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Indirect Estimation of Child Mortality for Papua New Guinea

Introduction

IN recent **years,** interest in infant and child mortality research in the developing countries has increased tremendously (Haines *et al,* 1983; Arriaga, 1980; Caldwcll, 1979). One major reason for the increase is that infant and child mortality levels are used as sensitive indices of social and economic well-being. Another reason for the interest in infant and child mortality is the development of the indirect methods which permit the estimation of infant and child mortality from information obtained in censuses and survey data (Brass *et al.*$_t$ 1968; Brass, 1975; Sullivan, 1972; Trussell, 1975; Feeney, 1976, 1980).

Specific researches on child mortality in general in Papua New Guinea (PNG) are very limited due to lack of adequate data on the subject. Some of the researchers dealt with child mortality only briefly in connection with malnutrition. Nevertheless, attempts have been made to estimate child mortality rates for some areas of the country in recent years (see for example, Malcolm, 1969; Sturt, 1972; Rafiq, 1979).

This paper presents estimates of child mortality based on a survey conducted between November 1979 and March 1980. The survey, 'A Study of Fertility and Mortality among the Indigenous Population of PNG' was carried out in rural and urban areas of the eight provinces of PNG viz., Milne Bay, Gulf, Chimbu, Southern Highlands, Madang, East Sepik, East New Britain, and North Solomons.

A single-stage systematic sample design was employed for the selection of the respondents both in the rural and urban areas. Details of the survey have been published elsewhere (Agyei, 1984). The effective sample is made up of 3,986 females in the childbearing age group (15-49 years old) and 2,297 males between the ages of 20 and 54 years old. 1,066 males and 1,857 females lived in rural areas and 1,231 males and 2,129 females lived in urban areas.

Data and Methodology

The data were obtained from the 3,986 respondents on (i) the number of children ever born (retrospective fertility); (ii) complete pregnancy histories; (iii) their age composition. The variables derived from them include ihe average number of deceased children and the proportion dead by sex of child, current age and residence of mother, separately for rural and urban areas (Table 1).

The method employed for our analysis is the refined Brass (1968) and Trussell (1975) method discussed in details in U.N. Manual X (U.N.. 1983). Basically, the method involves the conversion of the proportion dead (Di) among children of women of different *age* groups from 15-49 years old to probabilities of dying from birth to age *x*, $q(x)_t$ for each age group. For example, we obtained the probability of dying at age 1 from women in the 15-19 year age group, the probability of dying at age 2 from women in the 20-24 year age group, and so on up to age 20 from women in the 45-49 year age group. In addition, we obtain the probability of surviving from birth to exact age x, i.e. $l(x) = 1.0 — q(x)$. The method furthermore, provides, a reference period, $t(x)$, i.e. the number of years prior to the census or survey of each $q(x)$ estimate.

The data on the proportion dead (A) in the various age groups are adjusted for the effects of the age pattern of child-bearing with mortality multipliers fc(i), which are estimated from the Trussell variant and $P(1)/P(2)$ and P(2)/P(3) ratios. The "West*' model life tables were selected for our analysis. The choice of the "West" model is based on known parameters of fertility and mortality schedules of the PNG population. In addition, several researchers have used the "West" model in the analysis of PNG censuses data as the model minimizes the danger of underestimating child mortality.

Our estimates of probabilities of dying, $q(x)$ and surviving, $l(x)$, are presented in Table 2 for the rural urban residence. As the estimates obtained from the 15-19 year age group are not very reliable, the estimates obtained from the age group 20-24 years old are usually taken to be the closest to reality. It should be noted that under the assumption of declining mortality, the children born to the older women will have been exposed to higher mortality experience than children born to the younger women. The declines in child mortality levels between the estimates corresponding to the younger and older women indicate that the children born to older women were experiencing higher mortality (as indicated by higher probabilities of dying). It ii unlikely that this pattern is due to reporting errors since it is reasonable to assume that the proportion dead would be less completely reported by older women as 'recall lapse" tends to increase with age of the respondent.

Levels and Patterns of Child Mortality

As regards the current levels and patterns of child mortality, the estimates

TABLE 1-AVERAGE NUMBER OF CHILDREN EVER BORN (Pi), AVERAGE NUMBER OF DECEASED CHILDREN AND PROPORTION DEAD (A) BY CURRENT AGE AND RESIDENCE OF MOTHER : PAPUA NEW GUINEA 1979-1980

Age of Mother	*Interval i*	*Average Number of Children Ever Born (P_i)*			*Average Number of Deceased Children*			*Proportion Dead (D_i)*		
		Males	*Females*	*Both Sexes*	*Males*	*Females*	*Both Sexes*	*Males*	*Females*	*Both Sexes*
Rural Areas										
15—19	1	0.079	0.075	0.154	0.009	0.008	0.017	0.114	0.107	0.110
20-24	2	0.692	0.659	1.351	.(084	0.074	1.158	0.121	0.112	0.117
25—29	3	1.494	1.435	2.929	0.214	0.198	0.412	0.143	0.138	0.141
30—34	4	2.176	2.065	4.241	0.357	0.316	0.673	0164	0.153	0.159
35-39	5	2.618	2.484	5.102	0.483	0.445	0.928	0.1S4	0.179	0.182
40-44	6	2.867	2.742	5.609	0.604	0557	1.161	0.211	0203	0.207
45—49	7	3.319	3.165	6.484	0.810	0.718	1.528	0.244	0.227	0.236
Urban Areas										
15-19	1	0.072	0.069	0.141	0.004	0.004	0.008	0.056	0.058	0.057
20-24	2	0.681	0.648	1.329	0.077	0.068	0.145	0.113	0.105	0.109
25-29	3	1.415	1.360	2.775	0.198	0.182	0.380	0.140	0.134	0.137
30—34	4	1.991	1.890	3.881	0.323	0.286	0.609	0.162	0.151	0.157
35—39	5	2.353	3.233	4.586	0.399	0.36S	0.767	0.170	0.165	0.167
40-44	6	2.734	2.604	5.348	0.526	0.485	1.011	0.192	0.186	0.189
45-49	7	3.106	2.961	6.067	0.731	0.649	1.380	0.235	0.219	0.227

AH Sectors

15—19	1	0.074	0.071	0.145	0.007	0-005	0.012	0.095	0.070	0.083
20—24	2	0685	0.653	1.338	0.083	0.068	0.1S1	0.12J	0.104	O.U3
25-29	3	1.474	1.417	2.891	0.208	0.191	0.399	0.141	0,135	0.138
30-34	4	2.111	2.012	4.123	0.346	0.305	0.651	0.164	0.151	0.13B
35—39	5	2-526	2-407	4.933	0.462	0.401	0.863	0,183	0.167	0.175
40-44	6	2.844	2.710	5.554	0.573	0.528	1.100	0.201	0.195	0.198
45—49	7	3.245	3-093	6.338	0.779	0.691	1.470	0.240	0.223	0.232

TABLE 2—ESTIMATES OF PROBABILITIES OF DYING AND OF SURVIVING BY SEX DERIVED FROM CHILD SURVIVAL DATA CALSSIFIED **BY** AGE OF MOTHER, WEST MODEL : PAPUA NEW GUINEA 1979-1980

Age Group	*Age (x)*	*Probabilities of Dying, q(x) and of Surviving, l(x)*					
		Male		*Females*		*Both Sexes*	
		q(x)	*l(x)*	*q(x)*	*l(x)*	*q(x)*	*l(x)*
Rural Areas							
15-19	1	0.1354	0.8646	0.1268	0.8732	0.1305	0.8695
20-24	2	0.1298	08702	0.1203	0.8797	0.1256	0.8744
25-29	3	0.1521	0.8479	0.1381	0.8619	0.1409	0.8591
30-34	5	0.1641	0.8359	0.1533	0.8467	0.1593	0.8407
35—39	10	0-1868	0.8132	0.1821	0.8179	0.1850	0.8150
40-44	15	0.2114	0.7886	0.2038	0.7962	0.2077	0.7923
45-49	20	0.2427	0.7573	0.2262	0.7738	0.2350	0.7650
Urban Areas							
15-19	1	0.0685	0.9315	0.0707	0.9293	0.0696	0.9304
20-24	2	0.1212	0.8788	0.1127	0.8873	0.1169	0.8831
25-29	3	0.1387	0.8613	0.1330	0.8670	0.1359	0.8631
30-34	5	0.1606	0.8394	0.1500	0.8500	0.1558	0.8442
35—39	10	0.1708	0.8292	0.1662	0.8338	0.1680	0.8320
40-44	15	0.1903	0.8097	0.1848	0.8152	0.1876	0.8124
45-49	20	0.2313	0.7687	0.2160	0.7840	0.2237	0.7763
All Sectors							
15-19	1	0.1145	0.8855	0.0840	0.9160	0.0998	0.9002
20-24	2	0.1302	0.8698	0.1119	0.8881	0.1216	0.8784
25-29	3	0.1407	0.8593	0.1349	0.8651	0.1378	0.8622
30-34	5	0.1638	0.8362	0.1511	0.8489	0.1579	0.8421
35-39	10	0.1854	0.8146	0.1695	0.8305	0.1774	0.8226
40 44	14	0.2009	0.7991	0.1953	0.8017	0.1981	0.8019
45—49	25	0.2382	0.7618	0.2217	0.7783	0.2304	0.7696

show that child mortality levels have declined from those of the older women (e.g- $_{20}q_0$) the younger women (e g. $_3q_0$ or $_2q_0$). We must make special mention of mortality levels corresponding to $_1q_0$ estimates. Some of the estimates in this category do not fit into the overall pattern of declining levels with estimates based on women of increasing age. This is due to the fact that the $_1q_0$ estimates derived from the method used are probably inflated because they rely heavily on births to very young mothers which are disproportionately first order births.

Normally the value of $_2q_0$ is taken as the index of the level of child mortality, rather than $_1q_0$ because the relation between $_2q_0$ and mortality rates at later ages are more stable, and accordingly $_2q_0$ is a better guide for the selection of a model life table than the $_1q_0$ value. Again, under the assumption of declining mortality, the $_2q_0$ estimate which is based on women aged 20-24 years old reflects child mortality to a more recent time period and presumably a higher model life table level (corresponding to lower mortality level) than would be the case for the $_3q_0$ or $_5q_0$ estimates, which are based on children ever born to women 5 or 10 years older.

The probabilities of dying between birth and birth-day x ($_xq_0$) estimated from the proportion dead and corresponding values of expectation of life at birth ($_0e_0$) based on the "West" model life tables are given in Table 3 to provide further information on the levels and trends in child mortality in PNG. The increase in the $_0e_0$ values between 1966 and 1979-80 period suggests rapid decline in mortality in general. The $_0e_0$ values also suggest that mortality had fallen faster for the females than for the males. On the whole, female $_0e_0$ values

TABLE 3— PROBABILITY OF DYING BETWEEN BIRTH AND x ($_xq_0$), COMPUTED FROM PROPORTION DEAD, AND EXPECTATION OF LIFE ($_0e_0$): PAPUA NEW GUINEA

Age (x)	$_xq_0$ Based	Census Data		$_0e_0$ Based on 1966*		$_0e_0$ Based on 1971* Census Data		$_0e_0$ Based on 1979-80 Survey Data	
	1966	1971	1979-80	Mates	Females	Males	Females	Males	females
2	0.199	0.163	0.122	43.7	43.5	48.1	48.3	52.5	55.8
3	0.215	0.179	0.138	43.7	43.9	47.8	48.3	52.3	540
5	0.236	0.199	0.158	43.5	44.0	47-3	48.0	51.1	33.5
10	0,272	0.223	0-177	41.9	42.6	46.5	47-0	50.2	53.0
15	0.291	0.246	0.198	41.5	42.4	45.5	46.5	49.8	51.5
20	0.331	0.271	0.230	39.8	409	44.9	46.2	47.8	50.8

•**Taken from** Rafiq **(1979), p. 309.**

based on the 1971 census data and our survey data reveal higher longevity than for males at each age group. Nevertheless, the female longevity advantage decreases as age advances.

The reference period, *t(x)* to which the estimates of child mortality refer are given in Table 4. The f(x)-values imply that the estimates of q(1), *q(2)*, *q(3)*

TABLE 4-ESTIMATES OF THE REFERENCE PERIOD, t(x)* TO WHICH THE ESTIMATED PROBABILITIES OF DYING REFER, WEST MODEL : PAPUA NEW GUINEA 1979-1980

	Age Group	*Age (x)*	*Parameter Estimate*	*Reference Period, t(x)**		
				Males	*Females*	*Hath Sexes*
Ratal Area						
	15-19	1	q(1)	0.81	0.81	0.81
	20-24	2	q(2)	2.13	2.13	2.29
	25-29	3	q(3)	4.09	4.07	4.08
	30-34	5	q(5)	6.55	6.51	6.53
	35-39	10	q(10)	9.30	9.24	9.27
	40-44	15	q(15)	12.20	12.12	12.15
	45-49	20	q(20)	15.17	15.10	15.14
Urban Area						
	15-19	1	q(1)	0.72	0.74	0.73
	20-24	2	q(2)	2.09	2.09	2.09
	25-29	3	q(3)	4.17	4.14	4.15
	30-34	5	q(5)	6.76	6.71	6.74
	35-39	10	q(10)	9.66	9.58	9.62
	40-44	15	q(15)	12.67	12.56	12.62
	45-49	20	q(20)	15.66	15.55	15.60
All Sectors						
	15-19	1	q(1)	0.77	0.78	0.78
	20-24	2	q(2)	2.10	2.10	2.10
	25-29	3	q(3)	4.08	4.06	4.07
	30-34	5	q(5)	6.58	6.54	6.56
	35-39	10	q(10)	9.37	9-30	9.34
	40-44	15	q(15)	12.30	12.21	12.26
	45-49	20	q(20)	15.29	15.20	15.25

Number of years prior **to** the Survey.

etc. refer to the mortality experiences prevalent approximately one year, two years, four years, and six and one-half years before the survey respectively, thereafter the estimated t (x)-values increase by two and three quarters to approximately three years per each age group The *t* (x)-values are consistent with the notion that because the q(1) estimate, for example, is based on fertility information corresponding to women in the 15-19 age group whose fertility experience is very recent, the *q(l)* estimate should also refer to the recent experience of the population.

We have also presented the "West" mortality levels with their corresponding reference dates ior the rural and urban areas in Table 5. If we disregard the estimates of *q(1)* because they are associated with relatively low levels in the Coale-Demeny model life tables, we observe that estimates of the levels decline steadily, except in a few cases, with an increasing age of the mother suggesting that child mortality has been declining. The reference dates presented in Table 5 show the child mortality trends for the male and female children. The data reveal that approximately between 1964 and 1977 child mortality has been declining for male and female children.

Differentials in Child Mortality

Several features are worth noting in terms of child mortality differentials. First, the results indicate sex differentials in child mortality. Child mortality for female children are generally lower than those for the male children in both rural and urban areas. This conforms to what is found in most other populations, a slightly higher proportion of female children than male children survives. Second, rural child mortality exceeded urban child mortality. In other words, children born in the urban areas of PNG have slightly better chances of survival than children born in the rural areas. The rural-urban differential is very pronounced for the $_1q_0$ estimates (where the rural estimates are about twice those estimated for the urban areas).

There are, however, regional differentials in the levels of IMR. According to our estimates (not tabulated here) child mortality conditions appear to be worse in the New Guinea Mainland and the Highlands regions than the Papua and New Guinea Islands regions. The New Guinea Islands region has the lowest child mortality levels among the four regions. As a matter of fact, the New Guinea Islands region exhibits lower child mortality levels than those for the urban areas except for the 1q0 estimates. The Papua region occupies a position between the New Guinea Islands region and the New Guinea Mainland and the Highlands regions.

One possible interpretation of the rural-urban and regional differentials might be that as social and economic development proceeds, some groups and regions receive the benefits of improved education, housing, sanitation and public health earlier than others. Thus the urban areas and the New Guinea

TABLE 5—MORTALITY LEVELS IN THE WEST MODEL LIFE TABLES CONSISTENT WITH THE CHILDHOOD MORTALITY ESTIMATES $q(x)$, PAPUA NEW GUINEA 1979-1980

Age	*Rural*				*Urban*				*All Sectors*			
	Males		*Females*		*Males*		*Females*		*Males*		*Females*	
x	*West Mortality Level*	*Refer-ence Date*	*West Mortality Level*	*Refer-ence Date*	*West Mortality Level*	*Refer-ence Date*	*West Mortality Level*	*Refer-ence Date*	*West Mortality Level*	*Refer-ence Date*	*West Mortality Level*	*Refer-ence Date*
1	13.3	1978.2	12.4	1978.2	18.5	1978.3	17.0	1978.3	14.8	1978.2	15.8	1978.2
2	15.3	1976.9	14.8	1976.9	15.8	1976.9	15.2	1976.9	15.3	1976.9	15.3	1976.9
3	14.6	1974.9	14.4	1974.9	15.4	1974.8	14.7	1974.9	15.2	1974.9	14.6	1974 9
5	14.6	1972.5	14.3	1972.5	14.8	1972.2	14.4	1972.3	14.7	1972.4	14.4	1972.5
10	14.2	1969.7	13.7	1969.8	15.0	1969.3	14.4	1969.4	14.3	1969.6	14.2	1969.7
15	13.7	1966.8	13.3	1966.9	14.5	1966.3	14.1	1966.4	14.1	1966.7	13.6	1966.8
20	13.1	1963.8	13.1	1963.9	13.5	1963.3	13.5	1963.[illegible]	13.3	1963.7	13.3	1963.8

Islands region appear to benefit more than the rural areas and the other three regions. According to this view, differentials in child mortality could be expected to widen before they would eventually narrow as a result of more widespread diffusion of the benefits of education, public health, better nutrition, better housing and sanitation. While this is quite plausible, it must be noted that the differentials themselves may be changed for reasons quite independent of such a process. For example, selective rural-urban migration may attract the more educated with lower child mortality to the larger urban areas like Port Moresby and Lae and thus lower child mortality rates in these urban areas at the expense of those in rural areas.

Summary and Conclusion

This paper has attempted to estimate child mortality for PNG from survey data utilizing the refined Brass technique. The data provided adequate information for us to examine child mortality levels, patterns, differentials as well as trends. The analysis revealed substantial decline in overall child mortality between 1964 and 1978 based on the estimated reference date. A comparison of % values based on the 1966 and 1971 censuses data and the 1979-80 survey data also suggests rapid mortality decline, and further, the decline was faster for females than for males.

The analysis generally revealed some moderate to marked child mortality differentials. The observed sex differential in child mortality, although moderate, holds for the rural-urban residence as well as the regions. Child mortality is found to be slightly lower in urban areas than in rural areas which may be attributed to the availability and easy access to better health service! in the urban areas. Regional differentials in child mortality are more marked compared to the rural-urban-differentials. The New Guinea Islands region stands out clearly as a region of lower child mortality even when compared with those of the urban areas. It is evident that urban areas and the New Guinea Iilands region are receiving the benefits of social and economic developments more than the rural areas and the other three regions.

We have provided useful information in this paper. These type of information could be potentially useful to health planners and policy makers in general in targeting particular areas or age group for further research and health policy formulation. Also, to the extent that infant and child mortality is a health/development indicator, then declines, for example, in child mortality over time might facilitate assessment of the achievement of health services and the provision of general "basic needs*' during the development process.

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