AN EVALUATION OF THE PARITY DATA COLLECTED ON BIRTH CERTIFICATES IN BOMBAY CITY*

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I. INTRODUCTION

1.1. *Completeness of Birth Registration in Bombay:* Unlike many other eastern localities, Bombay has an extremely high proportion of deliveries that take place in maternity hospitals. This wide use is due partly to housing problems which have compelled a large number of families to share the same accommodation with others, thus leaving no space or privacy for delivery, and partly to lack of sanitary requirements in the homes in some sections of the city. Furthermore, there exists a large number of maternity hospitals whose services are free or at nominal charges and, according to estimates given by the registration authorities, maternity hospitals accommodate over 85 per cent of the births in Greater Bombay.

This high percentage of hospital births implies a correspondingly high degree of completeness of birth registration, since hospitals are required to prepare the birth certificates. Home births, on the other hand, are covered partly by law which obligates parents to register the births and partly by registration personnel called 'karkouns' who are charged with inquiring about and reporting the vital events that take place in their sections.[1] At the time of smallpox vaccination, which is obligatory within six months after birth, the vaccination registers are matched with those of birth registration and the 'karkoun' is sent to the residence to prepare the birth certificate when-

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[1] Registration laws in Bombay hold even the occupants of the same premises responsible for reporting the occurrence of births.

ever a baby is found to be missing from the birth registers. Registration authorities in Bombay are, therefore, of the opinion that under-registration of births can be sizable only in the suburban areas of Greater Bombay.

1.2. *The Bombay Birth Study:* This high degree of completeness of birth registration in Bombay has encouraged the Demographic Training and Research Centre, Bombay, to investigate the possibility of utilizing the information collected on the birth certificates for studying certain aspects of differential fertility in Bombay. The certificate includes two items on the mother's reproduction, one on the total number of her pregnancies and the other on the total number of her live births. If accurate enough, either one of these two figures, when coupled with the age of the mother, will give an index that can be utilized to assess fertility differences between population strata which can be distinguished from the information recorded on the birth certificate. The detailed description of this study and its results will be given in another report.

The present article is confined to a pilot study undertaken to evaluate the accuracy of the numbers of pregnancies and live births recorded on the birth certificate, which are known to be subject to errors of memory, misunderstanding and misreporting. For the purposes of this study it was decided to take a sample of mothers of babies born within one recent year, question them intensively about the details of their marital and pregnancy histories, and then match the totals of pregnancies and live births obtained from the interview with their counterparts recorded on the certificate. A case study of the registration procedure in ten leading maternity hospitals was also carried out and its findings were coupled with those of the survey of mothers in order to prepare the recommendations given at the end of the article.

Information collected from this sample of mothers pertinent to fertility, such as that on the reproductive patterns and on the spacing of children, will be presented in another report. In the same interview, questions on knowledge and practice

of family planning were also asked. The answers to these latter questions are now being analyzed by the centre and the findings will be presented elsewhere.

1.3 *Registration Procedure:* When the mother arrives at the hospital for delivery, the usual procedure is for a hospital clerk or nurse to collect from any adult accompanying the mother, the 'admission information' which includes a large part of the information required to be recorded on the birth certificate. The number of pregnancies is invariably collected at this stage but the number of live births is usually collected after the delivery, from the mother herself. The birth certificates are usually prepared on the day of the delivery by a hospital clerk or nurse. When available, the 'admission information' is utilized in answering the registration questions, and then the clerk or nurse collects the remaining information from the mother. The municipal 'karkoun' calls to collect the certificates, practically daily in the state and municipal hospitals but considerably less frequently in the case of private hospitals. In a few hospitals he still has to collect from the mother information on some items other than pregnancies or live births.[2]

The certificates are then delivered through the district registration offices of the hospital and the residence to the central registration office in the Public Health Department of the Bombay Municipal Corporation. The journey from the hospital to the central office usually takes less than two weeks from the date of birth. In the case of home births, the birth is reported to the district office by the individuals or by the 'karkouns' and the certificates are subsequently dispatched to the central office.

In the central registration office, copies of the birth certificates are bound in volumes by date of registration after arranging the certificates of each day according to ward and section of the mother's residence, and then given a serial num-

[2] The information in this statement was collected during visits to maternity hospitals. (See Section 3.5).

ber. A new series of numbers is started on the first of January of each year.

It is important to note that stillbirths are also covered by registration. A birth and a death certificate are issued in each case and treated, for registration purposes, in the same manner as live births.

II. The Sample

2.1. *The Universe:* The survey was conducted in Bombay City proper. The suburban areas which together with the city proper constitute Greater Bombay were not included. The universe from which the sample was drawn consisted of all births registered in the 12 months between September 1, 1959 and August 31, 1960. The period was taken as recent as practically possible in order to minimize the chances of missing a mother through change of address.

2.2. *Sample Size and Design:* The sample size was fixed on purely financial and practical grounds at 1,000, which is approximately 1.4 per cent of the population it represents.[3] Since the seven administrative wards constituting the city proper are further subdivided into 38 sections clearly marked on the copies of the birth certificates in the Central Registration Office, it was deemed preferable to stratify the sample according to sections rather than wards, thus increasing the chances of achieving closer representation of different socio-economic groups in the city. The sample size in each section was determined by distributing the 1,000 cases in proportion to the number of births registered therein in 1958, the most recent year for which statistics on the number of births by section were available at the time the survey was planned. A sample of the determined size for each section was then selected at random from the births registered on the 3rd, 13th and 23rd of each month in the period between September 1, 1959 and August 31, 1960.[4] The number of days within each month was

[3] The total number of births in the city proper was 74,391 in 1959 and 71,044 in 1960.

[4] In the period under consideration here, registration of births was carried out every day of the year, including Sundays and public holidays.

restricted to three in order to reduce the labor required for selecting the sample from the registration volumes. Within these days, the selection was carried out for each section by using the serial numbers of the certificates belongings to that section.

III. The Data

3.1. *The Forms:* Having thus obtained the registration numbers of the sample of 1,000 births, the available information relevant to the study was transcribed from the certificates to a form designated as Form I. This information included the ward and section, date of birth, home address, name of maternity hospital (if any), names and places of birth of both parents, their durations of stay in Bombay, father's occupation, whether the baby was born alive or was still born, his race, caste or nationality, mother's age at confinement, 'numerical order of live birth' and 'actual order of pregnancy'.

Of all this information, only the home address and the names of both parents were again transcribed in the interviewing schedule. It will be noted that the three copied items constitute the information necessary for identifying the mother in the field[5] and that the information on mother's age, total pregnancies, and total live births as found on the certificate was not provided to the interviewer.

The first sheet of the interviewing schedule, designated as Form II, aimed essentially at obtaining the details of the pregnancy history. The questions asked were thus concerning the dates of the woman's marriages and cohabitations, the date of termination of each pregnancy, the duration of each pregnancy, whether the pregnancy ended in a foetal death, a stillbirth or

[5] When the completed interviewing schedules were returned to the office they were matched with Form I to ascertain that the correct woman was interviewed. This was carried out by comparing such common items as mother's age and, more essential, the date of birth of the baby whose birth was registered between September, 1959 and August, 1960. A number of cases were found where the woman interviewed was not the right mother, even though the parents' names and the address were the same as those given on the birth certificate. The interviewers were then sent back to try to locate and interview the right woman. In one case it was found that the couples lived next door to each other and that each of the two mothers had a baby late in 1959.

a live birth,[6] whether in the case of a live birth the child was alive or dead at the time of the interview, and the present age of the child.

At the interview a number of questions were also asked relevant to some aspects of differential fertility in the city about which information was either not available on the birth certificate or was inadequate or inaccurate. It is not possible, for instance, to use the information regarding father's occupation available on the certificate to study fertility differences between broad socio-economic groups. This is so because in more than half of the cases the reported occupation is simply 'service' and the ambiguous term 'business' is also widely used. Questions on occupation and educational status of both parents and on the type of their accommodation were therefore added on Form II.

The second part of the interview schedule, designated as Form III, was devoted to questions on knowledge and practice of family planning.

The major part of the interviewing was undertaken during October and November, 1960. Four women did the work. Their instructions included the following: Insist on interviewing the mother herself (i.e., the woman whose name comes under mother's name on the schedule) even if you have to call back. Follow the marital history from the beginning of the mother's first marriage, giving as exactly as possible on the schedule the dates of marriage, cohabitation and termination of pregnancies, for each marriage. If the dates are not known to the mother give estimates based on intervals between one

[6] The definitions of live birth and stillbirth as used here are identical with the international definitions given, for instance, in the U.N. "Principles of Vital Statistics System," United Nations Statistical Office, Document ST/STAT/SER.M/19, 1953. A stillbirth is thus a "late foetal death" or the death prior to complete expulsion or extraction from its mother of a product of conception which has attained 28 or more completed weeks of gestation.

As regards foetal deaths, the definition used here is "the death prior to complete expulsion or extraction from its mother of a product of conception which has not attained 28 complete weeks of gestation." This definition differs from the international definition in that the latter is irrespective of the duration of pregnancy and is thus including stillbirths. The divergence was made here for the purposes of the analysis presented in this article.

event and the next in the marital and pregnancy histories. All terminations of pregnancy from all marriages, irrespective of the type of termination, should be given on the schedule in chronological order. Between any two terminations mentioned by the mother, and also between marriage and the first subsequent termination mentioned by her, make sure that there were no intermediate miscarriages.

3.2. *Reduction of Non-response:* Special efforts were made to secure the information from the mothers themselves and to cut to a minimum the number of homes that could not be located. These included 216 call-backs on 160 cases. The call-backs included visits to the new homes in Bombay of 64 mothers who were found during the first visit to have moved to another address which the interviewer managed to obtain from the neighbors. In one case eight visits were made before the mother was found at home and interviewed.

On the completion of the above stage there were still 253 untraced mothers. The interviewing forms of these cases were taken back by the interviewers themselves to the central records in the municipal corporation for checking the address which they failed to locate against the registration address and to learn whether there was misspelling of the parents' names or of the name of the building or the street, or whether these names as entered on the certificate contained one or more obscure letters which could be read in more than one way. This step led to adjustment of the address and subsequent contact with the family in 55 cases. The remaining 198 cases were then taken to the hospitals where the births took place for checking the address reported in the hospital registers at the time of admission for delivery against the address given on the birth certificate. This step yielded additional information which led to successful location of the home in 74 cases.

The field work ended with 685 mothers successfully interviewed and 124 failures whose homes could not be located. Among the remaining 191 mothers, 67 were nonresidents who came to Bombay City only for delivery and then returned

to their own homes,[7] 80 had left Bombay between delivery and interview, and 38 had moved to unknown addresses in the city. In addition, there were two refusals, three deaths and one mental case.

3.3. *Accuracy of the Interview Reports on Pregnancy History:* By its nature, this survey had several built in checks supplied by a number of items on the birth certificate, which would necessitate serious attention from the interviewers during the data collection. The interviewers were aware, for instance, that the date of birth of the last baby[8], the mother's age and the father's broad occupational group were available on Form I to which they had no access. Moreover, they were aware that the total pregnancies and live births as reported in the registration existed on the same form and that the corresponding totals obtained in the interview were likely to raise doubts and lead to further field checking if they differed substantially.

In addition to the original checking of the figures copied from the birth certificate on Form I, all cases in which the registration figure on pregnancies or live births did not tally with its counterpart obtained from the pregnancy history were taken

[7] The total number of women who were found to have come to Bombay City for delivery and then returned to their own homes was 92, among whom 25 were successfully interviewed. With the exception of two, all the successfully interviewed women were residing either within Greater Bombay or in other parts of Maharashtra State near Bombay and the interviewers managed to reach them. The remaining two were living outside Maharashtra but returned to the mother's place prior to the interviewer's visit, one because the baby fell sick and the other because she was expecting another baby.

These data enable us to give a minimum estimate of 10.5 per cent for the proportion among all women who deliver in the city of those who come for delivery and then return to their usual place of residence. In calculating this proportion, women whose registration address was not located were excluded from the denominator. It has been assumed here that the 660 mothers successfully interviewed who were not reported by the interviewers as 'came for delivery' cases were actual residents of the city. This assumption is justifiable from the observation that in 99 per cent of the cases the interview took place three months or more after the delivery and in 82 per cent the span was equal to six months or more.

Among the mothers who were not residing in the city, 58 per cent came to the parent's home before the delivery, 7 per cent came to that of the parents-in-law, 5 per cent stayed with the husband who was working in the city and virtually all of the rest came to the homes of other relatives.

[8] (or the last but one, in the few cases where the mother had a birth since the one registered between September, 1959 and August, 1960.)

back to the registers where they were checked again for copying errors. This particular measure led to virtually no change in the figures on Form I.

In the few cases with interview figure on pregnancies or live births lower than that given in the registration, the women were interviewed again and asked further questions prepared on a new schedule designated as Form IV. One part of this schedule aimed at re-collecting practically all the information available on Form I, the purpose being to ascertain that the woman interviewed was the mother of the baby who was selected in the sample. The second part included questions on the husband's marital history, his children by his previous marriages, and also on the relationship to the mother of the person who answered the registration questions at the time of the delivery. These questions were designed to find out whether the husband had added his own children by earlier marriages in the cases where the registration questions were answered by him. The third part of Form IV was devoted to a statement obtained from the woman, after explaining to her the purpose of the investigation, as to what she thought was the cause of discrepancy between the pregnancy history and the registration figures. These final interviews gave useful information on some weaknesses in the present registration system which will be discussed later, but again they led to changes in very few pregnancy histories.

It goes without saying, however, that the interview data on pregnancies and live births are bound to have a margin of error in some cases, no matter how carefully the interviewing was conducted. Memory and other personal factors introduce elements of error and a pregnancy may occur and terminate without even being noticed. It is realistic, therefore, to say that what this survey is actually checking is the accuracy of figures some of which are given by a relative prior to the delivery on the woman's arrival at the hospital and some by the woman immediately after delivery, compared to those which the woman herself reports under more convenient circum-

stances, as she goes slowly and systematically through her marital and pregnancy histories with the assistance of the interviewer. The interview data are also free from errors caused by miswording or misunderstanding the registration questions on orders of pregnancy and live birth.

3.4. *Effect of Non-response:* As regards the effect on the results arrived at in this report of the absence of information from the 31.5 per cent of mothers not interviewed, it can be said that these mothers did not differ significantly from those interviewed in age, total pregnancies or total live births as reported on the birth certificate. These three factors are significant in the present study of accuracy since it was found among the cases interviewed that the degree of accuracy in the registration report on pregnancies or live births was highly correlated with the number of pregnancies or live births.[9] With respect to age, it was actually found that the non-interviewed mothers were one year younger on the average than those who were interviewed, with both mean and median ages being 26 years among the former and 27 among the latter. As regards pregnancies, both groups had virtually identical averages in each age group up to 35 years, with the maximum difference being 0.03 of a pregnancy per mother. The live birth reports were again quite similar, with the maximum difference equal to 0.24 of a live birth per woman in the 25–29 age group.

In connection with socio-economic differences between the two groups it can be said that the percentages successfully interviewed ranged between 61 and 74 of the samples in the seven wards of the city and that the differences were statistically insignificant. But if we use the type of maternity hospital as another indicator we find that among the 463 sample mothers who had their deliveries in state and municipal hospitals, which are all free, 65.4 per cent were successfully interviewed while the corresponding percentage among the 495 mothers who delivered in private hospitals was significantly larger and equal to 72.3.

[9] See sections 4.1 and 5.1.

However, the study of errors in pregnancy reports from educational groups presented in section 4.3 and the information on registration procedure in leading hospitals presented in sections 4.2 and 5.2 supply evidence that it is not so much the socio-economic characteristics that affect the accuracy of registration reports but rather the flaws in the registration procedure followed in the particular hospital where the birth took place.

3.5. *Data Collected from Hospitals:* The evaluation of accuracy of registration reports was supplemented with an investigation of the registration procedure in maternity hospitals which aimed at studying the adequacy of the routine followed and of the questions asked. Another purpose was to examine the validity of an observation made from the data, namely that the birth under registration seemed to be frequently not included in the report on live births.

In selecting the ten leading maternity hospitals which were visited, preference was given to the largest, with some modification aiming at representing the three main types, namely state, municipal and private hospitals. The sample thus included three out of four state hospitals, four out of nine municipal hospitals and three out of about 175 private hospitals.[10] From the names of the hospitals entered on the 1,000 birth certificates constituting the sample it was found that the ten selected hospitals contributed 45 per cent of the births that took place in these three main types of hospitals and 43 per cent of all the births.

One interviewer was sent to the selected hospitals. She was required to study the registration procedure, including the following points: what data were collected prior to the delivery, immediately after the delivery and later on in the hospital wards; what the exact wording of the questions on pregnancies and live births was; who was the questioner and the respondent to each question; type of record where the answers

[10] The great majority of the private hospitals are quite small compared to those belonging to the state or the municipality. The sample included the largest two private hospitals, one of which is actually the largest maternity hospital in Bombay, and one of the smaller hospitals.

were entered; who prepared the birth certificate and from which sources; the frequency of calls by the municipal 'karkoun'; whether he collected some of the information, and whether he did any checking of the information already entered on the certificate by the hospital staff.

The information collected regarding these points has revealed some procedural weaknesses as well as some difficulties and misapprehension concerning the wording of the parity questions. Several recommendations based on these observations are made in Part VI of this article.

IV. Evaluation of the Registration Reports on Pregnancies

4.1. *Discrepancy between Registration and Interview Reports:* Out of the 685 cases interviewed there were 677 which had a report on total pregnancies entered on the birth certificate. Tables 1 and 2 give the distribution of these cases according to the deviation of their registration report on pregnancies from that shown by the pregnancy history, in each pregnancy group. The two tables show that in 78 per cent of these cases the registration and interview figures on pregnancy were equal. They also show that this agreement decreased from the very high level of 97 per cent in the one-preg-

Table 1. Distribution of mothers interviewed by number of pregnancies reported in the interview and deviation of their registration report on pregnancies from that of the interview.*

R − I	Number of Pregnancies Reported in the Interview					Total
	1	2	3–5	6–8	9+	
−(3+)	—	—	2	9	7	18
−2	—	—	10	14	5	29
−1	—	10	45	26	6	87
0	114	110	226	68	9	527
+1	2	1	7	1	1	12
+(2+)	1	—	1	1	1	4
Total	117	121	291	119	29	677

* The table excludes eight cases with no registration report.
R = Number of pregnancies reported in the registration.
I = Number of pregnancies reported in the interview.

nancy cases to 91 per cent among those with two pregnancies to 78 per cent among the women who had 3–5 pregnancies. The percentage then decreased rapidly to 57 in the 6–8 pregnancy group and became as low as 31 among women with more than 8 pregnancies.

When the registration figure on pregnancies differed from that of the interview, the former was usually smaller. Only in two per cent of the 677 cases was the registration figure larger, while in 20 per cent it was smaller. The under-report in the registration, when it existed, was equal to one pregnancy in the great majority of cases. In fact the 20 per cent under-reported cases are the sum of 13 per cent, 4 per cent and 3 per cent under-reported by one, two and three or more pregnancies respectively. Table 2 also shows that the percentage under-reported by a given number increased with the number of pregnancies to the mother. For instance, the percentage under-reported by one increased from eight among the mothers who reported two pregnancies in the interview to 15 among those who reported 3–5 pregnancies and then to 22 among those reporting 6–8 pregnancies.

4.2. *Overlooking Pre-natal and Post-natal Mortality:* Let us examine the reasons for the discrepancy between the registration and the interview figures on pregnancy. We will leave

Table 2. Per cent of distribution of mothers in each pregnancy group according to deviation of their registration report from that of the interview.

R − I	Number of Pregnancies Reported in the Interview					All Women
	1	2	3–5	6–8	9+	
−(3+)	—	—	0.7	7.6	24.1	2.7
−2	—	—	3.4	11.8	17.2	4.3
−1	—	8.3	15.5	21.9	20.7	12.9
0	97.4	90.9	77.7	57.1	31.0	77.8
+1	1.7	0.8	2.4	0.8	3.5	1.8
+(2+)	0.9	—	0.3	0.8	3.5	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.1

R = Number of pregnancies reported in the registration.
I = Number of pregnancies reported in the interview.

aside for the present the 16 'over-reported' cases and confine the discussion to the 661 mothers whose registration figure was either equal to or lower than that of the interview. By studying the details of the pregnancy histories among the latter, as summarized in Table 3, one can easily find that mortality, both

Table 3. Distribution of tallying and deficient cases in registration report on pregnancy by type of mortality and discrepancy from interview report.

Cases with Foetal Deaths

Type of Mortality	Total	Tallying	Deficient						
			Total	F=I−R	F+Other M=I−R	F>I−R	F+Other M>I−R	F<I−R	F+Other M<I−R
F only	66	20	46	43	—	2	—	1	—
F and S	7	4	3	2	—	—	—	—	1
F and D	45	17	28	17	6	2	2	—	1
F, S and D	3	—	3	1	—	2	—	—	—
Total	121	41	80	63	6	6	2	1	2

Cases with Stillbirths and No Foetal Deaths

Type of Mortality	Total	Tallying	Deficient						
			Total	S=I−R	S+D= I−R	S>I−R	S+D> I−R	S<I−R	S+D< I−R
S only	20	15	5	3	—	1	—	1	—
S and D	21	15	6	6	—	—	—	—	—
Total	41	30	11	9	—	1	—	1	—

Cases with Deaths of Live Births Only

Type of Mortality	Total	Tallying	Deficient			
			Total	D=I−R	D>I−R	D<I−R
D only	165	131	34	22	9	3

Cases with No Deaths

Total	Tallying	Deficient
334	325	9

F = Foetal death, S = Stillbirth, D = Death of a live birth.
M = Mortality of all types.
I = Number of pregnancies reported in the interview.
R = Number of pregnancies reported in registration.

Educational Group	Type of Mortality					
	Foetal Death			Stillbirth		
	Total No. of Foetal Deaths	No. of Foetal Deaths Omitted	Percentage Omitted	Total No. of Stillbirths	No. of Stillbirths Omitted	Percen Omit
Illiterate	70	43	61	34	9	28
Can Read and Write	52	32	62	17	2	11
Finished Primary School	49	32	65	12	1	8
Finished Secondary or Higher Education	14	11	79	—	—	—
Total	185	118	64	63	12	19

Table 4. Omission of different types of mortality from registration report on pregnancy by educational status of the woman.

pre-natal and post-natal, features as the paramount reason for deficiency in the registration report. Thus, while only 3 per cent of the 334 cases with no mortalities in their pregnancy histories showed deficiency in their registration reports, the corresponding percentage was as high as 38 among the 327 cases which had mortalities in one form or another. Likewise, the same table shows that 93 per cent of the 134 deficient cases had experienced these mortalities and that the corresponding percentage among the 527 tallying cases was only 38.

The existence of differences between the chances of failure to include in the registration report on pregnancies, and not in the interview, the three types of mortality can well be realized from Table 3. This table shows that among the mothers who had foetal deaths only, stillbirths only, and deaths of live births only, the percentages with deficient registration reports, compared to those of the interview, were 70, 25, and 21 respectively. It is also noticed from the same table that in 43 out of the 46 deficient cases with foetal deaths only, the deficiency was exactly equal to the number of foetal deaths and it was therefore fully accounted for by these deaths, and in two more of these cases the number of foetal deaths was larger than the deficiency. The same situation holds for the stillbirth cases

Death of Live Birth		
No. of Deaths	No. of Deaths Omitted	Percentage Omitted
231	45	20
92	15	16
43	6	14
8	1	13
374	67	18

and for those with deaths of live births only. It was thus in only one case out of the five deficient stillbirth cases that the number of stillbirths to the mother was less than the registration deficiency. Likewise, it was in only three out of the 34 deficient cases which had deaths of live births only that the deficiency was not completely accounted for by the number of those deaths; among the remaining 31 cases, the number of deaths was exactly equal to the deficiency in 22 cases and was larger than the deficiency in the other nine cases.

When all types of pre-natal and post-natal mortality are combined we find that the deaths reported in the interview were, as may be calculated from Table 3, exactly equal in number to the deficiency in 75 per cent of all deficient cases. Moreover, we find another 13 per cent in which the number of mortalities was larger than the deficiency. In other words, the three types of mortality could more than account for the deficiency in 88 per cent of the deficient cases.

Estimates of the chances of overlooking each of the three types of mortality while giving the registration report on pregnancies are given in Table 4. The table gives the following values for the average chances of omission: 0.64 for a foetal death, 0.19 for a stillbirth and 0.18 for a death of a live birth.

Analysis of the returns from each of the leading hospitals has shown large differences between hospitals in accuracy of registration reports of mothers who had experienced mortalities. Thus, while in all leading hospitals the reports on pregnancy were virtually identical with the corresponding numbers obtained from the pregnancy histories, the proportions with tallying reports varied from 80 per cent to nil among mothers with foetal deaths only and from 93 per cent to 50 per cent among those who had only deaths of live births. Such wide variations,

when considered with the observation made in Section 4.3 that there were no apparent differences in accuracy between educational groups, indicate the existence of corresponding variations in the accuracy with which the question is worded or explained when it is asked prior to the delivery.

In the case of home births[11] the sample returns showed that in the absence of mortality all the registration reports were equal to the numbers given by the pregnancy histories. When mortality existed, however, the percentage with equal registration and interview reports dropped to 67 when there were deaths of live births only and to 20 among the mothers who had foetal deaths only.

4.3. *Differences in Accuracy between Educational Groups:* In order to study the differences in accuracy of registration reports on pregnancy between different educational groups, the sample women were divided into illiterates, those who read and write, those who finished primary school, and those with a higher level of education. For each group, the total numbers of foetal deaths, stillbirths and deaths of live births reported in the interview, and the total numbers of each of the three types of mortality [which were considered to have been omitted in the registration reports] were calculated.[12] As far as foetal

[11] The sample of 1,000 births included only 35 home births, but this low percentage should not be taken as an estimate of the frequency of home births in Greater Bombay because such births are known to be more frequent in the suburbs of Greater Bombay.

[12] In preparing Table 4, an observed deficiency in the registration report was considered to have arisen from omitting the mortality or mortalities which took place in the pregnancy histories of the 125 deficient cases in whose histories mortality had occurred. The decision as to which type or types of mortality account for the deficiency was more or less automatic in virtally all the cases. This was obviously so among the 93 cases in which the mother experienced only one type of mortality or more than one type with the total incidence exactly equal to the deficiency. Likewise, no problem of selection between types of mortality arose among the 23 mothers who suffered two types, of which one was deaths of live births, and for whom it was ascertained from the registration reports on live births that the deaths of live births were not overlooked; (the conclusion was fully confirmed by the observation that in all these cases the deficiency was exactly equal in number to the mortalities of the second type, i.e., foetal deaths or stillbirths.) There were five more cases in which the size of deficiency in both the registration and live birth reports gave a clear-cut indication of which mortalities have been overlooked. It was thus in four cases only that no clear evidence was available

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deaths are concerned, no significant difference between the percentages omitted was observed (in fact, as Table 4 shows, the percentage omitted rose systematically from 61 among the illiterates to 79 among those whose education was above the primary level, but the differences were too small to be statistically significant.) As the educational level rose, downward trends were observed in the percentages omitted of stillbirths and of deaths of live births: the percentage dropped from 28 to 8 among the stillbirths and from 20 to 13 among the deaths of live births, but again it could not be established whether the trend was true or whether it arose from the smallness of the groups.

4.4 *Registration 'Over-Reports':* A study of the information collected on Form IV showed that among the 16 cases in which the registration report on pregnancies was larger than the number obtained from the pregnancy history, there were three cases in which the excess arose because the husband added his own children by previous marriage when giving the report to the hospital clerk before his wife's delivery. One woman intimated to the interviewer that she had deliberately increased the number of her pregnancies and live births on the registration report because she wanted to be sterilized and she had been told that the operation would not be performed unless she had a larger number of children. No significant explanation was obtained in the remaining cases; the common answer was that the hospital people were given the correct information and that the latter must have misunderstood. One woman referred to the language difficulty as a possible reason for the misunderstanding.

V. Evaluation of the Registration Reports on Live Births

5.1. *Comparison between Registration and Interview Reports:* The registration reports on live births were equal to the

as to which of the mortalities had been overlooked. It was assumed in these four cases that the deficiency arose from omission of foetal deaths, then stillbirths, and then deaths of live births, in this order. Needless to say, any errors in this assumption would cause no significant change in the results.

corresponding numbers obtained from the pregnancy histories in 65 per cent of the 586 cases interviewed for which there was an entry on the birth certificate against the question on the order of live birth. As in the case of pregnancies, the discrepancy was mainly an under-report in the registration, with the percentages under-reported and over-reported being equal to 32 and 3 respectively.

As Tables 5 and 6 show, most of the under-reported cases were deficient by one live birth; the percentages under-reported by one, two and three or more were found to be 23, 5 and 4 respectively. As with the case of pregnancies, we notice an increase in the percentage under-reported in the registration as the number of live births increased. We also find that in 16 out of 19 over-reported cases the over-report was equal to one live birth.

5.2. *Main Causes of Deficiency:* Failure to take deaths into consideration again can be easily spotted as the main reason for the observed deficiencies in the registration reports on live births; the deaths in this case being obviously post-natal deaths only. Thus, while 61 per cent of the deficient cases had one death or more, the corresponding percentage was only 21 among the cases in which there was agreement between the registra-

Table 5. Distribution of mothers interviewed by number of live births reported in the interview and deviation of their registration report on live births from that of the interview.*

R − I	Number of Live Births Reported in the Interview					Total
	0	1	2	3–5	6+	
−(3+)	—	—	—	8	14	22
−2	—	—	1	19	11	31
−1	—	2	33	77	20	132
0	3	115	75	152	37	382
+1	1	1	1	7	6	16
+(2+)	—	—	1	1	1	3
Total	4	118	111	264	89	586

* The table excludes 99 cases with no report on live births.
R = Number of live births reported in the registration.
I = Number of live births reported in the interview.

R − I	Number of Live Births Reported in the Interview					All Women
	0	1	2	3–5	6+	
−(3+)	—	—	—	3.0	15.7	3.8
−2	—	—	0.9	7.2	12.4	5.3
−1	—	1.7	29.7	29.2	22.5	22.5
0	75.0	97.5	67.6	57.6	41.6	65.2
+1	25.0	0.9	0.9	2.7	6.7	2.7
+(2+)	—	—	0.9	0.4	1.1	0.5
Total	100.0	100.1	100.0	100.1	100.0	100.0

R = Number of live births reported in the registration.
I = Number of live births reported in the interview.

Table 6. Per cent distribution of mothers in each live birth group according to deviation of their registration report from that of the interview.

tion and the interview records. These two percentages were derived from the detailed information given in Table 7.

Subsequent visits to ten leading hospitals in Bombay have shown that in eight of the largest hospitals the question that was being asked by the hospital clerk or nurse, at the time of our interviewer's visit, was "How many children do you have?" or "How many children do you have at home?" It is not surprising, therefore, to find that the percentage with tallying reports in these hospitals dropped from 71 among the 128

Table 7. Distribution of tallying and deficient cases in registration report on order of live birth according to type of mortality and discrepancy from interview report.

R − I	Total	Cases with No Mortality	Cases with F or S	Cases with Deaths (with or without S and F)				
				D = 1	D = 2	D = 3	D = 4	D = 5
0	382	243	59	63	11	4	2	—
−1	132	53	15	56	5	2	1	—
−2	31	3	1	13	12	2		—
−3	16	1	—	—	6	7	2	—
−4	3	—	—	—	—	1	2	—
−5	2	—	—	—	1	—	—	1
−6	—	—	—	—	—	—	—	—
−7	1	—	—	—	—	—	—	1*

* In this case the woman had 8 D's.
F = Foetal death.
S = Stillbirth.
R = Number of live births reported in the registration.
I = Number of live births reported in the interview.

mothers who had no deaths of live births to 36 among the 74 who had such deaths.[13]

In the case of home births, the interview returns showed that the registration reports were all correct among mothers who had no deaths and all erroneous among those to whom such deaths occurred.

Although reports on live births are not affected by errors arising from omission of foetal deaths and stillbirths, it was found that, compared to pregnancies, the registration reports on live births showed larger divergence from the numbers obtained from the pregnancy histories. This divergence is shown not only by the lower percentage of tallying cases, which was 65 compared to 78 in the case of pregnancies, but also by the observation that the number of live births in the registration had a mean deviation of .50 per mother from the number derived from the interview as compared to 0.35 in the case of pregnancies.

Besides deaths, the data strongly suggest the existence of another factor responsible for part of the observed deficiency in the registration report on live births, namely failure to include the birth under registration in this report even though it was counted among the pregnancies. The conclusion is derived from the observation that out of the 185 deficient cases there were 68 (i.e. 37 per cent) for which, although there had been no deaths among their live births, the registration report on live births was one less than the number obtained from the pregnancy history. This observation means that what was given in the registration in these cases was, in all probability, a report on the situation prior to the last birth. The same error would also explain why in another 20 cases (11 per cent) the deficiency in the registration figure was exactly one more than the number of deaths in the offspring.

Information collected from visits to ten leading hospitals

[13] The corresponding percentages in the remaining two hospitals, where the question asked at the time of the interview was explicitly pertinent to live births, were 100 and 75 consecutively, but the numbers of observations were so small that these percentages may not be reliable.

has confirmed this conclusion since it was found that in three large hospitals the question being asked at the time of our interviewer's visit had no reference to the birth under registration. In fact when we compare live birth reports returned by these hospitals and those given by the seven hospitals where the question on live births referred to the birth under registration we find that, among the mothers who had experienced no deaths of live births, the proportions of those whose registration reports tallied with the numbers obtained from the pregnancy histories decreased from 90 per cent among 87 mothers reported by the latter seven hospitals to 43 per cent among 49 mothers who delivered in the former three hospitals.

Table 7 shows that the 185 deficient cases among all sample mothers can be distributed as follows according to the possible explanation of the cause of deficiency:

68 cases (37 per cent)	omitted the birth under registration; the registration figure was one less than that obtained in the interview even though there was no death in the offspring.
20 cases (11 per cent)	omitted the birth under registration as well as the deaths that took place among their live births; the observed deficiency was one larger than the number of deaths.
56 cases (30 per cent)	omitted either the birth under registration or the one death that occurred among the offspring; they had a deficiency equal to one live birth each.
22 cases (12 per cent)	omitted the deaths; the deficiency was larger than one and was exactly equal to the number of deaths.
8 cases (4 per cent)	very probably omitted the birth under registration; they had more than one death but had a deficiency of one live birth only.

5 cases (3 per cent)	in which the deaths more than account for the deficiency.
6 cases (3 per cent)	in which the deficiency was too large to be accounted for by the deaths, if any, in addition to the birth under registration.

Although it is not possible to measure separately the frequency of omission of deaths and omission of the birth under registration (mainly because of the 56 cases affording no basis for judging which of the two was actually overlooked), the above figures show that the two factors account exactly for the deficiency in 90 per cent of the deficient cases and could more than account for that deficiency in another 7 per cent.

The new factor which appeared in the case of live births, namely omission of the birth under registration, seems to be mainly responsible for the observed larger discrepancy between registration and interview reports on live births than on pregnancies. Actually, if we allow for the under-reporting of one libe birth in the 88 cases where omission of the birth under registration seems to have been most likely, the mean deviation of the registration reports on live births from their interview counterparts decreases from .50 to .35, which is the same as the corresponding mean deviation in the case of pregnancies.

5.3. *Causes of Registration 'Over-Reports':* A study of the mortality experience of the 19 'over-reported' cases indicates the existence of a registration error, namely counting the stillbirth as a live birth in some cases. This was observed among 6 mothers whose over-report was equal to one live birth and who had exactly one stillbirth each. In fact, in two of these cases the information on the birth certificate itself supported this presumption because, while the birth under registration was recorded as still born, the entries on pregnancies and live births were equal, a situation that obviously is not possible. It was verified in subsequent call-backs that other mortalities were not involved.

In addition to the stillbirth cases, it was found from the information collected on Form IV that in two of the 'over-reported' cases the husband's children by previous marriages had been added by him to his current wife's pregnancies and live births when he answered the questions at the time of her admission to the maternity hospital. Eight women stated that the correct information had been given to the hospital staff and that some misunderstanding must have occurred; as mentioned before, one mother mentioned the language difficulty as a possible cause.

5.4. *The 'Non-reports':* We should not conclude this discussion without indicating the existence of another deficiency in the 'order of live birth' data, namely the absence of the report in as high a proportion as 16 per cent of the selected 1,000 certificates.

The information obtained by visiting ten leading hospitals has shown that in most of the cases where there was no report, the person who prepared the certificate simply inserted the figure on pregnancy in the space between the two lines on which the reports on pregnancies and live births are required to be entered. It was also found from the certificates returned by the leading hospials that the incidence of this neglect varied widely from nil or almost nil to 80 per cent, 92 per cent or even 100 per cent in some relatively large hospitals. Such high proportions will only reflect the need for paying more serious attention to the registration process in some hospitals.

VI. Conclusion and Recommendations

Completeness of birth registration and accuracy of registration information concern not only the administrator but also the statistician who wants to study population growth, particularly the demographic analyst who aims at assessing fertility levels and fertility differences. Registration data will permit calculation of specific birth rates in the population groups which can be distinguished from the information given on the birth certificate, provided the sizes of these groups are

available from the census. Even when the census tabulations are not detailed enough to give the sizes of the groups, the registration information on parity by age of the mother enables one to study some aspects of reproductive patterns and fertility differences in these groups.

Preparation of the birth certificate in the maternity hospitals in Bombay immediately after delivery is indeed a very efficient way of securing a high degree of completeness of birth registration. If the process is carried out properly, the fact that the mother stays in the hospital for some days and that the father usually visits her frequently should also enable the registration authorities to collect valuable information from its primary sources. The accuracy of this information will naturally be much higher than in many other eastern communities where registration is not compulsory, where the reporting is done mainly at a registration office by the father or another family member, or where the frequency of hospital births is usually much smaller.

This study has shown that the registration reports on pregnancies are reasonably accurate compared to information obtained more elaborately in much longer interviews. It has also shown, however, the existence of several procedural defects which cause errors in the data, particularly in the registration numbers of children ever born. One source of error is the procedure followed in all hospitals whereby most of the registration information, including order of pregnancy, is copied from the information entered in the hospital records, which had been obtained prior to the delivery from any adult who accompanied the mother. This adult obviously may or may not know about all the mother's pregnancies, particularly may not know about her miscarriages, and may or may not know the details of her pregnancy history during her previous marriages. And even if the person knows all these events, memory will influence the accuracy of the report, to say nothing about the effect of the state of anxiety prior to the delivery.

Only a few hospitals ask the registration question on order

of live birth at the time of admission for delivery; the question is usually asked when the birth certificate is being prepared. This, of course, is a better procedure except that the question is usually misworded. The wording frequently gives the impression that what is required is the number of children who are still alive, and sometimes is even worded so that the children residing outside the mother's home are not to be included.

Moreover, it was noticed in a number of leading hospitals that the person in charge of preparing the certificate did not realize that the live birth which had just taken place should be included in the report on order of live birth. Consequently, this birth is frequently overlooked.

Some confusion also exists as to whether a stillbirth should be included in the report on live births. Furthermore, a number of cases have been observed where the reporting was done by the husband who included his own children by previous marriages to the reports on his current wife's pregnancies and live births.

These important details are left entirely to the interpretation of the hospital clerks or nurses who prepare the birth certificates without instruction from the hospital or registration authorities. Even in the same hospital it was noticed during a second visit that a change of the nurse in charge might mean a change in the interpretation of the question.

Another serious deficiency in the 'order of live birth' data is that in some cases the question is completely ignored and the figure on pregnancies is entered on the birth certificate in the space between the two lines devoted to the two questions on pregnancies and live births. This has resulted in the absence of the live birth report in a substantial number of certificates, and has consequently contributed another limitation to the utility of the registration information on live births.

The manner in which the question on live births is handled at present results in loss of information due to non-reports in 16 per cent of the cases, and gives rise to erroneous reports caused mainly by failure to include the children who had died

and by the overlooking of the birth under registration in another 29 per cent. In the case of pregnancies, non-reports amounted to only one per cent and the reports which did not tally with the pregnancy history information were equal to 22 per cent, caused mainly by omission of miscarriages and partly by failure to include stillbirths and deaths of live births. Among the cases interviewed for whom registration reports were given, the reports on live births and pregnancies were deficient on the average by one-half of a live birth and one-third of pregnancy, respectively.

The need for greater attention to the registration information is also shown by the entries on 'father's occupation.' The occupation reported on 54 per cent of the 1,000 birth certificates was simply 'service' and on another 10 per cent it was just 'business.' Furthermore, six per cent of the certificates had no reports on occupation. Needless to say, such data can hardly be of any statistical use.

In view of the findings of the present study, the following recommendations are presented in the hope that they will be successful in considerably improving the accuracy of the registration information:

1. The registration information should be collected on the birth certificate by the nurse or hospital clerk from the mother herself before she leaves the hospital, except for the items pertinent to the father, which should be collected from him whenever possible.

2. The registration information should be collected independently of that entered in the hospital records on admission, or immediately after delivery.

3. The nurses and clerks who handle the preparation of the birth certificate should be given some training which would explain to them the importance of the registration information, how the questions should be asked, and how the answers should be recorded. A regular briefing, perhaps for only one hour every three months, should keep them aware of the correct details of the registration procedure. The municipal clerks who

register home births and those who collect the certificates from the hospitals should be given the same training.

4. If the information on father's occupation is to be of any statistical use, the clerks and nurses should be instructed to collect and enter on the certificate the actual occupation in specific terms.

5. In the state and municipal hospitals, the municipal clerk calls practically daily to collect the certificates. This procedure should be maintained, but he should visit the mothers in the wards and check the information.

6. The registration question on order of live birth, which can be usefully utilized to obtain data on differential fertility, needs to be worded more elaborately to raise the accuracy of the answers well above the level observed in the present study. In order to minimize the errors arising from omission of deaths, omission of the birth under-registration, inclusion of still-births, overlooking the births to previous marriages of the mother and confusion between the parity of the husband and the wife, the following two questions are suggested as a substitute for the present question on 'order of live birth':

Live Births Prior to the Birth Under Registration:

a) Number of live births to the mother *who are now alive,* including those from previous marriages (if any) and those who are not living with her.

b) Number of live births to the mother *who have died since their birth,* including those from her previous marriages (if any) and those who were not living with her at the time of their death.

The number of children ever born is then obtained by adding the two figures, plus one if the birth under registration is a live birth.

7. The actual number of pregnancies to the woman is difficult to find out at registration or even in a longer interview. If this question is dropped, then the number of items on the birth certificate will remain constant after the question on live births is split into two parts, as suggested here.