Delayed clamping of the umbilical cord improves hematologic status of Guatemalan infants at 2 mo of age[1–3]

Rubén Grajeda, Rafael Pérez-Escamilla, and Kathryn G Dewey

ABSTRACT Iron deficiency anemia is a serious health problem that affects the physical and cognitive development of children. Therefore, it is important to develop cost-effective interventions to improve the hematologic status of the millions of children affected by this condition worldwide. We studied 69 Guatemalan infants who had been randomly assigned to one of three groups at the time of delivery: *1*) cord clamping immediately after delivery ($n = 21$); *2*) clamping when the cord stopped pulsating, with the infant placed at the level of the placenta ($n = 26$); or *3*) clamping when the cord stopped pulsating, with the newborn placed below the level of the placenta ($n = 22$). Maternal and infant hematologic assessments were performed at the time of delivery and 2 mo postpartum. At baseline the groups had similar socioeconomic, demographic, and biomedical characteristics and the newborns had similar hematocrit status. Two months after delivery, infants in the two groups with delayed cord clamping had significantly higher hematocrit values and hemoglobin concentrations than did those in the early-clamping group. The percentage with hematocrit values < 0.33 was 88% in the control group compared with 42% in group 2 and 55% in group 3 ($P = 0.01$). These results suggest that waiting until the umbilical cord stops pulsating (≈1 min after delivery) is a feasible low-cost intervention that can reduce anemia in infants in developing countries. *Am J Clin Nutr* 1997;65:425–31.

KEY WORDS Anemia, infants, iron deficiency, umbilical cord

INTRODUCTION

Iron deficiency anemia affects millions of children worldwide and has been associated with impaired physical and cognitive development (1). Improving iron status via interventions during gestation or early infancy has proven to be a challenge because maternal supplemental iron is not likely to have a strong effect on breast milk iron concentrations (2) and its effect on fetal iron stores is unclear (3–5). Direct supplementation of infants with medicinal iron is an option but compliance is often a problem and there are the potential risks of accidental poisoning, competition for absorption with other nutrients such as zinc (6), and possibly a reduction in the antiinfective properties of human milk lactoferrin in the breast-fed infant's gastrointestinal tract because of saturation with iron (7). Therefore, it is important to examine alternative cost-effective measures that may reduce the prevalence of iron deficiency early in life.

Iron status of infants is strongly influenced by their total-body iron content at birth (8). Obstetric practices, particularly the timing of clamping of the umbilical cord, can affect the volume of blood transferred from the placenta to the newborn and thus the total-body iron content. The purpose of this paper was to report results from a randomized clinical trial in which the effect of delayed clamping of the umbilical cord on infant iron status was examined in a low-income Guatemalan population. The specific hypotheses tested in this study were as follows: *1*) delaying the clamping of the umbilical cord will enhance hematologic status during early infancy, and *2*) placing the newborn below the level of the placenta, in addition to delaying the clamping of the cord, will enhance even further the hematologic status of infants. To our knowledge, this is the first longitudinal study conducted in a developing country that addressed these hypotheses using a randomized design.

SUBJECTS AND METHODS

Study design

Between September 1994 and February 1995 we recruited 88 infants delivered at the municipal hospital of Amatitlán, which serves rural and urban areas from four districts and is located 28 km from Guatemala City at an altitude of 1190 m. Women were contacted in the hospital while they were in their first stage of labor. After their consent was obtained, women were randomly assigned to one of the following three groups: group

[1] From the Instituto de Nutrición de Centro América y Panamá (INCAP), Guatemala City, Guatemala; the Department of Nutritional Sciences, University of Connecticut, Storrs; and the Program in International Nutrition and Department of Nutrition, University of California, Davis.

[2] Supported by the University of California DAVIS-INCAP institutional linkage; the University Development Linkage Program of the US Agency for International Development (Cooperative Agreement no. DAN-5063-A-00-1115-00); and the College of Agriculture and Natural Resources, University of Connecticut, Storrs.

[3] Address reprint requests to R Pérez-Escamilla, Department of Nutritional Sciences, University of Connecticut, Storrs, CT 06269-4017. E-mail: rperez@canrl.cag.uconn.edu.

Received March 21, 1996.

Accepted for publication October 3, 1996.

1, cord clamping immediately after delivery (control, $n = 29$); group 2, clamping when the cord stopped pulsating, with the infant placed at the level of the placenta ($n = 30$); or group 3, clamping when the cord stopped pulsating, with the newborn placed below the level of the placenta ($n = 29$). All deliveries were attended by the first author of this paper and by medical staff trained for this project. Randomization was done by day of the week, ie, each day a different delivery method was used so that each treatment was repeated every third working day until the sample was completed. Hematologic assessments were performed pre- and postpartum and 2 mo after delivery. The follow-up staff and laboratory personnel were blind to group assignment. The study was approved by the Human Subjects Review Committees of the Institute of Nutrition for Central America and Panama, the Municipal Hospital of Amatitlán, and the University of California, Davis.

Selection criteria and attrition

All subjects met the following selection criteria: birth weight ≥2000 g, gestational age ≥ 37 wk, singleton birth, vaginal delivery, no maternal gestational diabetes, no serious hemorrhages during pregnancy, no previous cesarean delivery, no cefalopelvic disproportion during delivery of study child (defined as lack of dilation of the cervix or fetal descent after 1 h of oxytocin infusion in conjunction with at least three contractions per 10 min lasting ≥ 50 s each), and no major congenital anomalies or perinatal complications such as neural tube defects, hyaline membrane, and respiratory distress syndrome. Initially, 111 women were contacted but 23 were not included because of previous cesarean delivery or cefalopelvic disproportion ($n = 7$), preeclampsia ($n = 3$), fetal distress ($n = 1$), premature delivery ($n = 1$), placental separation before delivery ($n = 1$), or multiple delivery ($n = 1$), or because delivery took place when the research staff were not available ($n = 9$).

Of the 88 women and infants who were recruited into the study, we were able to contact 73 at 2 mo postpartum for a follow-up interview and physical examination. Fifty of these subjects returned to the clinic for the follow-up, as requested, whereas 23 were examined in their homes. Fifteen subjects were lost to follow-up because we could not locate them. Of the 73 subjects who were recontacted, blood samples were successfully obtained from 69 infants. Thus, these 69 infants formed the sample for the analyses presented herein: 21 in group 1, 26 in group 2, and 22 in group 3. Loss because of dropouts or missing hematologic data ranged from 19% to 24% and was not significantly different among groups ($P = 0.87$). The 19 subjects for whom follow-up hematologic data were not available did not differ significantly in socioeconomic or demographic characteristics from the other 69 subjects, but mean infant birth weight was lower in this group (2.9 ± 0.5 kg compared with 3.1 ± 0.5 kg, respectively; $P < 0.05$).

Methods

Pretested structured survey questionnaires were used to collect the following information from the mothers at the hospital, at follow-up, or both: *1*) socioeconomic and demographic characteristics, *2*) maternal reproductive and health histories including current pregnancy, *3*) infant feeding practices, and *4*) infant morbidity since birth. At the time of delivery, an observer used a stopwatch to record the time elapsed before clamping the umbilical cord relative to head crowning and appearance of the newborn's shoulders.

All anthropometry was performed by the first author following standard procedures (9). Weight, length, and head circumference of the newborns were measured at birth; maternal weight, height, and triceps skinfold thickness and infant weight, length, and head circumference were measured 2 mo postpartum.

Two blood samples were collected by venipuncture from the mothers, one within 1 h before delivery and the other 2 mo after delivery. A venous blood sample was obtained from the infants at the 2-mo follow-up visit. In a subsample of infants (the last 41 recruited into the study), venous blood samples were also collected 24 h after birth for measurement of hematocrit. After hematocrit tubes were filled, each blood sample was divided into two tubes, one with and one without heparin. Samples were kept in a refrigerator for ≤ 4 h and then transported to the laboratory on ice. In the laboratory, hematocrit and hemoglobin were measured and the remaining blood was centrifuged (3500 rpm, 5 min, 7 °C), with the serum and plasma samples frozen for later analysis. Hemoglobin concentrations of newborns at delivery and at 2 mo of age were determined by using the Drabkin micromethod (10). Infant's hemoglobin at 2 mo of age was measured by using the Hemocue 990 instrument (HemoCue AB; HemoCue Inc, Mission Viejo, CA). Hematocrit was determined by using standard procedures.

In the maternal samples and in those from infants at 2 mo of age, additional hematologic analyses included infant serum and maternal plasma ferritin (Ramco kit; RAMCO Laboratories Inc, Houston), serum iron (11), and plasma C-reactive protein (CRP) (latex agglutination method; Stanbio Laboratory, San Antonio, TX) determinations. A concentration ≥ 5 mg CRP/L with this method indicated a positive result. All assays were done in duplicate whenever possible. Serum iron was not analyzed when there was obvious hemolysis in the sample. Ferritin values for subjects with a CRP concentration indicative of infection were excluded from data analysis because ferritin concentrations tend to be elevated under such conditions (12). Sample sizes for the hematologic indexes varied because of inadequate sample volume in some cases.

Newborn health was assessed within 1 h of and again 24 h after delivery by study medical personnel. This examination included a clinical assessment of neurologic and motor development, jaundice, and gastrointestinal and respiratory function.

Statistical analyses

All analyses were carried out by using the SPSS for Windows statistical package (13). Baseline characteristics and outcomes were compared across groups by using the chi-square statistic for categorical variables and analysis of variance (ANOVA) for continuous variables. Group means were compared by using Tukey's honestly significant difference test. All results were based on two-tailed tests and a P value ≤ 0.05 was used as the criterion for significance.

RESULTS

There were no significant differences among groups in socioeconomic or demographic characteristics, maternal anthropometric indexes, prenatal care, gestational age, birth weight

TABLE 1
Descriptive statistics, by group[1]

	Group 1: early clamping (n = 21)	Group 2: delayed clamping, placenta level (n = 26)	Group 3: delayed clamping, below placenta (n = 22)
Socioeconomic and demographic			
Maternal age (y)	25.8 ± 7.0[2]	25.3 ± 6.3	23.7 ± 6.1
Maternal schooling (y completed)	3.1 ± 2.1 [21]	3.0 ± 2.4	3.2 ± 2.4
Marital status (% with partner)	90 [19]	92	100
Maternal employment (% employed)	5 [20]	4 [24]	0
Number of children born alive[3]	2.4 ± 2.6	2.1 ± 2.2	1.4 ± 1.3
Household size (no. of persons)	8.4 ± 3.3	8.6 ± 6.5	7.5 ± 5.3
Have a dirt floor (%)	19	15	27
Have a separate kitchen (%)	62	81	68
Urban services index[4]	2.4 ± 0.7	2.1 ± 1.0	2.4 ± 1.0
Household belongings index[5]	3.6 ± 1.9	3.3 ± 2.1	3.1 ± 2.2
Biomedical			
Time of cord clamp (min)			
From time of head crowning	0.9 ± 0.5	2.2 ± 1.2[6]	1.9 ± 0.6[6]
From time of appearance of shoulders	0.3 ± 0.3	1.4 ± 0.8[6]	1.2 ± 0.6[6]
Mother			
2 mo Follow-up			
Body mass index (kg/m^2)	24.2 ± 3.4 [20]	24.9 ± 5.9	25.6 ± 9.7
Height (m)	1.51 ± 0.08 [20]	1.50 ± 0.09	1.51 ± 0.12
Triceps skinfold thickness (mm)	14.9 ± 3.5 [19]	13.9 ± 4.2 [25]	13.3 ± 3.4 [21]
Prenatal			
Took a prenatal vitamin-mineral supplement (%)[7]	57	69	73
Took a prenatal iron supplement (%)	29	46	23
Number of prenatal visits	2.7 ± 2.0	4.1 ± 2.7	4.0 ± 2.9
Received prenatal care (%)	79 [19]	84 [25]	81 [21]
Infant			
Birth			
Sex (% female)	62	50	27
Gestational age (wk)[8]	38.5 ± 1.2	38.8 ± 0.9	38.4 ± 1.2
Apgar score at 5 min	8.9 ± 0.4	8.9 ± 0.4	8.9 ± 0.4
Birth weight (kg)	3.0 ± 0.4	3.2 ± 0.5	3.2 ± 0.5
Birth length (cm)	48.8 ± 2.5	49.8 ± 1.7	49.0 ± 1.9
2 mo Follow-up			
Age (mo)	2.2 ± 0.4 [20]	2.2 ± 0.5	2.2 ± 0.4
Feeding mode			
Fully breast-fed (%)	70	73	86
Partially breast-fed (%)	20	23	14
Breast milk substitutes only (%)	10	4	0
Received vitamin supplement (%)	5 [20]	4	5
Received iron supplement (%)	0 [20]	0	0
Illness since birth (%)	50 [20]	54	64
Diarrhea in previous week (%)[9]	15 [20]	19	23
Upper respiratory infection (%)[9]	55 [20]	65	59

[1] Sample size in brackets for measurements for variables with missing data.
[2] $\bar{x}$ ± SD.
[3] Excluding the study child.
[4] An additive index based on the following four services (present = 1, absent = 0): electricity, piped water, sewage system, and telephone.
[5] An additive index based on the following 10 household belongings (present = 1, absent = 0): iron, stereo, television, videorecorder, refrigerator, sewing machine, blender, stove with oven, motorcycle, and car.
[6] Significantly different from group 1, $P = < 0.001$.
[7] With or without iron.
[8] Determined by clinical examination of the newborn according to the method of Dubowitz as modified by Capurro (14).
[9] During the week before the 2-mo follow-up interview.

and length, or infant characteristics at 2 mo of age (**Table 1**). There was a marginally significant difference in infant sex, with fewer girls in group 3 (delayed clamping, below the placenta). As expected, the time between birth and clamping of the umbilical cord was significantly shorter (by ≈1 min) in the control group than in the two experimental groups. Hematocrit values of newborns in the three groups did not differ significantly 24 h after birth (**Table 2**), and the clinical assessment (including jaundice) revealed no significant difference in newborn health status across groups. However, polycythemia (percentage with a hematocrit value > 0.65) was more likely to occur in the group with delayed clamping and placement of the newborn below the level of the placenta (2 of 8) than in the other two groups (0 of 22). Both subjects with polycythemia were asymptomatic and their hematocrit values were just above the cutoff value (0.656 and 0.660). Maternal hematologic indexes were similar among groups both at baseline and 2 mo after delivery (**Table 3**).

Infants in the groups with delayed cord clamping had significantly higher hematocrit values 2 mo after delivery compared with the control group (Table 2). The percentage of subjects with a hematocrit value < 0.33 was 88%, 42%, and 55% in groups 1, 2, and 3, respectively ($P = 0.01$). Hemoglobin concentrations were also higher in the groups with delayed cord clamping, although the difference was significant only between group 1 (control) and group 2. There were no significant differences in hemoglobin or hematocrit between the two delayed-clamping groups. Concentrations of ferritin, total-iron-binding capacity (TIBC), serum iron, and transferrin saturation did not differ significantly among groups, although the trends for ferritin and TIBC were in the expected direction (Table 2).

Only two infants had a positive CRP test at 2 mo (considered to be a marker of infection or inflammation, which is associated with higher ferritin concentrations) (Table 2). There were no significant between-group differences in the proportion of women who had a positive CRP test (Table 3). An analysis of the whole sample indicated that, among women, a positive CRP test was linked with somewhat higher ferritin concentrations both at delivery and at 2 mo of age [29.2 ± 32.4 μg/L compared with 17.0 ± 23.3 μg/L at delivery ($P = 0.13$); 32.2 ± 25.5 μg/L compared with 22.2 ± 22.0 μg/L at 2 mo ($P = 0.14$)].

Multivariate-regression analyses were performed to rule out effects of potentially confounding variables on infant hematocrit and hemoglobin at 2 mo postpartum. The differences in hematocrit among groups remained significant after the follow-

TABLE 2
Infant hematologic outcomes, by group[1]

	Group 1: early clamping (n = 21)	Group 2: delayed clamping, placenta level (n = 26)	Group 3: delayed clamping, below placenta (n = 22)
Delivery			
Hematocrit (l)			
$\bar{x}$ ± SD	0.571 ± 0.042	0.558 ± 0.086	0.598 ± 0.086
Range	0.500–0.650 [12]	0.335–0.650 [10]	0.400–0.660 [8]
Hematocrit > 0.65 (l)	0 [12]	0 [10]	25[2] [8]
Follow-up			
Ferritin (μg/L)			
$\bar{x}$ ± SD	119.7 ± 83.2	130.9 ± 54.0	130.4 ± 66.5
Range	4.0–332.2 [16]	8.5–229.7 [21]	7.6–216.6 [12]
Ferritin (μg/L)[3]			
$\bar{x}$ ± SD	119.3 ± 91.6	131.2 ± 55.4	130.8 ± 69.8
Range	4.0–332.2 [12]	8.5–229.7 [20]	7.6–216.6 [11]
Hematocrit (l)			
$\bar{x}$ ± SD	0.301 ± 0.023	0.338 ± 0.036[4]	0.338 ± 0.028[4]
Range	0.260–0.352 [17]	0.275–0.440 [24]	0.300–0.400 [20]
Hemoglobin (g/L)			
$\bar{x}$ ± SD	99.9 ± 9.3	107.6 ± 11.1[5]	106.0 ± 8.5
Range	82.0–119.5 [19]	83.0–133.0 [25]	93.5–121.5 [21]
Serum iron (μmol/L)			
$\bar{x}$ ± SD	13.8 ± 5.5	14.6 ± 4.9	13.6 ± 4.4
Range	8.6–33.2 [18]	8.4–24.8 [18]	3.8–20.2 [14]
TIBC (μmol/L)[7]			
$\bar{x}$ ± SD	61.1 ± 22.0	58.3 ± 18.0	50.6 ± 11.1
Range	22.9–105.0 [17]	29.1–101.2 [18]	36.8–73.2 [13]
Transferrin saturation (%)			
$\bar{x}$ ± SD	25.8 ± 15.9	26.4 ± 9.1	29.8 ± 11.0
Range	9.0–80.0 [17]	12.0–45.0 [18]	15.0–53.0 [13]

[1] Sample size in brackets.
[2] Significantly different from groups 1 and 2, $P = 0.05$ (Tukey's honestly significant difference test).
[3] Excluding those positive for C-reactive protein. Only two 2-mo-old infants had a positive test. The remaining four infants excluded had missing data for this variable.
[4] Groups 2 and 3 significantly different from group 1 (Tukey's honestly significant difference test): $P = 0.001$.
[5] Group 2 significantly different from group 1 (Tukey's honestly significant difference test): $P = 0.03$.

TABLE 3
Maternal hematologic outcomes, by group[1]

	Group 1: early clamping (n = 21)	Group 2: delayed clamping, placenta level (n = 26)	Group 3: delayed clamping, below placenta (n = 22)
Delivery			
Ferritin (μg/L)			
$\bar{x}$ ± SD	19.9 ± 20.9	23.0 ± 27.3	20.2 ± 30.0
Range	3.4–94.2 [21]	3.4–117.1 [26]	2.9–148.6 [22]
Ferritin (μg/L)[2]			
$\bar{x}$ ± SD	16.0 ± 12.1	13.3 ± 10.0	23.8 ± 41.9
Range	3.4–45.1 [14]	3.4–29.7 [16]	2.9–148.6 [11]
Positive for CRP (%)	6 [20]	10 [26]	6 [17]
Hematocrit (l)	0.366 ± 0.064	0.385 ± 0.053	0.395 ± 0.040
	0.205–0.406 [21]	0.200–0.463 [26]	0.290–0.460 [19]
Hemoglobin (g/L)			
$\bar{x}$ ± SD	116.3 ± 21.2	122.3 ± 18.1	125.4 ± 14.3
Range	75.0–153.0 [21]	73.0–140.0 [26]	100.0–158.0 [19]
Serum iron (μmol/L)			
$\bar{x}$ ± SD	9.8 ± 3.6	12.8 ± 5.8	12.7 ± 5.1
Range	5.5–17.1 [17]	4.6–30.4 [20]	3.9–20.7 [15]
TIBC (μmol/L)			
$\bar{x}$ ± SD	56.6 ± 9.9	63.1 ± 27.2	59.9 ± 13.1
Range	42.3–72.5 [17]	36.8–167.0 [20]	37.9–91.8 [15]
Transferrin saturation (%)			
$\bar{x}$ ± SD	23.7 ± 21.8	23.8 ± 15.6	21.8 ± 10.4
Range	9.0–102.0 [17]	4.4–72.6 [20]	7.3–49.5 [15]
Follow-up			
Ferritin (μg/L)			
$\bar{x}$ ± SD	22.7 ± 20.6	26.7 ± 25.8	25.0 ± 25.2
Range	2.3–91.1 [21]	3.2–118.3 [25]	3.4–84.1 [22]
Ferritin (μg/L)[2]			
$\bar{x}$ ± SD	17.3 ± 12.8	27.1 ± 28.1	19.8 ± 18.7
Range	2.3–48.5 [14]	3.2–118.3 [21]	3.4–67.8 [15]
Positive for CRP (%)	6 [20]	4 [26]	5 [20]
Hematocrit (l)	0.394 ± 0.044	0.396 ± 0.032	0.408 ± 0.036
	0.270–0.450 [20]	0.330–0.450 [26]	0.330–0.460 [20]
Hemoglobin (g/L)			
$\bar{x}$ ± SD	125.8 ± 17.6	128.6 ± 13.3	134.2 ± 13.9
Range	81.0–148.0 [20]	95.0–158.0 [26]	104.0–157.0 [20]
Serum iron (μmol/L)			
$\bar{x}$ ± SD	10.8 ± 5.7	11.4 ± 3.5	12.5 ± 6.3
Range	3.8–25.9 [17]	5.0–15.9 [17]	3.9–24.8 [12]
TIBC (μmol/L)			
$\bar{x}$ ± SD	62.5 ± 17.2	56.7 ± 17.5	60.6 ± 15.0
Range	39.1–100.5 [17]	40.0–113.4 [17]	41.8–84.3 [12]
Transferrin saturation (%)			
$\bar{x}$ ± SD	18.3 ± 8.6	23.8 ± 15.6	21.9 ± 10.4
Range	9.0–37.6 [17]	4.4–72.6 [20]	7.3–49.5 [15]

[1] Sample size in brackets. TIBC, total-iron-binding capacity; CRP, C-reactive protein.
[2] Excluding those positive for CRP.

ing were controlled for: infant sex, infant hematocrit at birth, maternal parity, number of prenatal visits, birth weight, feeding mode (percentage fully breast-fed), prenatal iron supplement intake, and each of the maternal hematologic indexes at delivery and at 2 mo postpartum (coded either as continuous or dichotomous variables using standard cutoff values). Likewise, the magnitude of the difference in hemoglobin remained constant when these potentially confounding variables were included in the analyses, although the significance of the various models did not always reach the criterion of $P \leq 0.05$ because of loss of statistical power with multiple independent variables. Because none of the variables other than experimental group was significantly associated with infant hematocrit or hemoglobin, only the results based on the simpler models are shown (Table 2).

DISCUSSION

The results indicate that delaying the clamping of the umbilical cord until it stops pulsating (≈1 min after delivery of the

newborn) improved the hematologic status of the Guatemalan infants studied. The randomized nature of this study and the equivalence of the groups at baseline support the conclusion that this effect was causal. Although an improvement in the infant's iron status is a likely explanation for our findings, we cannot rule out the possibility that other nutrients might also have been involved. In this study it was not possible to follow the multiple-indicator approach to assess iron deficiency because the appropriate cutoff points that should be used for ferritin and transferrin saturation remain largely unknown for very young infants. Research regarding suitable indicators of iron deficiency during the first semester of life should be given priority.

Previous studies carried out in industrialized countries more than five decades ago also showed that delaying the clamping of the cord has a positive effect on blood volume and hematologic indexes soon after birth (15–17). However, these studies generally did not include measurements beyond the first week after delivery, except for the study by Wilson et al (18), which documented among low-income infants in the United States that delayed clamping was associated with increased hemoglobin concentrations 9 mo after delivery. That study, however, did not present adequate between-group comparisons of infant feeding, infant health, and socioeconomic indicators to be able to rule them out as potential confounders. In that study the cord was clamped immediately after birth in the control group and not until the placenta began to descend from the vagina in the experimental group.

Recent studies conducted in developed countries have also shown that delaying the clamping of the umbilical cord for 0.5–3.0 min has a positive effect on the hematologic status of preterm (19) and full-term neonates (20) in the first week of life. Our study documents for the first time in a population of a developing country that hematocrit and hemoglobin concentrations can be increased 2 mo postpartum by delaying the clamping of the cord. The position of the newborn in relation to the placenta at the time of clamping was not a significant factor.

Obstetric practices regarding cord clamping have varied, in part because of concern that the higher volume of blood transferred to the newborn with delayed clamping may have adverse health effects mediated by hyperbilirubinemia, polycythemia, or a diminished arousal state (19–21). In this study polycythemia 24 h after delivery was more likely to occur when cord clamping was delayed and the newborn was placed below the level of the placenta. Treatment of the two infants with polycythemia was not necessary because both were asymptomatic and their hematocrit values were < 0.70 (22). There was no evidence, however, of polycythemia or other negative health outcomes associated with delayed clamping when it was done with the newborn at the level of the placenta. This finding is consistent with those of previous studies, which showed no association between delayed cord clamping and hyperbilirubinemia, jaundice, or polycythemia (17, 18, 23). Advantages of delayed cord clamping may include a reduced risk of peri- and intraventricular hemorrhages (24) and a reduced need for red blood cell transfusions in preterm infants (19).

Nutritional anemias, particularly iron deficiency anemia, are the most prevalent nutrition-related disorders in the world, and are especially common among children living in developing countries. Anemia may start developing early in infancy as a result of poor iron stores at birth. The results available from this randomized trial indicate that the handling of the newborn's umbilical cord at birth can have an important effect on hematologic status early in life in a developing country population. On the basis of these findings we urge health care providers to delay clamping the umbilical cord until it stops pulsating and to clamp the cord while the newborn is at the level of the placenta. This simple, low-cost intervention could result in a significant reduction in the prevalence of anemia in vulnerable populations.

We are deeply indebted to Marleny Mejía and Lucrecia Carlito for their assistance with the hospital and fieldwork. We thank Omar Dary, Dora Ines Mazariegos, and Carolina Martínez for analyzing the blood samples, and Marie Ruel, Ricardo Sibrian, and Edgar Kestler for their support and advice.

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