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A Note on Estimating Death Rate Under Incomplete Death Registration

REGISTRATION of death in developing countries is incomplete both quantitatively and qualitatively. Therefore continuous monitoring of mortality conditions is rather difficult leaving frequent sample surveys as the only other alternative. The incompleteness in death registration statistics is mainly the result of the following two factors'

(a) Omission of deaths, aggravated by differential omission of deaths under one year of age.

(6) Misclassification of age at death, especially for those dying under 5 years of age.

Death rates calculated on the basis of registration are therefore inaccurate and misleading.

To overcome these errors in the data on deaths, Swaroop and Umeura (1957)[1] suggested that the ratio of deaths of age 50+ ($D_{50}+$) to the total number of deaths in any year *(D)* as an index of mortality level in the community. The index has two major limitations.[2]

1. S. Swaroop and K. Umeura, "Proportional Mortality of 50 years and above" Bulletin of the World Health Organisation, 17 : 439 (1957).

2. Mortimer Spiegelman, "Introduction to Demography", (Revis ed edition) Cambridge, Massachusetts Harvard University Press, (1969) p. 87.

(a) It depends on the age distribution and age-specific death rates of the population.

(b) Selection of age 50 as the cutting line is arbitrary.

Vaidyanathan (1972)[3] slightly modified the index to take account of the effect of errors in deaths under 5 years of age (i.e., omission of deaths under 1 year of age and misclassification of deaths by age). This index was suggested by the author primarily for examining differentials in mortality among sub-groups. However, the limitations indicated for Swaroop's index are not completely eliminated in this case also. Therefore these indices cannot be directly used.

The Problem

Instead of using the proportional mortality ratios themselves as indices of mortality level, it is considered that these ratios can be used to estimate the crude death rate itself. This is possible if a relationship between these ratios and crude death rate is established.

Registered deaths in any year (D) can be classified by the following age-groups easily, $0 - 4\ (D_{0-4})$, $5 - 14\ (D_{5-14})$, $15 - 49\ (D_{15-49})$, $50 + (D_{50+})$ so that

$$D = D_{0-4} + D_{5-14} + D_{15-49} + D_{50+};$$

and the ratios $\frac{D_{0-4}}{D}$, $\frac{D_{5-14}}{D}$, $\frac{D_{15-49}}{D}$ and $\frac{D_{50+}}{D}$

can be used to estimate the crude death rate. But as already mentioned, data for deaths in the age group $0 — 4\ (D_{0-4})$ are defective due to under-enumeration and misclassification. So by excluding this age-group in calculating the ratios, both in the numerator and denominator, the reliability of these ratios can be considerably improved.

3. Vaidynathan, K. E. "Some Indices of Differential Mortality in India", in "Studies on Mortality in India", Monograph series No. 5. The Gandhigram Institute of Rural Health and Family Planning, p. 72.

Therefore the following ratios are considered for the present study:

$$\frac{D_{5-14}}{D_{5+}}, \frac{D_{15-49}}{D_{5+}} \text{ and } \frac{D_{50+}}{D_{5+}}.$$

It is obvious that,

$$\frac{D_{5-14}}{D_{5+}} + \frac{D_{15-49}}{D_{5+}} + \frac{D_{50+}}{D_{5+}} = 1.$$

Hence if we know any two of these three ratios, the third is also determined. So only the following two ratios are considered for the study

$$\frac{D_{5-14}}{D_{5+}} \text{ and } \frac{D_{50+}}{D_{5+}}.$$

It is found possible to estimate the crude death rate with a linear combination of these two ratios, even when there is under-registration, provided the under-registration is uniformly distributed over the age span 5 and above.

Data and Model

The estimates of crude death rates and the per cent distribution of deaths by age obtained by the Sample Registration Scheme for different states for the year 1968 and 1969 are used. The data have been fitted with the regression equation,

$$Z = a + bx + cy + e,$$

where Z = crude death rate

$$x = \frac{D_{5-14}}{D_{5+}} \times 100$$

$$y = \frac{D_{50+}}{D_{5+}} \times 100$$

The data are presented in Table 1.

TABLE 1—OBSERVED AND EXPECTED VALUES OF CRUDE DEATH RATES, PERCENT OF DEATHS OF AGE 50+ TO DEATHS OF AGE 5+, PERCENT OF DEATHS OF AGE 5-14 TO DEATHS OF AGE 5+ FOR DIFFERENT STATES FOR 1968 AND 1969, SAMPLE REGISTRATION SCHEME[4]

State	*Year*	*Percent deaths of age 50+ to deaths 5+* y	*Percent deaths of age 5-14 to age 5+* x	*Crude Death rate observed* Z^O	*Crude death rate expected* Z^e
Andhra Pradesh	1969	59.36	11.48	17.17	15.18
	1968	57.93	11.83	15.83	15.78
Assam	1969	50.30	15.09	17.36	19.73
	1968	47.56	17.64	19.96	21.92
Gujarat	1969	52.22	16.58	20.24	20.03
	1968	52.94	12.64	17.37	17.62
Haryana	1969	63.09	16.26	11.75	16.82
Jammu & Kashmir	1969	54.64	8.79	14.38	14.99
	1968	49.65	9.59	17.47	16.83
Kerala	1969	62.66	9.88	9.00	13.37
	1968	64.70	10.23	10.03	13.00
Maharashtra	1969	59.90	13.94	15.52	16.41
	1968	55.92	14.69	13.86	17.94
Mysore	1969	54.74	13.95	15.37	17.85
Punjab	1969	73.27	8.96	11.64	9.90
	1968	69.99	9.01	11.95	10.84
Rajasthan	1969	55.81	19.43	23.99	20.63
	1968	53.96	15.95	18.40	19.19
Tamilnadu	1969	58.84	8.67	18.75	13.75
Uttar Pradesh	1969	55.21	16.86	25.58	19.35
	1968	56.27	14.89	23.47	17.95

Values of Regression Parameters

$a = 25.284$

$b = 0.560$

$c = -0.278$

χ^2 observed $= 12.25$

$\chi^2_{2\theta}$ Theoretical $= 31.41$ at 5% level.

a, f

4. Data are from Table 20(a) and Table 21 of "Measures of Fertility and Mortality in India", SRS Analytical Series, No. 2, 1972, Vital Statistics Division, Office of the Registrar General, India, New Delhi.

Goodness of Fit

Table 1 gives the observed values of the crude death rate and expected values calculated using the regression parameters. As could be seen from the table, the x^2 value is not significant indicating a close fit of the linear equation to the data. Second degree equation was also fitted and it was found that it did not substantially improve the estimate.

Conclusions

When registration data on deaths is defective due to *(a)* under-reporting and/or misclassification of deaths under 5 years of age, *(b)* uniform under-reporting of deaths over the age span 5 and above, and *(c)* when no reliable data on base population are available, a quick estimate of the crude death rate is possible using this regression equation.

It is suggested that similar regression equations may be developed for the following mortality conditions: viz. *(a)* stable and *(b)* declining in combination with the following levels of mortality: viz. (a) high, *(b)* medium and (c) low.

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