Title: The duration of postpartum bleeding in rural Bangladeshi women

Authors and Institutions: Darryl J. Holman\textsuperscript{1,2,3}, Jerusha T. Achterberg\textsuperscript{1,2}, Michael A. Grimes\textsuperscript{4,2}, Kathleen A. O’Connor\textsuperscript{1,2}

\textsuperscript{1}Department of Anthropology
\textsuperscript{2}Center for Studies in Demography and Ecology
\textsuperscript{3}Center for Statistics and the Social Sciences

University of Washington
Seattle, WA 98195

\textsuperscript{4}Department of Anthropology

Western Washington University
Bellingham, WA 98225

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Send Proof to:
Darryl J. Holman
Box 353100
Department of Anthropology
University of Washington
Seattle, WA 98195
Voice: (206) 543-7586
Fax (206) 543-3285
Email: djholman@u.washington.edu

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The duration of postpartum bleeding (DPB) in rural populations using traditional birth practices has received little attention from anthropologists and biomedical workers. An understanding of DPB and the variables that affect it can assist health care providers in identifying postpartum morbidity, improve health counseling, and provide better information and training for the use of the lactational amenorrhea method of birth control. We examine self-reports of DPB in 165 rural Bangladeshi women who gave birth in a traditional home setting. The data were collected in an 11-month mixed longitudinal study of birthspacing, where subjects provided twice-weekly self-reports of postpartum and menstrual bleeding. The data included 70 observations measured to the day, 24 right-censored observations, and 71 interval censored observations. Parametric hazards analysis was used to examine the effects of mother’s age, years married, child’s sex, mother’s parity, number of living children, and pregnancy loss history on DPB. None of the covariates was significantly associated with the duration of postpartum bleeding. The mean duration of postpartum bleeding was 24.5 (±1.2 SEM) days. The upper 95% CI was 47.5 (±2.9) days and the upper 99% CI was 63.2 (±4.1) days. The DPB found for rural Bangladeshi women falls squarely within values found in other non-western hospital populations, which show mean or median durations ranging from 22 to 27 days. When all of the samples and populations are considered, it appears that women in developed countries tend to have a mean or median duration of postpartum bleeding of over 30 days, whereas women in less-developed settings tend toward a mean or median duration of 27 days or less.
For most women, parturition is followed by an extended period of vaginal bleeding and fluid discharge termed lochia. Normal lochial discharge is the product of autolysis in which decidual tissue differentiates into a superficial layer and a new basal layer, and the superficial layer sloughs. The discharge is made up of the decidual tissue combined with blood, serum, and fetal hair (Marchant et al. 1999). The three stages of lochia described in the medical literature, lochia rubra, lochia serosa and lochia alba, correspond to discharge color (red, brown-pink, and yellow-white, respectively). For an initial period of days to weeks, the discharge contains a high proportion of blood, and gradually transitions to lochia alba (Oppenheimer et al. 1986). In some cases, uterine infection can result in secondary postpartum hemorrhage that extends the duration of locia rubria phase for weeks or months (Rome 1975).

Post partum bleeding during the puerperium is a normal part of recovery from child birth. Yet the duration of postpartum bleeding is not well characterized (Marchant and Garcia 1995; Visness et al. 1997; WHO 1999). A reliable characterization of the normal duration and pattern of postpartum bleeding is necessary for health workers to identify abnormal conditions like secondary postpartum hemorrhaging and uterine infection. One study found that uterine infection affects about 20% of women with 2% requiring hospitalization (Marchant et al. 2002). Accurate information on PPB is also helpful for counseling expectant mothers, and can lead to an improved postpartum experience (Visness et al. 1997).

Recent research in lochia has come from the literature on lactational amenorrhea (Visness et al. 1997; WHO 1999). Breastfeeding is widely promoted as a means to improve infant and child health, as well as an alternative family planning method for spacing births. An understanding of the duration of lochia is important for providing sound training to women who use the lactational amenorrhea method (LAM) method of birth control (WHO 1999; Kennedy et al. 1991), and can help women make more informed decisions on the best time to initiate the use of contraceptives (Kennedy et al. 1991).

Accurate information on the duration of postpartum bleeding is important for demographers and public health workers who use postpartum resumption of menses as a proxy for breastfeeding intensity and the return to fecundity. A surprising finding in previous investigations of postpartum amenorrhea (PPA) conducted in developing countries is that the distribution of amenorrhea is bimodal composed of a “normal” duration subgroup and a short-duration subgroup that resumes menses within 3 or 4 months (Henry 1961; Ford and Kim 1987; Holman et al. 2006). It is this short-duration subgroup that has puzzled demographers. Some investigators suspect that the short duration subgroup arises as an artifact of data collection errors. One such error is the misclassification of late postpartum
bleeding as resumption of menses (Potter and Kobrin 1981; Ford and Kim 1987; Huffman et al. 1987).

Few studies have investigated the duration of lochia or factors that affect the duration of lochia. Obstetrics texts describe lochia as lasting between 10 and 14 days, but usually without supporting references or empirical data (Visness et al. 1997; Marchant et al. 1999). We found six previous studies that report a mean or median duration of lochia or postpartum bleeding (Hingorani et al. 1970; Marchant et al. 1999; Oppenheimer et al. 1986; Sherman et al. 1999; Visness et al. 1997; WHO 1999), including one multi-center study of eight populations (WHO 1999). In all of these studies, the mean or median duration of lochia was on the order of 21-35 days.

Oppenheimer et al. (1986) studied 236 British hospital patients and found that the median duration for lochia rubra was 4 days (interquartile range 2-6 days), lochia serosa was 22 days (16-35) and the total duration of lochia was 33 days (23-48). Marchant et al. (1999) collected prospective diaries from 318 British mothers on the amount of lochial loss and retrospective reports of the postpartum age at which bleeding ceased. They found the median time to the end of “minimal flow” was 24 days, and the median and mean duration for postpartum bleeding of 21 days and 24 days, respectively.1 Sherman et al. (1999) investigated the duration, amount, and characteristics of each phase of lochia in 39 women in Israel, and found a mean duration of lochia of 35.0 (±7.5) days and a median of 37 (17-51) days. Hingorani et al. (1970) examined the duration of postpartum bleeding in Indian women; 185 women received an IUD 3-4 days after delivery and a control group of 100 women did not receive an IUD. Postpartum bleeding in the control group lasted from 6 to 45 days, with a mean duration of 23.3 days. Visness et al. (1997) examined postpartum bleeding in 477 breastfeeding Filipinas who were participating in a clinical trial of LAM for family planning, and found a median duration of 27 (5-90) days.

An investigation of 3,955 breastfeeding women in seven different WHO study centers exhibited an overall median of 27 days of postpartum bleeding (WHO 1999). There was significant variability among sites. Women from Chendu, China had the shortest duration with a median of 22 days (2-56 days). This was followed, in increasing-duration order, by Sagamu, Nigeria (median 23, 6-80 days), Guatemala City (median 24, 22-26 days), Santiago, Chile (median 25, 2-57 days), New Delhi, India (median 26, 3-75 days), Melbourne and Sydney, Australia (median 31, 5-90 days), and Upsala, Sweden (median 34, 12-87 days).

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1 One subject was still reporting vaginal bleeding at the end of the 12th week when the retrospective reports were collected. Therefore, the mean duration is likely biased downward, but the median duration is unbiased.
Previous studies have examined factors that potentially affect the duration of postpartum bleeding. Birth-weight or infant weight was associated with the duration of lochia in several studies. Oppenheimer et al. (1986) found that mothers of heavier infants have a longer duration of lochia. Infant weight taken within one week of delivery was positively related to the duration of lochia for two of the seven WHO study sites (Guatemala and Australia), but was not associated with the duration of lochia in the other five WHO study populations (WHO 1999). Birth weight was not associated with the pattern of lochia in Filipinas (Visness et al. 1997, 1999).

Oppenheimer et al. (1986) found no association between maternal weight and the duration of lochia. They did find that women of higher parity had a significantly shortened duration of lochia. Other studies have not found an effect of parity on the duration of postpartum bleeding (Visness et al. 1997; Sherman et al. 1999; WHO 1999), although in two of these studies (Visness et al. 1997; WHO 1999) all women were of parity two and above. No studies have found an association between maternal age and the duration of lochia (WHO 1999; Oppenheimer et al. 1986; Visness et al. 1997). The sex of an infant shows no association with the duration of postpartum bleeding (Oppenheimer et al. 1986; Visness et al. 1997).

Breastfeeding can potentially affect lochia. One proposed mechanism is through the release of oxytocin into circulation (Ojeda, 1996), which causes uterine contractions. In the immediate postpartum period, breastfeeding may help to expel the placenta (Carr, 1996), and reduce maternal blood loss (Carr 1996; Trevathan 1984). Bernstine and Bernstine (1951) found that breastfeeding women showed more lochial discharge than non-breastfeeding women, but they did not examine the duration of lochia. Sherman et al. (1999) found that breastfeeding was associated with the color-change pattern of lochia, but the differences did not change the overall duration of lochia. Other studies have not found an association between the duration of lochia and breastfeeding intensity (Oppenheimer et al. 1986; Visness et al. 1977; WHO 1999) or the level of supplemental feeding (Visness et al. 1977).

Participants in most previous studies of lochia or postpartum bleeding had delivered in hospital settings under modern medical care. None of the studies reported on the duration of lochia in traditional birth settings in which deliveries take place in homes without medical assistance, and where Western medical care is not used during the prenatal or postnatal periods.

In this study, we examine self-reports of the duration of postpartum bleeding in a sample of 165 rural Bangladeshi women. Our purpose is to quantify the distribution of lengths of postpartum bleeding as reported by breastfeeding women. Additionally, we examine covariates that potentially affect the distribution of postpartum
bleeding. The data were collected during an 11-month mixed longitudinal study of fertility, birth-spacing and breastfeeding, where subjects provided twice-weekly self-reports of postpartum and menstrual bleeding. Our primary motivation was to evaluate whether postpartum bleeding might influence estimates of the duration of PPA in cross-sectional studies or longitudinal studies employing infrequent sampling (Visness et al. 1997; WHO Task Force 1999).

SUBJECTS AND METHODS

Field Site

The research was conducted in 28 villages within Matlab thana, a rural administrative unit in Bangladesh, located 50 km southeast of the capital city of Dhaka. Most of Matlab is part of an ongoing large scale survey of demography, health, and disease conducted since 1966 by the International Centre for Diarrhoeal Disease Research in Bangladesh (ICDDRb). The ICDDRb demographic surveillance system (DSS) includes a continuous registration of pregnancy outcomes, deaths, marriages, divorces, and migrations. Currently, the DSS covers about 200,000 people in 143 villages. Half of the villages are part of a maternal, child health, and family planning (MCHFP) intervention area, and the other half are in a non-intervention area (van Ginneken et al. 1998). The subjects in this study all resided in villages within the non-intervention area.

The Matlab area is in a low-lying river delta, with a subtropical climate, high population density (~1100 people/km²), and high infectious disease load (Razzaque and Streatfield 2002). The primary economy of the region is subsistence farming of rice and jute; this is followed in economic importance by fishing (Bhuiya and Mostafa 1993). Rural Bangladeshi women have a low standard of living and relatively little formal education (Bhuiya and Mostafa 1993; Bhuiya and Streatfield 1992). A majority of the residents of Matlab thana are chronically undernourished (Pebley et al. 1985; Miller et al. 1994).
Subjects and data collection

Data were collected from February through December 1993 (Holman 1996). The field study consisted of three components: a one-time baseline survey, a follow-up survey administered twice-weekly for up to nine months, and a one-time exit interview.\(^2\)

From early February to early March 1993 a sample of 3,290 women were interviewed once as part of eligibility screening for the longitudinal component of the study. Interviews were given to all resident married women between the ages of eighteen and forty-five who were present in the household during the survey period and agreed to participate. Interviews were conducted in Bengali by female Bangladeshi study personnel who resided in the area. Women of all reproductive statuses were included in the survey. The baseline interviews included questions on past fertility, current reproductive status, contraceptive use, current breastfeeding behavior and postpartum amenorrhea.

In March 1993, eligible women who participated in the baseline survey were randomly selected for enrollment in a prospective follow-up study. Women of all reproductive statuses were selected by the following criteria: married women living with their spouse in the study area who were not using contraceptive methods and had not reached menopause. Continuous recruitment was used, so that at any time during the follow-up survey, about 100 subjects were enrolled. For subjects who became ineligible for the study, withdrew participation, or were otherwise lost to follow-up, a new subject was selected at random from the same village. Reasons for ineligibility included adoption of contraception, divorce or marital separation, or migration out of the study area. Women who gave birth during the follow-up study were typically followed for a period of weeks to some months following parturition, but were then dropped from the follow-up survey.

The follow-up questionnaire was administered twice-weekly for up to nine months. Information was collected on menses, pregnancy status, pregnancy outcome, contraception, and breastfeeding behavior. Subjects were asked to report vaginal bleeding throughout the study. For this reason, we use the term *postpartum bleeding*

\(^2\) Participants gave informed consent prior to participation in the study. The study protocol was reviewed and approved by the Pennsylvania State University Office for Regulatory Compliance and the International Centre for Diarrhoeal Disease Research, Bangladesh Research and Ethical Review Committees.
rather than the more general term *lochia* when discussing our results. At the first postpartum interview, subjects were queried as to the sex of the child, delivery complications, and death of the child.

During November and December 1993, a one-time exit interview was conducted. An attempt was made to re-contact subjects who provided interviews during the follow-up survey. The interview asked questions on reproductive status, the most recent start and end date of menses, and any pregnancy outcomes.

Additional data came from the ICDDRBDSS, including records on births, deaths, migration events, marriages, divorces, stillbirths, and spontaneous abortions collected from 1974 through 1992. The DSS records were used, in part, to verify the birth dates of children born prior to the baseline study.

**Statistical Methods**

The data consisted of mixed longitudinal observations, consisting of four different observation types: exact, right-censored, interval-censored, and cross-sectional responders. Parametric hazards analysis was used to fit a number of different candidate distributions to the data, and find the distribution that best fit the data. The candidate distributions were normal, lognormal, Weibull, gamma, and extreme value type 1 (Gumbel) distributions. The criterion for model selection is discussed below.

**The observations.** The observations of postpartum bleeding are specified as two durations from the date of delivery. Times \( t_o \) and \( t_c \) specify the minimum and maximum observed postpartum times between which postpartum bleeding stopped—that is \([t_o, t_c]\) is the half-opened interval that surrounds cessation of bleeding. The meanings of these two times, and special cases, are shown in Figure 1.

**Covariates and Estimation.** The covariates *mother’s age, years married, child’s sex, parity, living children, and pregnancy loss* were taken from the ICDDRBDSS records. Parity and living children include the index pregnancy. Pregnancy loss refers to the total number of recognized spontaneous abortions and stillbirths the mother has experienced. Estimation of the model parameters from exact, interval-censored and right-censored observations is accommodated using maximum likelihood (Wood et al. 1994). Covariate effects were modeled on the hazard of cessation of postpartum bleeding using a proportional hazards specification (see Holman and Yamaguchi 2005). The maximum likelihood estimates are values for the two intrinsic parameters plus covariate parameters that maximize the likelihood over all observations. Parameter estimates were found numerically using the \textit{mle} version 2.2 (Holman
Model selection. We examined a number of different two-parameter distributions for the underlying
distribution of the duration of postpartum bleeding, and a number of covariate parameters as well. The Akaike
Information Criterion (AIC) was used to select the model that most parsimoniously approximates the true (but
unknown) model from which the data were drawn (Akaike 1973, 1992; Burnham and Anderson 1998). The AIC for
each model was computed as $-2\ln(\hat{L}) - 2M$, where $M$ is the number of parameters in a model, and $\hat{L}$ is the maximized
likelihood for that model; most parsimonious model was that with the lowest AIC.

RESULTS

A total of 165 subjects were followed for some part of the postpartum period. This total excludes all
subjects experiencing miscarriages (6), stillbirths (4), and induced abortions (3) during the study. Characteristics of
subjects are given in Table 1. There were 73 girls, 85 boys, 6 children for whom sex could not be determined from the
DSS records, and one set of twins (a boy and a girl). Questionnaire answers and menstrual calendars were examined
for each subject to determine the end of postpartum bleeding or the interval within which postpartum bleeding
stopped. Figure 3 shows the durations and patterns of censoring for all observations. The observations included 70
times to the cessation of postpartum bleeding observed down to the day, 24 right-censored observations, and 71
interval censored observations (including types 3 and 4 in Figure 1).

The Gumbel distribution provided the best fit to the data of the candidate distributions tried (Gumbel, AIC 609.6; gamma, AIC 614.9; lognormal, AIC 631.5; normal, AIC 623.3; Weibull, AIC 613.4). The left side of Table 2
shows the parameter estimates for the full model that includes all five covariates. As assessed by AIC (or any
common test of significance), none of the covariates was significantly associated with the duration of postpartum
bleeding. The most parsimonious model only included the two intrinsic parameters of the Gumbel distribution with
no covariates (Table 2, right). The parametric distribution of lochia is shown in Figure 3.

The mean duration of postpartum bleeding was 24.5 ($\pm$1.2 SE) days, and the standard deviation was 12 days.
The median duration of postpartum bleeding was 22.5 ($\pm$1.1 SE) days. Parameter estimates from the most
parsimonious model (Table 2, right) were used to find confidence limits for the maximum expected duration of lochia.
The expected upper 95% confidence interval is 47.5 (2.9 SEM) days, and the upper 99% confidence interval is 63.2 (SEM 4.1) days.

DISCUSSION

We examined the distribution of postpartum bleeding in rural Bangladeshi women. The mean duration of 24.5 days and a median duration of 22.5 days found for Bangladeshi women falls squarely within the range of values found in other non-western populations, which show mean or median durations ranging from 22 to 27 days (reviewed above). When all of the samples and populations are considered, it appears that women in developed countries tend to have a mean or median duration of lochia over 30 days, whereas women in less-developed countries tend toward a mean or median duration of 27 days or less. The one exception is the study by Marchant (1999), in which the mean duration (24 days) for British women is under 30 days. This pattern may arise because of ethnic differences, as studies in developed settings included mostly women of European ancestry (WHO 1999); although, Oppenheimer et al. (1986) found no effect of ethnicity on duration of lochia. Alternatively, this pattern may reflect nutritional differences, differences in postnatal care, differences in early breastfeeding, or even cultural differences in the reporting and interpretation of postpartum bleeding and lochia.

None of the studies that have examined factors that potentially affect the duration of PPB has attempted to develop and test a causal framework of PPB. Duration of PPB is presumably increased with an increasing amount of decidual tissue, and decreased with increasing rate of expulsion. The amount of decidual tissue is probably affected by some combination of mother’s pre-pregnancy weight, mother’s weight at parturition, and child’s birth weight. Rate of expulsion may be affected by breastfeeding via time to initiation and subsequent breastfeeding intensity. Systematic differences in these factors may account for the increased duration of PPB observed in developed countries. That is, mothers in developed countries may gain more weight with pregnancy and take longer to initiate breastfeeding (if they do so at all). Possible confounding factors include mother’s age, parity, child’s sex, or delivery complications.

Consistent with three other studies (Visness et al. 1997; Sherman et al. 1999; WHO 1999), we found no effect of parity on postpartum bleeding. Only one previous study (Oppenhiemer 1986) found an association between parity and the duration of postpartum bleeding. We found no association between the duration of postpartum bleeding
and either maternal age or the infant’s sex, a finding consistent with all previous studies (WHO 1999; Oppenheimer et al. 1986; Visness et al. 1997).

In our sample, postpartum bleeding is expected to go beyond 47 days in 5% of women (Figure 4). Thus, postpartum bleeding after 50 days can be taken as abnormal for Bangladeshi women.

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LITERATURE CITED


Hingorani V, Bai U, Kakkar AN. (1970) Lochia and menstrual patterns in women with postpartum IUCD insertions. Am...


Table 1. Descriptive statistics for the sample of Bangladeshi mothers.

<table>
<thead>
<tr>
<th></th>
<th>Mother’s age</th>
<th>Years married</th>
<th>Parity</th>
<th>Living children</th>
<th>Pregnancy loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>28.2</td>
<td>10.6</td>
<td>3.9</td>
<td>3.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>6.1</td>
<td>7.5</td>
<td>2.4</td>
<td>1.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Minimum</td>
<td>17.3</td>
<td>0.4</td>
<td>1</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>47.6</td>
<td>35.0</td>
<td>13</td>
<td>9</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Table 2. Model with all covariates included.

<table>
<thead>
<tr>
<th>Name</th>
<th>Full model</th>
<th></th>
<th>Parsimonious model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SE)</td>
<td>t</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>$a$</td>
<td>21.0 (4.2)</td>
<td>4.9</td>
<td>18.9 (1.0)</td>
</tr>
<tr>
<td>$b$</td>
<td>10.9 (2.7)</td>
<td>4.1</td>
<td>9.6 (0.8)</td>
</tr>
<tr>
<td>$\beta_{mother_age}$</td>
<td>0.0010 (0.026)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>$\beta_{child_sex}$</td>
<td>0.079 (0.27)</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>$\beta_{parity}$</td>
<td>0.054 (0.10)</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>$\beta_{living_children}$</td>
<td>-0.015 (0.15)</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>$\beta_{past_pregnancy_loss}$</td>
<td>-0.065 (0.16)</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

$^1N = 158$, excluding 7 observations with missing covariates. AIC was 600.5 versus 592.2 for the best model with no covariates.

$^2N = 165$.

$^3a$ and $b$ are the intrinsic parameters for a Gumbel distribution.
FIGURE CAPTIONS

Figure 1. Four types of observations made during the study. The solid lines are periods in which a subject is known to be experiencing postpartum bleeding. The closed circle (observation 1) represents an observation for which the end of postpartum bleeding is known to the day. A line ending in a + (observation 2) is a right-censored observation. A dashed line (between two open circles) represents the interval within which postpartum bleeding is known to have ended. Observation 3 includes a period during which bleeding was observed (solid line) but postpartum bleeding stopped at some unknown time within the interval (dashed line). For observation 4, postpartum bleeding ended at some unknown time between parturition and the first postpartum interview.

Figure 2. Observations for the duration of postpartum bleeding in 165 Bangladeshi women. The observations are coded as in Figure 1, and right-censored observations are also denoted with a + to the right. Interval censored observations that do not show an open circle on the right extend beyond 92 days.

Figure 3. Distribution of the duration of postpartum menstrual bleeding based on parameter estimates in Table 2 (right).

Figure 4. Distribution (with 95% confidence intervals) of times to cessation of postpartum menstrual bleeding based on parameter estimates in Table 2 (right).
Duration from parturition
Percent with postpartum bleeding versus duration from parturition (days).