The Vice-Chancellor and the Syndicate of the University of Calcutta permitted me to submit Ph.D. thesis in Statistics on "A Study of some Problems on Sample Surveys in Demography" through No.3281/Ph.D/So/ Proceed dated 17 January, 1973. This thesis consists of independent research studies in different areas of sample survey done in different periods of time. Following five research studies in the area of definition of household members in sample households (serial number 1), control of survey operations serial number 2 planning the statistical scrutiny of the survey data on an electronic computer (serial number 2) and results from the Calcutta Fertility Survey (serial numbers 3, 4 and 5) have been included in the thesis. In fact rese arch topics mentioned in serial numbers 4 and 5 are appendices to that in serial number 3.

Titles of research studies:

1. A study of the concept of household membership (a published paper).
2. Some technical aspects of demographic surveys.
3. Some results from family planning surveys.
4. Attitude of currently pregnant females to family planning.
5. Studies on fertility differentials.

1. A study of the concept of household membership: Definition of household members in sample households is an additional problem in demographic sample surveys to the problem of correct demarcation of block or village as the first and household as the second stage sampling units in stratified sample designs.

Various definitions of household are employed in surveys. Four different concepts have been compared in this research study to build up estimates and other statistics from the same set of households. Household definitions by (i) dejure \( y_d \), (ii) census \( y_0 \), (iii) 16 days stay in a month \( y_1 \) and (iv) defacto \( y_f \) concepts were considered in the study. This study showed interesting results which are of considerable importance in organising sample surveys and in explaining observed differences between the results of a survey from the census or from other sample surveys. Main findings from this research are as follows.
(a) Total population or labour force population estimated from the $y$ or $y_o$ members of sample households are not different from each other.

(b) Population estimates by $y_o$ or $y_d$ members or labour force estimates by $y_o$ members are consistently lower than the corresponding total population or labour force population by $y_o$ or $y$ members.

(c) Population estimated by considering the defacto ($y_d$) members or by considering those who stay in the household for more than 15 days in a month are statistically similar. $y_d$ members include larger number of labour force population than the $y_o$ members.

This research study, based on the National Sample Survey (NSS) data of the Ninth round, explains the causes of systematic under estimation of total population in National Sample Survey rounds one to seventh. Household member group $y_o$ was considered in those rounds of the survey. National Sample Survey has been using the concept of $y$ group of household members in population surveys.

In organising the Calcutta Fertility Survey in 1970 by the Demographic Studies Unit of the Indian Statistical Institute $y$ group of household membership were considered but interviewers probed in doubtful cases to ensure inclusion of all the normally resident household members only. It was possible to obtain representative estimates of population by sex, age group and marital status. One copy of the Report on Calcutta Fertility Survey 1970 is submitted separately for ready reference.

The results from this research study on "A Study of the Concept of Household Membership" is not only new but is of considerable methodological importance in organising sample surveys in Demography.

2. Some technical aspects of demographic surveys: Apart from selection of sample frame, every survey has the problem of demarcation of sample units, correct location of sample households and substitution of households when all the members of sampled household are absent. Introduction of urban frame blocks by NSS has largely solved the ambiguities which used to arise out of improper block demarcations. Special types of problems arose during the operation of the Calcutta Fertility Survey (CFS) in few cases. Treatment of such cases with illustrations has been provided. Household identifications in many cases failed out due to incorrect address recorded at the time of household listing. Substitution of households become essential on this account.
All households of sample blocks were sub-stratified on the basis of information about existence of ever married females in the household. Some reporting errors of informants were discovered while the survey was in progress or when the interviewer contacted the household. Detailed records on the incorrect sub-stratification of selected households were maintained and were shown in this paper. These will be useful to organizers of sample surveys in future.

Errors creep into survey data through lapses by investigators. Detection and elimination of errors have to be attained through statistical scrutiny based on cross checks in the information pieces collected. Elimination of errors is feasible manually when small number of cross checks are used. Error detection and elimination becomes clumsy and laborious when large number of cross checks are used. This scrutiny work may be rationalised in a neat form by use of electronic computer in which instructions in codes punched in cards can be fed into it to carry out large number of checks in a desired sequence.

Information pieces from schedules of each household were transcribed into 12 cards and punched information pieces in cards were subjected to checks which were worked out in detail. They are shown in the research paper. Number of error cards detected by type of error is not only useful for control of errors in future surveys but it indicates the magnitude of intensive scrutiny that can be taken up on an electronic computer.

3. Some results from family planning surveys. This research paper may be divided broadly into 3 parts - (a) appraisal of the sample, (b) attitude of pregnant females to family planning and (c) family planning awareness of married females.

(a) Appraisal of the sample - Appraisal of the sample has been made in this paper by examination of the sample of households in relation to samples drawn or used in contemporary surveys.
Large number of family planning surveys had been conducted in Calcutta and in its neighbourhood but most of the surveys were based on selective individuals and results obtained therefrom were biased. It has been reflected through this research study that sample females in the Enquiry into Prevalence of Contraceptive Practices in Calcutta 1956-57 did not represent Calcutta females. The sample included a much larger section of educated females. A higher percentage (about 40%) of family planning practice in Calcutta was estimated at that time. It was established in this research study that sample persons in the sixteenth round of the National Sample Survey and sample females in the Calcutta Fertility Survey (CPS) represented unbiased samples from the respective populations. Sample design adopted in the CPS was more or less similar to that in the National Sample Survey. Estimation of total population by use of two staged stratified sample design was achieved in this survey whereas estimates built up by NSS are far from satisfactory.

(b) Attitude of pregnant females to family planning. Attitude of pregnant females to family size and practice of family planning methods have been examined in detail in the fourth research study mentioned. Pregnancy experience and family planning practice of pregnant females have been analysed by education level of the female spouse in the third research study.

About 58% of pregnant females were either illiterate or had education up to fourth class and 47% of the illiterate females lived in villages before marriage.

Inverse relationship between education attainment and family size was observed.

This study showed that about half the pregnant females had two or more surviving children. About 38% of females with 2+ surviving children desired for additional children, 40% wanted lesser number of children and the remaining 22% were indifferent to family size.
About 30% to 36% of pregnant females of marriage duration 5 to 19 years ever practised family planning methods. Ever practised percentages were 14% in respect of younger as well as older groups.

About 40% and 50% of pregnant females of age below 30 years and 30+ years having 2+ surviving children and desiring lesser number of children ever practised family planning methods. Only 30% of pregnant females with 2+ surviving children ever practised family planning methods. About 39% of them were either ignorant or unwilling to practise family planning methods.

This research study indicated that by timely education of the target couples in the use of family planning methods and by proper mobilisation of family planning resources, about one fifth of the births in 1970-71 could have been saved in Calcutta.

(c) Family planning awareness of married females: Trend in fertility behaviour of West Bengal and Calcutta females and progress of literacy amongst married females have been studied in the third research study. Effect of family planning practice by couples on family size has been investigated in the fifth research study.

In a paper presented in the International Statistical Conference in 1951 (India), the author obtained age specific marital fertility rates in respect of West Bengal and Bombay. West Bengal fertility rates by age group obtained from 1941 census has been compared in this paper with fertility rates obtained from nineteenth round of NSS (1964-65). It has been found that age specific marital fertility rates in rural West Bengal for age group 20-24 recorded a significant drop but that of age group 35-39 recorded a significant increase. Marital fertility rate for all age groups together did not indicate any change.

This research study showed higher age specific marital fertility rates in age group 15-19 in Western countries but average family size was not as high as in India. This was due to intensive family planning practice by females in Western countries. Comparative family size figures of India (urban), West Bengal (urban) and United Kingdom were 4.1, 4.0 and 1.8 respectively.
Age specific fertility rates after 30 years of age were found about half, or less in western countries than those of West Bengal.

Marital fertility rates of Calcutta females, living in slum localities, were not different from those of urban West Bengal figures. High age specific rates for age groups 20-24, 25-29 and 30-34 in Calcutta slum in comparison with those of urban West Bengal figures were indicative of non-acceptance of small family norm by females living in slum. It has been found that marital fertility rate (170) in Calcutta slum was significantly higher than the same from non slum locality (98). Observed fertility variations in Calcutta was found to be independent of caste or religion.

The fifth research study on fertility differentials showed 49% of illiterate married females in the ratio 2:1 between slum and other localities. Illiterate percentages were 68% and 32% in slum and in non slum sectors. Progress of literacy percentages amongst married females of later marriage cohorts was observed in this research study.

This study showed higher level of education amongst Bengali speaking high caste Hindu females than those in Bengali speaking other Hindus who in turn showed higher level of education than those of Hindi speaking Hindus or Muslims. Analysis of data relating to illiterate married females showed that family size was independent of locality, caste/religion or mother tongue. Higher family size of other Hindus residing in non slum sector has been attributed to mobility of married females from villages or from slum sector to non slum sector.

This research study showed inverse relationship between family size and education attainment of the female spouse irrespective of marriage duration and locality type.

Significant and positive product moment correlation was observed between education and family planning practice. Family size of females was found to be negatively correlated with education attainment and also with family planning.
Education and family planning practice of the Bengali speaking Hindu females showed a multiple correlation of 0.84 in marriage duration 0-14 years. This multiple correlation coefficient was 0.97 in case of marriage duration 15-19 years.

Multiple correlation of 0.99 for marriage duration 10-14 years of all language groups was higher than 0.84 for the Bengali speaking Hindu group.

Partial correlation coefficients between education and family size after eliminating the effect of family planning practice were significant in all the marriage durations irrespective of language groups. Eliminating the effect of education, partial correlation between family size and family planning practice indicated different types of situations in the Bengali speaking and all language groups. Partial correlations in respect of marriage durations 10-14 and 15-19 were highly insignificant for the Bengali speaking group but they were significant and negative in case of all language groups. It showed that in situations where literacy was high, family planning use was ensured whereas in other situations where literacy level was low, family planning education was required.

Considering all marriage durations, family size was found directly correlated with family planning practice. This was due to practice of family planning by aged married females after having enough number of live births. This was true in respect of the Bengali speaking group as well as for all language groups. Partial correlation between education and family planning practice eliminating family size was found to be lower in marriage duration 19 compared to marriage duration 10-14 or all durations indicating that family planning practice was dependent on number of children born.

Multiple correlation studies carried out in this research study showed that observed variations in fertility performances in any marriage duration of Bengali speaking Hindu females was due to literacy variations only.
Assuming that marital fertility of Calcutta females depends only on the level of education and that progress of literacy in Calcutta will be at the same rate as in the last decade, marital fertility rates would be 127, 119 and 112 in 1980, 1990 and 2000 A.D. respectively. Estimated marital fertility rate was 135 in 1970. Depending upon the achievement of the government in the promotion of female education in Calcutta, the targets in reduction of fertility rates may be met. If by more intensive drive, level of improvement in female education be higher, then faster fall in fertility may be achieved.

This research study highlights the importance of female education in the control of population size of the country and will be useful in framing population policy of the country. Government should increase resources for female education many fold. A good part of the resources now spent in family planning publicity may be spent on female education. After attainment of good literacy level, it may be possible for Indian housewives to organise measures such as, "no pregnancy year". Such programmes when initiated by housewives, will be accepted more readily by other women than other programmes initiated by the family planning department of the government.

In addition to the five research studies mentioned above, I have published research papers on (i) Graduation of Birth rates (Bulletin of the International Statistical Institute, Vol. XXXIII, Part IV, (ii) Measurement of Labour Force From Indian Census Data (Sankhya Series B, Vol. 24, Parts 3 & 4) and (iii) Studies on Age At First Marriage in India (proceedings of All India Seminar on Demography and Statistics, Banaras Hindu University).

I have six more working papers and technical reports which are listed below:


2. Controls in Surveys and in Data Processing (mimeographed report in RTS in October, 1964). This was presented in Science Congress Association Session held at Chandigarh, 1966.
3. **Population Projections and Growth Rate of India - Technical Report No. DEMO/7/1969, December, 1969.** This was presented in the Census Centenary Seminar, 1972 at New Delhi.

Castes in Matrimonial Engagements in West Bengal - Technical Report No. DEMO/8/70, December, 1970. This was presented in the Census Centenary Seminar, 1972 at New Delhi.

5. **Population Projections of India, 1951-71 - Technical Report No. DEMO/1/72, March, 1972.** This was presented in the Seminar on the First Results of the 1971 Census of India organised by the Indian Association for the Study of Population 1971.


In the light of important research studies carried out in various phases of Demography, I consider myself worthy of the award of Ph.D. in Statistics of the University of Calcutta.

I declare that I have not submitted any of the research studies mentioned in the thesis to any other authority for award of degree of diploma.

I am indebted to Dr C.R. Rao and Shri M.V. Raman of the Indian Statistical Institute for providing me the opportunity to organise the survey, the data processing and statistical analysis of data of the Calcutta Fertility Survey, 1970.

\[\text{Signed} \]

\[B.N. Sarkar\]

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