

**A STATISTICAL NOTE ON SOME ASPECTS OF HOSPITALISATION DURING
MATERNITY.**

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Introduction

Of late, there has been increasing tendency among all sections of the city population to avail of modern methods of medical care. Hospitals are the only large institutions from which one can obtain medical treatment free or for a nominal charge, and bulk of the city population being extremely poor, seek hospital aid for its cheapness if not for any other virtue. This is particularly true in case of patients seeking obstetrical care. A striking feature observed in recent times among such cases is the rapid increase in the proportion of normal deliveries. Although this does not imply that hospital admissions are representative of the general gravid population, nevertheless in view of the rapid and gradual swelling of the number of maternity inpatients in the hospital it has been found imperative to scan the relevant factors affecting hospitalisation or domiciliary confinements during maternity. Since the implementation of any comprehensive maternity and child welfare scheme presupposes a knowledge on the extent of hospitalisation (or clinic attendance) or domiciliary confinements during deliveries or miscarriages, the value of such a motivation study cannot be certainly ignored in providing very useful items of information in the planning of maternity and child welfare scheme.

Studies in Western countries (Eg. Maternity in U.K. by Royal College of Obstetricians, Gynaecologists and Population Investigation Committee) have revealed the association of certain socio-medical factors in favouring institutional confinements. Although a strict line of demarcation would be difficult to draw, a number of them can be categorised

as short term or cross-sectional, whereas others can be classified as long terms or longitudinal factors. For example, a great many of the mothers exhibit a tendency to avail hospitalisation during the days of their first motherhood. Also in case of any specific material complications such as, Abortions or Eclampsia the question of preference goes in the favour of hospital. But it has to be borne in mind that some such factors however important they are lead only to casual or sporadic hospitalisation. On the other hand, factors mentioned in the aforesaid literature such as shortage of space in the house, burden of too many children, relatively low social or economic condition or attraction of specialised advice free or at a nominal cost are included in the long term or longitudinal factors the effect of which can be discerned over successive order of pregnancies in the records of the places of confinement.

The present study envisages to evolve a methodology on the study of pattern of hospitalisation among a group of mothers (who usually are in a position to avail hospital aid, their dwelling places being located in the close proximity of the hospital). It further examines the extent of the association of hospitalisation during maternity with some of the socio-medical factors.

Present data and its limitations

Since, any investigation probing, into the details of the factors influencing Institutional or Domiciliary confinements during maternity should conform to the data consisting both classes of women who normally do or do not undergo hospital deliveries during their confinements (given the scope of avail-

ing hospital amenities to be more or less the same in both the classes), a very specialised technique based on exhaustive data is needed to highlight the factors relating to the choice of the places of confinements. Moreover, as motivation behind availing institutional or domiciliary confinements cannot be assessed merely by the frequency of hospital or domiciliary confinements in the pregnancy history of the mother, the difficulty of undertaking such motivation study through a sample survey can easily be discerned. A number of women who may be otherwise apathetic to hospital administration may have to reluctantly resort to hospitals for some serious maladies or due to financial difficulties. Whereas another hospital minded mother may report a domiciliary confinement simply because of her inability to procure a hospital bed in time or she has to reject the idea because the hospital is wide off from her neighbourhood. Notwithstanding such difficulties encountered in the study of hospitalisation through the data of a sample survey in the present investigation we have attempted to study the pattern of hospitalisation during maternity among a group of mothers who since the date of their first terminations have all along resided not only in the Calcutta city but mostly in the close proximity of the hospital their dwelling places being within a small belt surrounding the R. G. Kar Medical College and Hospital and thus were fully exposed to avail the benefit of a next door hospital. Although such a sample has its limitation for the study of hospitalisation (by being more inclined towards institutional confinements than domiciliary one) it is however believed that the methodology evolved in this study may be extended also on a control group of population with poor hospitalisation rate and the two together may constitute the appropriate sample for further investigation. Before proceeding to the methodology the sampling design of the survey may be highlighted in a very nutshell.

Sampling design

The survey was carried out by the Indian Statistical Institute to evolve certain useful indices in the maternal and child health condition. For this a sample of about 450 mothers admitted in the R. G. Kar Medical College and Hospital during the year 1960 were drawn and subsequently followed by trained paramedical investigators. Besides

collecting numerous items of demographic and maternal and child health condition the investigators also recorded the details of the past pregnancy terminations and respective places of confinement.

Since the sampling design had to conform to the main object of the survey stated earlier the selection of the sample may not be considered strictly random in view of the greater weights given to premature births complications and advanced order of pregnancies. Nevertheless with respect to the distribution of the places of confinement in the pregnancy terminations the sample however could be accepted as reasonably random and representative of the hospital population of the Calcutta city. Further as a result of purposive selection of all mothers whose last pregnancies were terminated in the hospital the proportion of hospital deliveries to the total deliveries to the sample were inflated unusually than its norm in the general hospital population. To obviate this difficulty the places of confinement of previous pregnancy terminations, excluding the current one were only considered in our analysis and the events of hospitalisation were assumed to occur with a constant probability from terminations to terminations.

Analysis

At the very outset, patients (or mother) were graded on the basis of the sequence of the places of confinements (excluding the current terminations) and four groups were evolved. Since observations over a reasonable number of parities can only enable us to conclude regarding the pattern of institutional and domiciliary confinements, mothers with 3 or more parities were only considered in this analysis. Of the four groups evolved, Group s_1 , constituted of all mothers who had all their pregnancies terminated in the hospital as against Group s_2 who had none of their pregnancies terminated in the hospital. Group s_2 however constituted of all mothers who resorted to hospital either during early or late parities or both, presumably due to certain short term factors such as some serious complications or in anticipation of some maladies during early or late parities or due to certain temporary difficulties which did not at least present during all the successive pregnancies. Finally, Group s_3 , constituted of mothers whose pattern of hospitalisation did not conform to any systematic pattern and

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the event of hospitalisation were more or less of sporadic nature.

Since the purpose of the present analysis lies in assessing the effect of some short term or long term factors in affecting hospitalisation (on the assumption that some such factors may bear significant role in determining the places of confinement during maternity) naturally it is worthwhile to pick a few of the plausible factors and then examine the respective importance of these, in so far determining motives behind availing of institutional confinements. Although hospitalisation may be related with a multiple factors, both social and medical a number of them as mentioned in the earlier studies are (1) family size (or the number of helping hands in the family), (2) Social standard, (3) Housing condition (or space available at house), (4) Complications during pregnancies (5) Accessibility of the hospital etc. Since the effect of the last factor is more or less held constant by choosing the sample of ours, to mothers residing within the near proximity of the hospital, in the present analysis we have attempted to gauge the relationship of hospitalisation with the multiple effects of the first four of the factors only.

As a matter of fact, hospitalisation during maternity is in many cases undertaken in absence of any helping hands in the family. Since in our enquiry no such direct question relating to the probable number of helping hands were available and in absence of any other information, we have mostly banked on family size to ascertain the probably number of helping hands on the a priori assumption that the number of helping hands might be directly proportional to the family size on the average. Shortage of space in the house may also be ascribed to be another important factor compelling a patient to undergo hospital delivery. This factor has therefore been included in the analysis under the category of housing condition (i.e. space or number of living rooms available per individual).

A third factor that could also be ascribed to bear some significant association is socio-economic cum educational standard of the family. Since medical consciousness to a great extent is related on social hierarchy, the social status is perhaps none the less important factor in the selection of the place of

confinement during maternity. However to analyse the effect of the socio-economic cum educational standard on hospitalisation in a more intricate manner, patients were further graded into three distinct categories according to the literacy cum financial standard of their husbands. The highest score 3 was attributed to these patients whose husbands' minimum educational standard were matriculation and family income equalled or exceeded Rs. 200/- whereas a score of 2 has been put against those husbands whose educational standard was either matriculation or above or income exceeded or equalled to Rs. 200/-. And finally a score of 1 was entered against all other husbands where neither the minimum educational standard nor the minimum level of income was realised.

Apart from the above mentioned factors, the most important of all factors which could otherwise be ascribed to be responsible in bringing bulk of the maternity inpatients into the hospital is probably the presence of complications during pregnancy or labour. This is particularly true in a low socio-economic set up as ours. To take a very rough quantitative estimate of the magnitude of complications during pregnancies or labour (taking the history of all pregnancies together) three difficult scorings were put against patients. A score of 3 was put where either all on a major proportion of the pregnancies or labour were complicated and similarly a code 2 against all cases where at least one very serious malady (taking account of all the pregnancies) were reported. In all the other cases a score of 1 was attributed which may be more or less indicative of normal cases, during all the pregnancies.

The present analysis begins in examining whether the patients belonging to four distinct groups of hospitalisation viz., S_1 , S_2 , S_3 and S_4 differ with respect to the four multiple factors viz., (i) Housing condition (x_1) (i.e. per capita space in the house), (ii) Average family size (x_2), (iii) Social standard (x_3), (iv) average degree of complications (x_4) (taking the account of all the post-pregnancies) and thus assess whether the multiple factors mentioned above bear any joint role in affecting places of confinement during pregnancies.

Table 1 shows the number of mothers belonging to various class of hospitalisation distributed according to the respective scores

in housing condition, family size, social standard and average complications during the last pregnancies.

formed in the data of Table 1, the computational details of which is given below. The Analysis consists of the following steps.

Table 1

Class of hospitalisation	Sample Size	Average Space in the Household (x_1)	Average Family, Size (x_2)	Average Social Score (x_3)	Average complication during post-pregnancies (x_4)
(S ₁): All deliveries terminated in hospitals or all institutional deliveries	59	.2727 = $\overline{(x_{11})}$	9.53 = $\overline{(x_{12})}$	1.92 = $\overline{(x_{13})}$	1.52 = $\overline{(x_{14})}$
(S ₂): Only early pregnancies late pregnancies or both terminated in the hospital	73	.3246 = $\overline{(x_{21})}$	8.69 = $\overline{(x_{22})}$	1.92 = $\overline{(x_{23})}$	1.65 = $\overline{(x_{24})}$
(S ₃): All domiciliary	21	.3250 = $\overline{(x_{31})}$	11.51 = $\overline{(x_{32})}$	11.54 = $\overline{(x_{33})}$	1.62 = $\overline{(x_{34})}$
(S ₄): Sporadic hospitalisation	16	.2404 = $\overline{(x_{41})}$	10.40 = $\overline{(x_{42})}$	1.90 = $\overline{(x_{43})}$	1.30 = $\overline{(x_{44})}$

To bring out whether the patients belonging to the groups S_i (i=1, 2, 3, 4) differ with respect to the characteristics x_i (i=1, 2, 3, 4) an analysis of dispersion has been per-

Let x₁, x₂, x₃ and x₄ be the characteristics with respect to which measurements have been taken in the four groups with sample size N₁, N₂, N₃ and N₄

And

$$S = \begin{matrix} & \begin{matrix} X_1^2 & X_1X_2 & X_1X_3 & X_1X_4 \\ X_2X_1 & X_2^2 & X_2X_3 & X_2X_4 \\ X_3X_1 & X_3X_2 & X_3^2 & X_3X_4 \\ X_4X_1 & X_4X_2 & X_4X_3 & X_4^2 \end{matrix} \end{matrix}$$

be the matrix of pooled variance and covariance

$$\text{where } X_i^2 = \frac{E_i(x_i - E_x(x_i))^2}{N} \quad X_iX_j = \frac{E_i(x_i - E_x(x_i))(x_j - E_x(x_j))}{N}$$

and

$$\left. \begin{matrix} \overline{x_{11}} & \overline{x_{12}} & \overline{x_{13}} & \overline{x_{14}} \\ \overline{x_{21}} & \overline{x_{22}} & \overline{x_{23}} & \overline{x_{24}} \\ \overline{x_{31}} & \overline{x_{32}} & \overline{x_{33}} & \overline{x_{34}} \\ \overline{x_{41}} & \overline{x_{42}} & \overline{x_{43}} & \overline{x_{44}} \end{matrix} \right\}$$

E_x = expectation

be the matrix

of the mean of the x₁, x₂, x₃, x₄ with respect to the hospitalisation classes S₁, S₂, S₃ and S₄ respectively then we are required to obtain the matrix (E) given by

$$(E) = (S) \times (N_1 + N_2 + N_3 + N_4 - 4)$$

where N_i's are the sample sizes of the class S_i's (i=1, 2, 3, 4)

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And further we define the matrix (H) given by

$$H = \begin{pmatrix} H_{11} & H_{12} & H_{13} & H_{14} \\ H_{21} & H_{22} & H_{23} & H_{24} \\ H_{31} & H_{32} & H_{33} & H_{34} \\ H_{41} & H_{42} & H_{43} & H_{44} \end{pmatrix}$$

$$H_{11} = \frac{(\bar{x}_{11})^2 N_1 + (\bar{x}_{21})^2 N_2 + (\bar{x}_{31})^2 N_3 + (\bar{x}_{41})^2 N_4}{N_1 + N_2 + N_3 + N_4}$$

$$= \frac{(\bar{x}_{11} N_1 + \bar{x}_{21} N_2 + \dots + \bar{x}_{41} N_4)^2}{N_1 N_2 + \dots + N_3 + N_4}$$

$$H_{12} = \frac{N_1 (\bar{x}_{11}) (\bar{x}_{12}) + N_2 (\bar{x}_{21}) (\bar{x}_{22}) + \dots + N_4 (\bar{x}_{41}) (\bar{x}_{42})}{N_1 + N_2 + N_3 + N_4}$$

$$= \frac{(N_1 (\bar{x}_{11}) + N_2 (\bar{x}_{21}) + N_3 (\bar{x}_{31}) + N_4 (\bar{x}_{41})) (\bar{x}_{12})}{N_1 + N_2 + N_3 + N_4}$$

and we compute |E| and |E+H|

|E| determinant of the matrix E

and finally compute

$$T = -\left(\epsilon - \frac{p-h+1}{2}\right) \log_e \frac{|E|}{|E+H|}$$

where $\epsilon = 169 - 4$ $h = 3$ $p = 4$

and T is distributed asymptotically as central χ^2 with ph. degrees of freedom.

In the example $\frac{|E|}{|E+H|} = \left(\frac{8.3767621 \times 10^{14}}{1.136270 \times 10^{14}}\right) = .7372158.$

and

$$T = -\left(\epsilon - \frac{p-h+1}{2}\right) \log_e \frac{|E|}{|E+H|} = 30.76185$$

A large value of the central χ^2 with 12 degrees of freedom however shows that the factors mentioned viz., (i) Poor Housing condition, (ii) Good socio-Economic-Educational standard, (iii) Large family size on presence of helping hands, (iv) Presence of complications during past pregnancies are all very important factors bearing significant effect in affecting hospitalisation during maternity. It would have been very much interesting to arrange the factors according to their merit in affecting hospitalisation. Such a recourse of course would help us in giving priority to most important of them and arrange the factors in terms of their relative importance in as far as affecting the place of confinement.

But in view of the great p-aucity in the data such a recourse has not been found feasible.

The preceding analysis, however, leads to take the matter further. If the above mentioned factors were found significant in affecting hospitalisation during maternity and moreover there is greater likelihood of these factors becoming longitudinal or long-term in the light of our previous definition it has been found worthwhile to scan whether the effect of the above mentioned factors can be discerned over successive order of pregnancies so far selection of the places of confinements during deliveries are concerned. Even a very casual glance of the data reveals the fact that

a great many of the mothers, once accepting the hospital service, during their maternities are also very likely to avail the benefit of the same in succession. Cases are not infrequent where hospitalisation although taken up as late as 6th and 7th parities has been continued without cessation till the 12th. A great many of the mothers (37.25%) not only enjoy the hospital amenities from early Parities but also were seen to continue the practice of the same in respect of subsequent terminations too.

However to justify the statistical validity of the aforesaid observations, attempt has been made to test the following hypothesis viz. whether hospitalisation revealed as a chain of events in the pregnancy history of the mother stands significantly against the null hypothesis viz. the hospitalisation occurs at random with constant probability π from termination to terminations. The out line of the methodology is however, given in the following lines :—

Let N_{ij} be the number of mothers with order of pregnancy i . ($i=3, 4, \dots, 9$) out of which a number J 's ($J=0, 1, 2, \dots, i$) are terminated in the hospital

An a priori Estimate of π from the set of observations is given by

$$\pi = \left(\frac{\sum_{i=3}^{\infty} \sum_{j=0}^i J N_{ij}}{\sum_{i=3}^{\infty} \sum_{j=0}^i i N_{ij}} \right) \dots \dots \dots (1)$$

and π has been estimated as .6038 Further out of i pregnancies the expected no of terminations in the hospital

$$= \sum_{i=3}^{\infty} \frac{\sum_{j=0}^i N_{ij}}{\sum_{j=0}^i i N_{ij}} \dots \dots \dots (2)$$

and the probability that out of i pregnancies a minimum number i 's are terminated in succession in the hospital and thus forming a run of i number of hospitalisation is given Y_i , in the solution of De Moivre's Problem, where the complementary probability

$$Z_i = 1 - Y_i \quad (i = 3, 4, \dots, 9) \quad (3)$$

satisfies the difference equation

$$Z_{i+1} - Z_i + (1-\pi) Z_i^{\pi} - Z_{i-1}^{\pi} = 0 \dots \dots \dots (4)$$

And the solution of Z_i is given by

$$Z_i = \beta_i \cdot i^{\pi} - \pi \cdot i^{\pi} \beta_i - i^{\pi} \pi \dots \dots \dots (5)$$

$$i = 3, 4, \dots \dots \dots (6)$$

where $\beta_i = \frac{i^{\pi+1}}{\sum_{j=0}^i (-1)^j} \cdot i - i^{\pi} \left[(1-\pi) \pi \cdot i^{\pi} \right]^i \dots \dots \dots (7)$

The respective probabilities Y_i thus being estimated for $i=3, 4, \dots, 9$ a comparison of the expected number of Women ($Y_i \sum_j N_{ij}$) ($i=3, 4, \dots, 9$) terminating, at least i number of pregnancies in the hospital in succession and thus forming hospitalisation a chain of events is compared with the observed value in Table II.

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Table II

Parity	Persons with at least the expected number of Pregnancies terminated in the hospital in succession		Persons less than the expected number in succession		total	x ² value
	observed	expected	observed	expected		
3	31	21.38	11	20.62	42	8.8167
4	34	26.14	6	13.86	40	6.8208
5	20	12.23	13	18.77	31	8.1530
6	9	3.8	7	12.19	16	9.2795
7	10	4.95	7	12.05	17	7.9225
8	5	1.93	6	9.07	11	5.9225
9-above	7	2.49	5	9.51	12	10.3075
	116		53		169	

Table II however reveals the great disagreement between the observed and expected frequencies for each parity groups i ($i=3, 4, 5, 6, 7, 8, 9$ above) and the x^2 values obtained for all the i th groups are highly significant even at 1% level of significance. This corroborates the finding as mentioned in the earlier part of the text.

Conclusion: The preceding analysis however very clearly illustrates the fact that mothers once affecting the hospital service are also very likely to avail the benefit of the same in succession in respect of the future terminations too. This further illustrates that low social standard poor housing condition, absence of helping hands in the family are source of the chronic factors which might compel a mother to resort to a hospital. Complications and hazards of instrumental deliveries are also very important factors in undergoing hospital confinements. This may be a reason why a greater proportion of a hospital pregnancies are complicated. Further as regards group S_1 of the hospitals viz., mothers who got admitted in the hospital during the early or late parities or both, although might do so initially for some specific temporary or short term factors but as even in a great majority of their cases nor the minimum level of Income was

there is also a tendency of having a chain of hospitalisation from late parities the reason of accepting this hospital service for parities together may only be explained in terms of certain long term or chronic factors as discussed earlier.

However, it is very relevant to extend the same piece of analysis on a control group of population too, who unlike the present group prefer domiciliary confinement and do not resort to a hospital unless very much pressed by the circumstances. Such a full fledged study can only provide complete information regarding the factors affecting the places of confinement during maternity. As such study is of great value in certain public health programmes and also is maternity welfare scheme, therefore a recommendation in regard to the need of some such enquiries in future is placed before the workers in the public Health Statistics.

REFERENCES

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