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RESEARCH

Doula Care, Early Breastfeeding Outcomes, and Breastfeeding Status at 6 Weeks Postpartum Among Low-Income Primiparae

Laurie A. Nommsen-Rivers, Ann M. Mastergeorge, Robin L. Hansen, Arlene S. Cullum, and Kathryn G. Dewey

Correspondence
Laurie A. Nommsen-Rivers, PhD, RD, IBCLC, Division of Neonatology, Cincinnati Children's Hospital, 3333 Burnet Avenue, MLC 7009, Cincinnati, OH 45229-3039. laurie.nommsen-rivers@cchmc.org

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ABSTRACT

Objective: To examine associations between doula care, early breastfeeding outcomes, and breastfeeding duration.

Design: Prospective cohort.

Setting: Regional hospital in northern California.

Participants: Low-income, full gestation primiparae receiving doula care ($n = 44$) or standard care ($n = 97$).

Measures: Birth outcomes and newborn feeding data obtained from the hospital record. Follow-up interviews conducted at day 3 to record the timing of onset of lactogenesis and breastfeeding behavior and at 6 weeks to obtain current breastfeeding status.

Results: Adjusting for baseline differences, women receiving doula care were significantly more likely to have a short stage II labor, a noninstrumental vaginal delivery, and to experience onset of lactogenesis within 72 hours postpartum (timely onset of lactogenesis). Overall, 68% of women receiving doula care and 54% of women receiving standard care were breastfeeding at 6 weeks. In the subset with a prenatal stressor ($n = 63$), the doula care group was more than twice as likely to be breastfeeding at 6 weeks (89% vs. standard care, 40%). Breastfeeding at 6 weeks was also significantly associated with timely onset of lactogenesis and maternal report that the infant "sucked well" at day 3.

Conclusions: Doula care was associated with improved childbirth outcomes and timely onset of lactogenesis. Both directly and as mediated by timely onset of lactogenesis, doula care was also associated with higher breastfeeding prevalence at 6 weeks.

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Laurie A. Nommsen-Rivers, PhD, RD, IBCLC, is an assistant research professor of pediatrics at the Cincinnati Children's Hospital Medical Center, Cincinnati, OH.

Ann M. Mastergeorge, PhD, is an assistant research education psychologist and adjunct faculty in the Department of Human and Community Development and MIND Institute, University of California, Davis.

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In the United States, there has been progress in increasing breastfeeding initiation rates, but much still needs to be done to improve breastfeeding duration and exclusivity. Only 11% of all infants born in the United States are breastfed exclusively for 6 months, as recommended (Centers for Disease Control and Prevention [CDC], 2006). At higher risk for short breastfeeding duration are women who are younger, less educated, and of lower income (Ahluwalia, Morrow, Hsia, & Grummer-Strawn, 2003;CDC; Heck, 1999). In addition, mothers who experience early breastfeeding difficulties are at higher risk for short breastfeeding duration (Cernadas, Noceda, Barrera, & Martinez, 2003; Chapman & Pérez-Escamilla, 1999a; Furman, Minich, & Hack, 2002; Hruschka, Sellen, Stein, & Martorell, 2003; McLeod, Pullon, & Cookson, 2002; Taveras et al., 2003; Wright & Walker, 1983).

A regional hospital in Sacramento, CA, implemented a 3 year pilot project, The Doula Care Project, designed to have trained lay-women provide childbirth and postpartum support to low-income, first-time mothers. A prospective evaluation of the Doula Care Project was conducted with the objective of examining the effect of a combined doula care/home-visiting program on breastfeeding outcomes among mothers at risk for short breastfeeding duration. It was hypothesized that (a) in the short term, doula care would improve early breastfeeding success outcomes (such as timing of onset of lactogenesis [OL] and infant breastfeeding behavior), both directly as a result of a less

Timely onset of lactogenesis is defined as occurring within 72 hours postpartum; delayed onset of lactogenesis is defined as occurring after 72 hours postpartum.

stressful childbirth experience and indirectly due to improved early feeding practices; and (b) in the long term, doula care would extend the duration of breastfeeding, both directly and as mediated through improved early breastfeeding outcomes.

Review of Literature

The Role of Timely OL in Breastfeeding Success

Normally, the volume of milk produced in the human mammary gland is minimal for the first 1 to 2 days postpartum. Lactogenesis stage II is defined by a marked increase in milk production that occurs in response to the drop in progesterone after parturition (Neville & Morton, 2001). Onset of lactogenesis stage II is defined as timely if it occurs within 72 hours postpartum and delayed if it occurs after that (Chapman & Pérez-Escamilla, 1999b; Dewey, Nommsen-Rivers, Heinig, & Cohen, 2003). Maternal perception of the milk "coming in" is highly correlated with OL as measured by either biochemical markers or milk transfer (Chapman & Pérez-Escamilla, 2000; Chen, Nommsen-Rivers, Dewey, & Lonnerdal, 1998; Dewey et al.). The sensitivity and specificity of maternal report of OL were estimated to be 71% and 79%, respectively, when milk transfer was used as the "gold standard" (Chapman & Pérez-Escamilla).

Maternal perception of delayed OL has been shown to have short- and long-term negative consequences. Among a cohort of California women committed to exclusive breastfeeding, the relative risk of excess neonatal weight loss (greater than or equal to 10% of birth weight at 72-96 hours postpartum) was seven times greater if the mother had delayed OL versus timely OL: 40.4% versus 5.7%, $p < .0001$ (Dewey et al., 2003). Among women in Connecticut who had planned to breastfeed for at least 6 months, median breastfeeding duration was 11.7 months in those with timely OL versus 3.4 months in those with delayed OL ($p < .00001$) (Chapman & Pérez-Escamilla, 1999a).

Delayed OL was reported by 23% of lactating women in California, despite a strong commitment to exclusively breastfeed (Dewey et al., 2003); 35% of breastfeeding mothers in Connecticut (Chapman & Pérez-Escamilla, 1999b); and 27% of mothers in urban Guatemala (Grajeda & Perez-Escamilla, 2002). By contrast, women in less medically managed birth settings seem to have a much lower incidence of delayed OL: 10% of 328 rural Guatemalan mothers, 42% of whom had home births (Hruschka et al., 2003); and 10% of 103 breastfeeding women in Zambia (L. Kasonka, University Teaching Hospital, Lusaka, Zambia, personal communication, 2004). Delayed OL was reported to be 11% among Australian mothers (Scott, Binns, & Oddy, 2007), but this is likely an underestimate because subjects who were interviewed before 72 hours postpartum and had not yet experienced OL were excluded from the analysis (19% of the sample). Nevertheless, the wide range in the reported incidence of delayed OL among study settings suggests that the phenomenon is influenced by factors in the maternity environment.

Risk Factors for Delayed OL

Several risk factors have been associated with delayed OL including primiparity (Chapman & Pérez-Escamilla, 1999b, 2000; Chen et al., 1998; Dewey et al., 2003; Grajeda & Perez-Escamilla, 2002; Hildebrandt, 1999; Scott, Berkowitz, & Klaus, 1999), Cesarean delivery (Chapman & Pérez-Escamilla; Dewey et al.; Grajeda & Perez-Escamilla; Hildebrandt; Scott et al., 2007; Vestermark, Hogdall, Birch, Plenov, & Toftager-Larsen, 1991), duration of labor (Chapman & Pérez-Escamilla; Chen et al.; Dewey et al.), perceived exhaustion after delivery (Chen et al.), use of labor pain medications (Hildebrandt), cortisol levels in both the mother (Chen et al.; Grajeda & Perez-Escamilla) and the fetus (Chen et al.), and type 1 diabetes (Hartmann & Cregan, 2001). Maternal obesity has also been linked to delayed OL in most (Chapman & Pérez-Escamilla; Dewey et al.; Rasmussen, Hilson, & Kjolhede, 2001) but not all (Scott et al.) studies.

While some of the factors noted to influence OL, such as parity, are not modifiable, many others are potentially amenable to changes in the maternity care environment. Five studies cited in this review included data regarding both the prevalence of Cesarean delivery and prevalence of delayed OL (all defined as greater than 72 hours postpartum) (Chapman & Pérez-Escamilla, 1999b; Dewey et al., 2003; Grajeda & Perez-Escamilla, 2002; Hruschka et al., 2003; L. Kasonka, personal communication, October, 2002). Assuming that the Cesarean delivery rate is a reflection of the level of medical intervention during labor and delivery, an ecologic analysis of these five birth settings provides further

Robin L. Hansen, MD, is a professor of pediatrics, director of the Center for Excellence in Developmental Disabilities, and director of Clinical Programs at the MIND Institute, University of California, Davis.

Arlene S. Cullum, MPH, is the director of Women's and Children's and Ambulatory Services, Sutter Medical Center, Sacramento, CA.

Kathryn G. Dewey, PhD, is a professor of nutrition and director of the Program in International and Community Nutrition, Department of Nutrition, University of California, Davis.

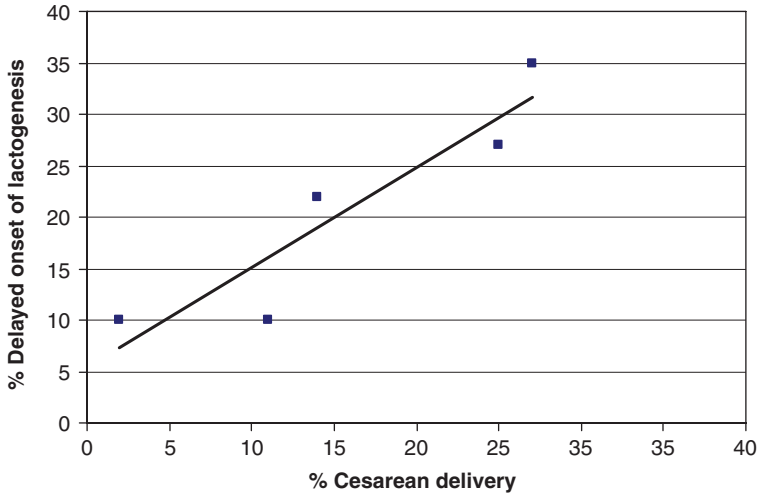

Figure 1. Incidence of delayed onset of lactogenesis by birth setting Cesarean delivery rate; $y = 0.97x + 5.44$, $R^2 = .85$. Birth settings, from left to right: Lusaka, Zambia (L. Kasonka, personal communication, October, 2002); rural Guatemala (Hruschka et al., 2003); Davis, CA (Dewey et al., 2003); urban Guatemala (Grajeda & Perez-Escamilla, 2002); and Hartford, CT (Chapman & Pérez-Escamilla, 1999b).

evidence of a relationship between birth environment and risk of delayed OL (Figure 1).

Associations Between Doula Care and Breastfeeding Success

Continuous emotional and physical support during labor and childbirth by an experienced woman (called a doula, from the Greek for "woman's servant") has been shown to increase satisfaction with the childbirth experience and decrease the incidence of childbirth interventions and complications (Hodnett, Gates, Hofmeyr, & Sakala, 2007; Hofmeyr, Nikodem, Wolman, Chalmers, & Kramer, 1991; Scott et al., 1999; Sosa, Kennell, Klaus, Robertson, & Urrutia, 1980). Doula support may enhance breastfeeding success, either indirectly by reducing maternal stress and obstetric interventions or directly via provision of encouragement and support for breastfeeding shortly after delivery. In a South African randomized-controlled trial, the doulas did not provide any direct assistance with breastfeeding, yet by 6 weeks postpartum the intervention group was significantly more likely to be exclusively breastfeeding: 51.4% versus 29.3% (Hofmeyr et al.).

In a Mexico study, part of the doula intervention protocol was to return to the hospital in the early postpartum period to further encourage breastfeeding. By 4 weeks, the rate of exclusive breastfeeding was 12% in the doula group versus 7% of control mothers ($p < .05$) (Langer, Campero, Garcia, & Reynoso, 1998). However, a multisite randomized-controlled trial among predominantly middle-class women in Canada and the United States in which nurses served as providers of labor support did not show a significant difference in the prevalence of breastfeeding at 6 weeks postpartum (Hodnett et al., 2002). The use of health care providers rather than lay women to provide childbirth support may reduce the effect of childbirth support on breastfeeding outcomes (Scott et al., 1999).

Two recent studies suggest that lay doula care has a positive effect on childbirth outcomes among low-income primiparous women in the United States. Mottl-Santiago et al. (2007) conducted a retrospective evaluation of Boston Medical Center's "Birth Sister" program, which matches women in their third trimester with a lay doula according to the language and cultural preference of the mother (Mottl-Santiago et al.). After adjusting for maternal age and race, women with Birth Sisters, as compared with standard care, were significantly more likely to initiate breastfeeding within 1 hour of delivery. In a randomized trial of lay labor support provided by a close female family member or friend, significantly better birth outcomes were observed among those in the intervention group and a higher percentage reported ever breastfeeding (55%) as compared with standard care participants (42%) (Campbell, Scott, Klaus, & Falk, 2007).

Methods

Setting: Description of the Doula Care Project

Doula Care Project Eligibility

The Doula Care Project was implemented at a regional hospital in Sacramento, CA. All women admitted to the hospital's Labor and Delivery Unit were systematically screened by their assigned nurse to determine if they met the Doula Care Project eligibility criteria, which were as follows: (a) primiparous patient of an authorizing practice group, (b) low-income as defined by not having private health insurance, (c) English- or Spanish-speaking, (d) zip code within 20 mile radius of the hospital, (e) not scheduled for a planned Cesarean delivery, (f) not more than 5 cm cervical dilation when admitted, (g) no known high-risk condition of newborn that is expected to result in Special Care Nursery admission, and (h) no absolute contraindication to breastfeeding such as infant placed out-of-home, or mother HIV+ or with current illicit drug use.

When an eligible patient was encountered, the nurse checked to see if a doula was available, and if so, contacted her via pager. Doula care was provided on an as-available basis. Therefore, once the doula was assigned to a woman, the project protocol stipulated that she remain with her continuously throughout labor and childbirth. Eligible women who presented in labor when a doula was not available (initially expected to occur about 50% of the time) were provided with standard care according to usual hospital practices.

In-Hospital Doula Care

Doulas were expected to be on site within 2 hours of pager contact. They were fluent in Spanish and English and trained to utilize strategies to help the mother manage labor, including providing emotional, informational, and physical support. Immediately after giving birth, the doula encouraged the mother to establish skin-to-skin contact with her infant, and guided her in the first breastfeeding.

Home Visit Component of the Doula Care Project

A unique aspect of the Doula Care Project was the provision of two early postpartum home visits by the same doula who provided childbirth support. The first home visit was planned to occur 1 to 2 days after hospital discharge and the second 7 to 10 days later. During the visits, the doula guided the mother in observing her infant's breastfeeding skills and showed her signs of breastfeeding going well. In the case of breastfeeding difficulties not easily resolved during the home visit, the doula helped the mother arrange an appointment with the hospital's lactation clinic or the mother's physician.

Evaluation Study Sample and Design

Between October 1, 2005, and November 15, 2006, all maternity clients eligible for the Doula Care Project, whether or not they received doula support, were visited by a research assistant during their postpartum hospital stay and invited to participate in the Maternal Caregiving Study (MCS). The primary purpose of the MCS was to evaluate the Doula Care Project. To minimize bias in data collection, all MCS research assistants were masked to the Doula Care Project status. The MCS study purpose was described to potential subjects as an examination of the relationship between the childbirth experience and maternal caregiving practices (including infant feeding). The doula care (DC) group was comprised of eligible, MCS-consenting subjects who received doula care under the Doula Care Project. The comparison, or standard care (SC) group, was comprised of eligible, MCS-consenting subjects who presented in labor when doula care was not available. The study protocol, consent form, hospital record access consent, and data collection forms were approved by the Institutional Review Boards of both Sutter Medical Center, Sacramento, and the University of California, Davis.

Measures

The MCS predischarge interview was conducted in-person to collect information on socio-cultural background, childbirth experience, and infant-feeding practices. Follow-up interviews were completed via telephone at 3 days (72-96 hours) and 6 weeks postpartum. At the day 3 telephone interview, data were collected on maternal perception of OL, breastfeeding concerns, infant-feeding practices, pacifier use, and infant breastfeeding behavior. Data were extracted from hospital records on admission status variables, labor and delivery details, infant birth status, and time of each breast- and/or formula feed. Doula care status was obtained from the Doula Care Project supervisor upon completion of all other data collection. Details on key variables are described below.

Maternal Body Mass Index (BMI)

Body mass index in the early postpartum was estimated as [(admission weight, kg) − (2×infant weight, kg)/(height, m)^2]. This estimate assumes that weight loss during and soon after delivery is

approximately twice the infant birth weight (Institute of Medicine Subcommittee on Nutrition During Pregnancy, 1990). Maternal obesity was defined as early postpartum BMI $\geq$ 30 kg/m^2.

Prenatal Stressor Status

The hospital record included information on presence of several conditions that could increase maternal stress during childbirth. A composite variable was created, where 1 = *at least one stressor present* and 0 = *none of the stressors was present*. The stressors included were history of substance abuse (current substance abuse was an exclusion criterion), tobacco use during pregnancy, diagnosis of clinical depression or anxiety disorder, chronic health condition (such as asthma, high blood pressure, sickle cell disease), pregnancy-induced hypertension, gestational diabetes, or other serious pregnancy complications. Risk factors not included in the composite variable were test positive for group B strep, anemia during pregnancy, and history of sexually transmitted disease, as all are somewhat common in this population and treatment is routine.

Labor and Delivery Variables

It was not possible to calculate duration of labor from the data available in the hospital record. However, time from hospital admission to birth was used as a proxy. Duration of stage II labor (pushing time) was extracted from the hospital record. Delivery mode was classified as spontaneous vaginal, assisted vaginal (forceps or vacuum), or Cesarean delivery.

Faces Pain Scale

During the predischarge and day 3 interviews, the Faces Pain Scale (Hicks, Von Baeyer, Spafford, van Korlaar, & Goodenough, 2001) was used to quantify pain and discomfort associated with childbirth. The scale consists of 6 faces ranging from an expression representing no pain (score = 1) to one representing worst possible pain (score = 6). In order to establish that the faces represent increasing levels of pain in our study population, we pilot tested the scale in both English- (n = 90) and Spanish-speaking (n = 45) low-income mothers. No one had difficulty with the concept of the faces representing increasing levels of pain. Subjects were asked to choose the face that represented the maximum amount of pain they experienced during their labor and delivery. The distribution of responses was similar in the various ethnic and language groups, indicating cross-cultural consistency in pain level associated with each face.

Early Infant-Feeding Practices

Breast, expressed breast milk, and formula feeding frequencies in the first 48 hours of life were calculated by summing frequencies recorded in the hospital record with maternal report of frequencies from the time of hospital discharge until 48 hours postpartum. Pacifier use was based on maternal recall at the day 3 interview of any use since birth.

Onset of Lactogenesis

Timing of OL was assessed by asking mothers to rate their current breast fullness, on a scale from 1 to 5, where 3 represents noticeably fuller. This 5-point scale was shown to be highly correlated with physiological markers of OL (Dewey et al., 2003). If the subject reported breast fullness of at least level 3, they were asked to recall the date and time postpartum when they first noticed their breasts becoming noticeably fuller. If not, the subject was asked if she ever experienced her breast fullness at a level of at least 3. If so, the date and time were recorded, otherwise it was assumed that OL had not occurred yet. As in previous research, *delayed OL* was defined as OL $\geq$ 72 hours postpartum and *timely OL* was defined as OL within 72 hours postpartum.

Milk Supply Concerns

At the day 3 interview, the subject was asked if she had any concerns about the amount of milk she was producing since the birth of her baby.

Infant Breastfeeding Behavior

At the day 3 interview, the subject was asked to rate her infant's breastfeeding behavior at the most recent breastfeed, using the maternal assessment question of the Infant Breastfeeding Assessment Tool (Matthews, 1988), which asks, "Which statement most closely matches your opinion of the most recent breastfeed?" Response options are (a) sucked well throughout, (b) sucked well off and on, but needed encouragement, (c) sucked poorly or weakly, or exhibited only some sucking effort for short periods or (d) baby did not suck.

Breastfeeding Status at 6 Weeks

At 6 weeks, current breastfeeding status was assessed by telephone interview. Subjects who had breastfed or expressed breast milk at least once in the prior 24 hours were defined as "breastfeeding"; otherwise they were classified as "weaned." When applicable, date of breastfeeding discontinuance and/or date of formula initiation were recorded.

Analysis

Evaluation of the Doula Care Project was based on a two-stage hypothesis: (a) Doula care will result in a less complicated labor and delivery experience and improved early infant-feeding practices and thereby improve early breastfeeding success outcomes; and (b) improved early breastfeeding success outcomes, along with the breastfeeding support provided by home visits, will result in a greater proportion in the DC group breastfeeding at 6 weeks, as compared with the SC group.

Data were analyzed using SAS 9.1 statistical package. Student's *t*-tests (for continuous variables) and chi-square tests (for categorical variables) were used to compare baseline characteristics, childbirth outcomes, early infant-feeding practices, early breastfeeding success outcomes and breastfeeding status at 6 weeks between DC and SC groups.

Logistic regression analysis was used to examine the odds ratio for each outcome in the DC group, with SC as the reference group. Therefore, an odds ratio greater than 1.0 represents greater odds of the outcome occurring in the DC group and an odds ratio less than 1.0 represents lesser odds of the outcome occurring in the DC group, as compared with the SC group. In both cases, if the 95% confidence interval for the odds ratio estimate does not include 1.0, it is equivalent to statistical significance at $p < .05$. Continuous and ordinal-scale outcomes were divided at the median to form dichotomous variables. Both crude and adjusted odds ratio models controlling for potentially confounding baseline characteristics were examined. In models examining early infant-feeding practices and breastfeeding status at 6 weeks, maternal education level and pre-admission feeding plans were also adjusted for, as both variables exerted a strong independent effect on feeding practices.

The role of timely OL as a mediator in the relationship between DC group and breastfeeding status at 6 weeks was examined within the conceptual framework of the joint significance mediation model (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002), which is appropriate for small to medium sample sizes. In this model, mediation is said to exist if separate tests of each path in the mediation model are jointly significant. Subgroup analyses were conducted to explore whether the effect of DC group on breastfeeding status at 6 weeks varied between levels of select baseline characteristics (effect modification). The following baseline characteristics were transformed into dichotomous variables (at the median for continuous and ordinal variables): maternal age, cervical dilation upon hospital admission, Hispanic ethnicity (vs. other), maternal education level, feeding plans upon hospital admission, obesity status, and prenatal stressor status.

Enrollment was initially estimated at 200 subjects based on available funds. At $\alpha = .05$, and 80% power, the minimal detectable difference in dichotomous outcomes between DC and SC groups was estimated as 43.0% versus 57.5%, assuming $n = 100$ study subjects enrolled in each group at day 3. Assuming 50% of SC group subjects were breastfeeding at 6 weeks, and assuming an 85% follow-up rate ($n = 170$ at 6 weeks), at $\alpha = .05$ and power = 80%, the minimal detectable rate ratio would have been 1.44, or 72.0% breastfeeding prevalence in the DC group at 6 weeks.

Results

Study Sample Size at Enrollment and Follow-Up

In total, 239 women meeting eligibility criteria for the Doula Care Project were invited to participate in the MCS of whom 71% consented and were enrolled ($n = 169$). Although the Doula Care Project planned to employ two doulas, during most of the MCS data collection phase only one doula was actively employed, as the second doula was on medical leave. This resulted in one half the anticipated number of women being offered doula care, and thus only 45 MCS subjects were exposed to the Doula Care Project (DC group). An additional 7 MCS subjects were offered doula care but declined (all stated that they had adequate childbirth support), and 7 received partial doula care, as a result of supervisor requests (3 received home visits, and 4 others received some childbirth support, but none was originally assigned to doula care). These 14 subjects were excluded from further analysis. The remaining 110 MCS subjects received standard care (SC group). Upon initial examination of baseline characteristics, it was observed that allocation to the Doula Care Project was biased against those indicating "formula" as their feeding choice upon hospital admission (1 in the DC group vs. 13 in the SC group). Because this level of bias is impractical to control for in regression models, all subjects planning to solely formula feed were also excluded from further analysis. Thus, the evaluation is based on 97 SC and 44 DC subjects.

Three DC and 2 SC subjects were lost to follow-up by the day 3 interview. These 5 subjects tended to

be less likely to have completed high school, but were otherwise similar to those interviewed at day 3. Breastfeeding status data at 6 weeks were available for 91% of the original sample (91 SC and 37 DC subjects). Women lost to follow-up at 6 weeks were more often Hispanic (9 out of 13), less likely to have completed high school (8 out of 13), and more likely to have been in active labor upon hospital admission (10 out of 13).

Subject Characteristics Upon Enrollment

Most baseline characteristics were very similar between SC and DC groups (Table 1). Notable differences were that a higher proportion of women in the DC group were Hispanic and spoke Spanish as their primary language. Standard care subjects were more likely to be admitted in active labor, as opposed to being admitted for labor induction. There was a tendency for a higher proportion of DC subjects to be obese (41.9% vs. 31.2%, DC vs. SC, $p = .22$). Ethnicity, labor status upon admission, and obesity status were associated with childbirth and breastfeeding outcomes, and therefore were included in multiple variable models.

Description of Doula Care Provided

Among those in the DC group, the median number of hours from doula arrival to birth of the infant was 10.5 ($n = 32$ with data). Details on type of support provided by the doula during labor are listed in Table 2. Among the 32 DC subjects with vaginal births, the doula assisted 30 in experiencing skin-to-skin contact with the infant in the immediate postpartum (median duration, 33 minutes) and assisted 25 with the first breastfeed. The doula was able to assist only 2 of the 12 DC subjects who delivered by Cesarean with skin-to-skin contact and 4 with the first breastfeed.

Thirty-five DC women received one home visit (79.5%) and 25 received two home visits (56.8% overall, 67.6% of those still breastfeeding). Five women declined the first home visit (1 did not breastfeed) and the doula was unable to contact 4. Of the 10 subjects who did not have a second home visit, one subject declined, 7 could not be contacted, and no reason was noted for 2. The first visit occurred between day 2 and 9 postpartum (median, day 3) and the second between day 6 and 23 postpartum (median, day 9).

Childbirth and Newborn Outcomes

Childbirth and newborn outcomes by DC group are presented in Table 3. The use of labor analgesia was common in both groups (92%). The adjusted odds of being below the median exposure of 5.7 hours of labor analgesia were significantly higher in the DC group. The adjusted odds of labor hospitalization duration being below the median of 14 hours were not significantly different between care groups, whether examined in the groups overall or stratified by labor status upon admission. However, among those attaining full cervical dilation ($n = 110$), the odds of stage II labor duration less than 1 hour were significantly higher in the DC group. Overall, 74.5% of subjects experienced a vaginal delivery, with no significant difference between groups. Among those experiencing a vaginal birth, the adjusted odds (95% confidence interval) of spontaneous delivery (in contrast to forceps or vacuum assisted), were 4.68 (1.14-19.28) times higher in the DC group. The odds of a favorable Apgar score at 1 minute (greater than or equal to 9) were significantly higher in the DC group, but by 5 minutes most infants in both groups received Apgar scores of 9 or 10.

Those receiving doula care were significantly more likely to experience the onset of lactogenesis within the first 72 hours postpartum.

Early Infant-Feeding Practices

During the first 48 hours postpartum, 39.7% ($n = 56$) of subjects exclusively breastfed, 19.9% ($n = 28$) provided 1 to 2 formula feeds, and 40.4% ($n = 57$) provided 3 to 17 formula feeds. Overall, the median breastfeeding frequency was 13 feeds over the first 48 hours. Nine subjects never breastfed and 7 breastfed once during the first 48 hours. Groups were similar in breast and formula feeding frequency in the first 48 hours, whether examined in crude or adjusted models (Table 3). However, DC subjects were more likely to avoid offering a pacifier in the first 3 days postpartum.

Early Breastfeeding Success Outcomes

The timing of the day 3 interview was not significantly different between groups (median = 94 hours postpartum in both groups, $p = .94$). There was no significant difference between groups in breastfeeding status at the day 3 interview (DC vs. SC: 46.3% vs. 52.6% were exclusively breastfeeding; 34.2% vs. 30.5% were both breast and formula feeding; and 19.5% vs. 16.8% were solely formula feeding; chi-square $p = .80$). Among those who breastfed more than once in the first 48 hours ($n = 120$), 58.3% of those in the DC group and 45.2% of those in the SC group experienced timely OL. After adjusting for baseline characteristics, women in the DC group were significantly more likely

Table 1: Comparison of Demographic and Prenatal Characteristics Between Standard Care (SC) and Doula Care (DC) Subjects

	Sample at Enrollment		
	SC ($n = 97$)	DC ($n = 44$)	
	Median (interquartile range)		p[a]
Timing of predischarge interview, postpartum hour	23.7 (15.3-33.7)	22.7 (15.7-34.0)	.88
Maternal age (years)	21.1 (19.5-23.3)	22.1 (20.1-25.8)	.18
Began prenatal care (gestational week)	10.0 (7.1-15.6)	9.9 (6.1-14.4)	.68
Admit dilation (cm)	2.0 (1.0-3.5)	2.0 (1.0-3.0)	.33
	Mean ± standard deviation		p[b]
Infant birth weight (g)	3,337 ± 410	3,374 ± 526	.68
Infant gestational age (weeks)	39.8 ± 1.2	40.1 ± 1.4	.26
	Number (%)		p[c]
Maternal ethnicity			
Hispanic	34 (35.1)	26 (59.1)	.04
White, non–Hispanic	33 (34.0)	8 (18.2)	
African American	23 (23.7)	6 (13.6)	
Asian	7 (7.3)	4 (9.1)	
Spanish primary language	5 (5.2)	10 (22.7)	.006
Maternal education level			
< High school graduate	31 (32.0)	15 (34.0)	.96
High school diploma	33 (34.0)	15 (34.0)	
Some college	33 (34.0)	14 (32.0)	
Enrolled in the Women, Infant, Children (WIC) supplemental nutrition program	68 (70.1)	32 (72.7)	.88
Planning ≤ 12 weeks of maternity leave	48 (49.5)	19 (43.2)	.48
Feeding plans upon admission[d]			
Breastfeed only	77 (79.4)	34 (77.3)	.78
Both breast and formula	16 (16.5)	7 (15.9)	
Undecided	4 (4.1)	3 (6.8)	
In labor upon admission	66 (68.0)	22 (50.0)	.04
Maternal body mass index ≥ 30[e]	30 (31.2)	18 (41.9)	.22
Prenatal stressors			
Substance abuse history	7 (7.2%)	3 (6.8%)	1.00
Tobacco use during pregnancy	6 (6.2%)	3 (6.8%)	1.00
Mental health diagnosis	7 (7.2%)	3 (6.8%)	1.00
Chronic health condition[f]	18 (18.6%)	3 (6.8%)	.08
Pregnancy-induced hypertension	6 (6.2%)	2 (4.6%)	1.00

Table 1. Continued

	Sample at Enrollment		
	SC ($n = 97$)	DC ($n = 44$)	
Diabetes (gestational or chronic)	4 (4.1%)	2 (4.6%)	1.00
Other pregnancy condition[g]	9 (9.3%)	7 (15.9%)	.26
At least one of the above	39 (40.2)	21 (47.7)	.40

Note. [a]*p*-value, Mann-Whitney-Wilcoxon test.
[b]*p*-value, Student's *t*-test.
[c]*p*-value, Fisher's exact test.
[d]*p*-value based on comparison of "breastfeed" versus "both/undecided."
[e]Estimated from [(admission weight, kg) − (2×infant birth weight, kg)]/(height, m)^2, $n = 139$.
[f]Asthma, $n = 8$; chronic hypertension, $n = 2$; chronic migraine headaches, $n = 3$; sickle cell anemia, $n = 2$; thyroid disorder, $n = 2$; chronic pain medication (Vicodin) use, $n = 2$; chronic sleep aid use, $n = 1$; protein S deficiency, $n = 1$; Crohn's disease, $n = 1$; multiple sclerosis, $n = 1$; 2 subjects had two conditions.
[g]Oligohydramnios, $n = 5$; Rh sensitization, $n = 5$ (2 typical, 3 atypical); antepartum bleeding, $n = 3$; antiemetic use throughout pregnancy, $n = 2$; recovering from chicken pox, $n = 1$; two-vessel cord, $n = 1$; 1 subject had two conditions.

to experience timely OL (Table 3). Women in the DC group were significantly more likely not to report milk supply concerns (Table 3). There was a strong correlation between delayed OL and having milk supply concerns (Spearman's correlation coefficient, $r = .32$, $p = .0004$). Of the subjects with concerns about their milk supply, 71.1% had experienced delayed OL. In contrast, only 38.8% of those without milk supply concerns experienced delayed OL. When asked about their infant's breastfeeding behavior at the most recent feeding, 61 (47.7%) responded that their infant "sucked well," 47 (36.7%) responded that their infant "sucked well off and on, but needed encouragement," 17 (13.3%) responded that their infant "sucked poorly" and 3 (2.3%) responded that their infant "did not suck." The proportion of infants who "sucked well" at day 3 did not differ between care groups (Table 3).

Aside from doula care, maternal BMI and active labor status upon hospital admission were also significantly associated with timely OL (Table 4). Avoidance of pacifier use and formula supplements were both significantly associated with "sucking well" (Table 4).

Table 2: Documentation of Types of Labor Support Provided to Doula Care (DC) Group

Labor Support Provided	Number (%)
Assist with ambulation	24 (54.6)
Birth ball	17 (38.6)
Breathing	44 (100)
Counter-pressure	20 (46.5)
Hot/cold compress	13 (31.0)
Massage/touch	30 (68.2)
Assist with birth position	35 (79.6)
Pelvic rock	14 (31.8)
Toilet sit	7 (16.3)
Verbal support, information	44 (100)
Visualization	22 (50.0)
Shower	15 (34.1)
Music/sounds for relaxation	13 (31.0)

Breastfeeding Status at 6 Weeks

The timing of the 6 week follow-up interview was not significantly different between groups (median = 43 days in both the DC and SC groups, $p = .98$). At the time of the 6 week interview, 25 of 37 (67.6%) DC and 49 of 91 (53.8%) SC subjects were breastfeeding, including 13 (35.1%) DC and 24 (26.4%) SC subjects who were breastfeeding exclusively. After adjusting for baseline factors, the DC group had marginally significant greater odds of breastfeeding at 6 weeks (Table 5, $p = .06$).

Mediating Effects of Early Breastfeeding Success Outcomes

The odds of timely OL and "no milk supply concerns" at the day 3 interview were significantly higher in the DC group and thus were examined for a significant effect on breastfeeding status at 6 weeks postpartum, to determine if the joint significance criteria for mediation were met. In both crude and adjusted logistic regression models, timely OL significantly increased the odds of

Table 3: Obstetric, Neonatal, and Breastfeeding (BF) Outcomes for Doula Care (DC) Versus Standard Care (SC) Groups

	Group	No. in Sample	% With Outcome	OR (95% CI)[a]	AOR (95% CI)[b]
Labor and delivery outcomes					
Labor analgesia/anesthesia					
None used	DC	44	13.6	0.47 (0.10-2.28)	0.65 (0.13-3.27)
	SC	97	15.5	(reference)	
If used, duration < 5.7 hr[c]	DC	34	67.7	**3.07 (1.29-7.31)**	**2.96 (1.16-7.53)**
	SC	78	42.3		
Time from admission to birth < 14 hr[c]					
If admitted for induction	DC	22	27.3	0.93 (0.27-3.18)	0.38 (0.08-1.87)
	SC	31	32.3		
If in spontaneous labor	DC	22	72.7	1.63 (0.56-4.70)	1.34 (0.39-4.54)
	SC	66	62.1		
Stage II labor < 1 hr[c,d]	DC	33	66.7	2.22 (0.95-5.21)	**3.07 (1.19-7.90)**
	SC	77	46.7		
Vaginal delivery	DC	44	72.7	0.97 (0.42-2.22)	1.56 (0.61-4.00)
	SC	97	75.3		
Vaginal births					
No episiotomy or tear > second degree	DC	32	48.4	1.08 (0.46-2.50)	1.76 (0.67-4.64)
	SC	73	45.8		
Unassisted delivery (vs. vacuum or forceps)	DC	32	93.2	**3.72 (1.02-13.58)**	**4.68 (1.14-19.28)**
	SC	73	79.4		
Very satisfied with birth	DC	44	95.1	2.78 (0.59-13.04)	2.43 (0.47-12.54)
	SC	97	87.4		
Childbirth pain rating < 6	DC	44	27.3	0.46 (0.21-1.02)	0.51 (0.22-1.19)
	SC	97	43.3		
Newborn status					
No resuscitation given	DC	44	88.6	1.19 (0.39-3.67)	1.78 (0.61-5.22)
	SC	97	80.4		
1 min Apgar ≥ 9	DC	44	56.8	**2.41 (1.16-5.03)**	**2.64 (1.17-5.98)**
	SC	97	35.0		
5 min Apgar ≥ 9	DC	44	93.2	1.73 (0.46-6.53)	1.86 (0.45-7.62)
	SC	97	88.7		

Table 3. Continued

	Group	No. in Sample	% With Outcome	OR (95% CI)[a]	AOR (95% CI)[b]
Early BF practices					
BF within 1 hr of birth	DC	44	63.6	1.22 (0.58-2.59)	1.22 (0.53-2.80)
	SC	97	59.8		
BF 13 times or more[c], 0-48 hr	DC	44	56.8	1.39 (0.67-2.87)	1.37 (0.60-3.13)
	SC	97	49.5		
≤ 2 formula feeds 0-48 hr	DC	44	59.1	0.91 (0.44-1.89)	0.98 (0.43-2.24)
	SC	97	59.8		
Avoided pacifier use, days 1-3	DC	41	51.2	**2.25 (1.06-4.78)**	**2.41 (1.03-5.65)**
	SC	95	32.6		
Day 3 measures of early BF success[e]					
Timely onset of lactation					
Overall	DC	41	53.7	1.33 (0.63-2.81)	1.69 (0.74-3.85)
	SC	93	47.3		
BF 0-1 time, 0-48 hr ($n = 14$)	DC	5	20.0	0.13 (0.01-1.67)	—
	SC	9	66.7		
BF >1 time, 0-48 hr ($n = 120$)	DC	36	58.3	1.82 (0.82-4.05)	**2.69 (1.07-6.78)**
	SC	84	45.2		
Infant "sucked well"	DC	38	47.4	1.04 (0.48-2.23)	0.95 (0.42-2.17)
	SC	90	47.8		
No low milk supply concerns	DC	39	71.8	1.69 (0.73-3.89)	**2.58 (1.02-6.57)**
	SC	93	62.4		

Note. [a]Unadjusted odds ratio (95% confidence interval); logistic regression model using sample available for analysis in adjusted model; odds ratios significantly different from 1.0 shown in bold font.
[b]Adjusted odds ratio (95% confidence interval); logistic regression model adjusted for admission status, maternal obesity, and ethnic group; odds ratios significantly different from 1.0 shown in bold font.
[c]Represents median in distribution.
[d]Cesarean delivery before arriving at stage II of labor, $n = 31$.
[e]Based on maternal report, adjusted for pre-admission feeding plans and education level in addition to baseline variables described in footnote b.

breastfeeding at 6 weeks (Table 5). Inclusion of timely OL in the first model of Table 5 decreased the adjusted odds ratio for care group by 34% (from 2.57 to 1.69). A similar pattern was observed for "no milk supply concerns." In both crude and adjusted logistic regression models, mothers reporting no milk supply concerns at the day 3 interview had significantly higher odds of breastfeeding at 6 weeks (adjusted odds ratio [95% confidence interval], 3.10 [1.25-7.68]).

The DC group was not significantly more likely to report on day 3 that their infants "sucked well" at the most recent breastfeed. However, DC subjects were more likely to avoid offering a pacifier in the first 3 days postpartum, which was associated with increased odds of the infant "sucking well" on day 3 (adjusted odds ratio [95% confidence interval], 2.79 [1.34-5.79]). In both crude and adjusted logistic regression models, the infant "sucking well" on day 3 significantly increased the odds of breastfeeding at 6 weeks (Table 5).

Effect Modification by Prenatal Stressor Status

The effect of DC group on breastfeeding status at 6 weeks postpartum was modified by the presence of a prenatal stressor. Among women without a prenatal stressor, there was no significant difference

Table 4: Factors Associated With Timely Onset of Lactogenesis and Maternal Report of Infant "Sucking Well" at Day 3

	Timely Onset of Lactogenesis (Timely OL)[a]		
	Timely OL (%)	OR (95% CI)[b]	AOR (95% CI)[c]
Ethnicity			
White	39.5	0.58 (0.25-1.36)	0.79 (0.32-1.96)
African American	57.1	1.34 (0.47-3.81)	2.09 (0.94-5.34)
Asian	50.0	0.89 (0.20-3.95)	0.76 (0.16-3.69)
(Reference = Hispanic)	52.8		
Maternal BMI < 30[d]	57.5	**2.71 (1.22-6.02)**	**2.82 (1.18-6.76)**
(Reference = BMI ≥ 30)	33.3		
In labor upon hospital admission	56.4	**2.24 (1.03-4.88)**	2.24 (0.94-5.34)
(Reference = admitted for induction)	35.7		
Doula Care	58.3	1.82 (0.82-4.05)	**2.69 (1.07-6.78)**
(Reference = standard care)	45.2		
	Infant "Sucked Well", Day 3[e]		
	Sucked Well (%)	OR (95% CI)[b]	AOR (95% CI)[c]
Pacifier use			
Avoided pacifier, days 1-3	62.8	**2.79 (1.34-5.79)**	**2.52 (1.19-5.36)**
(Reference = provided pacifier)	37.7		
Formula use, 0-48 hr postpartum			
Offered formula 0-2 times	57.1	**3.18 (1.46-6.93)**	**2.89 (1.30-6.42)**
(Reference = provide formula > 2 times)	29.6		

Note. [a]Timely OL defined as OL within 72 hr postpartum; based on maternal report; limited to subjects who breastfed more than one time in first 48 hr, $n = 119$ (missing day 3 interview, $n = 5$; missing milk onset, $n = 2$; missing BMI status, $n = 2$; breastfed less than twice in first 48 hr, $n = 13$).

[b]Unadjusted odds ratio (95% confidence interval); logistic regression model using sample available for analysis in adjusted model; odds ratios significantly different from 1.0 shown in bold font.

[c]Adjusted odds ratio (95% confidence interval); logistic regression model adjusting for other variables in the model, as shown; odds ratios significantly different from 1.0 shown in bold font.

[d]BMI = body mass index; estimated from [admission weight, kg − (2×infant birth weight, kg)]/(height, m)^2.

[e]Based on maternal report; limited to subjects who ever breastfed, $n = 128$ (missing day 3 interview, $n = 5$; never breastfed, $n = 4$; question missed, $n = 4$).

between groups in the odds of breastfeeding at 6 weeks postpartum. However, among women with at least one of the predefined prenatal stressors, the proportion of breastfeeding at 6 weeks postpartum was much higher in the DC group, 88.9% versus 40% in the SC group (Figure 2), and when adjusted for baseline factors, the odds of breastfeeding were 24-fold higher in the DC group (Table 5). None of the other selected baseline characteristics modified the effect of group on breastfeeding status at 6 weeks (data not shown).

Discussion

Meta-analyses of childbirth support trials suggest that there is heterogeneity in childbirth outcomes by type of support and provider: continuous versus intermittent and health care provider versus lay provider (Hodnett et al., 2007; Kennell & Klaus, 2003; Scott et al., 1999). The strongest effects of childbirth support have been observed in settings where the childbirth support is continuous and the provider is a lay person. Based on these observations, the Doula Care Project was designed to provide contin-

Table 5: Factors Associated With Breastfeeding at the 6 Week Interview

	Breastfeeding (BF) at 6 Weeks[a]		
	% BF	OR (95% CI)[b]	AOR (95% CI)
Model 1, Doula care with baseline factors[c]			
Ethnicity			
White	71.8	1.09 (0.43-2.74)	1.07 (0.39-2.92)
African American	25.0	**0.15 (0.05-0.43)**	**0.21 (0.07-0.65)**
Asian	40.0	0.29 (0.07-1.16)	0.22 (0.45-1.09)
(Reference = Hispanic)	68.6		
Education level			
Some college	67.4	1.96 (0.91-4.21)	2.41 (0.95-6.15)
(Reference = no college)	52.4		
Pre-admission feeding plan			
Breastfeed	64.1	**3.67 (1.43-9.39)**	**3.13 (1.02-9.62)**
(Reference = both or undecided)	32.0		
Maternal BMI[d]			
BMI < 30 kg/m^2	71.2	1.60 (0.76-3.37)	1.96 (0.78-4.90)
(Reference $\geq$ 30)	51.2		
Admission status			
Admitted in labor	60.3	1.18 (0.57-2.44)	2.07 (0.86-4.99)
(Reference = admitted for induction)	54.0		
Care group			
Doula care	67.6	1.90 (0.84-4.32)	2.57 (0.95-6.99)
(Reference = standard care)	53.8		
Model 2, Effect of early breastfeeding success outcomes[e]			
Onset of lactogenesis			
Timely onset (within 72 hr)	76.9	**3.61 (1.53-8.55)**	**4.88 (1.72-13.84)**
(Reference = onset $\geq$ 72 hr)	52.5		
Infant behavior at most recent breastfeed, day 3			
"Sucked well"	76.8	**2.95 (1.30-6.72)**	**3.72 (1.37-10.11)**
Less than "sucked well"	47.6		

Table 5. Continued

	Breastfeeding (BF) at 6 Weeks[a]		
	% BF	OR (95% CI)[b]	AOR (95% CI)
Model 3, Doula care interaction with prenatal stressor[c,f]			
Without prenatal stressor			
Doula Care, $n = 19$	47.4	0.57 (0.20-1.67)	0.64 (0.18-2.26)
(Reference = standard care, $n = 56$)	62.5		
With prenatal stressor			
Doula Care, $n = 18$	88.9	**12.00 (2.38-60.52)**	**23.76 (3.49-161.73)**
(Reference = standard care, $n = 35$)	40.0		

Note. [a]Defined as having breastfed or expressed breast milk at least once in the 24 hr before the 6 week telephone interview.
[b]Unadjusted odds ratio (95% confidence interval); logistic regression model using sample available for analysis in adjusted model; odds ratios significantly different from 1.0 shown in bold font.
[c]Adjusted odds ratio (95% confidence interval); logistic regression model; model includes baseline characteristics with differing distribution between care groups (ethnicity, admission status) and baseline variables shown to have a significant effect on breastfeeding practices (BMI category, education level and feeding plans upon hospital admission); $n = 126$ (missing BMI category).
[d]BMI = body mass index; estimated from [admission weight, kg − (2×infant birth weight, kg)]/(height, m)]^2.
[e]Adjusted odds ratio includes ethnicity and feeding plan upon hospital admission; other baseline variables are predecessors in the causal pathway for the effects examined in Model 2; logistic regression models based on subjects with data for both main effects and limited to subjects who breastfed more than one time in the first 48 hr; $n = 109$ (breastfed less than one time in the first 48 hr, $n = 15$; missing onset of copious milk production OL, $n = 2$; missing infant suck status at day 3, $n = 2$).
[f]Prenatal stressor defined as having at least one of the following: substance abuse history, tobacco use during pregnancy, clinical depression or anxiety diagnosis, chronic health condition, pregnancy-induced hypertension, diabetes (gestational or chronic), or other pregnancy condition.

uous, one-on-one lay childbirth support. The intervention targeted low-income, primiparous women, as they are at greatest risk for short breastfeeding duration. Women in the DC group were more likely to experience a short stage II labor and a spontaneous vaginal delivery. In addition, their infants were more likely to have 1 minute Apgar scores of 9 or 10. These results are similar to those found in ran-

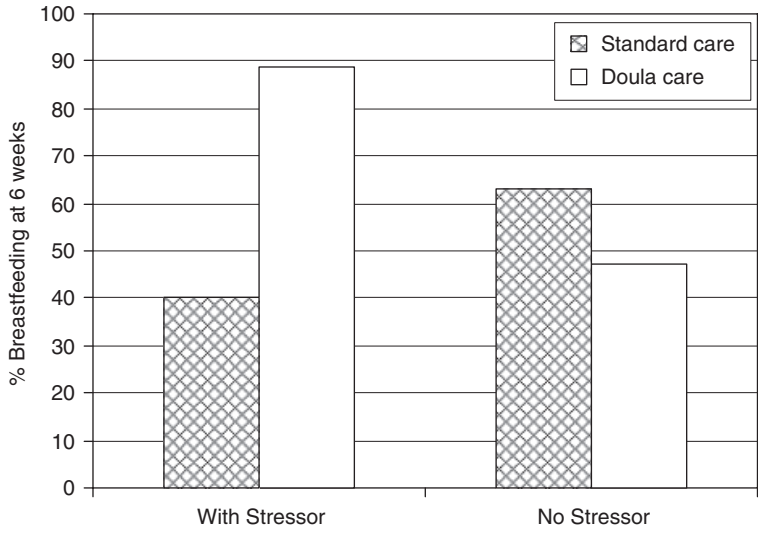

Figure 2. Breastfeeding prevalence at 6 weeks, illustrating care group by prenatal stressor interaction. Controlling for important baseline variables, Care group×Prenatal stressor interaction $\chi^2 = 11.7$, $p = .0006$; main effect of care group $\chi^2 = 6.1$, $p = .01$; main effect of prenatal stressor $\chi^2 = 1.7$, $p = .20$. Prenatal stressor defined as having at least one of the following: substance abuse history, tobacco use during pregnancy, clinical depression or anxiety diagnosis, chronic health condition, pregnancy-induced hypertension, diabetes (gestational or chronic), or other pregnancy condition.

domized doula support trials and provide evidence of the DC group having a less complicated childbirth experience than the SC group.

However, contrary to the study hypothesis, doula care exposure did not result in improved early infant-feeding practices, other than pacifier use. Timing of breastfeeding initiation and patterns of breastfeeding and formula feeding frequency were very similar between DC and SC groups in the first 48 hours of life. It is possible that the hospital environment overpowers any influence of doula care on early feeding practices. Nonetheless, among those who breastfed more than once in the first 48 hours, the DC group was significantly more likely to experience timely OL (58.3% vs. 45.2% in the SC group). This suggests that doula care had a direct physiological effect on the timing of OL, possibly as a result of improved childbirth outcomes. This finding is consistent with our previous studies (Chen et al., 1998), and the work of others (Chapman & Pérez-Escamilla, 1999b; Grajeda & Perez-Escamilla, 2002) showing that factors such as elevated cortisol levels during labor and long labor duration negatively impact the timing of OL.

Overall, 68% of DC versus 54% of SC subjects were breastfeeding at 6 weeks. However, even within this cohort of women considered at risk for short breastfeeding duration, the results suggest that doula care has the most impact among those with additional risk factors. Within the subset with a prenatal stressor, only 2 of 19 DC subjects had weaned by the time of the 6 week interview, as compared with 21 of 35 SC subjects. This finding was not part of an *a priori* hypothesis; thus it is more vulnerable to type I error. However, the magnitude of the observed effect (adjusted odds ratio = 24) is very large, decreasing the likelihood of a spurious association.

In the sample as a whole, the difference in breastfeeding prevalence at 6 weeks between DC and SC groups was only marginally significant ($p = .06$). Because of a much smaller sample size in the DC group than we anticipated, our power to detect a significant difference ($p < .05$) of this magnitude, approximately equivalent to a 44% increase in breastfeeding prevalence (Zhang & Yu, 1998), is only 65%. It is possible that we failed to detect a true overall effect of care group on breastfeeding status at 6 weeks as a result of insufficient power (type II error). However, even this level of difference, if a true effect of doula care, represents an improvement in breastfeeding rates that is of public health relevance: an approximate increase from 54% to 71% in breastfeeding prevalence after adjustment for confounding factors (Zhang & Yu).

Among women with at least one pre-defined prenatal stressor, those in the doula care group were more than twice as likely to be breastfeeding at six weeks postpartum.

In any case, the results provide evidence of an indirect effect of doula care on breastfeeding status at 6 weeks postpartum via its effects on timely OL and decreased prevalence of milk supply concerns at day 3. Consistent with our conceptual model, both timely OL and not having milk supply concerns at day 3 significantly increased the odds of breastfeeding at 6 weeks. Based on the joint significance test of mediation, doula care had a significant, indirect effect on breastfeeding status at 6 weeks postpartum, mediated by timely OL. Infant suck behavior on day 3 also had a significant independent effect on breastfeeding status at 6 weeks postpartum, underscoring the importance of early breastfeeding success in sustaining breastfeeding duration. These results are summarized in Figure 3.

As with any observational study, these results are vulnerable to bias and preclude cause-and-effect conclusions. Despite the Doula Care Project supervisor's efforts to ensure systematic allocation to doula care, selection bias did occur, as evidenced by significantly higher proportions of women planning to solely formula feed in the SC group, and significantly higher proportions of women of Hispanic ethnicity or being admitted for induction of labor in the DC group. Furthermore, the assessment of OL and infant breastfeeding behavior were based on maternal recall. Steps were taken to control for these potential sources of bias: (a) eliminating mothers planning to solely formula feed from the analysis, (b) examining the odds ratios in adjusted logistic regression models controlling for baseline differences, and (c) masking study subjects and research assistants to the primary exposure of interest (doula care). Exclusion of subjects who declined doula care may have introduced selection bias, especially if they were more at risk for poor breastfeeding outcomes. However, the opposite was true, as women who declined doula care were more likely to have characteristics associated with breastfeeding success: they were more than twice as likely to have attended college, and at hospital admission 83% planned to breastfeed only (data not shown). Thus, their exclusion would be expected to result in a shift of the odds ratio toward

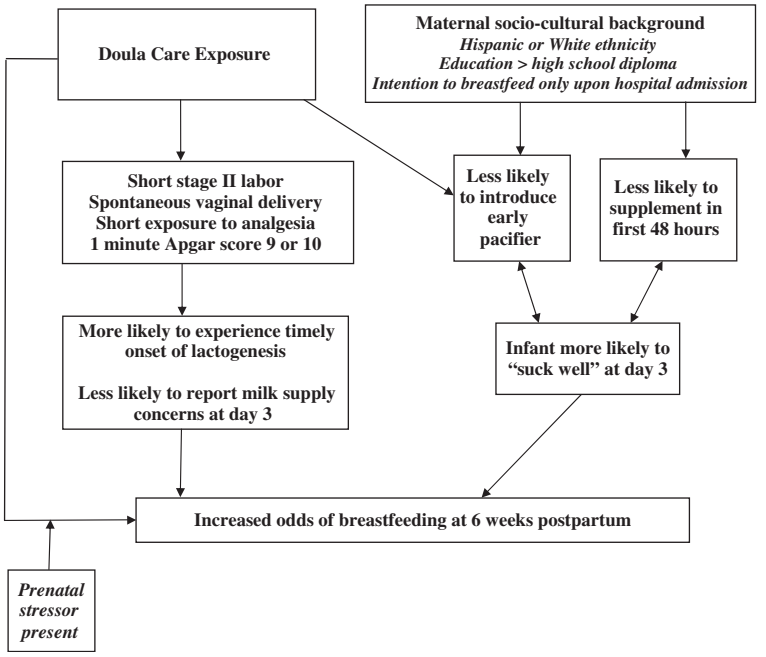

Figure 3. Model illustrating observed associations with doula care exposure.

nonsignificance rather than away from it. Differential loss to follow-up is another potential source of bias. However, the researchers were able to collect 6 week follow-up data on 91% of the original sample, which makes this source of bias unlikely.

The external validity of this study is limited by the narrow eligibility criteria for receiving the Doula Care Project. The results of this study will be applicable to low-income, primiparous women in an ethnically diverse population, but may not be generalizible to multiparous women or those of higher socioeconomic status. However, the strength and consistency of the results indicate that further study with a larger, randomized sample is warranted.

Conclusion

In summary, doula care increased the odds of improved childbirth and breastfeeding outcomes. In the DC group, the odds of shorter labor analgesia exposure, shorter stage II labor and unassisted vaginal delivery were all significantly higher than in the SC group. Their newborns tended to fare better also: the odds of the 1 minute Apgar score being 9 or 10 were significantly higher in the DC versus SC group. Despite most in-hospital breastfeeding practices being similar between groups, the odds of timely OL were significantly higher in the DC versus SC group. The latter finding supports our hypothesis that doula care may have a direct physiological effect on the timing of OL.

Furthermore, timely OL significantly increased the odds of breastfeeding at 6 weeks postpartum. Overall, 68% of DC and 54% of SC subjects were breastfeeding at 6 weeks. Among mothers with a prenatal stressor, doula care was particularly effective in increasing the odds of continued breastfeeding: within this subgroup, 89% of DC versus 40% of SC women were breastfeeding at 6 weeks. In conclusion, interventions to minimize labor and delivery complications, such as providing doula care, may be important in extending the duration of breastfeeding in vulnerable populations. Further evaluation of this approach, using a truly randomized study design, is warranted.

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