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Determinants of Duration of Post-partum Amenorrhoea in Gujarat: A Multivariate Life Table Analysis

Introduction

[r]THE duration of postpartum amenorrhoea (PPA) is the period taken to. return of mensus following a live birth or late term of abortion or still birth. This is a temporary infecundable period during which a woman is non-susceptible to pregnancy again due to suspension of natural cycle of ovulation and menstruation and the attainment of first menstruation is treated as the termination of PPA. As in some populations, the PPA may prolong upto 2 years (Bongaarts and Potter, 1983) which exerts a period of temporary infecundity that inhibits the fertility because a large proportion of women's reproductive life is spent in the amenorrhoea state. Further, the PPA varies across populations as well as within a population across socioeconomic and behavioural groups (Bongaarts and Potter, 1983; Srinivasan *etal.,* 1989). Hence, in view of the importance in health and demography, the patterns and determinants of PPA have been the subject of many studies and extends the interest of researchers to carry out a study in the population of Gujarat.

The postpartum amenorrhoea (PPA) is one of the five proximate determinants affecting natural fertility identified by Bongaarts (Bongaarts and Potter, 1983). The study of the mechanism underlying the variation of PPA acquires much more importance for the evaluation of the postpartum contraception programme as well as the ascertainment of natural fertility of women (Srinivasan *et* a/., 1989). It has been widely recognised that PPA is highly correlated with breastfeeding as a behavioural component in a non contracepting society. Empirical evidences show that prolonged lactation helps to increase the duration of PPA and thereby the period of temporary infecundability (Akin *et al.,* 1981, Jain *et al.,* 1979). The effect of breastfeeding has been clearly identified in the

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biomedical, demographic and social studies as one of the factors to reduce the risk of pregnancy. However, the practice of breastfeeding is also said to vary across different socio-economic and cultural groups and so is expected in the area under study. In this paper, specifically, we intend to find the effect of various covariates on the duration of PPA in the state of Gujarat. As most of the covariates may be fixed in nature, the duration of breastfeeding is considered as a time dependent covariate.

Data

The data base for this paper is taken from the large scale 'National Family Health Survey' conducted during 1992-93. As is well known, the main objective of the survey was to provide information on fertility, mortality, practices of family planning and MCH services at state and national levels. The state of Gujarat is one of the states which is covered in the survey. A total sample of 3,955 ever married women were identified for the survey and out of which 3,832 (96.9 per cent) women were interviewed and the remaining 3.1 per cent were not available or not responded at the survey. Data on postpartum amenorrhoea, breastfeeding and supplementation food given to the children were obtained from a series of questions in Section 4 of the Women's Questionnaire. These questions were asked to those women who have given live births during the last four years preceding the survey, i.e., from January 1989 to the date of survey. According to this criteria, there were 1,499 (39.1 per cent) women who have experienced at least a single live birth in the study population during the aforesaid time period, 14.2 per cent have at least two and only 1 per cent have experienced at least 3 births. The present study has considered the multiple births occurred in the study period as single birth and also considered the last and next to last birth.

Methodology

As mentioned, the duration of PPA, for the present study, is ascertained from the women who have given at least one birth between 1989 and date of survey. While determining the duration of PPA pertaining to the most recent birth before the survey, we have complete as well as censored observations in the survey. In the latter case, we further moved back to see if the women has given more than one birth to get the duration of PPA. If the women had not given more than one birth and has not yet resumed menstruation after the birth of the last child, we treat the duration between the date of birth of the last child and the date of the survey as the censored duration of PPA.

We utilise the concept of life table technique to derive the survival distribution of the duration of PPA by incorporating the complete as well as censored observations. The median duration of PPA has been obtained as a summary measure by a set of selected explanatory variables under the univariate analysis which is further extended to carry out a multivariate analysis under the proportional hazard model to study the determinants of PPA. It may be noted that if there is an independent duration variable which could

be either complete or censored, we need to evolve a methodology on the lines of bivariate life table and develop a method for the inclusion of a set of covariates. A via media is considered in the present paper to incorporate such a variable as time dependent status variable alongwith other fixed covariates. In the present case, the status of breastfeeding at time "t" is a time dependent covariate along with other social, economic and demographic factors as the explanatory variables. If we denote the risk of the attainment of menstrual cycle following a live birth, and x be a vector of independent variables and p be a vector of regression parameter, we can represent the risk of returning to mensus by the equation under the Cox proportional hazard model (see Cox, 1972 in general, specifically on the current line Mukherjee *et al.* (1991); Nath *et al.* (1993)).

$$h_i(t) = h_0(t)\, e^{bxi}, \tag{1}$$

where, $h_0(t)$ be the baseline hazard for which no specific function is assumed and represents the hazard function for individuals whose explanatory variables are all zero. If the status of breastfeeding at time 'V as "yes" or "no" be denoted by $BF(t)$, the specification of the above hazard model can be made as the following.

$$\log h(t) = \log h_0(t) + X._i\, b + y\, BF(t) \tag{2}$$

$$\log h(t) = \log h_0(t) + X_j.b + y\, BF(t) \tag{3}$$

where, $X.$ is a set of fixed covariates including household's standard of living status, $X.$ is a set of fixed covariates without household standard of living, and $BF(t)$ is an indicator variables assuming a value 1 if the woman is breast feeding (partially or fully) "t" months after the birth of the last child and 0 if she is stopped breastfeeding. The bP and y are unknown regression coefficients. It is used to examine whether breastfeeding status at a given point of time has an effect on PPA. It will also examine variations of PPA in each sub-group of population by controlling fixed covariates and time dependent covariates.

In hazard model, all women with same covariates have identical risks of returning to menses over the course of study and this risk may vary among groups with different covariates. In model, $h_0(t)$, the baseline hazard function is estimated with reference to a specified reference group and relative risks of the other groups is calculated in relation to base line group by exponentiating the regression coefficient, i.e., exp(b) which represents the effect of the covariate on the hazard function for reference group. The effect of the covariate is measured in terms of the relative risk of the attainment of menses; values greater than 1 indicate that the relative risk of the attainment of menses is greater than that for reference group, whereas values less than 1 indicate lower relative risks.

Four different proportional hazard models are considered to see the net relative risk of attainment of PPA. Basis of consideration of first two models differ with and without standard of living index. The third and fourth models are the extension of the first and second models respectively; one with the inclusion of interaction between place of residence and education (significant variables in model I), whereas the fourth model is the extension

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$$\log h(t) = \log h_0(t) + X_i \beta + y\, BF(t), \qquad (2)$$
$$\log h(t) = \log h_0(t) + X_j \beta + y\, BF(t), \qquad (3)$$

where, X_i is a set of fixed covariates including household's standard of living status, X_j is a set of fixed covariates without household standard of living, and $BF(t)$ is an indicator variables assuming a value 1 if the woman is breast feeding (partially or fully) "t" months after the birth of the last child and 0 if she is stopped breastfeeding. The b and y are unknown regression coefficients. It is used to examine whether breastfeeding status at a given point of time has an effect on PPA. It will also examine variations of PPA in each sub-group of population by controlling fixed covariates and time dependent covariates.

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of the second with addition of interaction between the education of women and standard of living index (significant variables in model II).

Independent Variables

We have included several explanatory variables to reflect social, economic and behavioural facets which may cause variations in the duration of postpartum amenorrhoea. Though PPA is largely a biological phenomena, it is said to be affected by various factors mentioned above which can be grouped into those pertaining to the household (place of residence, religion and caste, and household economic status); those pertaining to the woman (her education, work status, and her age at the time of birth); and those pertaining to the child (sex and regime of breastfeeding). Accordingly, the mechanism through which the duration of PPA varies can be considered as a biosocial process.

As life styles differ in rural and urban areas, a distinction is made in the place of residence by taking dichotomous variable, rural as 1 and urban as 0. Beliefs and practices have a stable and strong influence on human behaviour, which is moulded by caste and religious affiliation and hence it is important to incorporate these differences. For the variable religion, Hindu is considered as the reference category in relation to Muslims and others. Scheduled Castes and Scheduled Tribe are considered as separate variables keeping others as the reference group. The economic status of a household is measured by a composite index, namely standard of living index, indicating the different facilities and items present in the household such as the toilet facility, source of lighting, availability of kitchen rooms, type of fuel used for cooking, structure of the house, source of drinking water, livestock available at house and ownership of various consumer durables such as sewing machine, clock or watch, sofa set, fan, radio or transistor, refrigerator, television, VCRor VCP, bicycle, motorcycle or scooter, and car as constructed by Roy and Jayachandran (1996). We classify the households into three groups according to three socio-economic status viz., low, medium and high and considered in the form of dichotomous variables with the households falling in the high category to form the reference group.

The first woman level indicator is regarded as her educational attainment. Women were grouped according to whether they are illiterate or had no formal schooling, had primary or middle schooling (1-7 years of schooling) and had studied upto high school and beyond (8-10 years and more of schooling). The reference group comprises those women who had studied for at least 8 years. The next variable in the list of the woman characteristic is her work status. Those who were either engaged in household work or working without wages, were categorized as non-working and the remaining were considered as working and treated as the reference category. Under the strong hold of son preference, the boy babies have been receiving more attention and care including longer durations of breastfeeding than daughters. To see the effect of this, we have included a dichotomous variable indicating the sex of the child with female births as the reference category. Finally, as the mother's age especially at birth is supposed to be an important demographic determinant of PPA, we study the effect of it and derive the median duration of PPA

for two age groups who are less than 25 years and the other who are of twenty five and above.

Results

Following the life table methodology discussed above, we have found out the survival distribution of the duration of postpartum amenorrhoea and estimated the median length of PPA in Gujarat as given in Table 1. The median length of PPA in urban area of Gujarat is about 10 months whereas it is more than 12 months in the rural area of the state. There appears an inverse relationship between the length of PPA and the education of women. While an illiterate woman, on an average, have the length of PPA as 13.5 months, an advanced woman in terms of education i.e. above high school, has amenorrhoea period as low as a little less than 6 months. When we go by the religion of women, we do not find much difference in their amenorrhoea period with median length of amenorrhoea period for Hindu women as 12 months and for Muslim woman as about 11 months. As far as the differentials in amenorrhoea period by caste is concerned, it is found that the women from Scheduled Tribe community reported to have, on average, little less than 14 months of PPA as compared to about 11 months in case of either Scheduled Caste or non-SC/ST women. The median duration of PPA is almost same for working and non-working women at about 11 months. Mother age at the time birth of the child is taken as a biological reason to show difference in the amenorrhoea period. It is observed that the young women (aged less than 25 years) have median duration of PPA as about 11 months which increases with the age of the mother to show a level of more than 12 months for women aged 35 years and above. Towards the socio-economic condition of the household to which women belong, we find that women from low socio-economic background has about 15 months of amenorrhoea period whereas, the women from medium and high socio-economic groups respectively have the amenorrhoea period as about 11 months and 9 months. It may be noted that out of 1,499 women who have been identified as given at least one birth in last about four years, 37 women did not feed their child because of the death of the child soon after the birth, of which 18, (i.e. 50 per cent) were the case related to mother and or child sickness. 15 twin children are considered as a single birth. Considering three categories for the length of breastfeeding as 0-12 months, 13-24 months and 25 months and above, we have obtained the median duration of PPA in each category and find that the length of PPA increases with the increase in the duration of breastfeeding. The women who breast fed for less than 12 months have PPA as 11 months whereas, the women who breast fed for more than 25 months have PPA more than 15 months.

Further to the above findings from the univariate life table, multivariate life table analysis as described in the methodology section has been carried out in order to assess the net effect of various explanatory variables along with a time dependent co-variate. The fixed covariates are mainly socio-economic factors. Four multivariate models are considered. The first model assesses the effect of the place of residence, religion, caste,

TABLE 1: MEDIAN DURATION OF PPA ACCORDING TO DIFFERENT CHARACTERISTICS OF WOMEN

Characteristics	*Median Duration*	
	PPA	*Breastfeeding*
Overall	11.78	28.19 (1445)
Childhood Place of Residence		
Rural	12.22	21.98 (1067)
Urban	9.95	18.85 (378)
Sex of the Child		
Male	11.31	21.13 (736)
Female	11.62	21.47 (709)
Female Education		
Illiterate	13.50	22.86 (815)
Less than Primary	10.12	20.84 (96)
Primary complete	10.24	20.61 (187)
Middle complete	10.58	20.07 (111)
High School	7.19	16.26 (171)
Above High School	5.75	15.18 (65)
Religion		
Hindu	11.92	21.54 (1277)
Muslim	10.70	20.78 (142)
Others	5.1	14.77 (26)
Caste		
SC	11.52	20.48 (72)
ST	13.68	22.49 (244)
Others	11.14	21.20 (1129)
Occupation		
Not working	11.29	20.13 (896)
Working	11.38	22.99 (549)
Age of Women at Birth		
<25	11.17	20.97 (865)
25-34	11.81	21.68 (528)
35+	12.26	22.77 (52)
Standard of Living Index		
Low	15.16	22.25 (631)
Medium	10.86	21.75 (522)
High	8.86	18.44 (292)
Birth Order		
1	7.78	23.26 (402)
2-3	11.48	19.65 (647)
4+	14.61	22.32 (396)
Duration of Breastfeeding (months)		
0-12	11.06(743)	
13-24	11.55 (577)	
25+	15.45 (125)	

Note: The values in parenthesis show the number of observations in a particular category by various characteristic.

women's education, their age at the time of birth alongwith the status of duration of breastfeeding at time " t". The second model includes the standard of living index in addition to the above covariates (Table 2). The third model is the extension of the first one with the inclusion of interaction between place of residence and education, whereas the fourth model is the extension of the second with addition of interaction between the education of women and standard of living index (Table 3).

TABLE 2: RELATIVE RISK OF ATTAINING PPA WITH DURATION OF *BF* AS TIME DEPENDENT CO-VARIATE

Co-variate	*Model I*			*Model 11*		
	β	exp (β)	*S.E.*	β	exp (β)	*S.E.*
Fixed Co-variates						
Childhood place ofresidena [9]						
Rural	-0.1739*	0.8404	0.0765	-0.0682	0.9341	0.0788
Urban	—	1.0000	—	—	1.0000	—
Religion						
Muslim	0.00004	1.00004	0.1088	0.0132	1.0133	0.1086
Hindu & others	—	1.0000	—	—	1.0000	—
Caste						
ST	-0.1987*	0.8198	0.0902	-0.1584-	0.8535	0.0912
SC & others	—	1.0000	—	—	1.0000	—
Women's Education						
Illiterate	-0.3161***	0.7290	0.0686	-0.0967	0.9078	0.0792
Literate	—	1.0000	—	—	1.0000	—
Women's Occupation						
Not working	0.0290	1.0294	0.0692	0.0185	0.9817	0.0704
Working	—	1.0000	—	—	1.0000	—
Age at women at birth						
	-0.0165*	0.9836	0.0065	-0.0175**	0.9827	0.0065
Standard of living Index						
Low				-0.6571***	0.5184	0.1038
Medium				-0.4204***	0.6568	0.0888
High				—	1.0000	—
Time dependent co-variate						
Breastfeeding	-0.1505*	0.8603	0.0648	-0.1364*	0.8725	0.0650

Significance level *p < 0.1; **p < 0.05; ***p < 0.01.

β = regression coefficient; S.E. = Standard error.

In the table, we have presented the regression coefficients along with its exponent as the relative risk to attain PPA by women of various groups considered under the models. The standard error of the regression coefficients are also provided in the respective tables. The results from Table 2 clearly suggest that the relative risk of attaining PPA in rural

area is 16 per cent less than that for urban area and the difference is significant. This indicates that the women from rural areas have longer duration of PPA than the women from urban areas of Gujarat. The relative risk of the attainment of mensus among Muslim women is almost same as for Hindu and other religion. Having observed that there is no significant difference in the risk of attaining PPA between the women from SC and non-SC/ST categories, we have taken only two caste categories, one that includes only ST women and the other encompasses women from SC and other caste groups. It may be seen from the results under Model I given in Table 2 that the relative risk of attaining

TABLE 3: RELATIVE RISK OF ATTAINING PPA WITH DURATION OF *BF* AS TIME DEPENDENT CO-VARIATE WITH SOME INTERACTIONS

Co-variate	*Model III*			*Model IV*		
	β	exp (β)	*S.E.*	β	exp (β)	*S.E.*
Fixed Co-variates						
Childhood place of residence						
Rural	-0.2317*	0.7932	0.0933	-0.0688	0.9335	0.0791
Urban	—	1.0000	—	—	1.0000	—
Religion						
Muslim	-0.0012	0.9988	0.1087	0.0202	1.0204	0.1090
Hindu & others	—	1.0000	—	—	1.0000	—
Caste						
ST	-0.2036*	0.8158	0.0903	-0.1577	0.8541	0.0913
SC & others	—	1.0000	—	—	1.0000	—
Women's Education						
Illiterate	-0.4407**	0.6436	0.1357	-0.2249	0.7986	0.2167
Literate	—	1.0000	—	—	1.0000	—
Women's Occupation						
Networking	0.0296	1.0300	0.0693	-0.0169	0.9833	0.0705
Working	—	1.0000	—	—	1.0000	—
Age at women at birth						
	-0.0166*	0.9835	0.0065	-0.0177**	0.9825	0.0065
Standard of living Index						
Low				-0.6120***	0.5423	0.1498
Medium				-0.4632***	0.6293	0.0994
High				—	1.0000	—
Time dependent co-variate						
Breastfeeding	-0.1519*	0.8591	0.0648	-0.1408*	0.8687	0.0652
Rural* illiterate	0.1666	1.1813	0.1548			
Low* illiterate				0.0619	1.0639	0.2578
Medium* illiterate				0.1932	1.2131	0.2385

Significance level *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

β = regression coefficient; S.E. = Standard error.

PPA among ST women is significantly less than one, giving rise to a longer duration of PPA among these women as compared to non-ST women. The table also suggests that the women who are more educated have significantly shorter length of PPA as the relative risk to attain PPA among illiterate women is 26 per cent less than that for literate women. We do not see any significant difference in the risk of attaining PPA between the working and non working women. There is a positive and strong association between the durations of PPA and breastfeeding as the relative risk of attaining PPA significantly decreases with the increase in the length of the latter.

From the results under Model II given in Table 2, it is found that the duration of PPA sharply declines with the improvement in the living standard. With respect to the highest standard of living, the relative risk of returning to menstruation among women from medium standard of living is as less as about 34 per cent whereas, the risk is about 48 per cent less for women from the household of low standard of living. The time dependent covariate continued to be significant component to affect PPA even after the inclusion of the standard of living index. However, the inclusion of SLI in the model makes the effect of other variables insignificant by capturing all the effects into it. Similar results have also been reported in other parts of India (see, Mukherjee *et al.*, (1991); Nath *et al.*, (1993)).

The results under Model III are given in Table 3. It is found that there is no significant effect of interaction between place of residence and education on the length of PPA. Also, the consideration of interaction in the model does not change the significant effect of the fixed as well as the time dependent covariates as emerged under Model I. The last three columns of Table 3 refer to Model IV. The results show that there is no significant effect of interaction between SLI and educational attainment of women on the tempo of attainment of PPA. The results under this model continue to show the significant effect of SLI on the duration of PPA along with the length of breastfeeding period even after controlling the age of the mother at the time of birth.

Discussion and Conclusion

The forgoing analysis has shown that the rate of attainment of PPA varies significantly by mother's household standard of living, place of residence, age and education. The duration of breastfeeding has been found to emerge as a significant time dependent covariate affecting the length of PPA. We did not find any interactive effect on the length of PPA when examined the differential effect of education by place of residence as well as the standard of living of the household. The first model suggests that when there is no breastfeeding, the rural women have a lower rate of return to mensus which is reduced when breastfeeding is involved in the same way in both, rural and urban women. However, the results in Model II suggest that the rate of attaining PPA is different only by the women's household standard of living by capturing the effect of other fixed covariates. The time dependent covariate, status of breastfeeding, continues to have strong effect on the length of PPA.

The standard of living of women was negatively associated with the duration of amenorrhoea which may be partly supported by the finding that better living standard is associated with the better education of women and earlier introduction of supplementary feeding as well as an increased likelihood of giving liquid supplements timely to child which would lessen the suckling of the breast. There are many studies in respect of studying the effect of various socio-economic factors on the length of PPA. It is said that the mothers from the well off families are likely to receive relatively balanced diet in order to keep/ remain healthy particularly during pregnancy. On the other hand, mothers belonging to low standard households are in general, poorly nourished and they seldom get supplementary food even during pregnancy leading to poor health. As a result, the poorly nourished mothers produce less milk and practice breastfeeding more frequently and intensively. Hence, there is a likelihood of getting longer duration which may be less for women from higher standard of living. Due to the better nutrition, there could be acceleration in the attaining of PPA among healthy women, mostly belonging to the households of higher standard of living.

As found in other studies, in Gujarat also, there is a positive association between the mother's age and the length of PPA. The older women present the longer duration of amenorrhoea than the younger women possibly due to biological delay in hormonal mechanism responsible for ovulation. In general, the present study reinforces the importance of breastfeeding on the length of PPA, even after controlling for other covariates.

References

Akin, J. S., Bilsborrow, R., Guilkey, D., Popkin, B. M., Benoit, D., Cantrelle, P., Garenne, M. and Levi, P., 1981, The determinants of breast-feeding in Sri Lanka. *Demography,* 18(3): 287-307. Bongaarts, J. and Potter, R. G., 1983, *Fertility, Biology and Behaviour: An Analysis of the Proximate Determinants.* New York: Academic Press. Cox, D. R., 1972, Regression models and life tables (with *discussion). Journal of Royal Statistical Society,* Series B, 34: 187-220. Jain, A. K., Hermalin, A. I. and Sun, T. H., 1979, Lactation and Natural Fertility. *In:* H. Leridon and J. Menken (eds.), *Natural Fertility.* Liege: Ordina Editions. Nath, Dilip C., Singh, K. K., Land, K. C. and Talukdar, P. K., 1993, Breastfeeding and postpartum amenorrhoea in a traditional society: A hazards model analysis. *Social Biology,* 40(1-2): 74-86. Roy, T. K. and Jayachandran, V., 1996, Is I iving condition important for determining fertil ity and chi Id loss experience? An empirical investigation based on NFHS. Paper in the *Annual Conference of the Indian Association for the Study of Population,* held in Baroda during Feb. 26-28. Mukherjee, S., Singh, K. K. and Bhattacharya, B. N., 1991, Breastfeeding in Eastern Uttar Pradesh, India: Differentials and determinants. *Janasamkhya,* 9(1): 25-41. Srinivasan, K., Pathak, K. B. and Pandey, A., 1989, Determinants of breastfeeding and postpartum amenorrhoea in Orissa. *Journal ofBiosocial Sciences,* 21(3): 365-371.