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Presented at the 70th Annual Meeting of the Central Association of Obstetricians and Gynecologists, October 2003, San Diego, California

C. Doug Odom, MD,<sup>1</sup> Suneet P. Chauhan, MD,<sup>1\*</sup> Everett F. Magann, MD,<sup>2\*\*</sup> Rick W. Martin, MD,<sup>2</sup> Carl H. Rose, MD,<sup>2\*\*\*</sup> John C. Morrison, MD<sup>1</sup>

1. Department of Obstetrics and Gynecology, Mississippi Baptist Medical Center, Jackson, Mississippi (CDO)
2. University of Mississippi Medical Center, Jackson, Mississippi

\*Present address: Aurora Women's Pavilion, West Allis, Wisconsin

\*\*Present address: Naval Medical Center, Portsmouth, Virginia

\*\*\*Present address: Mayo Clinic, Rochester, New York

A Peer-Reviewed Journal on Nutraceuticals and Nutrition

Mark Houston, MD

Editor-in-Chief

ISSN-1521-4524

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## ABSTRACT

### Objective

Comparison of post-delivery pregnancy outcome variables in women who either did or did not add to their daily diet a concentrated, encapsulated fruit and vegetable juice powder (FVJP) along with standard prenatal vitamins during gestation.

### Design

Retrospective analytic comparison of charted singleton pregnancy outcome variables at delivery.

### Setting

Private obstetrics and gynecology practice in Jackson, Mississippi.

### Subjects

The pregnancy outcome information was collected from 356 pregnant women, half of whom added FVJP to their standard prenatal care.

### Measures of Outcome

Documented obstetric complications by medical staff at the time of delivery.

### Results

Women who added FVJP to their prenatal regimen had fewer Cesarean deliveries (47% vs 66%), no delivery before 37 weeks (0 vs 20%), and no diagnosis of preeclampsia (0 vs 21%) compared to women who did not.

### Conclusions

The findings of this retrospective chart review suggest that adding nutrition from FVJP to standard prenatal vitamin use may reduce the incidence of some obstetric complications. More study is needed to confirm these observations.

## INTRODUCTION

Current nutritional recommendations for pregnant women are based on the USDA Food Guide Pyramid and include four servings of vegetables and three servings of fruit, daily.<sup>1</sup> However, only 20.6% of women surveyed in

<sup>++</sup>Correspondence:

John C. Morrison, MD

Department of Obstetrics & Gynecology  
University of Mississippi Medical Center  
2500 North State Street

Jackson, Mississippi 39216-4505

Phone: 601-984-5350 Fax: 601-984-5378

E-mail: [jmorrison@ob-gyn.umsmed.edu](mailto:jmorrison@ob-gyn.umsmed.edu)

Mississippi (MS) reported consuming five or more servings of fruits and vegetables per day in 2003.<sup>2</sup> These foods, particularly the deeply pigmented varieties, provide a wide array of phytonutrients with antioxidant activity, including carotenoids and vitamins such as folate and vitamin C, while also being low in calories and fat.<sup>3</sup> As recently reviewed by Roberts et al, nutritional interventions anticipated to reduce complications during pregnancy have focused mainly on macronutrients such as protein or specific lipids, minerals such as calcium, zinc or iron, and relatively high doses of isolated vitamins such as vitamin C and vitamin E.<sup>4</sup> Although oxidative stress is one of several etiologies theorized to be involved in the development of preeclampsia, currently there are no studies available on the incidence of this complication in the final trimester and at delivery that focus on increased fruit and vegetable consumption in pregnant women throughout gestation.

Common and undesirable obstetric complications include preterm labor, preterm birth, preterm premature rupture of membranes (PPROM), low birth weight, preeclampsia, and intrauterine growth restriction. This retrospective analytic study is from one OBGYN practice averaging 471 deliveries annually in Jackson, Mississippi, a practice that includes many women at high risk for obstetric complications. The study was initiated after the nurses noticed that mothers who used a specific fruit and juice powder product (FVJP) reported anecdotally that they experienced fewer obstetric complications than other mothers served by the same practice. This nutritional product has been reported to both increase the concentration of blood antioxidants<sup>5-7</sup> and reduce homocysteine,<sup>8,9</sup> an amino acid reported elevated in women who developed preeclampsia.<sup>4</sup> These studies in healthy adults provided a biologic rationale for the observations of the nursing staff. The purpose of this investigation was to evaluate the hospital records for docu-

mented complications at delivery of mothers from this OBGYN practice who either chose to use a specific nutritional FVJP supplement (Group I) or not (Group II).

## MATERIALS AND METHODS

### Subjects

The study was approved by the Human Use Committee of Mississippi Baptist Medical Center, Jackson, Mississippi, for retrospective chart review. This hospital is one of four in the Jackson area accepting obstetric patients. We identified 178 women within the practice who reported taking the FVJP between January 1, 2000, and December 31, 2002, as Group I. The 178 comparison women making up Group II were selected as the next consecutive deliveries within the practice group who did not report taking FVJP and matched the Group I women by age (within 3 years), parity ( $\pm 1$ ), ethnicity, prior preterm birth history ( $\pm 1$ ) and private insurance coverage (yes or no). The groups were not matched for marital status and previous obstetric or medical history other than preterm birth. A total of 356 singleton pregnancies were included.

The hospital records were reviewed by a technician and obstetric complications were tabulated. A physician verified the accuracy of the data entered. For the purpose of this analysis: preterm labor was defined as labor before 37 weeks requiring medication to control; preeclampsia was documented by the attending physician; preterm premature rupture of membranes was defined as spontaneous ruptured membranes prior to 37 weeks gestation; and fetal distress was defined by late decelerations or non-reassuring non-stress-test as assessed by the attending physician.

The composition of the retrospective study groups is summarized in Table 1. During the 3-year observation peri-

**Table 1.** Socioeconomic and demographic characteristics of the groups

Parameter	Group I (n=178)	Group II (n= 178)
Age, (yrs)	28.7 $\pm$ 5.2	28.0 $\pm$ 5.1
Race		
Caucasian	152	158
African American	18	18
Other	8	2
Nulliparous	77 (43%)	82 (46%)
Covered by private insurance	165 (93%)	164 (92%)
Married	166 (93%)	161 (90%)
Previous obstetric/medical history		
Preterm delivery	10	12
Preterm premature rupture of membranes	0	1
Prior preeclampsia	16	9
Diabetes (gestational)	3	2
Chronic hypertension	3	2

**Table 2.** Pregnancy outcomes

Delivery Parameters	Group I (n=178)	Group II (n=178)	P value OR (95% CI)
Average gestational age at delivery	39.3 ± 0.9	38.2 ± 2.4	< 0.0001
Less than or equal to 32 weeks	0	8 (4%)	17.8 (1.0, 311)
Less than 37 weeks	0	35 (20%)	88.3 (5.4, 1453.2)
Greater than or equal to 41 weeks	9 (5%)	10 (6%)	1.1 (0.4, 2.8)
Obstetric complications:			
Preeclampsia	0	38 (21%)	97.8 (5.95, 1607.4)
Spontaneous preterm labor	0	16 (9%)	0.03 (0.0, 0.5)
PPROM	0	6 (3%)	0.14 (0.0,2.7)
Total cesarean deliveries	83 (47%)	117 (66%)	2.2 (1.4, 3.4)
secondary to:			
Cephal pelvic disproportion	78 (44%)	85 (48%)	0.9 (0.6, 1.3)
Fetal distress	3 (2%)	11 (6%)	2.5 (0.1, 0.9)
Breech	3 (2%)	2 (1%)	1.5 (0.3, 9.1)
<i>Herpes simplex virus</i>	3 (2%)	2 (1%)	1.5 (0.3, 9.1)
Preeclampsia	0	12 (7%)	0.04 (0.002, 0.6)

od, 83% (147 of the 178) of Group I women began taking the FVJP before 13 weeks gestation and all women in this group were taking it by 28 weeks gestation. The FVJP capsules (Juice Plus+®, NSA, Inc., Memphis, TN) contain primarily fruit (apple, orange, pineapple, cranberry, peach, acerola cherry, papaya) and vegetable (carrot, parsley, beet, kale, broccoli, cabbage, spinach, tomato) juice concentrate powder. Four capsules daily provide several nutrients common in plant foods (phytonutrients), including approximately: beta-carotene equivalent to 12,500 IU of vitamin A activity; 234 mg vitamin C; 45 IU vitamin E as alpha-tocopherol; 420 mcg folate; 60 mg calcium; and about 10 calories.

### STATISTICAL ANALYSIS

Kolmogorov-Smirnov test was used to determine if the data followed Gaussian distribution, and Student t-test or Mann-Whitney tests were used where applicable (GraphPad InStat version 2, GraphPad Software, Inc., San Diego, California). Odds ratio (OR) and 95% confidence intervals (CI) were calculated. If there was a zero in one of the 2x2 contingency cells, then 0.5 was added to each value and approximation of Woolf was used. A P value less than 0.05 was considered significant.

### RESULTS

The matching resulted in study groups that were not different, as shown in Table 1, including for unmatched variables such as marital status. Undesired obstetric outcomes in

Group I and Group II mothers are listed in Table 2. Gestational age averaged one week longer in Group I women than Group II women, and no Group I woman delivered before 37 weeks gestation, compared to 35 of the Group II women. The frequency of those delivering post-term (greater than 41 weeks) was similar between the two groups. No Group I women had preeclampsia while 21% (n=38) had this obstetric complication in Group II. Likewise, 16 patients had preterm labor while 6 had PPROM in Group II compared to no patients who took the supplement. Cesarean deliveries were performed on women in both groups (83 in Group I, 117 in Group II), although analysis shows a protective effect in Group I (OR 2.2). No Group I woman had a Cesarean delivery due to preeclampsia, compared to 12 in Group II. Cephal pelvic disproportion, breech, and infection (*Herpes simplex virus*) were similar in their occurrence between the two groups.

Various neonatal factors differed between the two groups (Table 3). Average birth weight was significantly higher ( $P < 0.0003$ ) among Group I ( $3,507 \pm 424$  grams) compared to Group II ( $3,280 \pm 709$  grams). Babies born to Group I mothers had a lower frequency of neonatal intensive care unit (NICU) admission (0 vs.17) when compared to Group II offspring (OR 38.7 CI 2.3, 648.9). The majority of these neonatal intensive care unit (NICU) admissions (13) in Group II were due to respiratory distress syndrome.

### DISCUSSION

These retrospective observations support the hypothe-

**Table 3.** Neonatal outcomes

<b>Infant at birth</b>	<b>Group I (n=178)</b>	<b>Group II (n=178)</b>	<b>P value OR (95% CI)</b>
Average birth weight (grams)	3,507 ± 424	3,280 ± 709	< 0.0003
< 1,500	0	3% (2)	7.1 (0.4, 139)
< 2,500	2 (1%)	22 (12%)	12.4 (2.9, 53.6)
> 4,000	20 (11%)	20 (11%)	1.0 (0.5, 1.9)
> 4,500	4 (2%)	1 (0.5%)	4.1 (0.5, 36.8)
NICU Admission	0	17 (10%)	38.7 (2.3, 648.9)
Respiratory Distress Syndrome	0	13 (8%)	29.1 (1.7, 494.1)

sis that the women who chose to take FVJP capsules during pregnancy in this practice and during this time frame, carried their babies longer than 37 weeks, had fewer babies weighing less than 2,500 grams, did not have preterm labor requiring intervention and did not require elective delivery due to preeclampsia. Although every attempt was made to assure the chart review was thorough and unbiased, the Group I women may have differed from the Group II women independent of the nutritional supplement in a way not apparent from the charted information. Pregnant women are advised to consume at least seven servings of fruits and vegetables every day when they are expecting,<sup>1</sup> yet very few women in Mississippi even consume five daily servings.<sup>2</sup> A study conducted in second trimester pregnant women in North Carolina found that higher-income, older, and better educated women reported consuming 3-5 servings of vegetables per day.<sup>10</sup> This retrospective study matched for age and insurance coverage, but it is possible that Group I included mothers whose higher educational status was higher than that of Group II mothers.

While it is not appropriate to assume that any nutritional product can replace all the components found in produce, it is possible to consider that the FVJP capsules may have complemented the nutritional status of the Group I women. Oxidative stress has been linked during pregnancy to preterm labor as well as low birth weight, (PPROM), preeclampsia, intrauterine growth restriction (IUGR), and numerous newborn complications. Endothelial dysfunction has been theorized to contribute to development of preeclampsia. It has previously been reported that healthy, adult study subjects given these FVJP capsules showed reduction in several indicators of oxidative stress in the body, specifically increased plasma ferric reducing/antioxidant power (FRAP)<sup>8</sup> and reduced lipid peroxidation.<sup>6,7</sup> It has also been reported to maintain normal vasoactivity in humans after a high-fat test meal.<sup>11</sup> While these investigations were not performed on pregnant subjects, it is reasonable to expect similar functional findings that might explain

the reduction in frequency of undesirable obstetric outcomes noted in the Group I mothers.

Findings from several recent studies illuminate the observations from this retrospective investigation. Women in the lowest tenth percentile for preconception vitamin C intake were at greater risk for preterm delivery and PPROM, although the odds were slightly improved when second trimester intake was higher than intake before pregnancy.<sup>12</sup> Another study found both placental tissue and maternal blood had lower carotenoid concentrations from mothers with preeclampsia than from those without.<sup>13</sup> Lower levels of tocopherols have been reported in women with preeclampsia compared to normotensive mothers.<sup>14</sup> Blood from Italian mothers with a diet poor in fruits and vegetables showed a decrease each sequential trimester in total antioxidant capacity, with umbilical cord blood values correlated to the maternal values at delivery. These findings led the authors to conclude that “efforts should be made to improve dietary habits in pregnancy.”<sup>15</sup> These and other nutrients are all present in the FVJP capsules used by the Group I women. Daily consumption of antioxidant nutrients in the FVJP capsules may be responsible for the significantly decreased rate of complications noted in these 178 deliveries, such as preterm labor, birth before 37 weeks, preeclampsia, NICU admission and infant respiratory distress syndrome. If these findings are confirmed in a randomized, prospective clinical trial currently being conducted, a simple and inexpensive nutritional solution may be available to effectively address common and costly obstetric complications.

#### ACKNOWLEDGMENT

No corporate funding was provided to support this study. One author, C. Doug Odom, MD, has an individual financial interest in the FVJP that was used by patients in the study. None of the other authors have any financial interests in the FVJP used by patients in the study.

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