

## ESTIMATING INFANT AND CHILD MORTALITY IN IRAN, 1989

KAZEM MOHAMMAD AND MAHMOOD M.M. FARAHANI

*From the Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran.*

### ABSTRACT

This paper presents estimates of infant and child mortality in the rural and urban areas of Iran for 1989. Data are from a one percent sample of the urban and rural population. The study makes use of data on the number of children born alive and children surviving, classified by age of the mother. Based on these data estimates of infant and child mortality for the urban and the rural areas have been calculated separately by using the Trussell version of the Brass method. The results of this study show that the infant mortality rates in the rural and urban areas of Iran are 70 and 35 per thousand, respectively.

The estimates obtained from previous retrospective studies are compared with the current rates. Details of the method, limitations of the data and discussion of the results are given in the paper.

*MJIRI, Vol. 4, No. 3, 215-218, 1990*

### INTRODUCTION

Infant and child mortality rates are often considered as significant indicators of a nation's health conditions

and provide guidelines for structuring of public health programs. They also represent a substantial proportion of total mortality in developing countries and therefore also greatly affect population dynamics. They are also

**Table I. Distribution of number of women and data on children ever born and children surviving by age of women and place of residence in 1989, Iran (Retrospective Survey of Fertility and Mortality)**

| Place of Residence | Age groups of mothers | No. of Women | Children ever born |                   |                     |               |
|--------------------|-----------------------|--------------|--------------------|-------------------|---------------------|---------------|
|                    |                       |              | Children surviving |                   | Children died later |               |
|                    |                       |              | Living with family | Living else where | Martyred            | Other reasons |
| Rural              | 15-19                 | 14487        | 3277               | 23                | 1                   | 387           |
|                    | 20-24                 | 9828         | 13227              | 83                | 8                   | 1228          |
|                    | 25-29                 | 7822         | 23695              | 228               | 11                  | 2702          |
|                    | 30-34                 | 6555         | 29382              | 798               | 22                  | 4197          |
|                    | 35-39                 | 5688         | 30540              | 2227              | 55                  | 5791          |
|                    | 40-44                 | 4323         | 2204               | 4016              | 96                  | 5735          |
|                    | 45-49                 | 3675         | 15572              | 5582              | 128                 | 5734          |
| Urban              | 15-19                 | 16032        | 2839               | 12                | 4                   | 133           |
|                    | 20-24                 | 14136        | 15241              | 89                | 9                   | 635           |
|                    | 25-29                 | 12452        | 29764              | 197               | 19                  | 1465          |
|                    | 30-34                 | 10448        | 37053              | 606               | 29                  | 2404          |
|                    | 35-39                 | 8347         | 35363              | 2112              | 100                 | 3048          |
|                    | 40-44                 | 6023         | 24385              | 4337              | 174                 | 3184          |
|                    | 45-49                 | 4441         | 15939              | 6131              | 199                 | 3266          |

## Infant and Child Mortality In Iran

**Table II. Results of the various steps of the application of the Trussell version of the Brass method to data for both sexes from 1367(1989) Iran retrospective survey**

| Age groups of mothers | No. of women | Children born alive | Children surviving | Children born per woman<br>Pi | Children surviving per woman<br>Si | Proportion of children dead<br>$\frac{1-S_i}{P_i}$ | Multiplier<br>k(i) | Probability of dying by age<br>q(x) | Age x | Time reference<br>t(i) | Reference date | Common index<br>q*(5) |
|-----------------------|--------------|---------------------|--------------------|-------------------------------|------------------------------------|--|--------------------|-------------------------------------|-------|------------------------|----------------|-----------------------|
| 15-19                 | 30519        | 6676                | 6156               | 0.2187                        | 0.2017                             | 0.0777   | 0.9530             | 0.0740                              | 1     | 1.1                    | 1365.9         | 0.0971                |
| 20-24                 | 23964        | 30520               | 28657              | 1.2736                        | 1.1958                             | 0.0611   | 1.0441             | 0.0638                              | 2     | 2.4                    | 1364.6         | 0.0705                |
| 25-29                 | 20274        | 58081               | 53914              | 2.8648                        | 2.6593                             | 0.0717   | 1.0278             | 0.0737                              | 3     | 4.1                    | 1362.9         | 0.0774                |
| 30-34                 | 17003        | 74491               | 67890              | 4.3811                        | 3.9928                             | 0.0886   | 1.0362             | 0.0918                              | 5     | 6.2                    | 1360.8         | 0.0918                |
| 35-39                 | 14064        | 79236               | 70397              | 5.6340                        | 5.0055                             | 0.1116   | 1.0544             | 0.1177                              | 10    | 8.5                    | 1358.5         | 0.1119                |
| 40-44                 | 10346        | 63974               | 55055              | 6.1835                        | 5.3214                             | 0.1394   | 1.0322             | 0.1439                              | 15    | 11.1                   | 1355.9         | 0.1314                |
| 45-49                 | 8116         | 52551               | 43551              | 6.4750                        | 5.3661                             | 0.1713   | 1.0180             | 0.1744                              | 20    | 14.2                   | 1352.8         | 0.1501                |

$p(1)/p(2) = 0.1717$

$p(2)/p(3) = 0.4446$

Multipliers based on South model Sex ratio at birth = 1.05

useful for the purposes of identifying target population groups for which mortality is high and also assessing program impact in terms of mortality reductions.

The conventional measurement of mortality requires two pieces of information: the number of deaths on one hand and the population subject of risk of dying on the other. Typically, the first type of information is derived from registration systems that record deaths as they occur, while the latter is obtained mostly from censuses. However, in the majority of developing countries registration systems either do not exist or are so affected by omission and other errors that measures based on the data that they produce fail to reflect properly either levels or trends of mortality.

Over the last twenty years, a number of methods based on information obtained exclusively from censuses or surveys have been developed. Since during that period survey and census data have also become more commonly available, considerable advances have been made to fill the gap produced by lack of reliable vital registration data. A procedure of estimating the levels of infant and child mortality from reports of women of their children surviving or dead has been derived, known as the Brass method. Other methods also exist for estimating child mortality, but they either

require considerably more information than the ones described here or have proved to be less reliable.

The aim of this paper is to present estimates of infant and child mortality for Iran and its rural-urban areas separately, based on data on the number of children alive and surviving classified by age of mother available from the recent survey based on one percent population in Iran in 1989.

### METHOD AND MATERIAL

Estimating infant and child mortality rate by the Brass method requires three pieces of information: the number of children ever born, the number of children ever born who died (children dead) and total female population.

In April 1989, a retrospective survey of fertility and mortality conducted in Iran included questions on children ever born and children dead. Table I shows the tabulation of data of children ever born (in this table we have one extra column for martyrs, which in calculation we assumed as children alive) and children surviving; from these data, it is possible to derive the proportion of children surviving to children ever born by ever

**Table III. Results of the various steps of the application of the Trussell version of the Brass method to data for sexes from 1367 (1989) rural retrospective survey**

| Age groups of mothers | No. of women | Children born alive | Children surviving | Children born per woman<br>Pi | Children surviving per woman<br>Si | Proportion of children dead<br>$\frac{1-S_i}{P_i}$ | Multiplier<br>k(i) | Probability of dying by age<br>q(x) | Age x | Time reference<br>t(i) | Reference date | Common index<br>q*(5) |
|-----------------------|--------------|---------------------|--------------------|-------------------------------|------------------------------------|--|--------------------|-------------------------------------|-------|------------------------|----------------|-----------------------|
| 15-19                 | 14487        | 3688                | 3301               | 0.2546                        | 0.2279                             | 0.1049   | 0.9434             | 0.0990                              | 1     | 1.2                    | 1365.8         | 0.1435                |
| 20-24                 | 9828         | 14546               | 13318              | 1.4801                        | 1.3551                             | 0.04845  | 1.0469             | 0.0885                              | 2     | 2.4                    | 1364.6         | 0.1002                |
| 25-29                 | 7822         | 26636               | 23934              | 3.4053                        | 3.0598                             | 0.1015   | 1.0325             | 0.1048                              | 3     | 4.0                    | 1363.0         | 0.1112                |
| 30-34                 | 6555         | 34399               | 30202              | 5.2477                        | 4.6075                             | 0.1220   | 1.0407             | 0.1270                              | 5     | 6.1                    | 1360.9         | 0.1270                |
| 35-39                 | 5688         | 38613               | 32822              | 6.7885                        | 5.7704                             | 0.1338   | 1.0588             | 0.1417                              | 10    | 8.3                    | 1358.7         | 0.1340                |
| 40-44                 | 4323         | 31894               | 26159              | 7.3777                        | 6.0511                             | 0.1798   | 1.0363             | 0.1863                              | 15    | 10.9                   | 1356.1         | 0.1680                |
| 45-49                 | 3675         | 27016               | 21282              | 7.3513                        | 5.7910                             | 0.2122   | 1.0216             | 0.2168                              | 20    | 14.0                   | 1353.0         | 0.1846                |

$p(3)/p(2) = 0.1720$

$p(2)/p(3) = 0.4346$

Multipliers based on South model Sex ratio at birth = 1.05

Table IV. Results of the various steps of the application of the Trussell version of the Brass method to data for both sexes from 1367 (1989) urban retrospective survey

| Age groups of mothers | No. of women | Children born alive | Children surviving | Children born per woman $P_i$ | Children surviving per woman $S_i$ | Proportion of children dead $\frac{1-S_i}{P_i}$ | Multiplier $k(i)$ | Probability of dying by age $q(x)$ | Age $x$ | Time reference $t(i)$ | Reference date | Common index $q^r(5)$ |
|-----------------------|--------------|---------------------|--------------------|-------------------------------|------------------------------------|---|-------------------|------------------------------------|---------|-----------------------|----------------|-----------------------|
| 15-19                 | 16032        | 2988                | 2855               | 0.1864                        | 0.1781                             | 0.0445  | 0.9757            | 0.0434                             | 1       | 1.1                   | 1365.9         | 0.0509                |
| 20-24                 | 14136        | 15974               | 15339              | 1.1300                        | 1.0851                             | 0.0397  | 1.0473            | 0.0416                             | 2       | 2.3                   | 1364.7         | 0.0447                |
| 25-29                 | 12452        | 31445               | 29980              | 2.5253                        | 2.4076                             | 0.0466  | 1.0258            | 0.0478                             | 3       | 4.1                   | 1362.9         | 0.0496                |
| 30-34                 | 10448        | 40092               | 37688              | 3.8373                        | 3.6072                             | 0.0600  | 1.0331            | 0.0620                             | 5       | 6.2                   | 1360.8         | 0.0620                |
| 35-39                 | 8376         | 40623               | 37575              | 4.8499                        | 4.4860                             | 0.0750  | 1.0511            | 10                                 | 8.6     | 1358.4                | 0.0758         |                       |
| 40-44                 | 6023         | 32080               | 28896              | 5.3262                        | 4.7976                             | 0.0992  | 1.0291            | 0.1021                             | 15      | 11.3                  | 1355.7         | 0.0945                |
| 45-49                 | 4441         | 25535               | 22269              | 5.7498                        | 5.0144                             | 0.1279  | 1.0152            | 0.1298                             | 20      | 14.4                  | 1352.6         | 0.1137                |

$p(1)/p(2) = 0.1650$

$p(2)/p(3) = 0.4475$

Multipliers based on South model Sex ratio at birth = 1.05

married women of different age groups. This information together with information on the parity for all women in the age groups (15-19), (20-24), permits the extraction of estimates of child mortality. The parity for all women can be obtained as product of the parity of ever married women and the proportion of ever married women in the age groups.

From these data, specifically, it is possible to estimate the proportion of children born alive who survive to age 1,2,3 and 5 by Brass method.

The Brass method derives estimates of  $q(x)$ -the probability of dying between birth and exact age  $x$ -from the proportion of children dead among those ever born by women in different age groups by allowing for the duration of exposure to the risk of dying. This duration of exposure is related to the ages of women and to the timing of their births since, on average, the older the women, the longer ago their children would have been born and, hence, the longer the children would have been exposed to the risk of dying.

The actual derivation of a Brass-type estimation procedure involves the use of simulation to generate proportions of children dead, the probabilities of dying

that they are related to, and the  $p(1)/p(2)$  and  $p(2)/p(3)$  ratios, [ $p(1)$ ,  $p(2)$  and  $p(3)$  are used to denote the average parties of women in age groups 15-19, 20-24 and 25-29, respectively] that provide the linkage between them. By using regression analysis one derives then the estimation equation that make the application of the procedure straightforward.

It is worth noting that there are several versions of the Brass method. They differ mostly in the type of models used to simulate the quantities of interest. One of them is that proposed by Trussell (1975) which we have used.

The method originally developed by Brass assumed that mortality was constant, so that cohort and period probabilities of dying were identical. That assumption was later relaxed through the work of Feeney (1980), Coale and Trussell (1978), and others. These authors showed that if the rate of change of mortality over time was approximately constant, the reference data of each  $q(x)$  could be estimated by making allowance for the age pattern of fertility via the  $p(1)/p(2)$  and  $p(2)/p(3)$  ratios.

Since the measurement of child mortality trends is

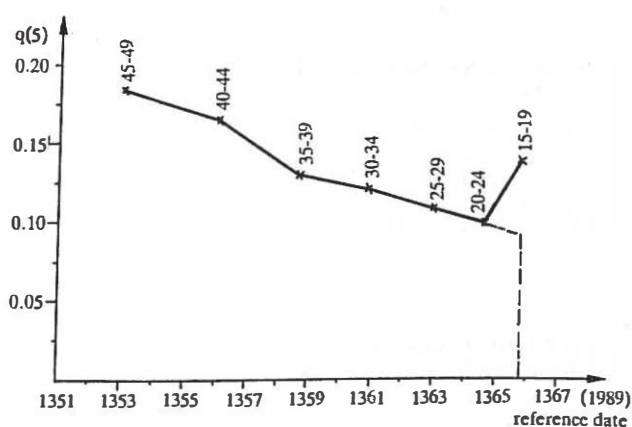


Fig. 1. Estimated under-five mortality,  $q(5)$ , using South model and Trussell version of the Brass method, total of Iran.

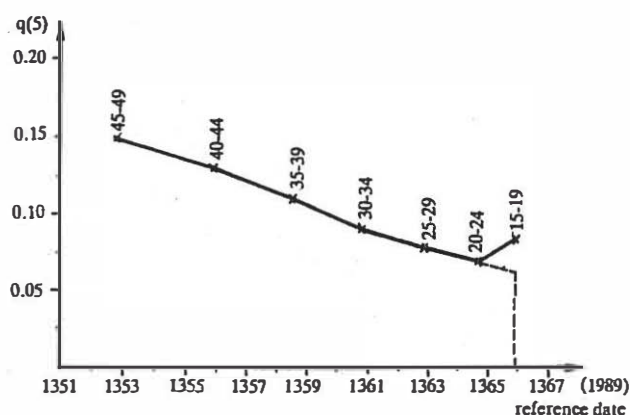


Fig. 2. Estimated under-five mortality,  $q(5)$ , using South model and Trussell version of the Brass method, total of rural areas.

## Infant and Child Mortality In Iran

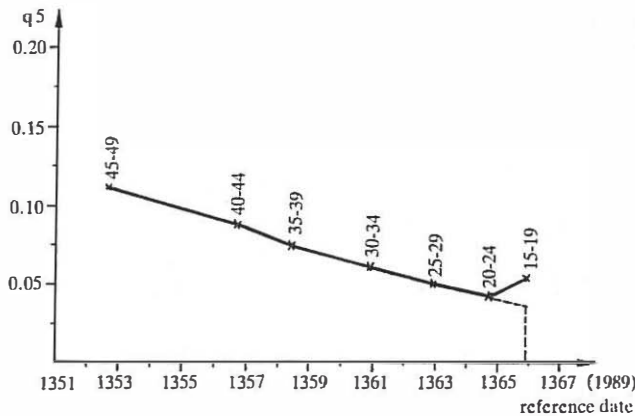


Fig.3. Estimated under-five mortality, q(5), using south model and Trussell version of the Brass method, total of urban areas.

an important objective in this paper, and also child mortality estimates based on reports of women aged 15-19 and, to a lesser extent, on those of women aged 20-24 are generally unreliable, often being higher than estimates based on reports of older women, we can use the trend to find child and infant mortality rates in recent years.

The Trussell version of the Brass method for multipliers employs regression mode of the form:

$$K(i) = a(i) + b(i) \frac{P(1)}{P(2)} + c(i) \frac{P(2)}{P(3)}$$

Where  $a(i)$ ,  $b(i)$  and  $c(i)$  are constants,  $i$  refers to the age groups, and for the calculation of the reference dates of  $q(x)$  can be estimated as:

$$t(i) = e(i) + f(i) \frac{P(1)}{P(2)} + g(i) \frac{P(2)}{P(3)}$$

Where  $e(i)$ ,  $f(i)$  and  $g(i)$  are constant.

### RESULTS

Estimates of  $q(x)$  for Iran and its rural-urban areas separately based on Trussell version of the Brass method are summarized in Tables II to IV. Infant and

Table V. Estimated infant and child mortality by under-five mortality and infant mortality by current data, rural-urban and total of Iran

| Regions | Infant mortality | Child mortality | infant mortality by current data |
|---------|------------------|-----------------|----------------------------------|
| Total   | 0.0498           | 0.060           | 0.0448                           |
| Rural   | 0.0696           | 0.090           | 0.0579                           |
| Urban   | 0.0352           | 0.040           | 0.0310                           |

\* Estimated by under-five mortality trend

child mortality for recent years estimated by trend of child mortality (Figures, 1,2,3) is compared with current data in Table V.

The infant and child mortality of current life table is lower than that implied by retrospective reports of the proportion of children dead. This is true for the rural and urban areas separately as well. The pattern of differentials between two sets of rates appear plausible because of the difference in the time interval to which the rates refer and the effect of change in mortality over time, though one might question whether the apparent differences are genuine features of mortality over time or partly caused by errors in two different data collection systems.

### REFERENCES

- 1- Brass W: Uses of census and survey data for the estimation of vital rates. Paper Prepared for the African Seminar on Vital Statistics, Addis Ababa (14-19) December, 1964.
- 2- Coale A.J et al: Regional model life tables and Stable populations second Edition, Academic press, New York, 1983.
- 3- Coale AJ, Trussell TJ: Estimating the time to which Brass estimates apply. Population Bulletin of the United Nations, No. 10, 1977.
- 4- Feeney. G: Estimating infant mortality trends from child survivorship data. Population studies, Vol. 34, No. 1, 1980.
- 5- Trussell T J: a re-estimation of the multiplying factors for the Brass technique for determining childhood survivorship rates. Population Studies, Vol. 29, No. 1, 1975.
- 6- United nations, Manual X: Indirect Techniques for Demographic Estimation. New York, United Nations, 1983.