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BIRTH AND DEATH RATES FROM A DUAL-RECORDS SYSTEM IN THE PHILIPPINES

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A five-year dual-records study, including a prospective reporting system and a semiannual retrospective survey system, and embracing a residential, noninstitutional population in an urban and a rural area of Misamis Oriental Province of about 23,000 persons each has produced birth, death, and infant-mortality rates for its first period of observation, September 1 to December 31, 1971. Rates are presented in crude, age-specific, and standardized form and assume an importance beyond mere local relevance as the first empirical data from a dual-records approach showing very high fertility for particular local Philippine rural and urban areas.

The nature of the two systems in the Mindanao Center for Population Studies' project (MCPS), Research Institute for Mindanao Culture, was briefly described in an earlier volume of this journal (Madigan 1971). The first system is an ongoing, prospective reporting organization using informants and part-time workers (STAR System), while the second is a semiannual retrospective survey team (ROVER System). Both systems cover the same population in exactly the same geographical area for the identical time period of study, but from different vantage points. The surveys make use of time-coverage periods which overlap for the purpose of preventing errors of recall from erroneously locating either in-scope or out-of-scope cases.

The basis of this five-year project, which began on April 1, 1971, is an exceptionally rigorous mapping operation in which the boundaries of the smallest area of study, the unit area (corresponding to the sitio in the rural study zone and to one or more city blocks in the urban study zone), are carefully located and drawn on the map in proper orientation to north, with careful attention to scale. Landmarks are then marked, and the housing sketched in with all physical detail that will help the interviewer to cover all households of the unit area and no households belonging to adjacent areas. Altogether, about 103 square kilometers of rural territory were mapped thus in scale by the MCPS mapping unit using malaria reconnaissance survey methods, since no scale maps of barrios or sitios existed previously for the study area. About 2.0 square kilometers of the City Poblacion were also mapped, but much more easily since a scale map of this area was available showing existing streets.

All houses and households are numbered and listed by unit areas and these lists are supplied both to STAR and ROVER workers assigned to the particular area. Tin plates bearing the house number are tacked to the exteriors of all houses. STAR workers are generally assigned one unit area of about 50 houses, while interviewers are generally assigned two to three unit areas.

The primary orientation of the project is methodological rather than substantive, the main interest being in such action-methodology as the feasibility and costs of applying a dual-records project to the developing economy of the Philippines, and possible economies of cost by the elimination of unnecessary features and the substitution of less expensive but almost equally accurate procedures – if such can be found. In addition, various methods of estimating vital rates from empirically gathered data will be compared.

The urban area is a 73 percent probability sample of the Cagayan de Oro Poblacion, as this was delineated in the 1970 Census. About

2.0 square kilometers in area, the sample includes a residential, noninstitutional population of almost 23,000 persons. Sampling was based upon the enumeration districts of the 1970 Census with a probability assigned each enumeration district of being drawn into the sample proportional to the size of its population. The rural district, which includes one entire municipality, half of a second, and slices of two further municipalities, embraces approximately 103 square kilometers of farmland and hills, and lies west of Cagayan de Oro in Misamis Oriental Province. It is about 25 kilometers by road to the center of this district. Because the purpose of the project is primarily methodological, the district was chosen purposively, principally in terms of clear-cut external district boundaries that would permit unambiguous delineation of the residential population. This district also contains approximately 23,000 residential, noninstitutional inhabitants. A resident is defined for purposes of the project as a person who has lived or intends to live for three complete months in the study area.

The Two Systems in Operation

The first period of observation, September 1 to December 31, 1971, had been preceded both by a mapping operation and a baseline survey. In this survey, information was gathered on the residential status, as well as the relevant household, age, sex, and relation-to-household-head data of every person in both study areas. The residence of parents of each student living away from home was also determined.

The STAR System began operations with 56 workers in the urban area and 67 in the rural area. Training sessions had lasted approximately 10 days. Married women between 30 and 40 years of age with college education or if necessary, with only some high school education if intelligent, were the types of workers sought, but in fact it proved necessary to employ some single women in their 20s and even some men. In all cases, their other occupations had to be such as to allow them one or two hours a day for work in their area of residence.

The ROVER interview round began on January 10, 1972, after three weeks of training, and continued into February. Seventeen interviewers were engaged in the urban survey, and 23 in the rural interviewing. Forty-five percent of the interviewers were college graduates, and all but 10 percent had begun or completed at least second year college. The lowest 10 percent had completed or at least begun first year college. Interviews per worker ranged from nine to 12 per day in the urban area, and from five to 12 per day in the rural; in the latter area it was necessary to walk to most locations to begin interviewing, since at that time the project had no transportation facilities of its own. While a few roads lead into the project interior from the National Highway, little public transportation is available on these routes.

Theory of a Dual-Records Approach

A dual-records endeavor must employ two data-gathering systems which gather data about the same subjects independently of each other for the same time period.

The logic behind such an approach needs exposition. Suppose the existence of data gathering system, S_1, which obtains information, for example, by means of a registration procedure on births and deaths. Presume that persons concerned with registration of births and deaths are to a great extent conscientious in reporting such events to the officials of this registration system, who are also concerned and diligent in carrying out their duties. One may assume at the end of the calendar year that the estimate, N_1, of the true number of births (or of deaths), N, which occurred, is close to the true number. However, one has really no way of measuring from within the system the extent of registration, that is, the number of cases which this registration system, despite all due diligence, has missed.

In the circumstances of developing countries with the usual difficulties of underdeveloped road and transportation systems, plus possibly arduous terrain, underregistration of vital events in municipal, pueblo, or commune centers is quite understandable. In such circumstances, this inability to measure the extent of underregistration accurately often proves a fatal flaw in attempts to gauge birth and death rates, and

rate of natural increase. Quite frequently, it is additionally true that even a crash program for improved registration cannot produce substantially complete data for as many as 20 years. In view of current population growth with its associated problems, it is impractical in developing countries to wait so long to obtain accurate data.

Suppose, however, that a second data-gathering system, S_2, is now introduced into the picture. Its goal is defined to be the gathering of birth and death data for precisely the same population and calendar period, as S_1, but by a different methodology. For example, suppose S_2 gathers data by interview at six-month intervals.

In these circumstances, N, the true number of births (or of deaths) can now be estimated.

First, one combines the number of births each system has caught in common, C, with the births caught only by one (N_1) or the other (N_2) of the two systems.

Thus, the preliminary estimate of N, the true number of cases is:

$$\hat{N} = C + N_1 + N_2$$

Then one adds to this value the estimated number of cases missed by both systems:

$$\frac{N_1 \; N_2}{C}$$

In explanation of this statistic, one may point out N_1 and C provide an estimate of the coverage of S_2, while similarly N_2 and C provide an estimate of the probability that S_1 will miss a case. On the assumption of independence of the two systems in finding cases (basic to the approach), these items may be arranged in the following fourfold table.

System 1

System 2	Births caught by System 1	Births missed by System 1	Sums
Birth caught by System 2	C	N_2	$C+N_2$
Births missed by System 2	N_1	X	$N_1 \times X$
Sums	$C+N_1$	N_2+X	N

On the assumption of independence, discovery or nondiscovery of a birth (or a death) case by System 1 should not affect discovery or nondiscovery of the same event by System 2. That being true, it follows that the ratio $\frac{C}{N_1}$ would equal $\frac{N_2}{X}$. Therefore an estimate of X, the number of cases missed by both systems, can be derived as follows:

$$\frac{C}{N_1} = \frac{N_2}{X} \text{ and therefore } X = \frac{N_1 \; N_2}{C}$$

This adds the missing piece needed for estimating N:

$$\hat{N} = C + N_1 + N_2 + \frac{N_1 \; N_2}{C}$$

Measures to Keep Both Systems Independent

Workers in each of the two systems were told explicitly that their performance would not be judged in relation to the worker of the opposite system who would gather data in the same unit area as themselves. They were informed that the staff realized that different efficiencies would characterize each system, and that no cross-system comparison of individual workers would be made.

On the other hand, they were told of the need for independence between the two systems, and the Chandrasekaran-Deming formula just cited (Chandra Sekar and Deming 1949) was explained to them. Strong efforts were made to build morale and esprit de corps in each system such that loyalty to the work of their companions (destroyed by the effects of collusion) would deter from possible inducements to collusion.

STAR reporters were assigned to unit areas where they resided or were well known. ROVER interviewers were assigned to areas where they had never lived, and where they were not well known.

All births and deaths reported by either STAR or ROVER, or by STAR and ROVER, were verified in the field by supervisors on a 100-percent basis.

STAR workers were not permitted to work in their unit areas from two days before the ROVER interviews were scheduled to begin there until two days after these interviews had been completed. On the day they stopped work (two days before beginning of the ROVER interviews), STAR workers were required to hand in all data, forms, and other materials pertaining to the project. These materials were

sealed in a large Manila envelope and placed in a locked cabinet. They were returned, still sealed, only two days after ROVER interviewing had ceased in the locality.

STARs who resided in a unit area of interview were not allowed to act as respondents for a ROVER interviewer when the ROVER came to interview the STAR worker's household *unless* this STAR should be the only person qualified to provide information on the household. Unlike other respondents whom the ROVER interviewers queried on events in other households in the same house, and on other houses of the neighborhood, the STAR, if compelled by necessity to act as respondent for her own household, was instructed to provide no information except for her own household. The ROVER was instructed to avoid STAR respondents, but if it were necessary to use a STAR as a respondent, the ROVER was to omit any questions not dealing strictly with the STAR's own household.

Different offices were set up for the ROVER workers during the survey period, and workers of one system were not allowed to visit the office of the other system in seeking advice or turning in data.

Alertness premiums were paid for the first report of a given birth or death. The premium was not large, nor frequently enough merited, to make collusion with the worker of the opposite system profitable, but was large enough to make each worker desire to obtain it only for himself or herself. Discovery of births averaged only about one a month per worker and deaths only about one every three months. The staff and supervisors thought that these alertness premiums contributed to the prevention of collusion. Finally, workers were carefully supervised and checked in their field work in an attempt to discover any evidence of collusion.

Strong efforts were therefore made to prevent, forestall, and motivate against collusion, but these efforts seemed justifiable in view of the importance of independence of the two systems from each other in a dual records study. In fact, no evidence of collusion was observed at any time.

Results from the First Period of Observation

The first period of observation, September 1 to December 31, 1971, was intended as a trial period for study of the two systems in operation and for "tuning up" the workings of these systems. It was however also conceived as a period for assemblage of the project's first substantive data.

Coverage and match rates

Match rates and coverage rates indicate both the relative efficiency of each system vis-a-vis the other system and the general level of efficiency of the two systems as a dual-records approach.

Match rates reveal the proportion of cases caught by one system which were also caught by the other system. Greater efficiency of one system relative to the other is reflected by a lower match rate, that is, by inclusion of a greater number of unmatched cases than the number caught by the other system. On the other hand, the general level of efficiency of both systems working together in a dual-records approach is shown by a high level of match rates for both.

A high coverage rate, on the other hand, indicates a more complete reporting of events by one of the systems in comparison with the other.

Match rates and coverage rates are shown in Table 1 for both the rural and the urban study areas. They show high relative efficiency for both rural and urban systems. In particular, coverage was high for births in both rural and urban areas. For deaths, coverage was high for both STAR and ROVER workers of the rural zone and for urban STAR workers, but was less complete for urban ROVER interviewers. Reticence of urban respondents about death, and cases of extralegal burial by parents of deceased members of their family, especially small children in rural barrios, may have occasioned this ROVER difficulty.

Crude birth rates

The 1971 annual crude birth rate in Cagayan is estimated from a 73-percent probability sample of the town poblacion. The estimate is 43.1 births per thousand persons with a 95-percent fiducial range of ±1.37 births. This rate is 7.9 percent lower than the 1958–62 Cagayan

Table 1

Completeness and match rates for birth and death data for STAR and ROVER systems (Cagayan de Oro Poblacion and El Salvador-Alubijid-Languindingan-Gitagum areas, Misamis Oriental, September 1–December 31, 1971)[a]

Events reported, observation area, and system	Coverage rate[b]	Match rate	Probability of both systems missing a case
A. Birth reporting			
1. Urban poblacion			.044
a. System 1 (reporters)	.870	.644	
b. System 2 (interviewers)	.644	.870	
2. Rural areas			.006
a. System 1	.926	.924	
b. System 2	.924	.926	
B. Death reporting			
1. Urban poblacion			.140
a. System 1	.727	.485	
b. System 2	.485	.727	
2. Rural areas			.024
a. System 1	.891	.788	
b. System 2	.788	.891	

[a]The study sites will henceforth be referred to in table and figure captions as the "Urban and rural study areas, Misamis Oriental."

[b]True number of cases is estimated by the Chandra Sekar-Deming formula, based on number of matches, of unmatched cases in System 1, and of unmatched cases in System 2. See Chandra Sekar and Deming (1949).

de Oro rate found in a previous study by the Research Institute for Mindanao Culture (Rimcu), 46.8 births per thousand persons (Madigan *et al.* 1972: 69). The difference is significant at the 0.05 level.

It is clear that fertility has declined in urban Cagayan since 1960. The operation of five family-planning clinics in Cagayan might lead one on *a priori* grounds to attribute this decrease to voluntary control over birth. In fact, however, the main reason for the decline appears to be delayed marriage, probably attributable to increased numbers of young women pursuing undergraduate or graduate degrees, and an increase in number of single working women. Some part of this fertility decline however seems due to birth limitation, as will be indicated later in this paper.

The annual crude birth rate estimate for 1971 for the rural study area was 45.8 births per thousand persons of the general population. This rate was also significantly different from the urban rate, at beyond the 0.05 level. However, the 1971 rural rate does not differ significantly from the rate of 47.7 births per thousand persons found in 1959 for three rural barrios of Cagayan de Oro by the Research Institute (Madigan 1962: 173). The 1971 rate is high and shows few effects of family planning. Such a finding is not altogether surprising. Until a few months ago, people from the Alubijid-Laguindingan area had to come all the way to Cagayan (an average of 25 kilometers) to visit a public family-planning service. Such a service has recently been established in Opol, about half-way to Cagayan.

It is of interest to note in Table 2 the relative efficiency of each of the two systems alone for

Table 2

Crude birth rates per 1000 persons estimated from births collected by each system and from the dual-records approach (Urban and rural study areas, Misamis Oriental, September 1 to December 31, 1971)

Area of observation	System 2 (ROVER) only	System 1 (STAR) only	Dual-records approach
1. Urban poblacion	28.51	37.36	43.14
2. Rural areas	42.24	42.36	45.76

obtaining the true birth rate. The table shows that in both rural and urban areas, the ROVER interview proved more likely to miss cases. But even the reporters did not obtain complete coverage, as Table 1 has already made clear. Crude birth-rate estimates for urban and rural areas, respectively, would have been 33.9 and 7.7 percent too low if based only upon reports of the ROVER interviewers, while estimates for the same localities would be 13.4 and 7.4 percent too low if computed only from the STAR reports.

Highly intensive efforts were exercised to obtain as complete coverage as possible in both rural and urban areas in each system. Accordingly, these results indicate that even crash programs to improve registration on a one-system basis are not likely to achieve an acceptably high degree of completeness for years to come.

Discussion

These are the first birth rates collected for Philippine local rural and urban areas by a dual-records approach. As such, they are very solid estimates. They therefore possess an importance transcending mere local relevance, since they may well reflect typical Filipino rural and urban fertility today. They reveal the vastness of the demographic problem confronting the country. Although many demographers had previously estimated national fertility at 45 to 50 births per thousand persons, they had done so by sample-survey, reverse-survival, and stable-population techniques. Such techniques depend greatly upon assumptions which are rarely well verified by circumstances. Questions have therefore arisen about the validity of results. The present empirical data will enable scientists to comprehend more adequately the dimensions of Filipino birth rates on the basis of verified field data. They also give administrators of family-planning services insight into the impact such services are having upon the birth rate. Especially will this be true as results of the dual-records approach are compared with each other over time every six months.

The birth rates shown above are undoubtedly very high. It is not, however, the level at which birth rates stand which is precisely of critical value for population planning, but the relation which birth rates bear to associated death rates. A society characterized by a rate of 50 births per thousand may grow very slowly if the associated death rate averages about 45 deaths per thousand. On the other hand, a society with a birth rate of 37 per thousand may be growing very rapidly if its crude death rate is only 7 per thousand. Rural and urban crude death rates are accordingly the topics of discussion in the next section.

Crude death rates

Crude death rates estimated from the two samples were quite low, 6.4 deaths per thousand persons for the Cagayan Poblacion and 7.6 per thousand in the rural areas of Alubijid, El Salvador, Gitagum, and Laguindingan. The advantages of a dual-records approach are again brought out by comparison of the results obtained by each system alone. Table 3 shows that the death rate based only upon reports of the urban ROVER interviewers is 54.7 percent lower than the estimated true rate, that is, the

Table 3

Crude death rates per 1000 persons estimated from deaths collected by each system and from the dual-records approach (Urban and rural study areas, Misamis Oriental, September 1 to December 31, 1971)

Area of observation	System 2 (ROVER)	System 1 (STAR)	Dual-records approach
1. Urban poblacion	2.90	4.36	6.40
2. Rural areas	5.96	6.74	7.59

rate obtained by the dual-records technique, while the rate based only on the work of the urban STARs is 31 percent lower.

The estimate based only upon reports of the rural STARs was also closer to the estimated true rate. The death rate based only on interview reports was 21.5 percent lower than the rate obtained from the dual-records approach, while the rate based only on the STAR reports was 11.2 percent less.

Discussion

At first sight, crude rates of 6.4 and 7.6 deaths per thousand for urban and rural persons of the study samples may seem too low to be credible. However, for the assumption of significant underestimation to be verified in the results of a carefully executed dual-records study, each of its two constitutive systems must equally have had no chance, or little chance, of discovering the events not reported. One or the other of the two systems would otherwise have caught enough difficult-to-find events to have made possible an estimate of the cases missed by both systems which would have closely approximated the true number of missed cases.

Without purposive concealment and/or removal from the study populations of mortality cases or of high mortality risks, the mere failure to recall deaths over a two-to-six-month period, even such deaths as those of new-born children, seems unlikely to cause a serious underestimate of deaths by a dual-records study.

Cultural practices possibly leading to purposive concealment. If purposive concealment and/or removal of cases of mortality or of high mortality risk from the study populations actually occurs on a significant scale, what reasons might underlie such behavior?

Research Institute staff have attempted from inquiry and experience to piece together explanations for such actions, if indeed they occur. The following hypotheses thus generated are by no means exclusive of each other.

1. Death is a subject considered likely to bring "bad luck" upon living members of the family of the deceased when talked about. To avoid discussions about this topic some families deny to both STAR and ROVER workers the occurrence of death.
2. Because of the expense of "wakes" and "novenas" (nine-day prayer gatherings, commencing on the day of the funeral, at which food and beverages must be served to relatives and friends at each service), poorer families bury their dead in rural barrios where they own land or have relatives. They do not register such deaths nor do they confide them to their neighbors nor to most of their friends. Obviously, they are even less likely to divulge them to research workers.
3. For much the same reasons, aged urban relatives are brought to various rural areas to live with relatives. When they die, they are buried there. Thus they escape notice of urban workers. These areas of course are very likely to be outside the limits of our rural sample.
4. To save costs of funeral cars, embalming, and similar expenses, when a family member has died, immediately after death the relatives wrap the deceased in a

blanket, and board a local jeepney or bus for a rural area, telling the passengers and driver only that the deceased is a very sick relative. Registration, if made at all, is carried out in the rural location.

5. Certain types of persons who have business licenses, naturalized citizenship, or other like privileges, are known to be clandestinely buried by their families and their rights sold to a stranger, or passed on to a son, who assumes the name and identity of the deceased person. The death of course is neither reported to research workers nor registered in the government records. This practice may be more widespread than commonly thought, in the sense that not only naturalized but native citizens may have economic reasons for such practices (avoidance of inheritance taxes, avoidance of division of the paternal property, and so on).

In the face of "purposive concealment," the dual-records approach will not obtain a proper estimate of the true number of deaths. (Neither of course will any other approach.) The assumption that each system will have an independent chance to find the death or deaths in question is violated. In fact, in cases of purposive concealment not only is the independence assumption violated, but for either system there is no chance at all of discovery of the event from the household in question, since the event is deliberately concealed by this household.

Arguments for validity of findings. On the other hand, the reasons advanced for "purposive concealment" as hypotheses under numbers 1 to 3 (above) would seem mainly to affect the lower economic class in the urban setting. Is this sufficient to account for the low *rural* death rate? If the argument is advanced that rural people are inclined to bury their dead locally without bothering about registration, one must point out, on the other hand, that such rural people do not seem inclined by temperament or custom to conceal the fact of their deceased. Finally, it is difficult to conceal death from neighbors. These neighbors generally do not feel the motivation for concealment as much as the family, and the STARs and ROVERs quiz all respondents about *any* deaths in the local area (deaths in other houses and households). Finally, the STARs are themselves neighbors of families upon which they report.

Reasons also exist for thinking that crude death rates in Misamis Oriental Province may well have been very low during the period in question. First, the physical and cultural context is favorable. The province is not densely settled. Impoverishment because of share tenancy is much less widespread than in many other Philippine provinces. Again, no epidemics of large importance for mortality have ravaged the province in recent years. The land is relatively fertile, and the province is shielded by two mountain ranges from the typhoons which devastate crops and homes in other areas of the Philippines. The peace-and-order situation in the province has been exceptionally good. None of the ethnic or political conflicts which have caused so much death in other Philippine provinces has broken out in the past 10 years in Misamis Oriental.

Second, the distance from the rural study area is short and roads from it to the city hospitals are exceptionally good, relative to many other localities. Four hospitals (including the Medical Center), many clinics, and a large number of qualified medical doctors in the city provide quite superior health care by Philippine standards for the city and surrounding areas.

Third, both urban and rural populations are extremely young. Tables 4 and 5 show the population distributions for the study areas, and Figures 1 and 2 present age and sex comparisons in graphic form. Study of these will make it evident that most persons exposed to risk in these populations are found at ages when mortality is very low. Thus the true crude death rates may actually be close to the levels reported in the dual-records results, even if a minor amount of purposive concealment of death takes place.

For urban males, 52.7 percent of the population at median date of observation were persons under 20 years old, while for females, 54.5 percent were under 20. These figures differ little from the population enumerated on January 22, 1972 (enumeration date), where the same

Table 4

Population distributions by age and sex at median point of observation (November 1, 1971, at 12:01 a.m.); Urban and rural study areas, Misamis Oriental

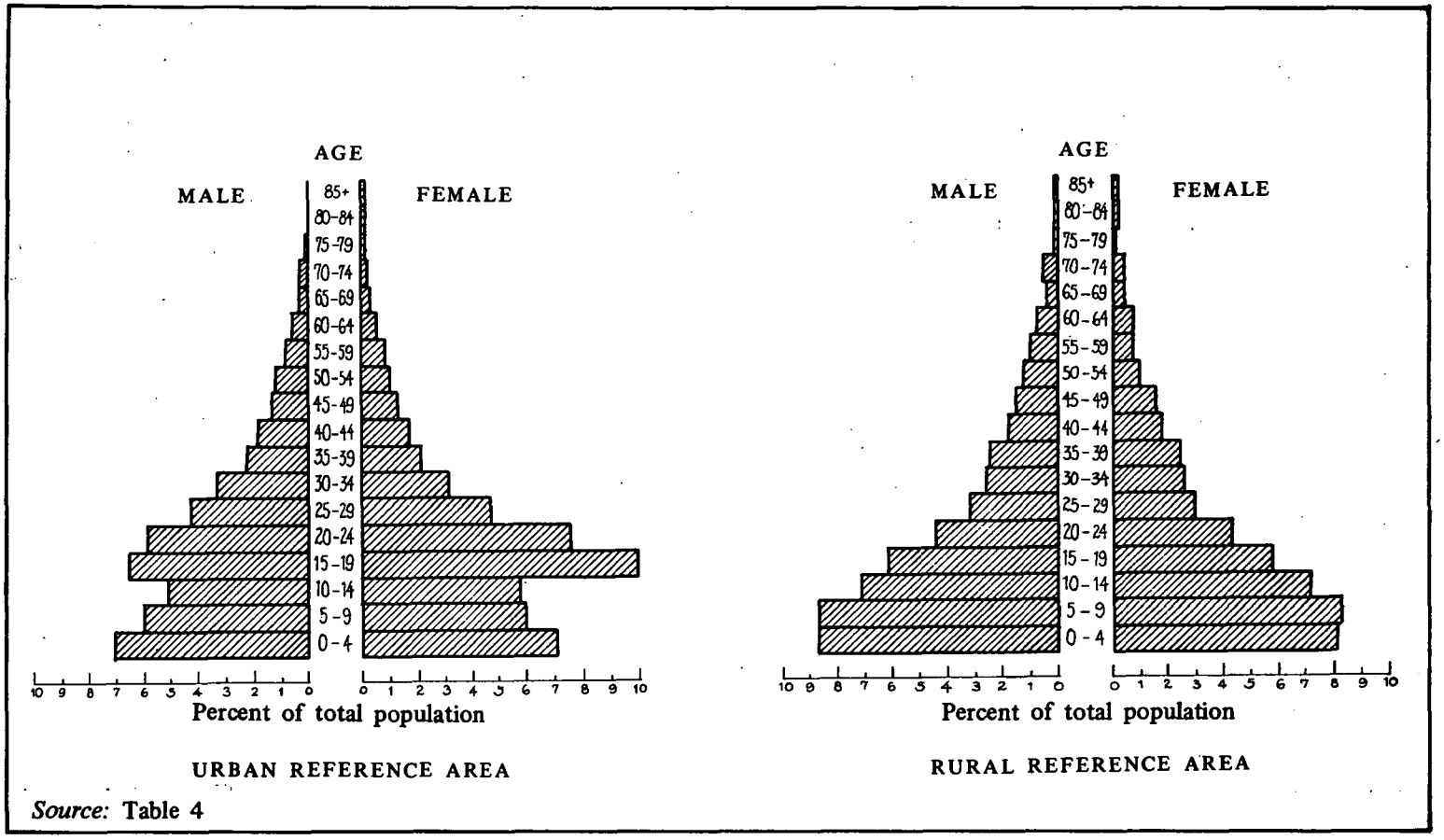
Age	Urban reference area		Rural reference area	
	Males	Females	Males	Females
0	3.1	2.7	3.9	3.8
1–4	12.3	11.0	13.7	13.2
5–9	12.7	11.3	16.9	16.7
10–14	10.7	10.9	14.1	14.7
15–19	13.9	18.6	11.8	11.7
20–24	12.5	14.4	8.4	8.6
25–29	9.1	8.8	6.4	6.0
30–34	6.8	6.2	5.0	5.3
35–39	4.7	4.3	4.9	4.9
40–44	3.9	3.1	3.5	3.6
45–49	2.7	2.3	3.0	3.4
50–54	2.6	2.0	2.4	2.0
55–59	1.7	1.6	1.9	1.7
60–64	1.3	1.2	1.6	1.7
65–69	0.7	0.6	1.0	1.0
70–74	0.6	0.4	1.0	0.8
75–79	0.3	0.2	0.2	0.2
80–84	0.1	0.1	0.2	0.3
85 +	0.04	0.1	0.2	0.5
Age unknown	0.3	0.2	0.0	0.0
All ages[a]	100.00	100.00	100.00	100.00
Median age in years	19.1	18.8	15.6	15.7

[a]Column values may not add to exact totals because of rounding.

total of 53.6 percent for both sexes together was found for persons under 20 years of age. For the remaining ages, 37.1 percent of the median population were congregated between the low risk ages 20 to 44, leaving but 9.2 percent at the ages of higher mortality above 44. Only 2.9 percent were under one year old, where mortality is also high.

The rural populations were even younger in age structure. Of the males, 60.4 percent were under 20 years of age, while 60.1 percent of the females were under 20.

The intrinsic death rates found in various "Model-West" tables of the Coale-Demeny volume (1966) were compared with the sample crude death rates. Three parameters drawn from the observed populations or believed to characterize them as limits were utilized to locate comparable Model-West tables: the observed crude birth rate, a range of natural increase from 3.0 to 4.0 percent, and the number of persons under 20 years of age. The crude birth rates were used as estimates of the intrinsic birth rates of the tables.



Source: Table 4

Fig. 1 – Population distributions of urban and rural study areas at median point of observation (November 1, 1971); Misamis Oriental Province, Philippines, 1971.

Table 5

Population distributions by age and sex at median dates of interview (January 22, 1972, and February 3, 1972, at 12:01 a.m. for the urban and rural study areas, respectively); Misamis Oriental

Age	Urban reference area		Rural reference area	
	Males	Females	Males	Females
0	3.2	2.6	3.8	3.6
1–4	11.9	10.8	13.3	12.9
5–9	12.7	11.3	17.1	17.0
10–14	10.7	10.9	13.9	14.7
15–19	13.8	18.9	12.0	11.7
20–24	12.4	14.5	8.6	8.7
25–29	9.1	8.9	6.2	6.0
30–34	6.9	6.0	5.1	5.4
35–39	4.9	4.2	4.9	5.0
40–44	4.0	3.1	3.6	3.6
45–49	2.8	2.4	3.0	3.3
50–54	2.5	1.9	2.3	2.1
55–59	1.8	1.6	2.0	1.7
60–64	1.4	1.2	1.7	1.6
65–69	0.7	0.6	0.9	0.9
70–74	0.5	0.4	0.9	0.7
75–79	0.3	0.2	0.2	0.2
80–84	0.08	0.14	0.2	0.3
85 +	0.05	0.11	0.2	0.4
Age Unknown	0.11	0.08	0.0	0.0
All ages[a]	100.00	100.00	100.00	100.00
Median age in years	19.1	18.8	15.7	15.8

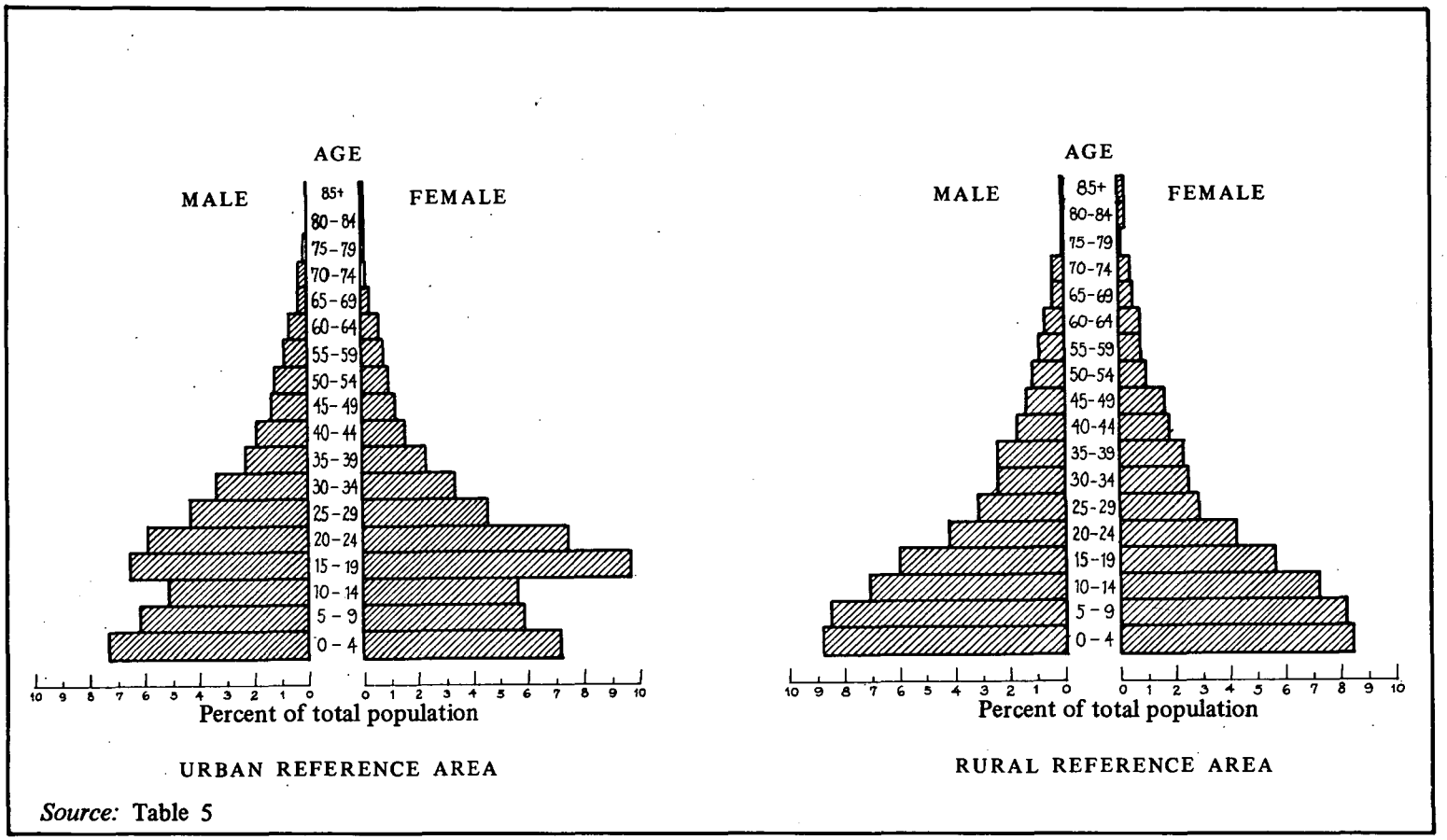
[a]Column values may not add to exact totals because of rounding.

The ranges of intrinsic death rates (estimates of crude death rates) read from tables which were close in value to some or all of these parameters for the urban area were: 4.89 to 10.01 deaths per 1,000 males and 3.94 to 8.73 deaths per 1,000 females, or 4.42 to 9.33 deaths per thousand persons of both sexes.

Similarly, the ranges of death rates for the rural study areas were 6.95 to 11.22 deaths per 1000 males, 5.77 to 9.87 deaths per 1000 females, and 6.37 to 10.55 deaths per 1000 persons of both sexes.

As will be noted in Table 3, the observed crude death rates tend to be toward the center of these ranges in both urban and rural cases, although somewhat below the median. This result would seem to support the view that the death rates obtained by the dual approach may be close to the actual rates.

Another point tends to support the low rates observed. These are the life-table death rates accompanying the Model-West tables for the values given above. These rates would range from 14.6 to 17.0 deaths per 1000 males and from



Source: Table 5

Fig. 2 – Population distributions of urban and rural study areas at median interview dates (January and February 1972); Misamis Oriental Province, Philippines, 1972.

13.8 to 16.0 deaths per 1000 females of the Cagayan population and from 15.7 to 17.7 deaths per 1000 males and from 14.8 to 16.7 deaths per 1000 females of the rural areas. Such rates reinforce the view that it is the youthful age-structure of the population which is more responsible for the low crude death rates than the exceptionally good health conditions.

Death rates obtained previously in urban Cagayan are similar to those obtained in the present study. These were 6.6, 7.5, and 5.2 deaths per thousand persons, respectively, for the periods 1953–57, 1958–62, and 1962. The urban rate found in the present study, 6.4 deaths per thousand persons, fits well into this context (Madigan *et al.* 1972: 160).

Finally, a matching operation was set up to check on the death rates for the out-of-scope period, December 25, 1970 to August 31, 1971, for which data had been collected by both Baseline and ROVER interviewers. The crude urban death rate estimated from a dual records approach using these two systems was 6.5 deaths. The crude rural death rate estimated from the same two rural systems was 6.8 deaths per thousand persons. These independent low results support the in-scope death rates observed since they do not differ significantly from them.

Infant mortality

Infant mortality, or the ratio between deaths of children under one year of age to number of live births, is a statistic often used to gauge general health and mortality conditions in a country or locality.

Infant mortality for the period in question, September 1 to December 31, 1971, was moderately high. In the urban area the dual-records estimate was 53.3 infant deaths per 1000 live births, and in the rural areas 40.9 per 1000. Such rates were typical of countries like Brunei, Hungary, Poland, Portugal, Rumania, and Yugoslavia, in 1969 and 1970 (United Nations 1971).

Age-specific birth rates

Table 6 presents the age-specific birth rates found in the urban and rural study areas. No births were reported for women under 15 or over 50 years of age.

Rates were clearly higher in the rural area by a considerable amount. Total fertility was 7,067.5 births per thousand rural women while total urban fertility was 4,828.6 births per thousand, only 68.3 percent as high.

It is interesting that the gross reproduction rate based upon actual number of female children born is somewhat less, in both urban and rural areas, than that computed by applying to total births the theoretical proportion of female children, .488. This may mean that more males per 100 females are born in the Philippines than is commonly the case or, as is more likely, it may be the result of variance due to time sampling in populations of only 23,000 persons. It will be of theoretic value to continue observing this phenomenon.

The total number of female children per mother estimated from the female child birth rates and from total fertility by application of the proportion .488, was for each of the two populations:

Area	From female child birth rates	Proportion of total fertility	From total fertility	Proportion of total fertility
Urban	2.315	.4794	2.3564	.488
Rural	3.134	.4434	3.4489	.488

The urban area. The observed sex ratios at birth were 107.3 for the urban population and 123.6 for the rural population. In the urban sample, 161 male births and 150 female births were observed. In the rural area, 194 male births and 157 female births were observed.

A point of special interest is the age group in which highest fertility was found. In the urban area, women of all marital statuses combined experienced highest fertility at 30 to 34 years of age, and their fertility at 29 years of age was a close second. After their 34th year of age, an

Table 6

Age-specific birth rates per 1000 women of specified ages and per 1000 currently married women per annum (Urban and rural study areas, Misamis Oriental, September 1 to December 31, 1971)

Age	Urban area			Rural area		
	Birth rates[a]	Female birth rates[b]	Marital birth rates[c]	Birth rates[a]	Female birth rates[b]	Marital birth rates[c]
10–14	0.0	0.0	0.0	0.0	0.0	0.0
15–19	25.1	13.9	527.9	92.8	38.5	766.4
20–24	196.6	107.4	639.2	350.3	170.6	632.4
25–29	276.8	111.9	443.8	334.2	145.1	432.2
30–34	280.8	122.9	356.5	262.1	113.7	293.7
35–39	119.1	56.4	143.3	290.5	121.5	319.6
40–44	67.3	*50.4*[f]	82.3	*51.1*	*29.2*	*58.4*
45–49	0.0	0.0	0.0	*32.5*	*8.1*	*36.9*
50–54	0.0	0.0	0.0	0.0	0.0	0.0
TFR[d]	4,828.6	2,314.9	10,964.7	7,067.5	3,133.6	12,697.8
GRR[e]	2.36	2.31	5.35	3.45	3.13	6.20

[a]For women of all marital statuses.

[b]Birth rates of female children only.

[c]For *currently* married women.

[d]Total fertility rates shown may differ slightly from column totals because of less rounded totals used in computations.

[e]Gross reproduction rate.

[f]Italics indicate less than 25 but more than zero births per annum. Rates for ages 40–44, from left to right in the table starting under *Female Birth Rates* for the urban area, were based respectively upon 18.9, 25.2, 21.1, 12.1, and 21.1 births per annum. (The decimal places are retained because the Chandra Sekar-Deming estimate of missed cases is small and distributed in proportion to cases observed by age groups.) Rural rates for age 45–49, starting under *Birth Rates*, were based respectively upon 12.1, 3.0, and 12.1 births. Populations at risk for urban cells of the table at the same ages, from left to right, were 287, 287, 229 women, respectively.

abrupt decline in fertility took place. Table 7 shows that such a decline was not typical of previous fertility in urban Cagayan. The table presents comparable fertility data for four earlier periods in urban Cagayan.

In addition, Table 7 makes evident the dramatic decline in fertility which has been experienced in urban Cagayan by women of all marital statuses combined. Every age group in Table 7 belonging to the earlier periods exhibits higher fertility than the 1971 rates. Sometimes the difference is as much as 100 points. Total fertility for these four earlier periods ranged from 6,786 to 8,414 and gross reproduction rates from 3.31 to 4.11 births. Birth rates are clearly lower in urban Cagayan today than they were 10 years ago.

Rural areas. The same sharp decline appears not to have occurred in the rural birth rates. Comparison of these rural rates with the earlier urban Cagayan rates reveals that the rural rates exhibit somewhat higher fertility levels than the earlier Cagayan rates. The point of highest fertility, significantly, is located at ages 20 to 24 years of age; women of the succeeding age group, 25 to 29 years of age, had the next highest fertility. In other words, ages of high fertility tended to be the same for women of

Table 7

Age-specific birth rates per 1000 women of specified ages per annum and per 1000 currently married women of specified ages per annum, with total fertility and gross reproduction rates (Cagayan de Oro City, 1948–62, and September 1 to December 31, 1971)

Years	Ages								
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	TFR	GRR
	A. Rates for all women of specified ages								
1948–52	42.3	244.3	364.2	381.8	309.6	246.0	94.7	8,414	4.1
1953–57	54.7	289.2	339.2	324.0	219.1	120.9	17.8	6,824	3.3
1958–62	59.2	282.1	377.2	342.3	242.7	93.4	10.7	7,038	3.4
1962	46.9	302.8	347.2	314.7	230.6	73.2	41.8	6,786	3.3
1971	25.1	196.6	276.8	280.8	119.1	67.3	0.0	4,829	2.4
	B. Rates for currently married women[a]								
1948–52	371.4	431.0	446.7	431.6	340.1	278.6	110.5	12,050	5.8
1953–57	480.5	510.1	416.1	366.3	240.6	136.8	20.8	10,856	5.3
1958–62	520.2	497.6	462.7	387.0	266.6	105.7	12.5	11,262	5.5
1962	411.8	534.1	425.8	355.8	253.3	82.9	48.8	10,562	5.1
1971	527.9	639.2	443.8	356.5	143.3	82.3	0.0	10,965	5.4

[a]Rates for 1948–62 are for currently married women, husband not away for extended absences. Rates for 1971 are for currently married women, as such.

Source of 1948–62 data: Madigan *et al.* 1972: 76, 79, 80, 92.

all marital statuses as for currently married women in the rural area. Nor does the rural fertility pattern exhibit the abrupt decline in fertility which characterizes the urban data for 1971. Total fertility and gross reproduction rates are higher in the rural study area than for any of the earlier Cagayan periods.

Comparison. In marked contrast to the rural rates, urban Cagayan rates for 1971 currently married women differ sharply from the urban rates for women of all marital statuses combined for the ages 15 to 34 years of age. Unlike the rates for all marital statuses, the currently married women exhibit no decline in fertility for these ages, and fertility is highest at 15 to 24 years of age.

Again in marked contrast to the rural rates, Cagayan rates for currently married women in 1971 closely imitate the rates for all women in the abrupt decline in fertility they exhibit after age 34. These Cagayan married women are precisely of those ages where the economic hardships of an already large family are most felt.

The decline in fertility of Cagayan urban women of all marital statuses from previous levels at 15 to 34 years of age can hardly be attributed to family planning. Much more probably this decline is due to delayed marriage as the major cause, occasioned by the enrollment of single women in collegiate or graduate curricula, or their engagement for several years in the working force before marriage. When these women marry, their fertility appears to remain as high as that of their predecessors up to 35 years of age.

Table 8 reinforces this view. One notes in it the relatively large number of urban women remaining single up through age 34 in comparison with women of the rural study area. None-

Table 8

Percentage distribution of women by marital status, ages 15–49 (Urban and rural study areas, Misamis Oriental, 1971)

Age	Single women	Currently married women	Widowed or separated women	All women[a]	Number of all women
	A. Percentage of urban women or each marital status on median interview date				
15–19	95.1	4.9	0.0	100.0	2,227
20–24	69.6	29.8	0.6	100.0	1,718
25–29	38.4	60.1	1.5	100.0	1,053
30–34	19.0	77.4	3.6	100.0	744
35–39	11.9	82.5	5.7	100.0	513
40–44	8.4	82.1	9.5	100.0	368
45–49	4.7	80.7	14.5	100.0	275
	B. Percentage of rural women of each marital status on median interview date				
15–19	86.5	13.4	0.0	100.0	1,358
20–24	41.0	57.6	1.4	100.0	1,003
25–29	19.7	77.8	2.4	100.0	695
30–34	7.5	89.6	2.9	100.0	613
35–39	5.7	90.8	3.5	100.0	575
40–44	4.5	86.2	9.3	100.0	420
45–49	3.3	88.4	8.4	100.0	395

[a]Sums may not add precisely to 100.0 percent because of rounding.

theless, after 34 years of age the number of urban single women declines quickly to relative insignificance.

On the other hand, the decline in fertility of both currently married women and women of all marital statuses at 35 to 49 years of age is probably due to practice of birth restriction. The proportion of separated and widowed women does not seem to have increased very greatly, nor does reason exist for suspecting diminution in capability to bear children. The number of single women is relatively small. As just noted, married women of these ages are likely be more strongly motivated for psychological and economic reasons to limit the number of their births. In the face of energetic attempts of family-planning clinics of the Cagayan area to attract new acceptors, attribution of the fertility decline at these ages to family planning seems the logical deduction.

In conclusion, the decline in fertility found during 1971 in the Cagayan Poblacion appears to be due chiefly to two major causes. The first of these is delayed marriage, a cause which seems to operate mainly during the earlier portion of the reproductive period, that is, from 15 to 34 years of age. The second is voluntary control over fertility, and this seems principally to operate at the present during the later part of the reproductive period, or from 35 to 49 years of age.

Age-specific death rates

The age-specific central death rates found in the first period of observation (but reported in terms of deaths per year) are presented in Table 9.[1] One notable characteristic is the large sex difference, found in both rural and urban areas, for children under one year of age. In the Cagayan Poblacion such male deaths per thou-

Table 9

Age-specific central death rates per 1000 persons of specified sex and ages per annum (Urban and rural study areas, Misamis Oriental, September 1 to December 31, 1971)

Age	Urban area		Rural area	
	Males	Females	Males	Females
0	130.6	23.8	76.3	22.0
1–4	2.9	8.6	8.0	12.4
5–9	2.7	0.0	3.1	1.6
10–14	0.0	0.0	0.0	0.0
15–19	0.0	1.6	2.2	0.0
20–24	0.0	0.0	0.0	0.0
25–29	0.0	0.0	0.0	0.0
30–34	10.1	0.0	0.0	0.0
35–39	7.1	7.4	5.4	5.3
40–44	0.0	0.0	7.4	0.0
45–49	37.1	13.0	9.0	8.1
50–54	27.2	16.1	11.6	12.6
55–59	19.8	20.0	26.4	15.6
60–64	25.6	50.6	95.6	32.5
65 & +	41.9	21.5	54.0	61.0
Age unknown	0.0	0.0	0.0	0.0
All ages	9.0[a]	4.1[b]	9.3[c]	5.8[d]

[a]Contains 12 persons of unknown age in denominator. Persons of unknown age were omitted from denominators of all age-specific rates.

[b]Denominator contains 10 persons of unknown age.

[c]No persons of unknown age in denominator.

[d]Denominator contains one person of unknown age.

sand were more than 100 points higher than female. In the rural study areas, male infants exhibited a death rate 54 points higher than did females. The magnitude of these differences is quite possibly due to time sampling in populations of only 23,000 persons.[2] However, female mortality over the whole range of life is clearly lower than male mortality. Even in the maternal period, 15–49, Table 9 shows that female mortality in both urban and rural areas was not higher than male mortality.

Table 10 presents comparable data from the earlier study of Cagayan referred to previously, and data from the present study. Neither set of rates are graduated in order to facilitate comparison of the mortality experienced.

These data of Table 10 show in general that neither the male nor the female death rates observed in the 1971 study period are out of context with previously observed rates. Particular rates may be somewhat high or low, owing to time sampling variability in particular age cells, but the general outlines of the 1971 mortality curve look reasonable in the time relationships and the age patterns of these sets of rates.

By way of sharpening the comparison of these urban death rates, all eight sets were age-standardized on the November 1, 1971, dis-

Table 10

Age-specific central death rates per 1000 persons of specified sex and age per annum (Cagayan Poblacion, 1948–62 and September 1 to December 31, 1971)

Age	Males				Females			
	1953–57	1958–62	1962	1971	1953–57	1958–62	1962	1971
0	118.5	68.2	101.7	130.6	87.1	109.6	35.2	23.8
1–4	11.6	8.7	7.0	2.9	9.2	10.8	10.3	8.6
5–9	3.8	2.8	0.9	2.7	4.2	2.8	2.6	0.0
10–24	1.7	2.1	2.0	0.0	1.5	2.0	0.7	0.7
25–44	2.6	2.4	1.4	4.2	3.5	3.8	2.6	1.4
45–64	9.7	14.0	6.6	28.7	10.9	8.7	7.9	21.9
Above 64	41.9	45.7	35.6	41.9	40.8	38.8	47.8	21.5
All ages (crude rate)	6.6	7.6	4.9	9.0	6.7	7.3	5.5	4.1

Source: Madigan *et al.* 1972: 161.

tribution of the Cagayan de Oro study sample and then upon the 1969 population of England and Wales (United Nations 1971: 366–69). Results are shown in Table 11.

Points to note in this table are the manner in which standardized death rates increase when the observed age-specific death rates are applied to the age-sex frequencies of the British population distribution. The age structure of this population is much more concentrated in the middle and older ages than is the Cagayan de Oro population. A second point to note is the manner in which the standardized rate favors one or the other sex as one or the other base is used for standardization. The phenomenon is especially observable in the rates for 1953–57 and for 1962. The reason for the differences is that frequencies at older ages are much greater in the British than in the Cagayan population. The high mortality rates for these ages had much less effect on the death rates when the Cagayan population was selected as the standard of comparison because relatively few had survived to the older ages in this population.

Table 11

Standardized central death rates per 1000 persons per annum (Cagayan de Oro central city population, 1953–57, 1958–62, 1962, and 1971, and England and Wales, 1969)

Standard population	Calendar period standardized central death rates			
	1953–57	1958–62	1962	1971
Study population, November 1, 1971				
Males	8.5	6.9	6.4	9.0
Females	6.6	7.3	4.5	4.1
England and Wales, 1969				
Males	10.8	11.1	8.3	15.0
Females	12.4	12.1	11.5	10.1

Mortality curves

The observed rates obviously labor under the effects of random variation due to time sampling. Unevenness will be found in the curves of mortality if the observed rates are plotted on graph paper and a line drawn connecting these points.

On the assumption that the present rates reflect approximately the true level of mortality and that observed unevenness is due to time sampling at different ages, a smooth curve may be drawn in the attempt to show what the "true" curve of mortality would look like if an exceedingly great number of time samples were on hand for a much enlarged population. Table 12 presents such "smoothed" rates. These rates were derived by redistributing the observed rates, corrected by the Chandra Sekar-Deming estimate of missed cases (which was distributed by age groups in proportion to the observed deaths), according to percentages of total deaths occurring in each of the different age groups of the appropriate Coale-Demeny Model-West life tables already referred to. The appropriate model table for each area and sex set of rates was determined by the birth, death, and natural increase values found in the observed sex population.

It will be seen that the result generally tends to lower deaths under one year of age for males and to increase them for females. It also tends to increase death rates at ages 65 and above for both sexes. For the ages of adolescence and early maturity it smoothes jagged peaks of mortality and gradually increases rates in keeping with the presumption of increasing risk of mortality after ages 10–14, and in keeping with the observed data for these ages.

Natural increase

Natural increase, the difference between the crude birth and death rates, is high in both the Cagayan poblacion and the rural study areas.

Table 12

Graduated central death rates per annum per 1000 persons of specified age and sex (Urban and rural study areas, Misamis Oriental, September 1 to December 31, 1971)

Age	Urban area		Rural area	
	Male rates	Female rates	Male rates	Female rates
0	91.0	31.0	71.5	30.4
1–4	7.0	1.4	6.6	1.9
5–9	2.1	0.5	1.5	0.6
10–14	1.6	0.4	1.2	0.4
15–19	1.7	0.3	1.9	0.8
20–24	2.2	0.5	3.3	1.3
25–29	2.6	0.8	4.0	1.9
30–34	3.2	1.2	4.7	2.2
35–39	4.7	1.9	5.1	2.5
40–44	6.3	3.0	7.8	4.0
45–49	10.4	5.1	10.7	5.5
50–54	13.4	7.8	16.3	10.6
55–59	22.8	12.1	21.4	16.2
60–64	33.5	19.4	29.7	21.7
65 +	115.6	128.0	85.0	99.4
Age unknown	0.0	0.0	0.0	0.0

The urban increase during the first study period is estimated from the foregoing data at 3.7 percent per annum, that is, 43.1 – 6.4 = 36.7 persons per thousand population. The rural increase is estimated at 3.8 percent, that is, 45.8 – 7.6 = 38.2 persons per thousand population.

These rates of increase may be somewhat higher than the national rates of increase because of more favorable mortality in Misamis Oriental, because of its good conditions of law and order, its typhoon-free location, its low incidence of serious epidemics, and other advantages. Nevertheless, the present Philippine increase cannot be very much lower, since the advance report of the Philippine summary for the 1970 Census manifests a national growth of approximately three percent per annum since 1960.

Conclusion

In conclusion, encouragement should be found in the decline of Cagayan fertility from previous higher levels. It appears that a beginning has been made to meet the challenge of the mushrooming of population size. Especially is this encouragement justifiable at ages 35–49, where fertility control seems responsible for the decline.

On the other hand, this encouragement should in no way induce relaxation in efforts to further bring down the birth rate. The high rates of natural increase rather point up the need to go much further in such efforts. Traditional birth rates remain so high and current mortality has reached such low levels that redoubled efforts are necessary to cope with and eventually solve the exploding-population problem.

Notes

Appreciation is expressed to the Commission on Population of the Republic of the Philippines and to the U.S. Agency for International Development for grant support of this research project. Also gladly acknowledged is the many-sided assistance extended by Professor Forrest E. Linder, Professor H. Bradley Wells, and their colleagues of the Laboratories for Population Studies program, department of biostatistics, University of North Carolina. Thanks are particularly expressed here to Professor James R. Abernathy, of the same department, for a critical reading of this paper and for many valuable suggestions.

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1. Such rates are the quotient of observed deaths by age group of deceased as dividend, and, as divisor, number of persons in same age group at midpoint of the period of observation.

2. These central death rates for children under one year of age are not identical with the infant mortality rates noted earlier. The denominators of infant mortality rates are the number of live births, while the denominators here are the number of children under one year of age. The number of deaths of urban male infants in the numerators of these annual central rates was 44.769 and the number of female infant deaths was 7.461. Similarly, the number of deceased rural male infants was 34.311 and the number of female deceased was 9.069. (Decimal places were kept in order to distribute smoothly the small Chandra Sekar-Deming estimate of missed cases. For the same reason, the decimal places were kept in the median period population bases of these rates.) The population bases for these rates, respectively, were: 342.9 urban infant males, 313.0 infant females, 449.6 rural infant males, and 412.4 infant females.

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COMING IN PSR 21(3–4)

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(Continued from p. 94)

Omohundro's work combines with efforts by a number of others whom he cites to yield a sizable and growing base of comparative data on Chinese "resident strangers" in urban areas in the Philippines. A Philippine, inter-urban comparative analysis would seem to be a "reasonable next step" toward the "more truly crosscultural perspective" on these communities Omohundro envisions.

Finnigan's note (pp. 180–85) describes a set of population projections designed and executed by the staff of the International Statistics Division, U.S. Bureau of the Census. These projections are available from the Bureau for a large number of countries and summary results for many of them, including the Philippines, are found in U.S. Bureau of the Census (1971).

The interested reader might compare these "analytic" projections with recent projections from the Bureau of the Census and Statistics (1972) based in part upon much smaller – and more realistic – fertility reductions. Together these exercises tell us that the Philippine population in the year 2000 could be as large as 100 million or so and will not be smaller than 60 million no matter how rapidly fertility is reduced (barring, of course, excess mortality). The likely outcome is much closer to the higher figure than to the lower one.

Social scientists will immediately see the implications for societal change imbedded in both these sets of figures – impending changes in basic relationships between man and resources, man and man – which must accompany the rise in numbers.

Four books are reviewed in this issue: a textbook in demographic methods, a field study of migrants to the Digos-Padada valley in Davao, a provincial history of Pampanga, and an analysis of student attitudes toward fertility and contraception.

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