# A STUDY OF RECENT TREND IN INFANTILE MORTALITY RATES IN CALCUTTA BY LONGITUDINAL SURVEY

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### 1. INTRODUCTION

Statistics relating to health problems in India have been known to be unreliable for a long time. It is generally realized that Infantile Mortality in India is high, although exact information on this subject is very meagre. The data on vital statistics in urban areas are usually collected by registration clerks and sanitary inspectors; in rural regions by *chowkidars* (village watchmen), *patwaris* (rent collectors), and police officers (vide also Bhore Committee Report, Vol. 1, 153-157). This procedure suffers, amongst others, from two major defects: firstly, most of these persons have limited or no general education and hardly any special training for this type of work; secondly, there is reason to believe that their routine is perfunctory and the informations are incomplete and not infrequently inaccurate or imaginary. The health statistics of the Provinces issued annually by the Directorates of Health are based solely on these returns. The report of the Public Health Commissioner (PHC) with the Government of India which were compiled from the materials submitted by the various provincial health departments, form the main, and perhaps the only source of information regarding Infant Mortality rates in this country.

Infant Mortality rate is an important and sensitive index of the standard of health in a country in its widest sense. In India this rate was high for many years in the past. A steady decline noted to have observed by the PHC in recent years seems however to be ill-founded and may lead to dangerous complacency. Until reliable machinery for accurate recording of vital statistics is set up in the country, knowledge on this and similar problems can only be acquired by individual or academic enterprises.

In a sub-continent like India with various patterns of populations and over 12 million annual births, the determination of the overall Infant Mortality rates, etc. presents colossal problems involving immense labour and expense. The knowledge of these indices would be interesting no doubt and may be useful for making comparisons with other nations of the world. For purposes of immediate health and welfare programmes, however, figures relating to compact administrative units (*e.g.*, city wards villages, etc.) would be more useful and perhaps serve the object better. In conducting Maternity and Child Welfare Services, say, in towns or villages, the authorities will

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*The Infant Mortality (IM) rate is the number of deaths of infants under one year of life per thousand live births.

apparently derive more benefit from the local enquiry reports than from any All-India or International figures.

The reasonableness and perhaps necessity of a survey work's taking special care in the assessment of the Infantile and other mortality rates separately for the component zones in compact administrative areas are also conspicuous from the consideration of a different view point. A city or a *thana* (area under police station) is generally composed of heterogeneous strata or zones, *i.e.*, wards or villages. The stratification of a population can be made on numerous bases, *e.g.*, geographical regions, religious communities, economic groups, etc. In practice a very wide variation of the Infant Mortality rates in the component strata or groups is observed. Comparison of the vital statistical figures for such zones may be made, as an illustration, of the city of Bombay for the year 1949. Bombay comprises 19 wards and the Infant Mortality rate 174.2 per thousand, represents the rate of all the wards. We quote here the figures for the 1st and 19th wards.

| ward no. | sections | area in acres | density of population per acre | number of births | infant mortality rate |
|---|---|---|---|---|---|
|   | Upper Colaba | 605.77 | 13.7 | 297 | 53.9 |
|   | Middle & Lower Colaba | 770.88 | 43.5 | 976 | 157.5 |
| 1 | Fort Southern | 454.26 | 29.5 | 355 | 28.2 |
|   | Chinchpokli | 477.31 | 125.2 | 1958 | 228.8 |
| 19 | Love Grove | 709.76 | 6.6 | 121 | 338.8 |

As a second illustration by taking a different basis of stratification, namely, religious communities, Infant Mortality rate during the years 1935-47 for the city of Calcutta may be compared. [We have reproduced later in Fig. 5 the overall Infant Mortality rate of the city with those for Hindu and Muslim Communities separately.] The value of the Infant Mortality survey being conducted in compact administrative units will be obvious from these illustrations. Here it may be relevant to note the remarks of the Executive Health Officers of Bombay and Calcutta that despite their vigilance and large health organisation at their disposal, the published figures do not represent the actual situation, indeed, considerable error is admitted. If these be the conditions in the two leading cities of India then the value of the reported vital statistics of other urban and rural areas of the country may well be imagined.

The necessity of accurate information regarding vital infant statistics has been keenly felt and the problem was specially considered by a sub-committee of the Indian Research Fund Association (IRFA) in 1949. This committee has made specific recommendations about the conduct of future Infant Mortality surveys. We offer two criticisms of these excellent proposals: (i) To conduct surveys on the suggested lines might prove extremely difficult due to lack of adequate funds and personnel, so that, the plan, may at best, be carried out on a very limited scale. (ii) The survey will reveal some health conditions prevailing at a particular time.

What is really important is not the determination of Infant Mortality rates in a region or community *at or about a given point of time*, but *the trend of the rates* over a number of years in a populatiom (permanent residents in a compact administrative

area). For this has the *unique* merit of indicating the effects of environment, nutrition and health measures on the population over a certain period and hence eliminating to a large extent the influence of chance in appraising the avoidable factors which might vitiate at times, results of sampling on successive occasions (cf. Yates, 1949, p.45). The type of material suitable for such objective of trend study is the *Longitudinal** data (historical data covering a period of time). The *Cross Section* studies (at or about a given point of time) are not sufficient for understanding the spread of any underlying cause or condition. For example if we conduct a census in an area now, and again say, after 10 years the populations will not be strictly comparable. In the first year $m_1$ mothers will give birth to $c_1$ children next year $m_2$ mothers to $c_2$ children and so on, at the end of ten years $m_{10}$ to $c_{10}$. Now depending on the frequency of pregnancies in mothers, there will be some overlapping of the groups in consecutive years, but in no sense can the two populations be strictly comparable. On the other hand, if we consider *Longitudinal* data, it is possible to obtain a realistic trend of Infant Mortality or other rates. Yearly survey-data *i.e.*, cross-section data, will also be available for analysis when the longitudinal survey is properly conducted on the entire population of a locality. Many factors which vary with time are likely to lend themselves for analysis in historical data. The method appears to have wide field of application. One of us (KNM) has been endeavouring for the past few years to evolve some practicable means of arriving at some valid estimates of certain rates and ratios which are of frequent importance in obstetric practice. The technique evolved has now been applied as an eploratory measure in the investigation of trends in Infant Mortality rates in Calcutta.

Since completing this survey we have come across a similar concept of statistical analysis in a recent book by Puffer (1950). There is an excellent discussion by Puffer on the method of longitudinal surveys based on historical data as advocated by the late Dr. Wade Hampton Frost. We also find mention in her book of an enquiry into the mortality rates among premature infants conducted in the Tennesse Valley, U.S.A.

## 2. REVIEW OF PREVIOUS WORK

The reports of the Public Health Commissioner (PHC) with the Government of India as we have noted, form the main.and perhaps the only source of information about the Infantile mortality rates in India. It may be of some interest to recall the history of these reports. The first of these appeared in 1864, as the annual report of the Sanitary Commissioner with the Government of India. It then dealt with the health statistics of the Indian and British troops, jail prisoners and general public. With the change of designation of the Sanitary Commissioner, the report in 1920 was issued as the annual report of PHC and has since then been published until the year

*For details about the distinction between Cross Section and Longitudinal data, see Puffer (1950), p.21.
†The lack of efficiency which one may find, however, in this method of approach rests in the exclusion of infants whose mothers are dead. It is not unlikely that the mortality rates of these tables may be a little higher than others. But while the Infant mortality rate in India is about 170 per 1000 live births, the Maternal mortality rate is only 20 per mille.

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1946. The post of the PHC was abolished in August, 1947, as proposed by the Health Survey and Development Committee (Bhore Committee) and the medical and health services were integrated. The functions of the Director General, Indian Medical Service, on the curative side and those of the PHC on the preventive aspect have been combined and placed under the Director General, Medical and Health Services. No report has yet been published from this reorganised all India Health Directorate since the year of their functioning in 1947.

In the report for the year 1930 the PHC discussed at some length the subject of the trend of Infant Mortality rate in the eleven provinces and in India as a whole and made comparative study of the trend of rates from 1892-1930. After commenting in the registration of births especially during the first half of the period considered by him, he noted a continuous improvement in the mortality rates after 1918. This reduction according to him might be due to several factors and was probably due to better registration of births (p.25).

The Infant Mortality rates in India from 1926-35 as reported in PHC annual reports have been analysed by Basak (1938). He comments about the defective registration of births in earlier years and felt that they were not comparable with the practice of later years. He concluded that there was no indication of any appreciable decrease in Infant Mortality rates during this decade.

The Infant Mortality rate from 1935 to 1944 has varied between 164.0 and 169.3 per mille; discussing the health conditions in India during the year 1944, Col. Bozman (Addl. PHC) pessimistically remarked about prevailing Infant mortality in India and made a strong plea for improving the conditions. Next year the Infant mortality rate was reported to be 150.9 (lowest so far recorded in India) and the following year another steep fall to about 132.6 has been shown. No explanation has been given in these reports to explain these phenomenal reductions in Infant Mortality rate. In the recent annual health reports, *repeated* comments on the grave food situation in the country as well as the severe restrictions of health activities imposed by war have been made by the PHC. We shall refer to these official rates later in this work.

Main findings of some special surveys conducted to determine the Infant Mortality rate in India are given here in tabular form.

| authors | age (in months) | deaths | lost contact | infant mortality rate limits | |
|---|---|---|---|---|---|
| | | | | lower | upper |
| Ghosh & Chandrasekar (1942), in Calcutta: study of 2580 infants | 0-½ | 105 | 104 | 40.6 | 43.8 |
| | ½-1 | 67 | 218 | 68.7 | 74.7 |
| | 1-3 | 47 | 404 | — | — |
| | 3-6 | 36 | 247 | — | — |
| | 6-9 | 24 | 263 | — | — |
| | 9-12 | 20 | 379 | — | — |
| | 0-12 | 299 | 1705* | 146.1 | 175.5 |
| Idem. (1944), in a rural area near Calcutta, 448 infant | 0-½ | 17 | — | | |
| | ½-1 | 26 | — | | |
| | 0-12 | 36 | 1 | | 80.5 |
| Orkney (1940): in suburbs of Delhi 1941, 502 infants | 0-1 | 26 | | | |
| | 0-12 | 101 | 105 | | 220.1* |

*It is hard to account for the inclusion of so many cases with whom contact was lost at varying intervals upto one year in these studies.

## INFANTILE MORTALITY RATES BY LONGITUDINAL SVRVEY

A few interim abstracts of investigations carried in the All-India Institute of Hygiene have been briefly mentioned in the Reports of the Scientific Advisory Committee of the IRFA (1947-49). The completed studies have not been published so far.

A number of studies most of which are included in the following list, have reported the incidence of stillbirth and death of infants during their stay in hospitals (from 3-14 days). Neal Edwards et al (1940) and Jhirad (1941) in their studies into the causes of maternal mortality in the cities of Calcutta and Bombay reported the incidence of total number of births and still births during the periods of their survey. Das and Mahalanobis (1934) analysed the Maternity Statistics of the Eden Hospital, Calcutta, from 1850-1901. Nair (1936) has made a similar study of the data of Government Hospital for Women and Children, Madras, from 1920-1933.

A FEW STUDIES ON STILLBIRTHS AND NEONATAL DEATHS FROM HOSPITAL STATISTICS IN INDIA, 1850-1950

| serial no. | author | period of review | source of information | number of births for the period studied | | | infant deaths during stay in hospital | stillbirths rate | neonatal mortality rate |
|---|---|---|---|---|---|---|---|---|---|
| | | | | live birth | still birth | total | | | |
| 1 Das & Mahalanobis (1934) | 1850-1901 | Eden Hospital, Calcutta | 5421 | 1060 | 6481 | — | 119.6 | — |
| 2 Nair (1936) | 1920-1933 | Govt. Hospital for women, Madras | 36543 | 3527 | 40070 | 2497 | 96.5 | 68.33 |
| 3 Mitra, S. (1934) | 1931-33 | Seva Sadan, Calcutta | 4082 | 404 | 4486 | 256 | 98.07 | 62.7 |
| 4 Kumar (1945) | 1932-36 | Queen Mary's Hospital, Lucknow | 920 | 167 | 1087 | 89 | 181.52 | 96.74 |
| 5 Neal Edwards (1940) | 1936-37 | City of Calcutta | 28714 | 2889 | 31603 | — | 100.61 | — |
| 6 Jhirad (1941) | 1937-38 | City of Bombay | 35592 | 2451 | 38043 | — | 68.86 | — |
| 7 Waters (1946) | 1945 | N. M. Wadia Hospital, Bombay, | 5741 | 348 | 6089 | 336 | 60.62 | 58.53 |
| | | | Bai Motli Bai Hospt. Bombay Nursing | 2248 | 205 | 2453 | 169 | 91.1 | 75.18 |
| | | | Homes, Bombay | 1214 | 25 | 1239 | 13 | 20.59 | 10.71 |
| 8 Sarkar (1951) | | | Eden Hospital Calcutta | 4074 | 353 | 4427 | 166 | 86.85 | 40.75 |
| | | | " " " | 6563 | 454 | 7017 | 402 | 69.18 | 61.25 |

Das Gupta (1947) has made a comprehensive study on the bearing of premature* and immature births on Infant Mortality in Bombay, Only a brief interim report is available to us. All infants who weighed upto 4 lb. 15 oz.† at birth in thirteen reliable Bombay hospitals provided the material for study. In this investigation 2817 mothers and their 2922 infants were studied. The neonatal mortality rate, 192 and Infant Mortality rate, 220 are distributed as under.

| | total infant deaths upto 1 year | infant mortality rate |
|---|---|---|
| 1282 infants (43.9%, premature) | 443 | 345.6 |
| 1476 " (50.5%, immature) | 158 | 107.0 |
| 164 " (5.6% information awaited) | •40 | 243.9 |

*In accordance with the standard in international use any infant whose birth weight is 5½ lb. (2500 grammes) or less is considered either *immature or premature* according as the estimated period of gestation is fulltime (40 weeks) or not. Usually immaturity is not specified separately and included under prematurity.
†In a personal communication Dr. B. C. Das Gupta has informed about adopting birth weight less than 5lb. to define premature/immature births. He contends that the average birth weight of Indian infants being less, the international standard is too high for adoption in India. All other references in this paper are based on the International standard.

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Investigation revealed the average caloric value of diets of the mothers to be 1500C per person per day. "They lacked in protective foods, proteins, fats and vitamins, and were unbalanced or inadequate to satisfy or sustain the mothers, who were in consequence mal-nourished and under-fed." The health of t!e mothers was found to be unsatisfactory in the majority of instances. Severe anaemia (Haemoglobin 25%-55%) was present among 1428 and was responsible for 50% of the diseases present in these women.

The incidence of premature births has important influence on the Infant Mortality rates. Figures from hospital statistics in England show the premature birth rate to be 6% to 18% of total births. In India this incidence has been studied by Balfour (1930) from the hospital records of Cama and Albless Hospital, Bombay and the Dufferin Hospitals, India, and give the figures 135/1261 births (10.71%) and 234/2254 births (10.38%) respectively. In Eden Hospital, Calcutta, the rates were 891/4427 births (22.16%) and 1176/7017 births (16.76%) during 1946 and 1950 respectively.

### 3. The Material, Processing of Data and the Results

The material of the present study consists of detailed and careful obstetric histories* elicited from 1502 Hindu women belonging to middle income group in Calcutta. Most mothers were literate and their histories appeared reliable. Dates of birth were noted to the nearest years. The information about each individual pregnancy was transferred to a separate *Hollerith Punch Card* and then the pregnancies were sorted out according to year of delivery. The number of births recorded before 1938 is small and the data for 1950 are incomplete as the sequel to most of the pregnancies were not available at the time of the survey. The statistical analysis in the present work is based on 4034 pregnancies spread over the period 1938-1949.
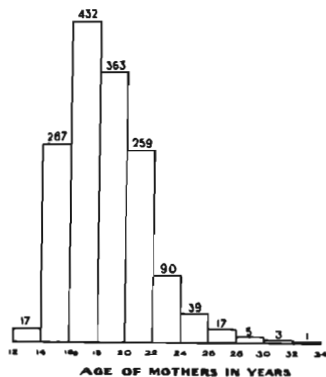


Fig. 1.  Showing the distribution of 1404 mothers according to age at first childbirth

*These informations were recorded in forms specially prepared for the purpose. The Survey was carried during the period 15th July to 15th December, 1950.

The study of some points like economic status, cause of death, etc., has been based on the entire material.

It is known that fates of siblings are influenced by maternal age, parity and frequency of conception. Usually the first pregnancy and labour are associated with more hazards and these are reflected by higher Stillbirth and Neonatal Mortality rates The rates are lowest in the second and then slowly rises until it is as high in the fifth as in the first pregnancy. Thereafter it rises with each pregnancy. (Neonatal Mortality and Morbility, 1949).

First pregnancy occurring at too early age (before 14) or in elderly women (past 30) is specially attended with difficulties. The distribution of ages at first pregnancy of this group is shown in Table 1, below. The total number of mothers is 1494, as in 8 cases the ages at first pregnancy noted were uncertain.

TABLE 1

DISTRIBUTION OF MOTHERS ACCORDING TO AGES AT FIRST PREGNANCY

| age groups in years | number | percentage of total |
|---|---|---|
| 12–13 | 17 | 1.2 |
| 14–15 | 267 | 17.9 |
| 16–17 | 432 | 28.9 |
| 18–19 | 363 | 24.3 |
| 20–21 | 259 | 17.3 |
| 22–23 | 90 | 6.0 |
| 24–25 | 39 | 2.6 |
| 26–27 | 17 | 1.2 |
| 28–29 | 5 | 0.3 |
| 30–31 | 3 | 0.2 |
| 32–33 | 2 | 0.1 |
| total | 1494 | 100.0 |

Fig. 1 shows the Histogram of this data. The average age at first birth in the present observation is 18.05 years with a S. D. of $\pm 2.00$ years.

TABLE 2

SHOWING THE DISTRIBUTION OF 4034 PREGNANCIES FOR THE PERIOD 1939-49 ACCORDING TO AGE OF MOTHERS AND YEAR OF DELIVERY WITH PERCENTAGES FOR ALL YEARS

| age at pregnancies | number of pregnancies during | | | | | | | | | | | | all years | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1946 | 1947 | 1948 | 1949 | | |
| 12–13 | 1 | 0 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 10 | 0.25 |
| 14–15 | 15 | 14 | 33 | 13 | 8 | 9 | 13 | 20 | 17 | 20 | 7 | 1 | 170 | 4.21 |
| 16–17 | 31 | 17 | 38 | 52 | 41 | 35 | 22 | 47 | 43 | 44 | 51 | 39 | 460 | 11.40 |
| 18–19 | 63 | 39 | 43 | 28 | 47 | 76 | 65 | 44 | 69 | 62 | 111 | 45 | 692 | 17.15 |
| 20–21 | 38 | 10 | 64 | 54 | 51 | 31 | 49 | 94 | 101 | 68 | 100 | 33 | 693 | 17.18 |
| 22–23 | 25 | 8 | 38 | 22 | 72 | 62 | 51 | 45 | 54 | 76 | 123 | 30 | 606 | 15.02 |
| 24–25 | 11 | 17 | 34 | 9 | 26 | 23 | 54 | 77 | 44 | 44 | 66 | 40 | 445 | 11.03 |
| 26–27 | 13 | 4 | 11 | 10 | 28 | 8 | 21 | 24 | 42 | 64 | 52 | 25 | 311 | 7.71 |
| 28–29 | 19 | 10 | 7 | 1 | 8 | 12 | 25 | 11 | 24 | 18 | 50 | 30 | 224 | 5.55 |
| 30–31 | 3 | 1 | 26 | 11 | 7 | 6 | 6 | 14 | 23 | 7 | 25 | 14 | 143 | 3.54 |
| 32–33 | 4 | 1 | 4 | 1 | 16 | 15 | 8 | 3 | 7 | 21 | 26 | 7 | 113 | 2.80 |
| 34–25 | 0 | 2 | 5 | 0 | 1 | 1 | 14 | 13 | 6 | 4 | 8 | 9 | 63 | 1.56 |
| 36–37 | 0 | 0 | 0 | 2 | 1 | 0 | 2 | 1 | 12 | 13 | 6 | 3 | 40 | 0.99 |
| 38–39 | 1 | 1 | 0 | 0 | 0 | 3 | 2 | 0 | 1 | 2 | 10 | 9 | 29 | 0.71 |
| 40–41 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 1 | 2 | 10 | 0.25 |
| 42–43 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 4 | 0 | 10 | 0.25 |
| 44–45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.03 |
| unknown | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 14 | 0.35 |
| total | 226 | 124 | 306 | 214 | 308 | 285 | 334 | 398 | 451 | 448 | 651 | 280 | 4034 | 99.99 |

In Fig. 2 is shown the distribution of 4034 pregnancies in our study according to ages at delivery during the year 1938-49. All year percentages by ages of delivery
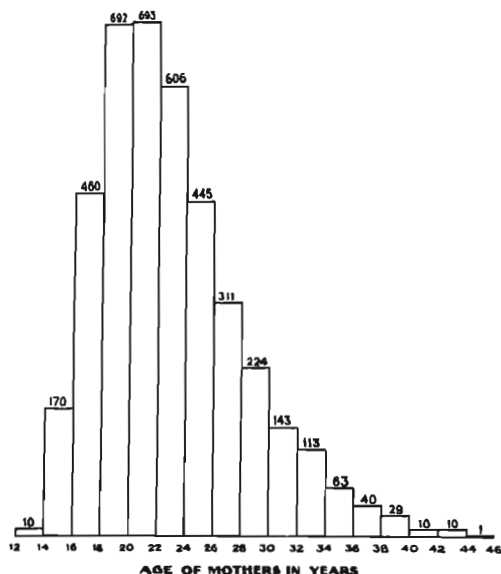


Fig. 2. Showing the distribution of 3034 pregnancies according to ages of mothers.

are shown in the last column of Table 2. The report referred above notes that the ideal family in Britain, from the standpoint of low foetal mortality would be 4 or 5 children, with the mother not more than 24 at first child-birth and the last not later than at the age of 35. Although ages quoted in this statement are not applicable strictly in our country, the results in Tables 1 and 2 provide interesting comparison. There is no preponderance of primigravidae in our group and the age of mothers at first and subsequent pregnancies was very satisfactory from both the obstetric and infant mortality points of view and may, therefore, be deemed to have little or no effect in augmenting Infant Mortality rates.

With the increase of the family other problems arise. A good deal will depend, on the relative increment of the income with the growing family. Frequent pregnancies at short intervals have a cumulative effect in undermining the health of the mother which is manifested by malnutrition, exhaustion and anaemia. Table 3 and Fig. 3 show the interval of gestation in 4576 cases of pregnancies from the whole material

consisting of 1502 mothers. Nearly 66% of the pregnancies were below the interval of two years. It has been observed in India that the baby may be still suckling when the next one is born, preventing the mother from giving adequate care to either. The poor middle class group cannot afford adequate domestic help so that repeated preg-
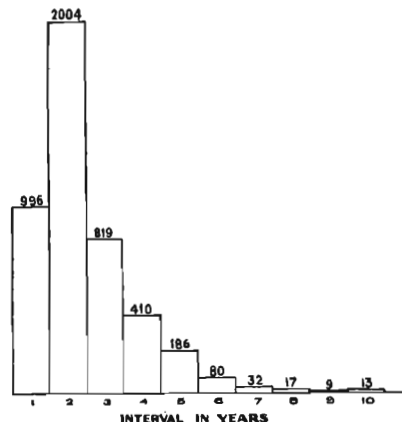


Fig. 3. Showing the interval of gestation in 4576 pregnancies

**TABLE 3**

SHOWING THE INTERVAL OF GESTATION
IN 4576 PREGNANCIES

| interval in years | number | percentage |
|---|---|---|
| 1 | 996 | 21.8 |
| 2 | 2004 | 43.8 |
| 3 | 819 | 17.9 |
| 4 | 410 | 9.0 |
| 5 | 186 | 4.1 |
| 6 | 30 | 1.8 |
| 7 | 32 | 0.7 |
| 8 | 17 | 0.4 |
| 9 | 9 | 0.2 |
| 10 | 13 | 0.3 |
| 11 | 1 | 0.0 |
| 12 | 5 | 0.1 |
| 13 | — | — |
| 14 | 1 | 0.0 |
| 15 | 2 | 0.0 |
| 16 | 1 | 0.0 |
| total | 4576 | 100.0 |

nancies at short intervals cause obvious strain on the already over-worked housewife. This we believe, has an adverse effect on the health and energy of the mothers which may in turn have been responsible for increase in the stillbirth, neonatal and infant mortality rates, especially among the poorer women.

The material was processed for the extraction of a table to show the number of births falling in different years. We have included here the figures for the 12 year period, 1938-49, for our study of trends. In Table 4 will be seen the fate of 4034 pregnancies over the specified period. This table provides columns for the incidence of abortions (not ordinarily available in vital statistical reports), stillbirths, neonatal and infant deaths etc. Estimated yearly rates of these with their standard errors are also shown. Graphs showing these rates are given in Fig. 4.

Infant Mortality rates for the Hindu community (graphical presentation of which is given in Fig. 5) in the Calcutta Health Officer's reports, when allowances are made for their admitted errors, will be found in most cases to compare well with our figures. The reported Infant Mortality rates are somewhat exaggerated figures as a higher percentage of deaths than births are usually registered. This has been observed in many places e.g. the PHC (1930) estimates an excess of 20% (approximately) in the official figures by an actual checking of the enumeration work in Madras Presidency where the collection of vital statistics is as accurate or otherwise as in any other

TABLE 4

SHOWING THE ESTIMATED YEARLY RATES OF ABORTION, STILLBIRTHS, NEONATAL AND INFANT MORTALITY WITH THEIR STANDARD ERRORS

| year | total number of pregnancies | total abortion | abortion rate per 100 pregnancies | number of twins | total number of births | total stillbirths | stillbirth rate per 1000 total births | total number of live births | total number of infant deaths | total number of neonatal deaths | infant mortality rate per 1000 births | neonatal mortality rate per 1000 live births | neonatal mortality as % of infant mortality |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1938 | 226 | 7 | 3.10±1.15 | 3 | 222 | 8 | 36.0±12.5 | 214 | 31 | 16 | 144.9±24.1 | 74.8±18.0 | 51.0 |
| 1939 | 124 | 4 | 3.23±1.60 | 2 | 122 | 6 | 49.2±19.6 | 119 | 24 | 12 | 200.9±37.0 | 103.4±26.2 | 50.0 |
| 1940 | 306 | 11 | 3.59±1.00 | 2 | 297 | 11 | 37.0±11.0 | 286 | 45 | 33 | 157.3±21.5 | 115.4±18.0 | 73.3 |
| 1941 | 214 | 13 | 6.07±1.63 | 2 | 203 | 3 | 14.8±8.5 | 200 | 31 | 17 | 155.0±25.6 | 86.0±19.7 | 54.8 |
| 1942 | 308 | 17 | 5.62±1.30 | 5 | 296 | 7 | 23.7±8.8 | 289 | 50 | 23 | 173.0±22.2 | 70.0±15.0 | 40.0 |
| 1943 | 285 | 16 | 5.61±1.36 | 3 | 272 | 5 | 18.4±8.1 | 267 | 51 | 24 | 191.0±24.1 | 89.0±17.5 | 47.1 |
| 1944 | 334 | 30 | 8.98±1.56 | 4 | 308 | 9 | 20.2±9.0 | 299 | 46 | 20 | 150.5±20.7 | 97.0±17.1 | 64.4 |
| 1945 | 398 | 26 | 6.53±1.24 | 1 | 373 | 14 | 37.5±9.8 | 340 | 61 | 30 | 174.8±20.3 | 103.2±16.3 | 59.0 |
| 1946 | 451 | 42 | 9.31±1.37 | 7 | 416 | 20 | 48.1±10.8 | 396 | 74 | 40 | 186.9±19.6 | 101.0±15.1 | 54.0 |
| 1947 | 448 | 32 | 7.14±1.22 | 5 | 421 | 18 | 42.8±9.0 | 403 | 74 | 51 | 183.6±19.3 | 120.6±16.0 | 68.9 |
| 1948 | 652 | 61 | 9.36±1.14 | 2 | 593 | 41 | 60.1±10.4 | 552 | 111 | 63 | 201.0±17.1 | 114.1±13.5 | 56.8 |
| 1949 | 288 | 84 | 29.17±2.68 | 4 | 208 | 50 | 240.4±29.6 | 158 | 89 | 60 | 563.3±30.5 | 417.7±30.2 | 74.2 |
| total | 4034 | 343 | 8.50±1.61 | 40 | 3731 | 102 | 51.6±3.7 | 3520 | 080 | 410 | 194.4±6.7 | 116.2±5.4 | 69.8 |

part of India. Ghosh and Chandrasekar (1944) found even a higher percentage of error. The extraordinary Infant Mortality rate of the years 1943-44, 1944-45, were ascribed
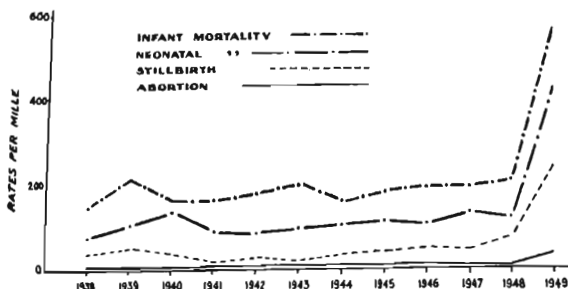


Fig. 4. Showing the trends of Abortion, Stillbirth, Neonatal and Infant Mortality rates for the years 1938-1949.

to the registration of a large number of "imported" deaths (1943 famine) and to a severe epidemic of small-pox in the following year. Our sample observation escaped extremes of these calamities.
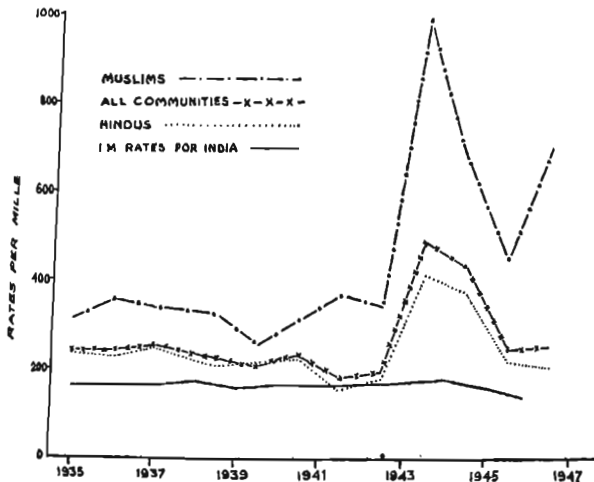


Fig. 5. Showing the Infant Mortality rates among Hindus, Muslims and All Communities in Calcutta for the years 1935-1947

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Table 5 shows the number and percentage of deaths by different causes. These figures should be accepted with reserve as the cause were as stated by mothers. It appears, however, that most infants were seen by doctors. But as is known accurate diagnosis needs also post-mortem examination in majority of infant deaths.

The distribution of mothers in five income groups are shown in Table 6. Its column 3 gives the percentages of the total number of pregnancies. The number and proportion of neonatal and infant deaths are noted in corresponding rows. We shall refer to these results later in our discussion. It is seen that the mortality is higher in lower income groups, the fact being in conformity with the findings of various workers of the western countries.

TABLE 5

SHOWING THE FREQUENCY OF INFANT DEATHS BY DIFFERENT CAUSES DURING THE
PERIOD UNDER SURVEY

| serial no. | causes of death | number of deaths | percentage of total |
|---|---|---|---|
| 1 | unknown (including rare causes) | 45 | 6.6 |
| 2 | fever (including malaria, typhoid) | 149 | 21.7 |
| 3 | prematurity & debility | 142 | 20.7 |
| 4 | asphyxia | 82 | 12.0 |
| 5 | cyanosis | 57 | 8.3 |
| 6 | pneumonia | 41 | 6.0 |
| 7 | smallpox | 32 | 4.7 |
| 8 | accident and trauma | 31 | 4.5 |
| 9 | diarrhœa (including cholera) | 20 | 2.9 |
| 10 | dysentery | 19 | 2.8 |
| 11 | rickets | 17 | 2.5 |
| 12 | sepsis | 15 | 2.2 |
| 13 | diphtheria | 9 | 1.3 |
| 14 | meningitis | 9 | 1.3 |
| 15 | convulsions | 7 | 1.0 |
| 16 | marasmus | 5 | 0.7 |
| 17 | measles | 5 | 0.7 |
| 18 | heart failure | 1 | 0.0 |
| total (all cases) | | 686 | 99.9 |

TABLE 6

SHOWING RELATIONSHIP OF ECONOMIC STATUS WITH NEONATAL
INFANT DEATHS

| income group (in rupees) | number of pregnancies | percentage of pregnancies | neonatal deaths | | infant deaths | | ratios | |
|---|---|---|---|---|---|---|---|---|
| | | | no. | % of total | no. | % of total | col. 5 col. 3 | col. 7 col. 3 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 0—150 | 1296 | 32.1 | 148 | 36.1 | 251 | 36.6 | 1.35 | 1.140 |
| 151—250 | 2210 | 54.8 | 218 | 53.2 | 359 | 52.2 | 0.97 | 0.95 |
| 251—500 | 443 | 11.0 | 43 | 10.5 | 70 | 10.2 | 0.95 | 0.93 |
| 501—750 | 76 | 1.9 | 1 | 0.2 | 7 | 1.0 | 0.13 | 0.52 |
| 751— | 9 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| all groups | 4034 | 100.0 | 410 | 100.0 | 686 | 100.0 | | |

## 4. DISCUSSION

Speaking generally the important factors which influence Infant Mortality rates are, the genetic causes, the environment and the efficacy of the Health and Medical Services. Amongst these we believe that the most important as well as the most variable factor influencing Infant Mortality rates in India is that of *Environment* in its widest concept. The widespread poverty in India is usually associated with bad housing, overcrowding, illiteracy, ignorance, squalor and apathy; and these are the commonest causes of disability, disease and death of infants. It should be emphasised that under existing conditions, the medical and health services function with extreme difficulty and with much less effect. Pregnancy and the results of child-birth are intimately correlated to social and economic conditions and the high incidence of sickness and mortality is largely due to wretched living conditions of the majority of the people.

A large number of genetic causes resulting from faulty material environment have been investigated over since the classic studies of the late William J. Ballantyne. Under the prevailing conditions in India the effects of malnutrition in the mother are so overwhelming that they tend to mask the other factors, which are, therefore, of insignificant importance in a study of present nature. In our discussions, environment implies the effects of housing, sanitation, mode of living and *nutrition*.

It has been increasingly appreciated in recent years that the nutrition of the pregnant mother has profound effect on the future health and birth vigour of the sibling. Hammond (1944) postulated his hypothesis on the partition coefficient of nutrients in the maternal tissues and the foetus. Subsequent observations on experimental and farm animals and in human beings have generally corroborated his view. The foetus gets a high priority of nutrients. If the diet is inadequate or unbalanced the mother suffers first and in *extreme cases* the foetus is affected *directly*. In mild or moderate degree of malnutrition the foetus is affected indirectly by the altered maternal environment.

Pregnancy may be likened to a "Diet Efficiency Test" and border line cases of malnutrition are frequently aggravated during this period into actual deficiency states. These are manifested by diverse and often bizarre clinical features some well known, others that are gradually being recognised. The effect on the foetus varies. Burke et al (1943) studied the effects of nutrition of mothers during pregnancy on the conditions of their infants at birth. They observed that all "functionally immature", premature and congenitally defective infants were born to mothers whose diet was inadequate (poor to very poor) during pregnancy. On the other hand if the diet was excellent the physical condition of the infant was good in nearly all instances. It may be noted here that practically the same causes determine the incidence of stillbrith premature labour and neonatal mortality. Prematurity is one of the most important causes of infant death in the earlier age period, so that any factor which tend to augment premature births will increase Infant Mortality rates.

Attempt has been made to determine the effect of environment by studying the relation between the social and economic status of the parents with the incidence of stillbirth, premature birth, neonatal and infant mortality rates. The Registrar-General in England and Wales recognises five social classes. In the period 1930-32 among legitimate children, the stillbirth rate was 30% higher in Class V than in Class I, neonatal death rate 50% higher and Infant mortality rate for the age group 6-12 months, four times higher. Baird (1945) has shown that the high neonatal mortality rate in Scotland as compared to Holland and for the social Class V in England and Wales compared to Social Class I, is due to the relatively high proportion of premature births, which is in turn associated with poor social and economic conditions affecting adversely the physique, health and nutrition of the mother. About 90% of the mothers of premature infants studied by Das Gupta (1947) were living on grossly inadequate diets as a result of poverty. It is significant to note that 1476 (50.5%) of infants in this series though born at term weighed less than 5 lbs. and may be deemed to be "functionally immature". In so far as the total loss of child life is concerned these figures become even more significant when it is realized that the poorer class is a much larger group than the rich and that they have a higher reproductive rate.

On the basis of this knowledge we may now analyse the trend of Infant Mortality rate in India. The trend of Infant Mortality rates in British India (from PHC reports) as a whole for the years 1935-46 is shown in the graph of Fig. 5. From 1930-44 the rate has shown hardly any appreciable fall. During 1945-46 a fall of nearly 37.4 per thousand has been shown. The PHC notes this fall in 1946 without giving any explanation and in the same annual report again refers to acute food scarcity in certain Indian provinces and states.

During the last war especially after 1942 ther has been a steep rise in the cost of living without a corresponding rise in income of the vast majority of the people. There has been simultaneous and gradually worsening food scarcity due to various factors which has been further accentuated by the partition of India in 1947. Indeed the recent famine in Bengal was only an acute local manifestation of the chronic food scarcity that has become the feature in recent years. The increased cost of living, growth of population, lack of housing and increased congestion are other problems which are of serious concern and anxiety to the authorities. The claim of the reduction in Infant Mortality rate made in the PHC report of 1946, notwithstanding the serious deterioration in the food situation referred in the same report (pp.5-6) appears to be incongruous and is contrary to scientific medical experience.

Our own findings may now be analysed briefly: If we ignore the rise in 1930 (the number of cases studied being small), there is a slow but steady rise in Infant Mortality rates in our population reaching a peak in 1943 corresponding to the worst period of food crisis in the City. This community with fixed incomes could only spend a proportionate amount on food etc. The quality and quantity of food vary with the purchasing power. Total rationing in the city was instituted soon after, making available essential foodgrains at reasonable cost and this is reflected in the fall of Infant

## INFANTILE MORTALITY RATES BY LONGITUDINAL SURVEY

Mortality rate in the following year. There is again a steady rise in rate due, no doubt to the rising prices and worsening living conditions of the middle class population in the City. There was no serious trouble in Bengal in 1947. During the last three years, however, there has been large exodus of refugees. The majority of displaced persons stay permanently or during their transit in the City, causing serious dislocation of normal living conditions. This reached a climax in 1948-49 and the community studeid reflects the vicissitudes by a sharp and phenomenal rise in the Stillbirth, Neonatal Mortality and Infant Mortality rates of that year. This result is not surprising if we recall the present living conditions of the poor middle class in the City most of whom are also accommodating a number of destitute relatives from East Bengal. The rise in the rate is parallel with the deterioration in environment and is in accord with theoretical expectations.

We may in this context record the experience of other cities in India. One of us (KNM) during his visits to different places and from discussions with colleagues has gained the impression about the deterioration of the standard of health among pregnant women seeking treatment in the teaching hospitals of northern India during recent years.

On the basis of such overwhelming circumstantial evidence and from our own observations we are unable to agree with the euphemistic conclusions of the PHC (1946) and venture to suggest that the present state of Infant health in India, particularly in Calcutta, is alarming and demands immediate and radical measures for amelioration. Infant Mortality accounts for nearly a quarter of the total annual deaths in India from all causes. Family ties and love for children is as much a feature of society in India as may be found in any other country of the world. No figures would ever convey the magnitude of unhappiness in the domestic lives of the citizens caused every year by untimely deaths of beloved children. The mitigation of this suffering is surely everybody's concern.

The complex problem of making a reliable statistical estimate within reasonable cost in large scale sample surveys has been studied by Mahalanobis (1944). The determinations of Infant Mortality rates for the country as a whole may present similar problems. For the formulation of rational child welfare programmes it is necessary to know about certain health indices periodically. We suggest that the Infant Mortality survey for India might be conducted by the method followed by Mahalanobis utilizing Longitudinal Data every ten years.

The present survey has been based on a limited community and undertaken as an exploratory study only. From the experience gained from this exploratory survey we feel justified in commending this method as suitable for deducing trends in Infant Mortality rates of compact administrative units and as one involving a fraction of the cost of surveys by any other method. In a country like India the cost incurred in such surveys is always an important consideration.

### 6. SUMMARY

1. Reference is made to the continued high Infant Mortality rate in India and the paucity of reliable information on this serious national health problem.

2.  For practical purposes and in mitigating this grave threat to national health, the utility of determining the trend of Infant Mortality rates in compact administrative areas is emphasized.

3.  A plea is made of the superiority of Longitudinal (historical) data in conducting Infant Mortality surveys over occasional Cross-section data (at or about a given point of time) is the determination of the trend in Infant Mortality rates.

4.  An exploratory survey has been conducted to demonstrate the use and scope of the method. The results are in accord with theoretical expectations and reveal many valuable informations.

5.  From various considerations and from our own observations it appears that Infant Mortality rate is showing an uptrend.  Due to recent deterioration of environment in West Bengal there has been a sharp rise in Infant Mortality and other rates in Calcutta during 1949.

### ACKNOWLEDGEMENT

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