suck reflex. Breastfeeding is said to be improper if the baby does not take in the breast completely into his mouth or when the baby is unable to suck in the milk. As the baby sucks, the teat is pressed against hard pallet by the tongue. This causes the milk to wring out of the sinuses. Breast tissues are stretched by the baby by creating suction. Improper attachment can lead to improper breastfeeding with pain and soreness. It can also damage the skin of nipples and areola.

The most common cause for weaning of lactation is insufficient milk production. In one prospective cohort study of first-time mothers who initiated breastfeeding, 40% voiced concerns about their milk supply in the first 72 hours postpartum alone, and 22% still had milk supply concerns at day 14 postpartum and stopped breastfeeding within the first 2 months.[5]

A systematic review conducted in the year 2022 concluded that stress activates sympathetic nervous system, because of which there is decreased secretion of oxytocin and prolactin from hypothalamus, and pituitary glands.[6] Since let-down-reflex is affected by stress, studies have shown that milk ejection or synthesis can be improved by different relaxation techniques but there are no studies to prove the immediate effect of Four-Square Breathing and Progressive Muscle Relaxation on lactation among postnatal mothers within 24 hours of normal vaginal labor.

Hence, the primary objective of this study was to find the immediate effect of Four-Square Breathing and Progressive Muscle Relaxation on breastfeeding assessment tools among postnatal mothers and the second objective was to evaluate the immediate effect of Four-Square Breathing and Progressive Muscle Relaxation on the frequency and volume of lactation among postnatal mothers.

Methodology

Research Deign: In this Single Blinded parallel group Randomized Controlled Trial,

total of 90 participants were screened based on inclusion and exclusion criteria and were allocated into experimental group (n=45) and control group (n=45). The randomization was done by computer generated random sequencing and allocation was done using opaque sealed envelope method.

The ethical clearance for the proposed study was acquired from Nitte Institute of Physiotherapy Institutional Ethics Committee, Mangaluru, Karnataka, India with reference no NIPT/IEC/Min//06/2020-2021/ dated12-02-2022. The trial was applied for registration in the Clinical Trial Registry- India and was registered under CTRI number CTRI/2022/05/042814.

Setting: The participants were recruited from the department of Obstetrics and Gynecology of K S Hegde Charitable Hospital, Deralakatte, Mangaluru. The study was conducted from May 2022 to March 2023.

Samples: The participants of age group 18-35 years and those who underwent full-term, normal vaginal labor with or without episiotomy and delivered a single live baby were included in the study. Participants who delivered immediately after labor (within 2-24 hours) were included. Participants under sedation, with postnatal complications and uncontrolled vitals, presence of inverted nipples, prolonged labor of more than 12hours, babies of participants without suck reflex, babies in Neonatal Intensive Care Unit (NICU), baby's with APGAR (Appearance, Pulse, Grimace, Activity and Respiration) score less than 8, birth weight of the baby less than 2.5kgs and babies feeding on formula milk were all excluded from the study. G* power software version 3.1.9.4 was used to calculate total sample size. Based on 80% power, alpha error 5%, effect size 0.6 for 2 tail tests, the sample size required was 45 in each group, 90 in total.

Measurements: The primary outcome measure used was United Nations Children's Fund (UNICEF) Breastfeeding Assessment Tool. This assessment tool was filled on day 1 and day 2 for both experimental and control groups. It was also taken on day 3 only for those participants who delivered in the afternoon- Assessor Blinded. Test-Weighing Method was used to measure weight of the baby before and after feed, both in the morning and in the afternoon - Assessor Blinded. Weight of the baby was measured 10-15 minutes before the feed and 10-20 minutes after the feed on day 1 and day 2. The weight was also taken on day 3 only for those participants who delivered in the afternoon. The weight obtained in grams was converted to milliliters to check the volume of human milk.

Experimental Group: The screening was done within 2-24 hours of labor and participants were selected based on inclusion and exclusion criteria by the researcher. Consent forms were given to the eligible participants and the study was explained in detail in local language. Participants were divided into two groups (n=45 in each group). Participants in experimental groups were taught FSB of 20 rounds for about five minutes on day 1, within 2-24 hours of labor and day2, both in the morning and afternoon. PMR was taught for about 20 minutes on day 1 within 2-24 hours of labor and day 2, only in the mornings and also breastfeeding education was given to

participants. FSB of 20 rounds, for five minutes and PMR for about 20 minutes were taught on day 3 in the mornings to those participants who delivered in the afternoon and missed the intervention on day 1.

Control group: Participants received breastfeeding education for about 10-20 minutes within 2-24 hours of labor only on day 1. All the interventions were provided by the researcher to the participants in a calm, ventilated and closed room.

Data Analysis: The data collected were summarized using descriptive statistics (Frequency, percentage and Chi square test). The Chi square test was used to compare UNICEF breastfeeding assessments tool according to groups. Paired "t" test was used to compare weight irrespective of groups and independent sample "t" test was used to compare weights between groups. The p value <0.05 was considered as significant. The SPSS program, version 26.0 (SPSS Inc.; Chicago, IL), was used to analyse the data.

RESULT:

This study included 90 participants who underwent normal vaginal labor. Participants were divided into experimental group (50%) and control group (50%) Most of the (77.8%) postnatal mothers were housewife followed by farmers (13.3%). Mean age of participants in experimental group was 29.244 and 27.796 for control group and majorities (61.1%) were multigravida. The majority (51.1%) of the participants had residence at rural areas and 62.2% of the participants had joint family type. 68.9% had Stress of labor while majority of participants (46.7%) had duration of labor between 6 to 12 hours and 12.2% followed more than 12 hours of labor. About 42.2% of the mothers had first breastfeeding after two hours of delivery (Table 1).

The Chi square test was used to compare UNICEF breastfeeding assessments according to groups. Experimental group showed a difference ($p < 0.05$) in questions Q1D1, Q2D1, Q3D1, Q3D2, Q4D1, Q4D2, Q6D1, Q6D2, Q7D1, Q8D1 when compared to control group. (Table 2)

The Independent sample "t" test was used to compare the weight between groups. A difference ($p<0.05$) was seen in both the groups for before feed on both the days, both in the morning and in the afternoon. However, for after weight, there was significant difference in experimental group on day 1 and 2, both in the morning and in the afternoon. (Table 3)

The Paired "t" test was used to compare weight within the groups. There was an increase ($p < 0.05$) in weight within group A. During day – 2 afternoons however, an increase ($p < 0.05$) in weight within group B was seen on day 2 in the afternoon. (Table 4)

DISCUSSION

Human milk production is influenced by direct hormones (Oxytocin and prolactin) and indirect hormones (Estrogen and progesterone). Prolactin hormone remains inactive during pregnancy under the influence of estrogen and progesterone. After labor, the prolactin levels increases sharply, while estrogen and progesterone dip sharply.[7]

Oxytocin makes the milk flow along and helps in filling the ducts. The ejection of milk in fine stream is sometimes called "milk ejection reflex" or "Oxytocin reflex".

It helps in easy flow of the milk that is available in the breast.[8] The effect of stress during antenatal phase and during labor can reflect on milk ejection reflex, which in turn hampers lactogenesis and development of the infant.[9]

Marina Dimitraki conducted a study in the year 2016, to check the relationship between stress during birth experience and lactogenesis. It was concluded that mothers who experienced pain, stress and negativeness during long labor experienced delayed Lactogenesis.[5] In this regard, the current randomized control trial was undertaken to provide interventions to those mothers who have undergone normal vaginal labor.

The current study included 90 subjects (45 in each group). Mothers who have undergone normal vaginal labor and those within the age group of 18-35 years were selected.

The Four square breathing exercises acts as a protective mechanism to overcome stress. The parasympathetic nervous system is stimulated by deep abdominal breathing exercise. This results in excess oxygenation, as a result endorphins are released which leads to decreased heart rate and increased relaxation. A reduction is stress hormones are noted along with the suppression of sympathetic nervous system.[3]

The primary basis of PMR is neuronal "Top-Down" and "Bottom- Up" mechanism. The higher centers of brain like cerebral cortex are used in "Top- Down" process. While in "Bottom Up" process, proprioceptive stimulations are produced from the muscles that are holding the tension. These stimuli travel through the spinal cord and brain stem and reach brain. Quick relaxation is hence achieved through simultaneous activation of both the passages.[10]

The result of this current study suggests that there was significant effect ($p<0.05$) of FSB and PMR on UNICEF Breastfeeding Assessment Tool. The evaluation of breast feeding assessment tool signifies that the frequency of feed improved from day1 to day2 in most of the questions, implying that the interventions were effective.

The current study can be correlated to the study conducted by Soheila Karbandi, where the results conclude that there was a significant difference in pre-test and post test values of weight of the infants in between group analysis. The Interventional group had a great difference ($p<0.001$) when compared to control group ($p=0.16$). However, the research tools used were The Dennis breastfeeding self-efficacy standard questionnaire, demographic information form, and a relaxation self-report checklist and the post-test values.[11] Although the interventions were stated after 24-48 hours of delivery, the outcomes were taken after 8 weeks and not immediately after labor. Additionally, the study included sixty participants who gave birth to preterm infants.

In experimental group of the current study, there was significant difference in pre and post test values starting from morning feed of day1 when compared to control group. In control group, there was increase in post test values within the group on day 1 and 2, but between group values were reduced. Studies have shown a positive impact of frequent breastfeeding on improving the volume of

milk produced. Jacqueline Kent concluded in his study stating that the normal average milk intake within one hour of delivery will be 5ml of colostrum. The study also states that by day 2, there shall be 7% weight gain of the infant from birth. The prolactin secretion is greater during night. Hence most of the feeding takes place during night. This leads to increase in frequency of breastfeeding. Thus the average weight gain can increase not just from day 1 to day 2, but also from one feed to the next feed.

World organizations like UNICEF and WHO recommend initiating breastfeeding within one hour of parturition. There are studies to prove the effectiveness of various relaxation techniques on improving lactation after weeks or months of delivery (vaginal and cesarean section).

STRENGTH OF THE STUDY:

According to the databases searched, it is the first study to measure the immediate effect of Four-Square Breathing and Progressive Muscle Relaxation on lactation among postnatal mothers. This RCT study was feasible, simple and safe with face to face interactive session.

LIMITATIONS OF THE STUDY:

Long term follow up of the participants was not taken and the sample size was relatively small.

Harms: No individual was harmed and no adverse effects were reported during this study.

FUTURE SCOPE OF THE STUDY:

Breast pump can be used to evaluate direct measure of human milk within 12-24 hours of labor. Participants who underwent cesarean section delivery can also be included in the study.

CONCLUSION

Study concludes the effectiveness of FSB and PMR in improving lactation among postnatal mothers immediately after labor. A health care professional should advise such techniques to promote extensive breastfeeding.

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Trial Registration: The study got ethical clearance with reference no: NIPT/IEC/Min//06/2020-2021/ on 12-02-2022 and got registered under CTRI with reference number: CTRI/2022/05/042814.

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CONSORT FLOW DIAGRAM

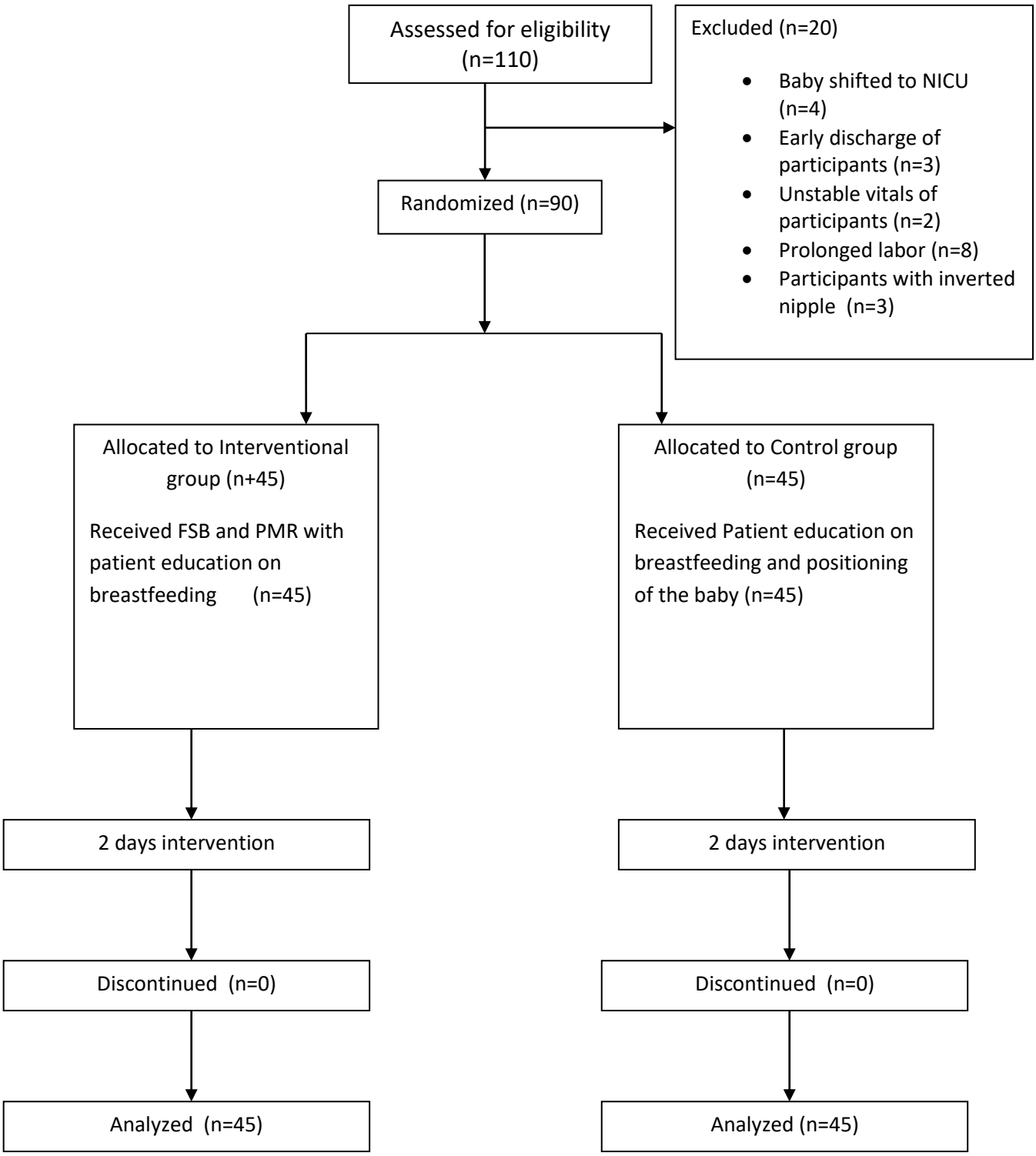

Table 1: ***Demographic Data***

(* Significant)

		Groups				Chi square test	P value
		Group A		Group B			
		n	%	n	%		
Family type	Nuclear	12	26.7	22	48.9	4.73	0.030*
	Joint	33	73.3	23	51.1		
Active during pregnancy	Yes	37	82.2	27	60.0	5.41	0.020*
	No	8	17.8	18	40.0		
Stress of labor	Yes	25	55.6	37	82.2	7.47	0.006*
	No	20	44.4	8	17.8		
Duration of labor (Hours)	< 3	13	28.9	3	6.7	11.99	0.007*
	3 to 6	12	26.7	9	20.0		
	6 to 12	18	40.0	24	53.3		
	> 12	2	4.4	9	20.0		
First breastfeeding (Hours)	In first half hourof delivery	17	37.8	7	15.6	9.90	0.007*
	After first half hour of delivery	16	35.6	12	26.7		
	After two hoursof delivery	12	26.7	26	57.8		

Table 2- ***Comparison of UNICEF breastfeeding assessments according to groups***

***QD: Questions answered on day 1 and day2**

		Groups				Chi-Square / Likelihood ratio#	p value
		Group A		Group B			
		N	%	n	%		
Q1D1: Your baby has at least 8-12 feedsin 24hours	Yes	43	95.6	26	57.8	15.99	< 0.001*
	No	2	4.4	17	37.8		
Q1D2: Your baby has at least 8-12 feedsin 24hours	Yes	45	100	44	97.8	1.40#	0.237
	No	0	0	1	2.2		
Q2D1: Your baby is generally calm andrelaxed when feeding and content after most feeds	Yes	45	100	37	82.2	11.87#	0.001*
	No	0	0	8	17.8		
Q2D2: Your baby is generally calm andrelaxed when feeding and content after most feeds	Yes	45	100	43	95.6	2.82#	0.093
	No	0	0	2	4.4		
Q3D1: Your baby will take deep rhythmic sucks and you will hear it	Yes	43	95.6	25	55.6	19.49	< 0.001*
	No	2	4.4	20	44.4		
Q3D2: Your baby will take deep rhythmic sucks and you will hear it	Yes	45	100	32	71.1	15.19	< 0.001*
	No	0	0	13	28.9		
Q4D1: Your baby will generally feed for between 5 and 40 minutes and will comeoff the breast spontaneously	Yes	43	95.6	25	55.6	19.49	< 0.001*
	No	2	4.4	20	44.4		
Q4D2: Your baby will generally feed forbetween 5 and 40 minutes and will come off the breast spontaneously	Yes	44	97.8	32	71.1	14.89	< 0.001*
	No	0	0	13	28.9		
Q5D1: Your baby has normal skin colour and is alert and waking for feeds	Yes	44	97.8	43	95.6	0.35#	0.553
	No	1	2.2	2	4.4		
Q5D2: Your baby has normal skin colour and is alert and waking for feeds	Yes	45	100	44	97.8	1.40#	0.237
	No	0	0	1	2.2		
Q6D1: Your baby has not lost more than10% weight	Yes	45	100	14	31.1	47.29	< 0.001*
	No	0	0	31	68.9		
Q6D2: Your baby has not lost more than10% weight	Yes	43	95.6	19	42.2	32.43	< 0.001*
	No	1	2.2	26	57.8		
Q7D1: At least 5-6 heavy, wet nappiesin 24hours	Yes	44	97.8	19	42.2	29.72	< 0.001*
	No	0	0	20	44.4		
Q7D2: At least 5-6 heavy, wet nappiesin 24hours	Yes	44	97.8	40	88.9	3.10#	0.078
	No	1	2.2	5	11.1		
Q8D1: At least 2 dirty nappies in 24hours, at least of 2 coin size, yellowand runny and usually more	Yes	45	100	29	64.4	22.85#	< 0.001*
	No	0	0	14	31.1		

Q8D2: At least 2 dirty nappies in 24hours, at least of 2 coin size, yellowand runny and usually more	Yes	45	100	43	95.6	2.82	0.093
	No	0	0	2	4.4		
Q9D1: Breasts and nipples are Comfortable	Yes	45	100	45	100	--	--
Q9D2: Breasts and nipples are comfortable	Yes	45	100	45	100	--	--
Q10D1: Nipples are the same shape atthe end of the feed as the start	Yes	45	100	45	100	--	--
Q10D2: Nipples are the same shape atthe end of the feed as the start	Yes	45	100	45	100	--	--

Table 3: Comparison of weight between groups

Weight			Before Feed				After Feed			
			Mean	S.D.	"t"	p value	Mean	S.D.	"t"	p value
Day 1	Morning	Experimental Group	2.91	0.31	1.14	0.258	2.97	0.30	2.11	0.038*
		Control group	2.83	0.32			2.76	0.55		
	Afternoon	Experimental Group	2.94	0.32	2.15	0.034*	3.00	0.32	2.99	0.004*
		Control group	2.80	0.31			2.80	0.32		
Day 2	Morning	Experimental Group	2.98	0.32	3.30	0.001*	3.05	0.33	4.07	< 0.001*
		Control group	2.75	0.34			2.76	0.34		
	Afternoon	Experimental Group	3.02	0.33	3.88	< 0.001*	3.10	0.35	4.78	< 0.001*
		Control group	2.74	0.35			2.74	0.35		
Day 3	Morning	Experimental Group	2.95	0.50	0.17	0.869	3.00	0.54	0.28	0.783
		Control group	2.92	0.33			2.93	0.32		
	Afternoon	Experimental Group	--	--	--	--	--	--	--	--
		Control group	2.51	0.00			2.51	0.00		

Table 4: Comparison of weight within the groups

Weight			Experimental Group				Control Group			
			Mean	S.D.	"t"	p value	Mean	S.D.	"t"	p value
Day 1	Morning	Before feed	2.91	0.31	-7.20	< 0.001*	2.83	0.32	1.00	0.325
		After feed	2.97	0.30			2.76	0.55		
	Afternoon	Before feed	2.94	0.32	-6.62	< 0.001*	2.80	0.31	-0.47	0.639
		After feed	3.00	0.32			2.80	0.32		
Day 2	Morning	Before feed	2.98	0.32	-4.50	< 0.001*	2.75	0.34	-1.38	0.174
		After feed	3.05	0.33			2.76	0.34		
	Afternoon	Before feed	3.02	0.33	-5.34	< 0.001*	2.74	0.35	-3.16	0.003*
		After feed	3.10	0.35			2.74	0.35		
Day 3	Morning	Before feed	2.95	0.50	-2.12	0.067	2.92	0.33	-2.17	0.082
		After feed	3.00	0.54			2.93	0.32		
	Afternoon	Before feed	--	--	--	--	2.51	0.00	--	--
		After feed	--	--			2.51	0.00		

Key Message

Lactation is the only source of nutrition for the new born. It not only has short term benefits but also has long term effect on immunity and reduces the risk of obesity and type 1 diabetes. Breastfeeding reduces morbidity and mortality for both infant and mother. Hence, World Health Organization suggests exclusive breastfeeding for 6 month after birth. However, the milk production and breastfeeding can be hampered immediately after birth due to various reasons.

In this study a relatively new technique called Four-square Breathing and Progressive Muscle Relaxation was incorporated. The two techniques were administered to mothers who delivered within 2-24hours. The study shows that the two techniques were safe and feasible to postnatal mothers. Result of the study concluded that the interventions were effective not only in improving volume of lactation, but also in improving frequency of lactation.

Thus, Four-Square Breathing and Progressive Muscle Relaxation are safe, feasible, cost effective techniques that help improving lactation without any adverse effect. They can be administered to mothers immediately after labor.

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