



Estimation of the duration of postpartum amenorrhea in the presence of some censored data

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OBJECTIVE(S) : To estimate the probabilities of the duration of postpartum amenorrhea (PPA) at various time intervals

METHOD(S) : One hundred and twelve women were interviewed and 39% reporting continuance of amenorrhea on the date of interview were considered as censored cases. Survival analysis procedure using life table approach was applied.

RESULTS : The median duration of PPA was 5.17 months. The effect of breast feeding practice on length of amenorrhea showed interesting findings.

CONCLUSION(S) : Mean and median time of onset of menses was higher in total breast feeding women than in partial breastfeeding women, though the log-rank test showed no statistical significance. A similar pattern was observed when women reporting breast feeding at fixed time were compared with those feeding on demand.

Keywords : amenorrhea, censored cases, survival probability

Introduction

The fecundability of a woman is temporarily suspended following each conception when menstruation ceases for some time. The interval after termination of conception and before the resumption of ovulation is known as postpartum amenorrhea (PPA) period. A conception may not always result in a live birth. The outcome of a pregnancy may end in a spontaneous abortion, in an induced abortion, or in a still birth. Postpartum amenorrhea is a biological variable associated with each conception regardless of its outcome. It depends on a number of factors which may vary from woman to woman in a population and for a woman depending on age, marital duration, number of pregnancies, nutritional status¹, and practice of breast feeding^{2,3} etc.

PPA in women varies from around a month to more than a year. The objective of the present study was to estimate the probability of duration of PPA at various time intervals for a group of women utilizing censored data through survival analysis procedure. Censored cases are cases for which the second event is not recorded, or simply does not occur before the end of the study. In the present context first event is the date of delivery of the last child when PPA period begins and the second event is the onset of first menses which is the end of PPA period. Presence of censored data makes the traditional statistical techniques inappropriate. A statistical technique useful for such situation is survival analysis which is a method of estimating time-to-event models in the presence of censored cases. The term survival up to time t [or in the interval $(t_1, t_2]$] here refers to nonoccurrence of first menses after last delivery up to time t [or in the interval $(t_1, t_2]$]. The aim of this study was to analyze the observed data on duration of PPA in a group of women who had delivered a child within last one year from survey date.

Methods

Subjects of the study were women whose youngest child was less than or equal to one year on date of survey.

Paper received on 03/02/2006 ; accepted on 10/10/2006

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Survival analysis procedure using life table method was applied and conditional probabilities of survival (nonresumption of menstruation) at monthly interval of time were obtained. Standard error, hazard rate, median duration of PPA were also determined. Further, keeping in view the known relationship between PPA and breastfeeding^{4,5}, subjects were divided into two groups according to practice of breast feeding (partial/full and fixed time/on demand) and log-rank test was applied to determine any significant difference in survival prospects between the groups.

A sample of 112 women was selected from the child immunization center in the year 2004 where they came with their child for vaccination. Women included in the study were those, whose youngest child was aged less than or equal to 1 year on the date of interview. Thus an open birth interval of these women was at the most 1 year. Child immunization starts at birth and at regular interval various vaccines and their subsequent doses are recommended. Some children enter late in the immunization schedule and some do not observe perfect timing of the recommended doses. So it may be assumed that mothers visit immunization center throughout the year, not necessarily at some fixed time point. Thus the sampled women were mothers of children aged 1,2,3.....12 months.

Inclusion criteria were (i) women aged 20-34 years, (ii) parity of any order, (iii) visiting the immunization center with her youngest child for vaccination, and (iv) youngest child aged less than or equal to 12 months.

Exclusion criteria were (i) women who had taken any hormonal treatment after last delivery to prolong the time of resumption of ovulation to ensure prevention of early conception, (ii) women who were not sure about time of their first menstruation after last delivery, and (iii) pregnant women reporting conception before the onset of first menses.

Since ovulation itself is difficult to identify, reliable estimate of the end of amenorrhoea is the return of menstruation itself. In this study the duration of PPA is estimated as a interval between termination of conception into last live birth and return of first menses. The 112 women thus selected were interviewed through a study proforma which included general information, sociodemographic and some biological variables like number of conceptions, number of births, birth intervals, marital duration, date of birth of last child, period of amenorrhoea, whether amenorrhoea was continuing or terminated, if terminated time of return of

first menses, and pattern of breast feeding viz., full or partial and fixed or on demand.

Subjects were asked about their duration of postpartum amenorrhoea in months. Women reporting continuance of amenorrhoea on the date of interview were considered censored cases and their durations of PPA (between last delivery and survey date) were recorded and treated as censored data. For such women it was not known when they would resume ovulation in future after the survey date. Subjects with censored data contribute valuable information and they should not be omitted from the analysis. It would also be wrong to treat the observed time at censoring as the survival time. Analysis of survival data requires special techniques because for some cases the observation period is cutoff before the event occurs. Survival analysis is statistical technique useful for this data. There are two procedures of survival analysis, viz. follow-up life table procedure and Kaplan-Meier procedure. The basic idea of life table is to subdivide the period of observation into smaller time intervals and for each interval all who have been observed atleast that long are used to calculate the probability of a terminal event occurring in that interval. The probabilities estimated from each of the intervals are then used to estimate the overall probability of the event occurring at different time points. The Kaplan-Meier survival analysis procedure does not rely on partitioning the observation period into smaller time interval, rather it estimates conditional probabilities at each time point when an event occurs. There are three assumptions for this methodology⁶. Firstly, at any time subjects who are censored have the same survival prospects as those who continue to be followed. Secondly, survival probabilities are the same for subjects recruited early and late in the study. Thirdly, the event happens at the time specified.

In this paper, life table method has been used. Survival probabilities, standard error, hazard rate, and median survival time have been obtained. Log-rank test was applied to compare the survival experiences of two groups formed on the basis of breast feeding practices.

Results

The data obtained were analyzed using SPSS ver. - 10 statistical software and results tabulated. Table 1 gives the basic data of the subjects. A large proportion of women were housewives belonging to middle class family and came from urban area.

The duration of postpartum amenorrhoea was divided into monthly time intervals. Table 2 gives the analysis of the data collected. As can be seen 13 women reported end of

Table 1. Basic data (n=112).

Age range (years)	20 -34
Parity	> 1
Number of women for whom event of interest occurred (PPA terminated on or before the survey date)	68 (60.7%)
Number of censored cases (continuance of amenorrhea on survey date)	44 (39.3%)

their amenorrhea (or onset of first menses) in the 2-3 months interval, whereas 9 reported continuance of amenorrhea by the end of the 2-3 months time interval and were treated as censored cases as shown in column 5 of Table 2.

The median survival time for the observed data was obtained as 5.17 months. For each time interval the probability that those who survived to the beginning of interval will survive to the end was worked out (Table 2). This is a conditional probability. The cumulative proportion surviving at the end of an interval which is the survival probability at the end of a given interval is also given in Table 2. Survival to any time point is calculated as the product of the conditional probabilities of surviving each time interval. In interval 3-4 months the value 0.6910 is the probability that a woman will survive (remain in amenorrhea) by the end of this time interval. Survival probability at the end of our interval was calculated from the proportion surviving at different time intervals till the relevant interval (for the interval 3-4 months : $0.8025 \times 0.8768 \times 0.9821 \times 1.0000 = 0.6910$; Table 2). The survival probability is gradually decreasing with the increase in

Table 2. Analysis of the data collected.

(1) PPA interval (months)	(2) Interval start time	(3) Number entering this interval	(4) Number of terminal events	(5) Number of censored cases	(6) Proportion surviving	(7) Survival probability at the end of interval	(8) SE of survival probability	(9) Hazard rate	(10) SE of hazard rate
0-1	0	112	0	0	1.0000	1.0000	0.0000	0.0000	0.0000
1-2	1	112	2	0	0.9821	0.9821	0.0125	0.0180	0.0127
2-3	2	110	13	9	0.8768	0.8611	0.0333	0.1313	0.0363
3-4	3	88	16	14	0.8025	0.6910	0.0465	0.2192	0.0545
4-5	4	58	12	10	0.7736	0.5346	0.0536	0.2553	0.0731
5-6	5	36	12	9	0.6190	0.3309	0.0569	0.4706	0.1320
6-7	6	15	6	2	0.5714	0.1891	0.0545	0.5455	0.2142
7-8	7	7	4	0	0.4286	0.0810	0.0424	0.8000	0.3666
8-9	8	3	2	0	0.3330	0.0270	0.0262	1.0000	0.6124
9-10	9	1	1	0	0.0000	0.0000	0.0000	2.0000	0.0000

The median survival time for these data is 5.17 months.

Column 4 shows number of women reporting end of amenorrhoea (onset of menses) in the interval.

Column 5 shows number of women reporting continuance of amenorrhoea in the given interval.

Column 6 shows probability of surviving in the given interval if surviving at the beginning of the interval.

Column 7 shows survival probability at the end of the given interval.

Table 3. Survival time and breast feeding.

Breast feeding	Number of women (n=112)	Number of events occurred	Number censored	Survival time (months)		Log-rank test for equality of survival distributions
				Mean \pm SE (95% CI)	Median \pm SE (95% CI)	
Full	69	40	29	5.03 \pm 0.27 (4.50, 5.57)	5.50 \pm 0.36 (4.79, 6.21)	Log Rank = 0.22 df = 1 P = 0.6400
Partial	43	28	15	4.87 \pm 0.36 (4.17, 5.57)	4.50 \pm 0.25 (4.02, 4.98)	

PPA interval. The decline is comparatively maximum between 4-5 and 5-6 months interval. The median duration of PPA for women under study was 5.17 months. Hazard rate is the probability per unit time that a woman who is in PPA period at the beginning of an interval will experience the terminal event i.e. resume menses during that time interval. Hazard rate showed increasing trend with increasing time interval (Table 2). The increase is maximum between 6-7 and 7-8 months intervals followed by the one between 4-5 and 5-6 months intervals. Relationship between amenorrhea and breast feeding has been studied by many researchers. It has been established that breast feeding prolongs the duration of PPA. Table 3 shows the relationship between survival time (duration of amenorrhea period) and full and partial breastfeeding. Out of 112 women 69 (62%) reported full and 43 (38%)

reported partial breastfeeding during the period of observations. Mean and median of duration of amenorrhea were relatively higher for full breast feeding mothers than for those who fed partially. However, log-rank test for testing the equality of survival distributions of full and partial breastfeeding was not found to be statistically significant (log-rank = 0.22, P=0.6400).

Table 4 shows the survival prospects of women who breast fed their child at fixed time (56%) and of those who breast fed on demand of the child (44%). Mean and median of duration of PPA for fixed time feeding women were found comparatively higher than those feeding on demand. However, log-rank test showed the difference to be not statistically significant (log-rank = 1.27, P=0.2599). Thus the observed data do not reveal sufficient evidence to conclude that full breastfeeding and feeding

Table 4. Survival prospects and type of breast feeding

Breastfeeding	Number of wome (n=112)	Number of event occurred	Number censored	Survival time (months)		Log-rank test for equality of survival distributions
				Mean ± SE (95% CI)	Median ± SE (95% CI)	
At fixed time	63	31	32	5.16 ± 0.28 (4.61, 5.70)	5.00 ± 0.26 (4.49, 5.51)	Log Rank = 1.27 df = 1 P = 0.2599
On demand	49	37	12	4.67 ± 0.30 (4.08, 5.26)	4.50 ± 0.37 (3.78, 5.22)	

at fixed time will relatively prolong the duration of PPA.

Discussion

Postpartum amenorrhea period is an interval which begins at termination of conception and ends on resumption of ovulation. This duration of temporary infecundability depends on a number of biological and sociodemographic factors which vary considerably among women. Data on 112 women when analyzed through survival analysis procedure showed a 5.17 months median time for return of menses. In a study based on data of urban and rural areas of Varanasi collected by Banaras Hindu University in 1987 researchers have reported the median duration of PPA as 5.82 months⁷. It can be seen that as the interval increases the probability of continuance of amenorrhea decreases. In the present study, probability that amenorrhea will continue at the end of 4-5 months interval was 0.5346 which declined sharply to 0.3309 for the end of 5 - 6 months interval. A similar result was seen in case of hazard rate for these two intervals. It can be said that the chance of resumption of menstruation for such females

slowly increases as interval progresses and is considerably higher in 5-6 months interval. Length of PPA depends on a number of factors. It has been suggested by a number of researchers that nutritional status may have an influence on the length of amenorrhea with better nourished women having shorter duration of PPA⁸. There is a definite relationship between pattern of breast feeding and amenorrhea. Amenorrhoea increase upto certain time with breast feeding. Women with more previous live births may experience longer amenorrhea⁹. A large proportion of women in the present study were of lower order parity, had average nutritional status and reported partial breast feeding. This may be one of the reasons for getting a shorter median duration of PPA of 5.17 months.

Effect of breast feeding practice on length of amenorrhea was also studied. Mean and median time of onset of menses was higher in full breast feeding women than in partial breast feeding women though, the difference was not statistically significant. A similar picture appeared when women who fed their child at fixed time were compared

to those who fed on demand. Lactation and amenorrhea are important inherent natural interventions before subsequent conception which pose an important aspect of studies on fertility behavior in general and birth interval in particular. The observations may be useful in developing biological interventions for family planning program and maternity, and child health care.

Conclusion

Survival analysis procedure applied here is useful in estimating survival probabilities for different time interval of amenorrhea in the presence of some censored data which exhibits accurate and valuable information.

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