

# Study of Integrated Approach of Antenatal Care to improve the Gestational Age at Birth

<sup>1</sup>Shubhada Neel, <sup>2</sup>Narendra Malhotra, <sup>3</sup>EV Swaminathan, <sup>4</sup>Pandharinath B Neel, <sup>5</sup>Joseph Lazar, <sup>6</sup>EV Gireesh  
<sup>7</sup>Pushpa Pande, <sup>8</sup>BK Pradnya Pawar, <sup>9</sup>Jaideep Malhotra

## ABSTRACT

**Aim and objective:** Study of integrated approach of antenatal care (ANC) to improve the gestational age (GA) at birth.

**Materials and methods:** A total of 532 women attending the antenatal clinic at Neel clinic in Panvel, Navi Mumbai, India, were enrolled between 18 and 28 weeks of pregnancy from April 2015 to March 2017, in prospective nonrandomized, matched, interventional study.

A total of 254 women were enrolled in the study group; 278 women were enrolled in the control group. Women were matched for age, gravida, parity, educational, religion, and residential area.

### Integrated approach of ANC:

- Stress management through Rajyoga meditation (Brahma Kumaris).
- Nutritious and *satwik* food.
- Antenatal physical and breathing exercises.

Exercises, walking, and meditation were practiced by the study group from date of entry into the study until delivery. The control group walked ½ an hour twice a day (standard obstetric advice) during the study period. Compliance in both groups was ensured by frequent telephone calls and maintenance of a daily activity charts.

**Result:** Preterm labor was significantly lower (<0.02) in the study group.

**Conclusion:** Stress management through meditation and nutritional management may contribute to decreased risk

of premature delivery or low birth weight (LBW) babies, and eventually would decrease problems in the infant, children, adolescent, and fetal origin of adult diseases. Exercise during pregnancy would reduce the risk of cesarean delivery.

Integrated approach of ANC is safe, relatively cheap to implement, and would reduce the costs of long-term health care.

**Keywords:** Antenatal care, Antenatal exercise, Birth outcome, Integrated approach, Low birth weight, Preterm labor, Rajyoga meditation.

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## INTRODUCTION

Pregnancy is a unique state of physiological stress which necessitates physical, mental, and social adaptation. Even an uncomplicated pregnancy can result in some stress during pregnancy. Stress is unfortunately a common and ordinary side effect of living. Stress can, however, be particularly harmful during pregnancy. Studies show that very high level of stress may contribute to an increased risk of premature delivery or LBW babies.

Recent evidence suggests that pregnancy-specific stress, e.g., maternal fears and anxiety related to the outcome of the pregnancy, the experience of labor, the ability to care of a new infant, and the health and well-being of the infant may be an important independent construct in an integrated approach of assessment of stress exposure and its relationship to shortened gestation.<sup>1</sup> For example, in bivariate analyses, Wadhwa et al<sup>2</sup> found that pregnancy anxiety was significantly and negatively associated with length of gestation. Dunkel-Schetter<sup>3</sup> reported that findings from numerous prospective studies exploring the association between maternal stress and length of gestation confirm that “the strongest predictor of gestational length and preterm delivery of all stress concepts was a new variable, pregnancy anxiety.” Low birth weight, prematurity, and intrauterine growth retardation (IUGR) remain the leading causes of perinatal morbidity, mortality,

<sup>1</sup>Consultant and Ex-Associate Professor, <sup>2</sup>Managing Director, <sup>3</sup>Mind & Memory Management Expert, <sup>4</sup>Anesthetist <sup>5</sup>Ultrasonologist, <sup>6</sup>Inspirational Speaker and Trainer and Stress and Anger Management Expert, <sup>7</sup>Senior Consultant Gynecologist, <sup>8</sup>Meditation Expert, <sup>9</sup>President

<sup>1,3-5</sup>Neel Hospital Management Services Pvt. Ltd, Raigad Maharashtra, India

<sup>2,9</sup>Global Rainbow Healthcare, Agra, Uttar Pradesh, India

<sup>7</sup>Department of Gynecology, Bombay Hospital, Jabalpur Madhya Pradesh, India

<sup>6,8</sup>Divine Sanskar Research Foundation, Neel Clinic, Navi Mumbai, Maharashtra, India; Medical Wing, Rajyoga Education & Research Foundation, Prajapita Brahma Kumaris Ishwariya Vishwa Vidyalaya, Mount Abu, Rajasthan, India

**Corresponding Author:** Shubhada Neel, Consultant and Ex-Associate Professor, Neel Hospital Management Services Pvt. Ltd, Raigad, Maharashtra, India, Phone: +9102227467850 e-mail: dr.spneel@gmail.com

neurodevelopment impairments, and disabilities among newborn babies.<sup>4</sup>

In studies dating to the 1960s, psychosocial measures have been examined as possible risk factors contributing to adverse birth outcomes. Some studies show an increased risk of preterm birth among women experiencing a greater number of life events, increased anxiety, or increased perceived stress. A positive association showing that preterm deliveries have often been preceded by stressful situations has been reported by Austin and Leader.<sup>5</sup> Copper et al<sup>6</sup> also reported that women with a GA between the 25th and 29th weeks of pregnancy, who perceived their lives as being stressful, are at increased risk for spontaneous preterm birth and LBW. Wadhwa et al<sup>2</sup> found that increase of prenatal life event stress was associated with a decrease in infant birth weight and with a significant increase in the likelihood of LBW. Pritchard and Teo<sup>7</sup> studied the relationship between persistent stressful aspects of daily life and birth outcomes like preterm birth and LBW.

A few studies examining depression and pregnancy outcome have shown an association. A study involving women with depressive symptoms late in pregnancy showed that these women had risk of delivering a LBW, a preterm delivery, and IUGR.<sup>8,9</sup>

Anxiety during pregnancy and its association with adverse birth outcomes have been examined in a few studies, some of which found an association.<sup>10,11</sup>

During exposure to a stressor, the whole system of stress regulation, consisting of the hypothalamus–pituitary–adrenal cortex system and the sympathetic nervous system–adrenal medulla system, is activated.<sup>12</sup> Various hormones, including corticotropin-releasing hormone (CRH), adrenocorticotropin-releasing hormone (ACTH), cortisol, and noradrenalin, are released in large quantities into the systemic circulation. Pregnant women respond differently to identical stressful stimuli, depending on genetic factors, personality traits, previous experience, and social support. In addition, normal pregnancy is associated with physical alterations, hormonal changes (often associated with rapid changes in mood), anxiety regarding labor and fetal outcome, all of which potentially worsen the stress response. The interaction between all these factors renders evidence-based stress research with pregnant women difficult and complicated. Several attempts have been made to reduce stress in pregnancy.

Dr Veronica O’Keane, an expert in mental health in pregnancy, said “many thousands” of the unexplained premature births are likely to be caused by soaring levels of stress hormones—and they could be prevented by treating stress and depression in pregnancy. Research has evaluated the effectiveness of psychological interventions

and the possible value of social support systems, which have improved maternal and fetal general well-being. A review by Hoffman and Hatch,<sup>13</sup> covering the last 10 years of research on stress, social support, and pregnancy outcome, concluded that acute life stressors have direct effects on birth outcome, whereas strong partner or family support as a promoter of fetal growth can with almost equal certainty be ruled in.

Several trials showing interventions to reduce perinatal stress did not prove effective when rigorously evaluated.<sup>14–16</sup> A recent Cochrane database systematic review<sup>17</sup> undertook a meta-analysis of 16 trials (with a total of 13,651 women) and concluded that programs offering additional social support for at-risk pregnant women were not associated with improvements in any perinatal outcomes, but were associated with a decrease in cesarean births and an increase in elective termination of pregnancy. These interventional programs probably failed, as they were very focused and not holistic or comprehensive. Yoga, on the contrary, uses a holistic approach to stress reduction and has been used to promote positive health for centuries in India.<sup>18</sup>

Narendran et al<sup>19</sup> examined the effects of yoga in pregnancy and its outcomes and concluded that an integrated approach to yoga during pregnancy is safe. It improves birth weight, decreases preterm labor, and decreases IUGR either in isolation or associated with pregnancy-induced hypertension (PIH), with no increased complications. Yoga by its holistic approach to health appears to be safe in pregnancy and leads to improved outcomes.

Kiran et al<sup>20</sup> define Brahma Kumaris’ Rajyoga as a method of autogenic relaxation with spiritual link, providing training in realization of the true self, contemplation on divine “Supreme Being” and a dialogue with the supreme. Autogenic relaxation is defined as a method for influencing one’s autonomic nervous system. Kiran et al<sup>20</sup> further refine the definition of Rajyoga meditation as a spiritual-based relaxation therapy.

Kiran et al<sup>21</sup> define Rajyoga meditation as a method of meditation based on spirituality involving realization of true conscious of self, realization of attributes like peace, purity, happiness, bliss, love, power and knowledge and linking the self with “supreme being” by contemplating on Divine Supreme.

Gupta<sup>22</sup> defines Brahma Kumaris’ Rajyoga meditation is a science and art of harmonizing spiritual energy (energy of soul), mental energy (energy of mind) and physical energy (energy of physical body), through the connection with ultimate source of spiritual energy, i.e., Supreme Soul, for enjoying ever healthy, ever-wealthy, and ever-happy life.

Patel and Giorgio<sup>23</sup> insist that Rajyoga meditation is taught within the context of a lived faith complete with daily teachings, practices, and lifestyle observances.

Gupta et al<sup>24</sup> specify the practical experience of opening of coronary blockage with unique user-friendly healthy lifestyle-integrated approach of health care program—Rajyoga meditation, *satwik* low-fat high-fiber balanced diet, and daily morning walk with sunrise in Mount Abu open heart trial. It shows the benefits of Brahma Kumaris' Rajyoga meditation lifestyle, proven in angiographically documented coronary artery disease patients in the landmark research study on regression of coronary blockages and better control of hypertension, diabetes, obesity, etc., through healthy lifestyle-integrated approach of health care program. Even 100% calcified blockages opened up in persons who sincerely adhered to the prescribed program.

### Rajyoga Lifestyle Concept taught by Brahma Kumaris

Four principles, intrinsic to Rajyoga, which underlie the program ethos, are:

1. Self-responsibility through self-empowerment: The word "healthy" is derived from two words; "heal" + "thy," i.e., to heal yourself. To heal oneself, one needs to be empowered by appropriate and proper information about, soul–mind–body connection, psychological and conventional risk factors, stress management, diet, exercise, sleep, substance abuse, and usual medical care.
2. Self-awareness: The Hindi word for healthy is "swasth," which consist of swa- meaning "inner self" and –stha mean "inner self-conscious." Outer self-consciousness (of body, role or material things, which are ever-changing and mortal) leads to instability and insecurity, which in turn leads to anger, anxiety, depression, type A behavior, isolation, and chronic life stresses. Conversely, inner self-consciousness (of spirit, which is enduring and immortal) leads to stability, which in turn leads to peace, love, and happiness. So, by abstraction, a healthy lifestyle means an "inner self-conscious lifestyle."
3. Multidimensionality: The current medical approach addresses only one dimension, the physical body, which might explain why despite medical advancements, the epidemic of noncommunicable diseases has not been curbed. A human being is not one-dimensional. Therefore, a new model of health, "soul–mind–body medicine" (three-dimensional health care) is called for. As per this new model, health is a dynamic process of harmony in flow of spiritual energy (knowledge of truth, purity, peace,

love, happiness, bliss, and power: of discretion, to judge, to withdraw, to pack up, to tolerate, to face, to accommodate, and to cooperate), mental energy (positive T.E.A.M.: thoughts, emotions, attitudes, and memories) and physical energy (healthy diet, exercise, sleep, and medication).

4. Biological clock/circadian rhythm: When activities are in rhythm with one's biological clock, they reduce energy expense and stress, and prove beneficial for the health of mind, intellect, and body.

All four principles should be sustained as far as possible in daily living.

The three major components of integrated approach of ANC program are:

1. Stress management through Rajyoga meditation: Stress is defined as the mental state in which the internal and external pressure exceed the inner strength (coping mechanism) leading to sympathetic overactivity and release of stress hormones, which in turn leads to vicious cycle of mental disease. Inner strength can be increased by Rajyoga. Rajyoga word has been derived from "raja" meaning king and "yoga" meaning union between soul (spiritual energy) and supreme soul (ocean of spiritual energy). Rajyoga meditation harmonizes spiritual, mental, and physical energy, thereby increasing inner strength to lead a stress-free and healthy life. It enhances individual's power of determination to manage and practice positive thoughts, emotions, attitudes, memories, and adhere to healthy diet, exercise, sleep, medication. Expert Rajyoga teachers from Prajapita Brahma Kumaris Ishwariya Vishwa Vidyalaya, Mount Abu teach Rajyoga meditation in three different stages. During stage I (inner self-empowerment), patients are provided with knowledge about soul and supreme soul and trained to form a link with the supreme soul to draw spiritual energy. This is followed by sessions of training in opening and healing the mind. In stage II of opening and healing the mind, patients are made to understand the role of nonphysical factors like depression, anger, cynicism, hostility, ego, jealousy, hurry, worry, anxiety, fear, isolation, lack of social and emotional support, job and family stress, etc., in the development of stress, as these negative traits are acquired from the environment and are not part of the original inner self. They are trained to inculcate the positive mental energy thereby enhancing will power to adhere to healthy and happy lifestyle program. In stage III by Rajyoga meditation, they are asked to focus the inner, radiant spiritual energy on various organs of the body including the baby *in utero*. A meditation commentary is provided to guide the mind in

a positive direction. They are encouraged to maintain an inner self (soul) conscious mental state even while engaged in day-to-day work activities.

2. Low-fat, high-fiber vegetarian diet: The essential components of diet program were: what? (low-fat, high-fiber vegetarian), when? (as per biological clock), and how? (proper chewing in inner self-conscious state). Diet consists of low-fat, cholesterol intake restricted food. Soluble fiber from oat bran, fruits, vegetables, sprouted seeds, beans, salads, etc.; complex carbohydrates; proteins from soya bean and other vegetarian sources; antioxidants from sprouted seeds, fresh fruits, vegetables, and nuts. Beneficial effects of the prescribed diet were explained both to the patients and to their spouses by audiovisual means by the experts. Diet was served in silence with light music played to enhance the quality of environmental ambience. Diet charts were also provided to each patient.
3. Antenatal physical and breathing exercises: Physical exercises were taught by fitness specialist. The physical exercises were performed while standing, sitting, lying prone or supine on the floor. The physical exercises take each joint in the body through full verge of motion: stretching, strengthening, and balancing each body part. Internal awareness and synchronization of physical postures with breathing is considered critical and important.

Rajyoga lifestyle as taught by Brahma Kumaris includes daily Rajyoga meditation practices, positive thinking classes, *satwik* food (food that is prepared in Godly remembrance and offered to God before taking), and practice of soul consciousness. There has been increasing calls from research bodies in India for further research projects to measure the efficacy of Rajyoga meditation and Rajyoga lifestyle as adjunct therapy in a number of medical conditions. At present, there is no study from the organization regarding the role or safety of Rajyoga meditation during pregnancy. This study is conducted to test the hypotheses that stress management in pregnancy using Rajyoga meditation as a part of integrated ANC, whether it would improve the pregnancy and childbirth outcomes. Scientific basis of the study was an attempt to study the impact of integrated approach of ANC to improve the GA at birth.

## MATERIALS AND METHODS

A total of 1,986 women were screened for ANC in the outpatient department at Neel clinic from March 2015 to April 2017. Out of 1986 screened women, 736 women registered for delivery at Neel clinic; 204 women were excluded as per exclusion criteria; 532 patients were matched for age, occupation, education, religion, residential area, socioeconomic status, gravida, and parity. Only

254 patients who were willing to follow the integrated approach of ANC, comparing of *satwik* vegetarian diet, exercise and walking, and meditation and were willing to sign the consent form were enrolled in study group; 278 patients were not willing to follow the integrated approach of ANC were enrolled in the control group. Patients who were unwilling to participate in the study group gave reason, such as

- Not able to follow *satwik* diet.
- Unable to come regularly for exercise and meditation.
- Family members disliked the ideas of their participation in the research.

The inclusion criteria are as given below:

- Age 18 to 35 years
- Any gravid (primi or multigravida), any para
- Second/third trimester (18–28 weeks)
- Singleton pregnancy
- No major obstetric or medical complications according to the prenatal check chart as detected at the time of prenatal registration
- Normal extremities and able to undertake physical activities
- Able to listen, speak, read, and write in Hindi/Marathi/English
- No prior experience of practicing Rajyoga meditation
- Had not undertaken regular physical exercise for at least 1 year

Medically high-risk pregnancies developed after enrollment continued to be part of the trial and were not excluded.

## Exclusion Criteria

- Age less than 18 or more than 35 years
  - Medically high-risk pregnancies like preeclampsia, heart disease in pregnancy, severe anemia in pregnancy (hemoglobin less than 5 gm %), diabetes in pregnancy, asthma, tuberculosis, convulsive disease during pregnancy, and medical renal disease
  - Previous cesarean delivery
  - History of previous pregnancy loss due to known chromosomal disorders, fetal malformations
  - *In vitro* fertilization
  - Bad obstetric history
    - Previous H/O more than 1 abortion
    - Previous H/O Intrauterine fetal death
  - Does not believe in the presence of Supreme Being
- The study received approval from the director of the hospital.
- The consent form was kept as a separate sheet. The information was kept completely confidential. Informed consent form was filled from all the subjects participating in this study to take their consent to participate in this study and to present/publish the



information collected in scientific forum, paper, and media or in any other form. The information subsequently shared/published would be without personally identifying any individual and maintaining confidentiality.

- The pregnant woman had the freedom to withdraw from the study at any point without it affecting her treatment in any way at the hospital.

Integrated approach of ANC included: (physical, mental, and spiritual care).

- Stress management through Rajyoga meditation (as taught by Brahma Kumaris)
- Nutritious and *satwik* food
- Antenatal physical and breathing exercises

All members of the study group were asked to practice the exercises at home at least 3 times a week, starting after the first practice session and continuing till delivery to ensure compliance with the research protocol. Compliance was ensured by frequent telephone calls and maintenance of a strict daily activity charts.

- They were asked to practice Rajyoga meditation from the date of entry into the study until delivery. They were asked to meditate for 30 minutes daily which could be once a day, or split into 2 to 3 sessions, with total duration being of 30 minutes/day. The recommended timing for mediation was *amritvela* (early hours of the day) evening meditation, and meditation before sleep.
- Physical exercises were taught by fitness specialist. The physical exercises were performed while standing, sitting, lying prone or supine on the floor. The physical exercises take each joint in the body through full verge of motion: stretching, strengthening, and balancing each body part. Internal awareness and synchronization of physical postures with breathing are considered critical and important. They were asked to follow the following exercises:

(1) Walking, (2) breathing exercises, (3) strengthening and mobility exercises, (4) stretching exercises, (5) ergonomics (postural correction), and (6) exercises before labor.

Strengthening and mobility exercises included ankle toe movement, Kegel's exercises, static back, static abdomen, pelvic tilting exercises, trunk rolling, cat and camel exercises, and straight leg raising in supine.

Stretching exercises included back stretching exercises, leg (lower limb) stretching exercises, squat position, and butterfly exercise.

Exercises before labor included breathing exercises, positions for labor, squat position, and butterfly exercise

Exercises had the following benefits:

- Pregnancy usually leaves women feeling tired; exercise gives more energy to make through the day.

- Exercise allows better sleep.
- Improves mood, lessens mood swings, improves self-image, and gives some sense of control.
- Prepares for childbirth. Studies show shorter labor, fewer medical interventions, and less exhaustion during labor.
- Subsequently, women were asked to practice integrated approach of ANC, i.e., Rajyoga meditation and physical breathing exercises at home and were revised and reviewed every 2 to 4 weeks during their routine antenatal visits.
- Group II was the control group and was comprised of those women who were living the life as they normally live with no interventions or education by the researchers. They, however, received normal ANC and medical interventions as indicated. They were asked to walk 30 minutes twice a day (standard obstetric advice) during the study period.
- Compliance in both groups was ensured during ANC follow-up/telephone calls and strict maintenance of a weekly chart.
- Objectives that were serially measured during the antenatal visits and labor as detailed in the case pro forma:

Pregnant women were closely monitored during their routine antenatal visits. The following variables were measured at each visit:

- Blood pressure: A value  $\geq 140/90$  mm of Hg on two separate occasions (6 hours apart) or an increase by 15 mm from baseline value after the 20th week was considered as PIH.
- Ultrasound scanning to monitor fetal growth IUGR being defined as estimated weight less than the 10th percentile.
- Doppler ultrasound of the uterine and umbilical vessels to calculate the resistance index.

At birth, the following variables were measured:

- Mode of delivery (vaginal *vs* cesarean section)
- GA in weeks at birth
- Birth weight (grams) at birth

## RESULTS

A total of 532 pregnant women were included in the analysis (Table 1) for a comparison of the subject demographic characteristics. No significant difference was found in any of the demographic characteristics between the two groups. Compared with the control group, the interventional group (integrated approach of ANC) had a statistically significant decrease in preterm deliveries (Table 2).

Statistical analysis was performed using the Statistical Package for the Social Sciences software. By applying univariate analysis and Pearson chi-square, it does not

**Table 1:** Demographic and maternal characteristics

Variable	Study group (n = 254)	Percentage	Control group (n = 278)	Percentage	p-value
Mean marriage age	26.42		26.03		0.14*
<i>Education</i>					0.26*
Nongraduate	129	50.8	174	62.6	
Graduate	82	32.3	73	26.3	
Postgraduate	43	16.9	31	11.2	
<i>Occupation</i>					0.17*
Employed	69	27.2	59	21.2	
Unemployed	185	72.8	219	78.8	
<i>Residence</i>					
Urban	183	72.0	176	63.3	
Rural	71	28.0	102	36.7	
<i>Religion</i>					0.30*
Hindu	233	91.7	234	84.2	
Muslim	7	2.8	16	5.8	
Sikh	1	0.4	1	0.4	
Christian	2	0.8	10	3.6	
Buddhist	11	4.3	17	6.1	
<i>Socioeconomic status</i>					0.38*
Lower	1	0.4	3	1.1	
Middle	253	99.6	274	98.6	
High	0	0	1	0.4	
<i>Gravida</i>					0.24*
1	138	54.3	165	59.4	
2	78	30.7	77	27.7	
3	32	12.6	25	9.0	
>4	6	2.4	11	4.0	
<i>Parity</i>					0.35*
0	177	69.7	211	75.9	
1	72	28.3	49	17.6	
2	5	2	13	4.7	
>2	0	0	5	1.8	

\*There is no statistically significant difference between groups;  $p > 0.05$

**Table 2:** Labor outcomes

Variable	Study group (n = 254)	Percentage	Control group (n = 278)	Percentage	p-value
Preterm delivery	7	2.8	30	10.8	
<i>GA at delivery</i>					0.02*
<37 wk	7	2.8	30	10.8	
>37 wk	247	97.2	248	89.2	

\*Pearson chi-square shows statistically significant difference between groups, p-values, and significance;  $p < 0.05$  univariate analysis between groups, p-values, and significance

show significant difference statistically as  $p\text{-value} > 0.05$  (Table 1).

By applying Pearson chi-square, linear by association, and univariate analysis, it does show significant difference statistically, as the  $p\text{-value}$  is  $< 0.05$  (Table 2). Preterm labor was significantly lower ( $< 0.02$ ) in the study group.

Results were considered to be statistically significant if  $p\text{-value} < 0.05$ .

## DISCUSSION

In this study, we evaluated the impact of integrated approach of ANC to improve the GA at birth. Integrated approach of ANC was started at mid-gestation and

continued until delivery. We compared this study group with matched control group who were similar in patient demographic characteristic, but who followed standard obstetric advice, i.e., daily walk for  $\frac{1}{2}$  an hour twice a day. The integrated approach of ANC group had a statistically significant increase in mean GA at delivery and reduced preterm delivery, given the larger picture of multiple failed attempts to reduce prematurity due to stress and anxiety during pregnancy in the last decade. This study provides a potential intervention that might improve pregnancy outcome. Result from present study, an integrated ANC, suggest that pregnant women should be motivated to adopt this integrated approach of ANC concept.

## Integrated Approach of ANC

We speculate that integrated approach of ANC concept and its action mediate through there commonly postulated mechanisms:

- *Satwik vegetarian diet*: The diet rich in fruits, vegetables, and fiber can take care of poor nutrition and micronutrient deficiency. Poor nutrition and micronutrient deficiency play a role as a pregnancy stressor. So *satwik* vegetarian diet plays an important role in eliminating this pregnancy stressor by taking care of poor nutrition and micronutrient deficiency.
- *Beneficial effects of Exercise*: Exercise incorporates relaxation and breathing technique with postures which is adapted by pregnant mothers which help in reducing stress, anxiety, and depression during pregnancy.
- *Rajyoga meditation*: It may be mediated as interaction between the autonomic nervous system and the endocrine system. Shift of autonomic balance toward relative parasympathetic predominance, besides causing marked reduction in secretion of stress hormones like epinephrine, norepinephrine, and cortisol. Rajyoga is also attaining in awareness, which produces definite changes in perception, attention, and cognition. During Rajyoga meditation, the practitioner remains awake and vigilant, but the body enters a state of deep muscle relaxation. It also helps in building strong will power for compliance with integrated approach of ANC programmer. It teaches a holistic lifestyle modification. It also enhances inner strength to lead a stress-free and healthy life. It might have caused a marked reduction in psychologically favorable stressor and modified unhealthy behavioral pattern, which in turn may be responsible for improvement in the duration of GA at delivery, the possible mechanism that has been postulated.

## Physiology Role of CRH in Parturition

Pregnancy is the only known physiological state in humans in which CRH circulates in plasma at levels that would normally activate the pituitary-adrenal axis.<sup>25</sup> In addition, pregnancy is characterized by hypercortisolism. The source of this elevation in cortisol could be in part secondary to increases in free CRH as pregnancy progresses.<sup>26</sup> However, to a large extent, circulating CRH in pregnancy appears to be tightly bound to a CRH-binding protein that may limit its bioactivity until the end of pregnancy, when CRH may play a role in the initiation of parturition.<sup>27</sup> During human pregnancy, the CRH gene is also expressed in the placenta and membranes and results in the increasing production and release of placental CRH into both maternal and fetal compartments over the course of gestation.<sup>28,29</sup>

A growing body of empirical evidence supports a central role for placental CRH in orchestrating and coordinating fetal and maternal endocrine events involved in parturition. Placental CRH also directly acts on the uterus and cervix to augment changes produced by estrogens on these tissues. The CRH interacts with prostaglandins and oxytocin, the two major uterotonins likely responsible for the stimulation and maintenance of myometrial contractility at term and during labor.<sup>30,31</sup>

## Pathophysiology of Stress Role of CRH in Preterm Birth

### *Role of CRH as the Mediator of the Stress Response*

The stress system includes the CRH neurons in the paraventricular nucleus of the hypothalamus. When CRH is released from the median eminence of the hypothalamus, it exerts a powerful effect on the pituitary by releasing ACTH, thus regulating the glucocorticoid response to stress.<sup>32,33</sup>

Placental CRH is stress-sensitive. Maternal psychosocial stress is significantly correlated with maternal pituitary-adrenal hormone levels; both ACTH and cortisol stimulate placental CRH secretion. Thus, depending on the chronicity of the stressor, the resultant increase in CRH production may be a critical factor that contributes to spontaneous preterm labor and impaired fetal growth.<sup>28</sup>

### *Stress and Endocrine-immune Interaction leading to Infection and Preterm Birth*

Stress, anxiety, and depression in pregnancy are a major cause of premature birth, experts have warned. Research shows that stress hormones—which play a crucial role in the development of the unborn baby—shoot up in women who are depressed during pregnancy. High levels of these hormones are involved in triggering labor, leading scientists to believe that they could be behind many of the premature births that occur each year—with potentially devastating results. Because production of CRH appears to be stress-sensitive, this neuropeptide may play a critical role in the physiological mediation among stressful experiences, work stress, and fasting and risk of preterm birth. A direct relationship between maternal psychological stress/distress and LBW, prematurity and IUGR may be related to the release of catecholamines, which results in placental hypoperfusion and consequent restriction of oxygen and nutrients to the fetus, leading to fetal growth impairment and/or precipitation of preterm delivery.<sup>6,34</sup> In addition to the direct effect of elevated CRH on the initiation of labor, it may have an immunomodulatory effect such that women with high levels of CRH may be more susceptible to infection or the pathological consequences

of infection. Higher amounts of a stress-related corticosteroid or opiate increase the vulnerability to infectious diseases (particularly chorioamnionitis).

The mechanisms underpinning the association between stress and these immunological changes involve the hypothalamic-pituitary-adrenal axis and the autonomic system, glucocorticoids, and catecholamines. Under conditions of chronic stress, moderate-to-high levels of glucocorticoids exert several direct effects on the immune system. Cortisol also indirectly affects the immune system by modulating the expression of the parasympathetic and sympathetic components of the nervous system on thymocytes, monocytes, and macrophages.<sup>35,36</sup>

Proinflammatory cytokines promote spontaneous labor and rupture of membranes via synthesis and release of prostaglandins and metalloproteases in the gestational tissues; the production of inflammatory cytokines, cortisol, and dehydroepiandrosterone sulfate in the fetus; and CRH synthesis in the placenta.<sup>37-40</sup>

In one study, a cross-sectional investigation of a sample of 72 pregnant women, high levels of maternal psychological stress and low levels of social support were significantly associated with depression of lymphocyte activity.<sup>41</sup>

A higher degree of neuromuscular reactivity and increases in the secretion of oxytocin are other important direct mediators.<sup>34</sup>

### *Patterns of Poor Nutrition and the Risk of IUGR and Preterm Birth*

The risk of preterm birth and poor fetal growth is multifactorial and the maternal stress response appears to be influenced by other conditions, such as work strain and poor nutrition. These interactions are further influenced by the role of stress on neuro-endocrine-immune interactions, increasing the risk for infections, which are thought to play an important role in the pathophysiology of preterm labor. Poor nutrition by itself has emerged as a very important component of the stress syndrome that needs further characterization in the pathways for the risk of infection, poor fetal growth, and preterm birth. The Dutch famine in 1944 to 1945 is the best example of the effect of timing of poor nutrition on LBW<sup>42</sup> and preterm birth.

When the fetus is exposed to maternal stress or poor nutrition, maternal and fetal adaptations prepare it (fetal programming) for early delivery and survival in a hostile environment. However, the fetus pays a price for this chance to survive. Intrauterine programming significantly increases the risk for the early onset of adult diseases (known as the fetal origins of adult diseases). Barker and Osmond<sup>43</sup> were the first to show that LBW increased the

risk of coronary heart disease in adult life. Subsequently, different profiles of poor fetal growth for each trimester were found to be associated with hypertension and/or diabetes and stroke.<sup>44</sup> Even infants born preterm are at elevated risk of coronary heart disease.<sup>45</sup>

### *Indirect Mediators*

The relationship may be indirect; stressed or distressed women are more likely to smoke cigarettes or use substances, such as alcohol and caffeine.<sup>46</sup> According to Paarlberg et al,<sup>47</sup> there is a tendency to a higher muscular tone in stressing conditions, which can probably potentiate early contractions, triggering preterm labor, especially in the later phases of pregnancy. The interaction of maternal stress exposure and nutritional deficiency on the risk of adverse birth outcomes and the possible biochemical mechanisms of this interaction are also proposed.

## **CONCLUSION**

The study finding suggests that integrated approach of ANC practices by its holistic approach to health appears to be safe in pregnancy and leads to improved pregnancy outcome. It decrease the preterm labor; therefore, the results provide evidence of the benefit of using integrated approach of ANC as an alternative nursing intervention to improve the quality at maternal and child health care. This study provides an index for future research on integrating the integrated approach of ANC in caring for pregnant women with other health conditions. The enrolled women did not have risk feature for the poor pregnancy outcomes (LBW or prematurity) common in developing countries, such as poor socioeconomic status, excessive physical stress, maternal malnutrition, or disease. It is possible that greatest benefits of integrated approach of ANC might be seen in higher stress environment.

The drawbacks of the study were that it was not a randomized controlled trial, no stress scores were recorded either pre- or postintegrated approach of ANC, and the patients' selection bias of self-selected groups. Therefore, based on this pilot study, we advocate randomized controlled trial in a large population to definitely demonstrate the beneficial effects of integrated approach of ANC on pregnancy and labor outcomes.

Stress management through Rajyoga meditation, nutritional management, and exercise may contribute to decreased risk of premature delivery or LBW babies and eventually would decrease (1) Developmental and behavioral problems in the children, as a toddler and adolescent, (2) risk of developing depression later in life, (3) later mental health problems in the mother, and (4) fetal origin of adult diseases, such as insulin-dependent diabetes mellitus,



hypertension, and coronary heart disease. Increased exercise during pregnancy would reduce the risk of cesarean delivery.

Integrated approach of antenatal care is safe, relatively cheap to implement, and would reduce the costs of long-term health care.

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## REFERENCES

1. Da Costa D, Larouche J, Dritsa M, Brender W. Variations in stress levels over the course of pregnancy: factors associated with elevated hassles, state anxiety and pregnancy-specific stress. *J Psychosom Res* 1999 Dec;47(6):609-621.
2. Wadhwa PD, Sandman CA, Porto M, Dunkel-Schetter C, Garite TJ. The association between prenatal stress and infant birth weight and gestational age at birth: a prospective investigation. *Am J Obstet Gynecol* 1993 Oct;169(4):858-865.
3. Dunkel-Schetter C. Maternal stress and preterm delivery. *Prenat Neonatal Med* 1998;3:39-42.
4. WHO. Physical status: the use and interpretation of anthropometry. Technical Report Series 854. Geneva: World Health Organization; 1995.
5. Austin MP, Leader L. Maternal stress and obstetric and infant outcomes: epidemiological findings and neuroendocrine mechanisms. *Aust N Z J Obstet Gynaecol* 2000 Aug;40(3):331-337.
6. Copper RL, Goldenberg RL, Das A, Elder N, Swain M, Norman G, Ramsey R, Cotroneo P, Collins BA, Johnson F, et al. The preterm prediction study: maternal stress is associated with spontaneous preterm birth at less than 35 weeks' gestation. *Am J Obstet Gynecol* 1996 Nov;175(5):1286-1292.
7. Pritchard CW, Teo PY. Preterm birth, low birthweight and the stressfulness of the household role for pregnant women. *Soc Sci Med* 1994 Jan;38(1):89-96.
8. Steer RA, Scholl TO, Hediger ML, Fischer RL. Self-reported depression and negative pregnancy outcomes. *J Clin Epidemiol* 1992 Oct;45(10):1093-1099.
9. Orr ST, Miller CA. Maternal depressive symptoms and the risk of poor pregnancy outcome: review of literature and preliminary findings. *Epidemiol Rev* 1995;17(1):165-171.
10. Gorsuch RL, Key MK. Abnormalities of pregnancy as a function of anxiety and life stress. *Psychosom Med* 1974;36(4):352-362.
11. Molfese VJ, Bricker MC, Manion LG, Beadnell B, Yaple K, Moires KA. Anxiety, depression and stress in pregnancy: a multivariate model of intra-partum risks and pregnancy outcome. *J Psychosom Obstet Gynecol* 1987 Oct;7(2):77-92.
12. Mulder EJ, Robles de Medina PG, Huizink AC, Vanden Bergh BR, Buitelaar JK, Visser GH. Prenatal maternal stress: Effects on pregnancy and the (unborn) child. *Early Hum Dev* 2002 Dec;70(1-2):3-14.
13. Hoffman S, Hatch MC. Stress, social support and pregnancy outcome: a reassessment based on recent research. *Paediatr Perinat Epidemiol* 1996 Oct;10(4):380-405.
14. Fenster L, Schaefer C, Mathur A, Hiatt RA, Pieper C, Hubbard AE, Von Behren J, Swan SH. Psychologic stress in the workplace and spontaneous abortion. *Am J Epidemiol* 1995 Dec;142(11):1176-1183.
15. Villar J, Farnot U, Barros F, Victora C, Langer A, Belizan JM. A randomized trial of psychosocial support during high risk pregnancies. The Latin American Network for Perinatal and Reproductive Research. *N Engl J Med* 1992 Oct;327(18):1266-1271.
16. Langer A, Farnot U, Garcia C, Barros F, Victora C, Belizan JM, Villar J. The Latin American trial of psychosocial support during pregnancy: effects on mother's wellbeing and satisfaction. Latin American Network for Perinatal and Reproductive Research (LANPER). *Soc Sci Med* 1996 Jun;42(11):1589-1597.
17. Hodnett ED, Fredericks S. Support during pregnancy for women at increased risk of low birth weight babies. *Cochrane Database Syst Rev* 2003;3:CD000198.
18. Collins C. Yoga: intuition, preventive medicine, and treatment. *J Obstet Gynecol Neonatal Nurs* 1998 Sep-Oct;27(5):563-568.
19. Narendran S, Nagarathna R, Narendran V, Gunasheela S, Nagendra HR. Efficacy of Yoga on pregnancy outcome. *J Altern Complement Med* 2005 Apr;11(2):237-244.
20. Kiran U, Behari M, Venugopal P, Vivekanandhan S, Pandey RM. The effect of autogenic relaxation on chronic tension headache and in modulating Cortisol response. *Indian J Anaesth* 2005 Dec;49(6):474-478.
21. Kiran U, Makhija N, Malik V, Gharde P. Relaxation therapies in pain management. *Indian J Pain* 2009;23:218-225.
22. Gupta SK. Soul-Mind-Body medicine for healthy happy living: for prevention of angina and heart attacks. World Congress on Clinical and Preventative Cardiology, 22-24 Sep 2006. Souvenir Program.
23. Patel N, Giorgio B. Meditation in a lived faith context as therapeutic intervention for substance abuse, dependence and addiction: an empirical study. *Arch Indian Psychiatry* 2005;7(1):52-56.
24. Gupta SK, Sawhney RC, Rai L, Chavan VD, Dani S, Arora RC, Selvamurthy W, Chopra H, Nanda NC. Regression of coronary atherosclerosis through healthy lifestyle in coronary artery

- disease patients—Mount Abu opens heart trial. *Indian Heart J* 2011 Sep-Oct;63(5):461-469.
25. Sasaki A, Shinkawa O, Yoshinaga K. Placental corticotropin-releasing hormone may be a stimulator of maternal pituitary adrenocorticotrophic hormone secretion in humans. *J Clin Invest* 1989 Dec;84(6):1997-2001.
  26. Hobel CJ, Dunkel-Schetter C, Roesch SC, Castro LC, Arora CP. Maternal plasma corticotropin-releasing hormone associated with stress at 20 weeks' gestation in pregnancies ending in preterm delivery. *Am J Obstet Gynecol* 1999 Jan;180(1 Pt 3):S257-S263.
  27. McLean M, Bisits A, Davies J, Woods R, Lowry P, Smith R. A placental clock controlling the length of human pregnancy. *Nat Med* 1995 May;1(5):460-463.
  28. Challis JR, Matthews SG, Van Meir C, Ramirez MM. Current topic: the placental corticotropin-releasing hormone-adrenocorticotropin axis. *Placenta* 1995 Sep;16(6):481-502.
  29. Petraglia F, Florio P, Nappi C, Genazzani AR. Peptide signaling in human placenta and membranes: autocrine, paracrine, and endocrine mechanisms. *Endocr Rev* 1996 Apr;17(2):156-186.
  30. Jones SA, Challis JR. Steroid, corticotropin-releasing hormone, ACTH and prostaglandin interactions in the amnion and placenta of early pregnancy in man. *J Endocrinol* 1990 Apr;125(1):153-159.
  31. Quartero HW, Noort WA, Fry CH, Keirse MJ. Role of prostaglandins and leukotrienes in the synergistic effect of oxytocin and corticotropin-releasing hormone (CRH) on the contraction force in human gestational myometrium. *Prostaglandins* 1991 Aug;42(2):137-150.
  32. Rivier C, Vale W. Interaction of gonadotropin-releasing hormone agonist and antagonist with progesterone, prolactin, or human chorionic gonadotropin during pregnancy in the rat. *Endocrinology* 1982 Feb;110(2):347-351.
  33. Chrousos GP. Regulation and dysregulation of the hypothalamic-pituitary-adrenal axis. The corticotropin-releasing hormone perspective. *Endocrinol Metab Clin North Am* 1992 Dec;21(4):833-858.
  34. Omer H. Possible psychophysiologic mechanisms in premature labor. *Psychosomatics* 1986 Aug;27(8):580-584.
  35. McEwen BS, Biron CA, Brunson KW, Bulloch K, Chambers WH, Dhabhar FS, Goldfarb RH, Kitson RP, Miller AH, Spencer RL, et al. The role of adrenocorticoids as modulators of immune function in health and disease: neural, endocrine and immune interactions. *Brain Res Brain Res Rev* 1997 Feb;23(1-2):79-133.
  36. Chrousos GP. Stressors, stress, and neuroendocrine integration of the adaptive response. The 1997 Hans Selye Memorial Lecture. *Ann N Y Acad Sci* 1998 Jun;851:311-335.
  37. Petraglia F, Sutton S, Vale W. Neurotransmitters and peptides modulate the release of immunoreactive corticotropin-releasing factor from cultured human placental cells. *Am J Obstet Gynecol* 1989 Jan;160(1):247-251.
  38. Falkenberg ER, Davis RO, Dubard M, Parker CR Jr. Effects of maternal infections on fetal adrenal steroid production. *Endocr Res* 1999;25(3-4):239-249.
  39. Romero R, Mazor M, Munoz H, Gomez R, Galasso M, Sherer DM. The preterm labor syndrome. *Ann N Y Acad Sci* 1994 Sep;734:414-429.
  40. Romero R, Gomez R, Ghezzi F, Yoon BH, Mazor M, Edwin SS, Berry SM. A fetal systemic inflammatory response is followed by the spontaneous onset of preterm parturition. *Am J Obstet Gynecol* 1998 Jul;179(1):186-193.
  41. Herrera JA, Alvarado JP, Martinez JE. The psychosocial environment and cellular immunity in the pregnant patient. *Stress Med* 1988 Jan-Mar;4(1):49-56.
  42. Stein Z, Susser M. The Dutch famine, 1944-1945, and the reproductive process. I. Effects on six indices at birth. *Pediatr Res* 1975 Feb;9(2):70-76.
  43. Barker DJ, Osmond C. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *Lancet* 1986 May;1(8489):1077-1081.
  44. Godfrey K, Robinson S, Barker DJ, Osmond C, Cox V. Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. *BMJ* 1996 Feb;312(7028):410-414.
  45. Rich-Edwards JW, Stampfer MJ, Manson JE, Rosner B, Hankinson SE, Colditz GA, Willett WC, Hennekens CH. Birth weight and risk of cardiovascular disease in a cohort of women followed up since 1976. *BMJ* 1997 Aug;315(7105):396-400.
  46. McAnarney ER, Stevens-Simons C. Maternal psychological stress/depression and low birth weight. *Am J Dis Child* 1990 Jul;144(7):789-792.
  47. Paarlberg KM, Vingerhoets AJ, Passchier J, Dekker GA, Van Geijn HP. Psychosocial factors and pregnancy outcome: a review with emphasis on methodological issues. *J Psychosom Res* 1995 Jul;39(5):563-595.