Phytonutrients from fruit and vegetable juice concentrates may decrease obstetric complications: A retrospective study

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Abstract
This retrospective descriptive analytic study focuses on pregnancy outcome variables from 178 women (Group I), who reported taking a specific daily fruit and vegetable juice powder concentrate nutritional supplement commonly available in the Jackson, Mississippi area compared to 178 women not reporting use of any additional supplements (Group II). All the mothers received standard care, including prenatal vitamins, from the same practice group of obstetricians. However, when pregnancy outcome was compared, Group I had significantly fewer complications than Group II: Cesarean delivery (47% vs. 66%); delivery before 37 weeks (0 vs. 20%); and, diagnosis of preeclampsia (0 vs. 21%). These findings suggest that consuming nutrients from fruit and vegetable juice powder concentrates during pregnancy, in conjunction with standard prenatal vitamins, may reduce the incidence of some obstetric complications.

Keywords: perinatal complications, pregnancy, phytonutrients

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.[1] However, only 21.2% of women surveyed in Mississippi (MS) reported consuming five or more servings of fruits and vegetables per day in 2002.[2] 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 being low in calories and fat.[3] 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.[4] Although oxidative stress is one of several etiologies theorized to be involved in development of preeclampsia, currently there are no studies available focusing on increased fruit and vegetable consumption in pregnant women throughout gestation on the incidence of this complication in the final trimester and at delivery.

Common and undesirable obstetrical complications include preterm labor, preterm birth, preterm premature rupture of membranes (PPROM), low birth weight, preeclampsia, and intrauterine growth restriction. This retrospective descriptive study is from one practice (four obstetricians) averaging 471 deliveries per year in Jackson, MS. This practice includes many women at high risk for obstetric complications. The study was initiated after the nurses noticed mothers who reported use of a specific fruit and vegetable juice powder concentrate anecdotally seemed to experience undesirable obstetrical complications less frequently than other mothers served by the same practice. This nutritional product has been reported to both increase the concentration of blood antioxidants[5-7] and reduce homocysteine,[8, 9] an amino acid that is elevated in women who have developed preeclampsia.[4] These studies in healthy adults provided a biological rationale for the observations of the nursing staff. The purpose of this investigation was to evaluate the hospital records of mothers from this practice who either chose (Group I) to use a specific nutritional supplement or not (Group II) for documented complications at delivery.

Materials and Methods

The study was approved by the Human Use Committee of Mississippi Baptist Medical Center, Jackson, MS for retrospective chart review. This hospital is one of four in the Jackson, MS area accepting obstetric patients. We identified 178 women within the practice who reported taking the fruit and vegetable juice powder concentrates 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 delivery within the practice group who did not report taking the nutritional product and that matched the Group I woman by age (within 3 years), parity (plus or minus 1), ethnicity, prior preterm birth history (plus or minus 1) and private insurance coverage (yes or no). The groups were not matched for marital status or previous obstetric or medical history other than preterm birth. A total of 356 singleton pregnancies were included in this retrospective chart review.

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 (PPROM) 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 period 83% (147 of the 178) of Group I women began the nutritional product before 13 weeks gestation and all women in Group I were using it by 28 weeks gestation. The nutritional product (Juice Plus+®, NSA, Inc., Memphis, TN) contains fruit (apple, orange, pineapple, cranberry, peach, acerola cherry, papaya) and vegetable (carrot, parsley, beet, kale, broccoli, cabbage, spinach, tomato) juice powder concentrates in four capsules daily that combined provide several phytonutrients including: beta-carotene equivalent to 12,500 IU of vitamin A activity; 234 mg vitamin C; 45 IU vitamin E; 420 mcg folate; 60 mg calcium; along with 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, CA). 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 46 of the Group II women. No Group I woman had preterm delivery while 44 Group II women had preterm delivery (38 secondary to preeclampsia). The frequency of those delivering post-term (greater than 41 weeks) was similar between the two groups. 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. Cephalic pelvic disproportion (CPD), 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 equal 0.0003) among Group I (3507 plus/minus 424 g) compared to Group II (3280 plus/minus 709 g). Babies born to Group I mothers 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 NICU admissions (13) in Group II were due to respiratory distress syndrome.

Discussion

These retrospective observations support the hypothesis that the women who chose to take a fruit and vegetable juice powder concentrate during pregnancy in this practice and during this time frame carried their babies longer than 37 weeks, had fewer babies weighing less than 2500 g, did not have preterm labor requiring intervention, or require elective delivery due to preeclampsia. Although every attempt was made to assure the chart review was through and unbiased, the Group I women may have differed from the Group II women independent of the nutritional supplement, 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,[1] very few women in MS even consume five daily servings.[2] 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.[10] This retrospective matched for age and insurance coverage, but it is possible that Group I contained more better educated women than Group II.

While it is not appropriate to assume that this nutritional product can replace all the components found in produce, it is possible to consider this product could 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, IUGR and multiple newborn complications. Endothelial dysfunction has been theorized to contribute to development of preeclampsia. It has been reported that study subjects given Juice Plus+® showed reduction in several indicators of oxidative stress in the body, specifically increased plasma ferric reducing/antioxidant power (FRAP)[8] and reduced lipid peroxidation.[6, 7] This nutritional product also been shown to maintain normal vasoactivity in humans after a high fat test meal.[11] These investigations were not performed on pregnant subjects; however, it is reasonable to expect similar functional findings in this population that might explain the reduction in frequency of undesirable obstetric outcomes in Group I mothers.

Findings from several recent studies illuminate the observations from this retrospective. Women in the lowest tenth percentile for preconception vitamin C intake were at greater risk for preterm delivery and PPROM, although this was slightly improved if second trimester intake was higher than intake before pregnancy.[12] Another study found both placental tissue and maternal blood had lower carotenoid concentrations from mothers with preeclampsia than from those without.[13] Lower levels of tocopherols have been reported in women with preeclampsia compared to mothers without.[14] Blood from Italian mothers with a diet poor in fruit and vegetables showed a decrease each sequential trimester in total antioxidant capacity, and umbilical cord blood values were correlated with the maternal values at delivery, leading the authors to conclude "efforts should be made to improve dietary habits in pregnancy."[15] These and other nutrients are all present in the nutritional product used by the Group I women.

In conclusion, daily consumption of antioxidant nutrients in the form of fruit and vegetable juice powder concentrate significantly decreased the rate of complications 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, a simple inexpensive nutritional solution may be available to effectively address common and costly obstetric complications.

References

1. American College of Obstetricians and Gynecologists. Patient education pamphlet "Nutrition During Pregnancy" ISSN 1074-8601, July 2002
2. CDC National Center for Chronic Disease Prevention and Health Promotion 5 A Day Data and Statistics Mississippi 2002. Available at: http://apps.nccd.cdc.gov/5ADaySurveillance/displayV.asp accessed 10/5/2004. Accessed October 5, 2004.
3. Craig WJ. Phytochemicals: Guardians of our health. J Am Diet Assoc 1997;97:S199-S204.
4. Roberts JM, Balk JL, Bodnar LM, Belizan JM, Berge E, Martinez A. Nutrient involvement in preeclampsia. J Nutr 2003;133:1684S-1692S.
5. Keifer I, Prock P, Lawrence C et al. Supplementation with mixed fruit and vegetable juice concentrates increased serum antioxidants and folate in healthy adults. J Am Coll Nutr 2004;23:205-211.
6. Leeds AR, Ferris EAE, Staley J, Ayesh R, Ross F. Availability of micronutrients from dried, encapsulated fruit and vegetable preparations: a study in healthy volunteers. J Hum Nutr Dietet 2000;13:21-27.
7. Wise JA, Morin R, Sanderson R, Blum K. Changes in plasma carotenoid, alpha-tocopherol, and lipid peroxide levels in response to supplementation with concentrated fruit and vegetable extracts: a pilot study. Curr Ther Res Clin Exp 1996;57:445-461.
8. Samman S, Sivarajah G, Man JC, Ahmad ZI, Petocz P, Caterson ID. A mixed fruit and vegetable concentrate increases plasma antioxidant vitamins and folate and lowers plasma homocysteine in men. J Nutr 2003;133:2188-2193.
9. Panunzio MF, Pisano A, Antoniciello A et al. Supplementation with fruit and vegetable concentrate decreases plasma homocysteine levels in a dietary controlled trial. Nutr Res 2003;23:1221-1228.
10. Bodnar LM, Siega-Riz AM. A diet quality index for pregnancy detects variation in diet and differences by sociodemographic factors. Public Health Nutr 2002;5:801-809.
11. Plotnick GD, Corretti MC, Vogel RA, Hesslink R, Wise JA. Effect of supplemental phytonutrients on impairment of the flow-mediated brachial artery vasoactivity after a single high-fat meal. J Am Coll Cardiol 2003;41:1744-1749.
12. Siega-Riz AM, Promislow JHE, Savitz DA, Thorp JM, McDonald T. Vitamin C intake and the risk of preterm delivery. Am J Obstet Gynecol 2003;189:519-525
13. Palan PR, Mikhail MS, Romney SL. Placental and serum levels of carotenoids in preeclampsia. Obstet Gynecol 2001;98:459-462.
14. Palan PR, Shaban DW, Martino T, Mikhail MS. Lipid-soluble antioxidants and pregnancy: Maternal serum levels of coenzyme Q10, alpha-tocopherol and gamma-tocopherol in preeclampsia and normal pregnancy. Gynecol Obstet Invest 2004;58:8-13.
15. Alberti-Fidanza A, Di Renzo GC, Burini G, Antonelli G, Perriello G. Diet during pregnancy and total antioxidant capacity in maternal and umbilical cord blood. J Matern Fetal Neonatal Med 2002;12:59-63.

Table 1 Socioeconomic and Demographic Characteristics of the Groups

Parameter	Group I (n equal 178)	Group II (n equal 178)
Age, years	28.7 plus/minus 5.2	28.0 plus/minus 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
PPROM	0	1
preeclampsia	16	9
diabetes (idiopathic)	3	2
chronic hypertension	3	2

Table 2 Pregnancy Outcomes

Delivery Parameters	Group I (n equal 178)	Group II (n equal 178)	*p* value OR (95% CI)
Average gestational age at delivery	39.3 plus/minus 0.9	38.2 plus/minus 2.4	less than 0.0001
less than or equal to 32 weeks	0	35 (20%)	17.8 (1.0, 311)
less than 37 weeks	0	8 (4%)	88.3 (5.4, 1453.2)
greater than or equal to 41 weeks	9 (5%)	10 (6%)	1.1 (0.4, 2.8)
Preterm delivery secondary to:			
preeclampsia	0	38 (21%)	0.01 (0.0, 0.2)
spontaneous 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:			
cephalic 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)
Herpes simplex virus	3 (2%)	2 (1%)	1.5 (0.3, 9.1)
preeclampsia	0	12 (7%)	0.04 (0.002, 0.6)

Table 3 Neonatal Outcomes

Infant at birth	Group I (n equal 178)	Group II (n equal 178)	*p* value OR (95% CI)
Average birth weight (grams)	3507 plus/minus 424	3280 plus/minus 709	0.0003
less than or equal 1500	0	2% (3)	7.1 (0.4, 139)
less than or equal 2500	2 (1%)	22 (12%)	12.4 (2.9, 53.6)
greater than or equal 4000	20 (11%)	20 (11%)	1.0 (0.5, 1.9)
greater than or equal 4500	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)