

Multivariate Approach In Epidemiological Assessment Of Continuity In A Cohort Of Oral Contraceptors

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The duration of continuity of oral contraceptors from rural areas of Allahabad has been obtained as a function of those medico-social factors which were found to be significantly associated with the continuity. A total of 10 such factors was examined. The significantly associated factors were social, viz. literacy status of the husband, motivator, family occupation and caste. Each of them was assigned a score for quantification. The regression, obtained through multivariate analysis, was significant at one per cent level and yielded a multiple correlation coefficient of 0.5. Such an analysis enables to predict, with reasonable accuracy, the continuity expected of a woman or a group of women, whose characteristics are known. Average contribution towards continuity by literacy status of the husband was highest and was about one and a half times that of motivator, about ten times that of family occupation and about thirty times that of caste. It thus brings into relief the areas of emphasis and the relative amount of emphasis needed to be stressed to attain optimum continuity in a specific population.

Introduction

Oral consumption of tablets containing hormones is a relatively new technique of contraception in India and is still in experimental stage, preliminary results of which have recently been made available (Mehra 1969, Gidwani and Purandare 1969). Efficacy of the pill, in terms of births prevented, depends upon the duration for which an eligible woman continues its regular consumption for the purpose of family limitation or spacing. This duration of continuity is essentially the end-results of multiple interactions of several determining factors which include family income, literacy status, occupation, age of the woman, her parity status, etc. The total influence of these factors determines the degree of motivation which in turn decides the duration of continuity. The extent of influence exerted individually by these factors differs from situation to situation and it can be hypothesized that, in a particular situation, only some of them which may be termed as **strong determinants** make a significant contribution, while others, as **mild determinants**, make only a negligible impact. If continuity is obtained as a function of the factors responsible for determining the duration, then this duration can be predicted for a woman whose individual characteristics are known and hence for a

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group of women or a particular population. In doing so, more attention shall be devoted to quantitative rather than qualitative effects as advocated by Lew (1962) for using biostatistics for predictive purposes. Such an analysis also discriminates between strong and mild determinants so far as the continuity is concerned and measures their quantitative contribution which may indicate how optimal continuity can be obtained in a particular population. The present paper, besides showing application of technique of multivariate analysis for making such a prediction, attempts to bring out the role of specific factors and their degree of influence on continuity in a cohort of oral contraceptors in the rural areas of Allahabad.

Material and Methods

The cohort under study consisted of 170 participating women from rural areas of Allahabad who consumed the pill (Ovulen) for varying periods. These women were of established fertility, of age-group of 20-40 years and with mean marital experience of about 13 years. The average parity was 5. The study was initiated at the beginning of January 1968 and was terminated at the end of March 1969 which amounted to 15 months of follow-up.

Ten medico-social factors, namely, age, family income, duration of marital experience, parity status, family occupation, literacy status of the husband, caste, motivator, reason of acceptance and side-effects experienced, were investigated for their possible association with continuity measured in terms of proportion of women continuing at the termination of the study. The chi-square test of independence, applied separately for each attribute, revealed that the continuity was significantly associated with motivator, family occupation, literacy status of the husband and caste at somewhat inflated level of 20%. Analysis of those participants who dropped out without assigning any specific reason, in respect of these four attributes, confirmed association of continuity with these attributes at 5% level also. This established that the duration of participation of a woman in the cohort was mainly associated with these four factors which, therefore, were strong determinants. This, however, does not mean that these factors and continuity were casually related.

While the degree of continuity was measurable in terms of months of use, quantitative level of the four strong determinants was not measurable at all. To overcome the problem, the factors in individual cases were assigned scores on a graded scale. These scores were in accordance with the estimated average contribution made by the factors towards continuity of the women in the cohort. This can better be understood by an example. It was observed that the women motivated by midwife, dai and basic health worker were continuing in almost the same but least proportions and so were assigned the least score of 1. Continuation rate for the women motivated by Health visitor was relatively higher and so was assigned the score of 2. Continuation rates for those motivated by social worker and family welfare worker was still higher and so were given the score of 3 and, similarly, self and doctor the score of 4. In assigning these scores, an extra precaution was taken that differences in continuation rates of the

women motivated by the workers with different scores were significant at least at 50% level of significance. Similar technique was applied for each of the four strong determinants. Scores thus assigned are shown in the Table. These scores were obtained only for those 108 women (63.5%) out of the total of 170 who did not have a specific and valid reason for dropping out from the cohort. These reasons were acceptance of some other family planning device, desire for a child, medical reasons, etc. Those experiencing consistent side-effects were also excluded as most of them were likely to drop-out at any moment. The reason of excluding such women from the analysis was that continuity of these women was not likely to have any direct relationship with the factors under consideration.

Table. Scores assigned to the strong determinants

| Strong determinants | | | | Continuity | Score assigned |
|---|----------------------------|-------------------------------|--------------------------------------|--|----------------|
| Caste | Literacy status of husband | Family occupation | Motivator | | |
| Hindu-Scheduled caste | Illiterate | Land-owner, Farming, Business | Midwife, Dai, Basic Health Worker | Dropped out within 2 months of use | 1 |
| Hindu—non Scheduled caste, Caste not reported | Literate | Service, Labour | Health Visitor | Dropped out after 2 but upto completion of 5 months of use | 2 |
| Non-Hindu (mostly Christians) | | Artisan | Social Worker, Family Welfare Worker | Dropped out after 5 but up to completion of 10 months of use | 3 |
| | | Mechanic, Others | Self, Doctor | Dropped out after 10 but up to completion of 15 months of use, continuing at the end with less than 10 months of use | 4 |
| | | | | Continuing at the end with 10 to 15 months of use | 5 |
| | | | | Continuing at the end with 15 months of use | 6 |

If the score of continuity is denoted by y and that of caste by x_1 , of husband's literacy by x_2 , of family occupation by x_3 and of motivator by x_4 , where each one of them is measured from their respective means, then the linear regression of y on x s is

$$y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4.$$

where β_s are the regression coefficients. The least square estimates of the regression coefficients are given by

$$\hat{B} = \lambda_{xy} \Lambda^{-1},$$

where \hat{B} is the column vector of estimates of coefficients, λ_{xy} is the column vector of the sums of products of x_s and y (i.e. $\sum x_k y$; $k = 1, 2, 3, 4$) and Λ is the matrix of sums of squares and cross-products of x_s . Significance of the relationship has been tested by the variance ratio F (Rao 1952) which in fact is the test of the hypothesis that

$$\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0.$$

Results

On the basis of the observations and the corresponding scores, the estimated regression coefficients, denoted by b_s , are given by the matrix equation

$$\begin{pmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{pmatrix} = \begin{pmatrix} 40.11 \\ 48.86 \\ 65.96 \\ 115.40 \end{pmatrix} \begin{pmatrix} 59.31 & 13.92 & 28.40 & 22.67 \\ 13.92 & 26.58 & 15.41 & 10.35 \\ 28.40 & 15.41 & 88.62 & 53.04 \\ 22.67 & 10.35 & 53.04 & 159.08 \end{pmatrix}^{-1}$$

By evaluation,

$$b_1 = 0.04, \quad b_2 = 1.52, \quad b_3 = 0.12, \quad b_4 = 0.58,$$

and so the estimated regression of y on x_s is

$$y = 0.04x_1 + 1.52x_2 + 0.12x_3 + 0.58x_4.$$

Since y and x_s are measured from their respective means, we have

$$Y - 4.00 = 0.04(X_1 - 1.77) + 1.52(X_2 - 1.44) + 0.12(X_3 - 1.78) + 0.58(X_4 - 2.63)$$

where Y and X_s are the original observations. This gives

$$Y = 0.04X_1 + 1.52X_2 + 0.12X_3 + 0.58X_4.$$

Value of the statistic F with (4, 103) degrees of freedom, therefore, is given by

$$F = \frac{69.8220}{218.5580} \times \frac{103}{4} \\ = 8.226 \quad (P < 0.01).$$

This shows that the regression was significant at 1% level. The value of the multiple correlation coefficient, which gives the degree of correlation between observed and expected (as given by the regression) values, is obtained by

$$R^2_{y \ x_1 x_2 x_3 x_4} = \frac{\sum_k b_k (X_k - \bar{X})(Y - \bar{Y})}{\sum (Y - \bar{Y})^2} \\ = 0.24 \text{ in our case} \\ \text{or } R = 0.5$$

Discussion

Factors contributing to continuity (which negatively were the reasons of drop-out) were not all quite the same in our study as reported in other studies (Pincus et al 1959,

Tyler et al 1961, Gidwani and Purandare 1969). This was mainly because the present investigation was based entirely on rural women in a different socio-cultural milieu. As a matter of fact, the factors showing significant association with the continuity, namely, caste, literacy status of the husband, family occupation and motivator, ultimately reflect, to a large extent, the degree of motivation of a participant, and the former may be looked upon as constituting components of the latter. Relationship of continuity with the degree of motivation is not strange, which can now be estimated in terms of the level of the four factors measured by the scores. Significance of the regression function as given by the statistic F shows that the relationship is useful in that it can be utilized to predict with reasonable accuracy, the expected extent of continuity for a particular woman belonging to a similar population whose characteristics—caste, literacy status of the husband, family occupation and motivator—are known. These characteristics are first needed to be scored as per scores shown in Table I and then the scores substituted in the regression equation to get a value of Y which, when referred back to Table I, gives the expected continuity in terms of months of use. Aggregation of such continuities for individual cases gives the expected average continuity for a community or a population.

Limitation of the above procedure is that the expected continuity would in no case exceed 15 months because the analysis is based on a 15-month follow-up only. We would only be able to say whether a participating woman is likely to be continuing at the end of 15-month period with, say, n months of use, or is likely to drop-out earlier after specific months of use. Secondly, though the function is valid in that it gives maximum value of Y for highest values of X_s but it gives 2.26, instead of 1, as the value of Y for least value of X_s . This score of Y corresponds to dropping out after 2 to 5 months of use. Thus, no values of X_s will predict drop out within 2 months of use. An expected score of nearly 2 of Y should, therefore, be interpreted as dropping out within 5 months of use.

Another point that emerges from the present analysis is the relative importance of the four factors in making contribution towards duration of continuity. The mean values of X_s were

$$\bar{X}_1 = 1.77, \bar{X}_2 = 1.44, \bar{X}_3 = 1.78 \text{ and } \bar{X}_4 = 2.63,$$

and so,

$$b_1\bar{X}_1 = 0.0708, b_2\bar{X}_2 = 2.1888, b_3\bar{X}_3 = 0.2136 \text{ and } b_4\bar{X}_4 = 1.5254$$

which shows that, on average, X_1 that is literacy status of the husband, was contributing most to continuity, followed by motivator, family occupation and caste in that order. It can also be seen that the average contribution by the literacy status was almost 10 times higher than by the family occupation. The relative importance of the factors, thus evaluated, gives an insight into the amount of stress needed to be given on various factors to achieve optimal continuity in a population similar to that under study. As stated earlier, provision for women with specific and valid reasons of drop-out will have to be made. A similar type of analysis can, however, be attempted to include

these women also and get fresh values of the regression coefficients, but then the regression function is not likely to be so effective as obtained above.

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