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TWENTY-TWO MONTHS OF VITAL RATE COVERAGE BY A DUAL SYSTEM IN NORTHERN MINDANAO

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Crude rates of birth, death, and natural increase, as well as age-specific central birth and death rates, rural and urban, from the Xavier University dual record system in Misamis Oriental for its first four periods of study, September 1, 1971, to June 30, 1973, bring up to date an earlier report. Coverage rates for each system are included. A mortality dip in adolescence and early adulthood, a decline in urban birth rates, and a persistently high sex ratio at birth were observed.

An earlier paper described the dual record project of the Mindanao Center for Population Studies (MCPS) at length (Madigan *et al.* 1973). The present paper will bring up to date findings of this project since that time. It will do so by comparing the data from period one (September 1-December 31, 1971) with that for periods two through four (January 1, 1972-June 30, 1973).

Survey rounds one and two covered the entire sample population of approximately 49,000 persons distributed over 30 municipal barrios (including three poblaciones) and one city poblacion. Because of a memory recall experiment, survey rounds three and four covered only 50 and 75 percent of the sample, in order to leave unrefreshed by a survey, the recollections of vital events by respondents first in 50, and (in round four) then in 25 percent of the sample. Survey round five (not yet available for analysis at this date) will conclude this experiment. This procedure will permit comparison of event recall over 18- and 12-month periods with recall over a six-month period, by means of households interviewed at six-month intervals, and households interviewed only after an 18-month period.

Rates for periods of study three and four therefore, are based upon cluster subsamples drawn by unequal probabilities proportional to size.

Coverage and Match Rates

Table 1 presents coverage and match rates of the recording system and of the survey system separately. Coverage rates express as a percentage the number of cases independently caught by the system in question out of estimated true number of vital events which occur in the specific population during the prescribed period of study. Match rates on the other hand express as a percentage the number of cases independently caught by one of the two systems which match with cases independently caught by the other system.

Match rates are not given directly in Table 1 but are almost immediately derivable because for any period and type of event the coverage rate of one system is the match rate of the other system. For example, the period one birth coverage rate for system 1 (the recording system) is 87.0 per cent. Therefore the match rate for system 2 (the interview system) for births in the same period is also 87.0 percent. Likewise, the match rate of system 1 for births in the same period was 66.4 percent.

Coverage rates, as the table indicates, have followed a fairly consistent upward path for each system in both urban and rural areas since

Table 1

Coverage rates, periods 1 to 4 of study, per hundred cases, Mindanao Center for Population Studies, September 1, 1971 – June 30, 1974

Birth Reporting	Period				Probability of both systems missing a case, per 100 cases[f] Period				Average probability period 1 to 4	
	1[a]	2[b]	3[c]	4[d]	1[a]	2[b]	3[c]	4[d]	Coverage Rates[e]	Prob. of Both Systems Missing a Case Per 100 Cases[e,f]
Birth Reporting										
Urban Cagayan					4.4	3.9	1.5	1.2		3.0
System 1 (STAR)	87.0	80.9	82.0	90.1					84.8	
System 2 (ROVER)	66.4	79.4	91.5	87.8					80.4	
Rural area (R.A.2)					0.6	0.3	0.1	0.1		0.2
System 1	92.6	96.8	98.2	98.5					96.5	
System 2	92.4	92.3	93.1	95.3					93.2	
Death reporting										
Urban Cagayan					14.0	5.6	3.6	1.6	79.3	5.1
System 1	72.7	81.0	77.1	81.3					75.3	
System 2	48.5	70.8	84.4	91.2						
Rural area (R.A.2)					2.3	0.7	0.2	0.1		0.6
System 1	89.1	95.9	97.6	96.6					95.0	
System 2	78.8	83.5	90.9	96.6					87.1	

[a]September 1, 1971 to December 31, 1971, inclusively.
[b]January 1, 1972 to June 30, 1972, inclusively.
[c]July 1, 1972 to December 31, 1972, inclusively; 50 percent probability subsample.
[d]January 1, 1973 to June 30, 1973, inclusively; 75 percent probability subsample.
[e]Weighted by number of events in each period.
[f]Formula: $[n_1n_2/m - (u_1 + u_2 + m)]/[n_1n_2 \div m]$ where n_1 = overall number of cases reported by system 1, and n_2 and m similarly the overall number of cases reported by system 2 and the overall number of cases reported by both systems (matched cases). This formula gives results somewhat different from those in several earlier reports which were based upon a formula in which fi was computed from homogeneous groups, i.e.:

$$\frac{\sum_{i}^{k}[(n_{1i}n_{2i}/m_i) - (u_1 + u_2 + m)]}{\sum_{i}^{k}[n_{1i}n_{2i}/m_i]}.$$

period one. This steady improvement has characterized the reporting of births and deaths. The steepest upward trend in coverage, however, was exhibited by the urban interview system in its reporting of deaths, advancing from a coverage of only 48.5 percent to 91.2 percent in the four periods of study (six months each except for the first which ran from September 1 to December 31, 1971). Also noteworthy is the improvement of rural death coverage, 78.8 percent to 96.6 percent. Birth coverages were higher from the beginning and therefore improved less spectacularly, although urban coverage improved more than rural.

In the past it has been said by population specialists that obtaining good death coverage is easier than obtaining good birth coverage. The MCPS experience in northern Mindanao belies this opinion. For various reasons, respondents were reluctant to speak of household deaths to our workers and even neighbors and informants were hesitant to supply information. It was not rare for respondents to deliberately not report a death of which they were conscious to an inquiring recorder or interviewer.

In addition to the intensive procedures followed to prevent collusion between the two systems already described in a previously cited article in this journal, the further precaution was taken to have completely different trainers and supervisors for each system. The interviewers train in the Central Office and are under direct Central Office supervision during their survey work through their own supervisors. Interviewers are never assigned to unit areas where they have interviewed once before or resided at any time. Ideally, a completely new set of interviewers is trained for each survey. (In fact, from 30 to 50 percent of the good interviewers of a preceding round have applied in each successive survey, and been reemployed.

Overall completeness of coverage obtained by both systems together $m + u_1 = u_2$ where m symbolizes cases caught by both systems, u_1 the cases caught only by system 1, and u_2, the cases caught by system 2 has also improved over the four periods. In the following coverage rates for the dual record urban area, the numbers in the stub refer to the periods of study (1-4 means an average for all four periods);

	1	2	3	4	1-4
Births	95.6	96.1	98.5	98.8	97.0
Deaths	86.0	94.4	96.4	98.4	94.9

These coverages are high although there has been improvement from earlier to later periods. They show consistent hard work on the part of both systems to obtain good initial coverage and to improve upon it later. However, with particular reference to deaths, it should be noted that coverage estimates can be biased upwards by deliberate concealment of death by respondents from both systems. Such events have zero or near zero probability of detection and therefore cannot be adequately reflected by the joint independent probability formula. Of course this upward bias would be even more likely in any single system approach in as much as a dual record system has two chances to pick up a deliberately concealed event as opposed to the one chance in a single system.

Overall completeness of coverage for the rural dual system are particularly impressive. In only one cell has it been less than 99 percent. Nevertheless, some improvement is manifested from early to later periods. In fairness to city workers, however, it must be said that keeping account of all events is somewhat easier in the more visible life of the rural households than it is in the commotion of urban life, particularly when the urban household runs such an enterprise as a family store and has less sympathy for an interviewer. The rural overall coverage rates were:

	1	2	3	4	1-4
Births	99.4	99.7	99.9	99.9	99.8
Deaths	97.7	99.3	99.8	99.9	99.4

Match rates have also increased over time in both sets of areas as will be noticed in Table 1 and in the two preceding text tables. (Match rates, as previously mentioned are identical with coverage rates of the opposite system for

the same place, time, and type of event). It is inevitable that as each system enlarges its coverage, it discovers an increasingly greater number of cases which were also found independently by the other system. By the same token, each system finds fewer and fewer cases not also found by the other system. As noted previously, collusion between workers of the two different systems can be ruled out as a practicable possibility because of the field preparations for the surveys and because of the intensive supervision over both interviewers and recorders by their own system's supervisors.

With regard to particular match rates, one notes from Table 1 that only 66.4 percent of the urban births found by the recorders (system 2) were also found by the interviewers during survey 1 whereas 87.8 percent of the births discovered by the urban recorders were also found by the interview system during survey round 4. Unmatched urban death reports declined more sharply over the same period. Fifty-two percent of all the deaths reported by system 1 during period 1 were not discovered by the interviewers during their survey round. This had shrunk to less than 9 per cent by survey round 4.

Crude Rates of Birth, Death, and Natural Increase

Urban birth rates

A gradual decline of crude birth rates occurred in the Cagayan de Oro poblacion between September 1, 1971 and June 30, 1973. Table 2 shows that from a high of 43.0 births per thousand, level of fertility had declined to about 37.4 births per thousand. Annual period rates are given in this table.

Although the downward trend which appears in Table 2 has been steady, the differences between the largest and smallest rate are not yet large enough to be statistically significant even at the 5 percent level.[1] Nor is the downward trend yet meaningful. This fact indicates that caution should be observed in interpreting this decline, as it has not yet been demonstrated that mere chance factors may not have produced this result.

Table 2 shows not only the rates for single periods of study but also combined rates for periods 1 and 2, periods 3 and 4, and for periods 1 to 4. The decline which appeared in the single period rates appears more clearly in the contrasting averages for periods 1 to 2 and for periods 3 to 4. The average for periods 1 to 2, i.e., 42.3 births per thousand persons is well above both the four period average, 39.8 and exceeds the average for periods 3 to 4, 37.4 by almost 5 points.

The decline observed in the dual record system does not appear clearly in the survey data. Instead the lowest birth rate (due to low coverage) found by the survey alone appeared in period 1. The second lowest rate appeared in period 2 as well as in period 4. This illustrates the manner in which a single system approach can mislead analysis precisely because it cannot estimate its own coverage in any particular round and therefore is likely to confuse changes in coverage of events from round to round with true changes or variations in fertility.

Rural fertility

The rural rates do not exhibit a decline in birth rates, rather they reflect the type of seasonal variation typical of a population practising limited or no voluntary control over fertility. The general level of fertility is lower, however, than one might expect in the rural Philippines where many demographers have estimated rates as high as 50 births per thousand persons. During the first four periods of study, at least, the rates appear to go down too far but do not spring back high enough to maintain an average level. If a decline has therefore taken place in the rural fertility of western Misamis Oriental, this must have occurred before September 1971.

Urban death rates

Unlike fertility, urban mortality has not shown a clear declining tendency. In fact, as Table 2 shows, mortality was at its lowest during period 1, and since then has fluctuated upwards twice (January to June, 1972 and

Table 2

Annualized crude birth and death rates, Mindanao Center for Population Studies sample areas, periods 1 to 4 of study, by system

Area of study and system	Period						
	1	2	3[a]	4[b]	1-4[c]	1-2[c]	3-4[c]
				Birth Rates			
Urban Area							
System 1	37.4	33.4	30.5	33.7	33.8	35.4	32.1
System 2	28.5	32.8	34.1	32.8	32.0	30.6	33.4
Dual System	43.1	41.5	37.2	37.5	39.8	42.3	37.4
Rural Area							
System 1	42.4	38.3	47.1	37.4	41.3	40.4	42.2
System 2	42.2	36.5	44.7	36.2	39.9	39.4	40.4
Dual System	45.8	39.6	48.0	38.0	42.8	42.7	43.0
				Death Rates			
Urban Area							
System 1	4.4	6.4	5.2	6.2	5.6	5.4	5.7
System 2	2.9	5.6	5.7	6.9	5.3	4.3	6.3
Dual System	6.4	8.0	6.7	7.7	7.2	7.2	7.2
Rural Area							
System 1	6.7	7.2	7.2	6.5	6.9	7.0	6.8
System 2	6.0	6.3	6.7	6.5	6.4	6.2	6.6
Dual System	7.6	7.5	7.4	6.7	7.3	7.6	7.0

[a]Estimate based upon 50 percent subsample of sample areas.
[b]Estimate based upon 75 percent subsample of sample areas.
[c]Each period given equal weight.

1973) and downwards once (July to December, 1972). Since periods 1 and 3 tend to be low and 2 and 4 high, these fluctuations appear to result from seasonal variation of a mean of about 7.2 deaths per thousand. These rates have also been annualized.

Rural death rates

Rural mortality shows a slight downward trend from periods 1 to 3 with an accelerated drop in period 4. However, the declines are mere fractions of the standard errors involved, and the downward trend may be based purely upon chance.[2] Discussion of a downward rural trend in any meaningful sense therefore seems premature at this time.

Infant mortality

It is not evident that any real decline in infant mortality (children dying at less than one year of age divided by the number of live births during same period of observation) has taken place during the 22 months of field study of the MCPS. In fact, infant mortality both rural and urban, was lower in the first than in the fourth period.[3] Infant deaths per thousand live births were:

	1	2	3	4
Urban	53.3	66.6	36.0	65.6
Rural	40.9	62.5	64.9	66.8

Urban infant mortality has fluctuated more than rural. Nevertheless, the rural four-period average shown below has not differed much from the urban average. If the periods are grouped into successive pairs, the urban rates have progressed from high to low and the rural rates from low to high. This suggests random variation. These average rates were:

	1-2	3-4	1-4
Urban	60.0	50.8	55.4
Rural	51.7	65.8	58.8

Natural increase

Crude rates of natural increase, derived by subtracting the crude death rate from the crude birth rate, are the main determinants of population growth in the Philippines where net international migration is relatively small in comparison with numbers of births and deaths.

These rates of increase for the rural and urban samples are as follows by period and period combinations:

	1	2	3	4	1-2	3-4	1-4
Urban	3.7	3.4	3.0	3.0	3.6	3.0	3.3
Rural	3.8	3.2	4.1	3.1	3.5	3.6	3.6

Urban rate of natural increase has declined during the 22 months of the project to date, as appears from both the periods individually, and from comparison of period 1 to 2 average with the periods 1 to 4 and 3 to 4 averages. The rural rate has remained fairly constant and despite the slight difference, has probably not increased.

The decline in urban natural increase (not to be confused with urban increase from all causes) is encouraging in view of the urgent Philippine population problem. While this decline is still small, one may trust that the decline will become more substantial with the passage of time.

Provincial and city estimates

The MCPS is primarily a methodological project. Therefore, its study areas were not selected with substantive data-gathering in view, but rather with methodological considerations in mind. Thus, while the urban area is a probability cluster sample of the Cagayan de Oro Poblacion, the Cagayan Poblacion and the rural areas were selected by purposive sampling.

Nevertheless, assuming that the Cagayan Poblacion fertility approximates that of the Gingoog City Poblacion, and that the rural sample fertility approximates that of all areas outside the two city poblaciones of the province, provincial estimates can be made based on the urban and rural sample rates.

Little specific information is available regarding the fertility of the northeastern

segment of the province (from Tagoloan Municipality to Magsaysay Municipality). However, with the exception of availability of electricity, conditions in the rural western segment are fairly similar to those in the northeast. Since the beginning of 1972, electricity has become wide and cheaply available to the rural western area through the Misamis Oriental Rural Electric Service Cooperative (MORESCO). Nevertheless, the birth rates for the four years of the study do not show notable effects of electrification upon the level of fertility in western Misamis Oriental.

Provincial rates estimated from the two strata mentioned above, urban and rural, were per thousand persons by periods:

	1	2	3	4	1-2	3-4	1-4
Birth	45.1	39.9	46.3	37.9	42.5	42.1	42.3
Death	7.4	7.6	7.3	6.9	7.5	7.1	7.3
% Increase	3.8	3.2	3.9	3.1	3.5	3.5	3.5

Similar estimates can be made for rural and urban Cagayan de Oro City by following the same procedures. In this case, the rural sample is assumed to approximate the fertility of all barrios of the city (41.5 percent of the population) outside the poblacion and the urbanized barrios and/or districts aggregated with the poblacion (58.5 percent of the population). On the basis of these assumptions, the rates were:

	1	2	3	4	1-2	3-4	1-4
Birth	44.2	40.7	41.7	37.7	42.4	39.7	41.1
Death	6.9	7.8	7.0	7.3	7.4	7.2	7.2
% Increase	3.7	3.3	3.5	3.0	3.5	3.2	3.4

A decline both in fertility and in natural increase appears from these rates.

Specific Birth Rates

Urban rates

Table 3 shows that between the first and fourth periods of study, general fertility, total fertility, and gross reproduction rate all declined by 11 to 15 percent in the Cagayan poblacion.

With the exception of ages 15-19, a decline occurred between the average Cagayan rates for periods 1 and 2 and the average rates for periods 3 and 4 for each age group in the table. Several of these declines are not very clear-cut, e.g., at ages 25-29. Nevertheless, the occurrence of six declines in seven comparisons is impressive. Given a hypothesis of no decline with P of higher or same level fertility equal to .5, the one-tailed probability of six random declines in seven trials is only 10.9 percent.

The above decline in fertility might be attributed principally to deferment of marriage by urban women were it not for the rates in the lower half of Table 3, which relate to the fertility of currently married women. One should recall here that widowhood, legal (or de facto permanent) separation from husband and delayed marriage do not affect the fertility of these women.

The same decline in fertility found between periods 1 and 4 for all women are found for currently married women in Table 3. In the absence of evidence on long and frequent absences of husbands from wives, one is inclined to attribute this decline to voluntary restriction of conception. Moreover, the ratios of the birth rates of all women (expressed below in percentage form) between the first pair of periods (1 and 2) and the second pair of periods (3 and 4) are not very different from the ratios (expressed similarly) for currently married women, by age groups:

	20-24	25-29	30-34	35-39	40-44	45-49
All Women	94.0	84.0	77.0	86.4	78.0	82.7
Currently Married Women	93.0	83.0	67.4	89.9	78.5	81.9

The high fertility of these currently married women may surprise those more accustomed to data on ever-married women. However, the rates are not unusually high for currently

Table 3

Annualized age specific urban birth rates per thousand women, and per thousand currently married women, Mindanao Center for Population Studies sample areas, periods 1 to 4 of study

Age of Mother	Periods						
	1[a]	2[b]	3[c]	4[d]	1-4[e]	1-2[e]	3-4[e]
				All women			
15-19	25.1	46.4	42.4	45.8	39.9	35.8	44.1
20-24	196.6	157.7	193.3	139.8	171.8	177.2	166.6
25-29	276.8	275.0	187.5	276.1	253.8	275.9	231.8
30-34	280.8	232.2	187.0	207.9	227.0	256.5	197.4
35-39	119.1	155.3	106.8	130.4	127.9	137.2	118.6
40-44	67.3	67.4	66.8	38.4	60.0	67.4	52.6
45-49	0.0	15.0	12.3	0.0	6.8	7.5	6.2
GFR[f]	141.1	137.6	123.5	125.1	131.8[c]	139.4[c]	124.3[c]
TFR[g]	4,828.6	4,745.0	3,980.9	4,192.0	4,436.6[c]	4,786.8[c]	4,086.4[c]
GRR[h]	2,356.4	2,315.6	1,942.7	2,045.7	2,165.1[c]	2,336.0[c]	1,994.2
				Currently Married Women			
15-19	527.9	883.0	700.6	783.4	723.7	705.4	742.0
20-24	639.2	507.0	616.5	449.1	553.0	573.1	532.8
25-29	443.8	437.2	311.2	419.8	333.0	440.5	365.5
30-34	356.5	296.4	235.2	204.9	273.3	326.4	220.0
35-39	143.3	178.0	127.5	161.2	152.5	160.6	144.4
40-44	82.3	82.0	81.0	48.0	73.3	82.2	64.5
45-49	0.0	18.9	15.4	0.0	8.6	9.4	7.7
GFR[f]	346.8	326.5	289.0	293.7	314.0	336.6	291.4
TFR[g]	10,964.7	12,012.5	10,437.3	10,332.0	10,936.6	11,488.6	10,384.6
GRR[h]	5,350.8	5,862.1	5,093.4	5,042.0	5,337.1	5,606.4	5,067.7

[a]September 1, 1971 to December 31, 1971, inclusively.

[b]January 1, 1972 to June 30, 1972, inclusively.

[c]July 1, 1972 to December 31, 1972, inclusively; estimates based upon 50 percent subsample of sample areas.

[d]January 1, 1973 to June 30, 1973, inclusively; estimates based upon 75 percent subsample of sample areas.

[e]Each period given equal weight. Rounding may make GFR, TFR, GRR period averages (e.g. 1-4) slightly different from sum of same period age averages.

[f]GFR: General fertility rate.

[g]TFR: Total fertility rate.

[h]GRR: Gross reproduction rate (.488 TFR).

Table 4

Annualized age specific rural birth rates per thousand women, and per thousand currently married women, Mindanao Center for Population Studies sample areas, periods 1 to 4 of study

Age of Mother	Periods						
	1[a]	2[b]	3[c]	4[d]	1-4[e]	1-2[e]	3-4[c]
				All Women			
15-19	92.8	77.7	85.8	72.7	82.2	85.2	79.2
20-24	350.3	287.2	386.8	253.6	319.5	318.8	320.2
25-29	334.2	315.9	308.5	311.3	317.5	325.0	309.9
30-34	262.1	258.1	366.0	250.3	284.1	260.1	308.2
35-39	290.5	215.9	257.6	204.6	242.2	253.2	231.1
40-44	51.1	80.5	81.6	53.9	66.8	65.8	67.8
45-49	32.5	15.3	0.0	41.6	10.4	23.9	20.8
GFR[f]	212.8	184.5	221.7	174.2	198.3[c]	198.6	198.0
TFR[g]	7,067.5	6,253.0	7,431.4	5,940.0	6,673.0	6,660.2	6,685.7
GRR[h]	3,448.9	3,051.5	3,626.5	2,898.7	3,256.4	3,250.2	3,262.6
				Currently Married Women			
15-19	766.4	566.7	698.4	507.8	634.8	666.6	603.1
20-24	632.4	493.4	673.8	450.7	562.5	562.9	562.2
25-29	432.2	402.5	387.7	404.6	406.8	417.4	396.2
30-34	293.7	281.8	416.4	287.7	319.9	287.8	352.0
35-39	319.6	237.7	280.6	226.6	266.1	278.6	253.6
40-44	58.4	93.4	91.2	60.6	75.9	75.9	75.9
45-49	36.9	17.5	0.0	47.9	25.6	27.2	24.0
GFR[f]	353.1	299.6	369.0	289.5	327.8[c]	326.4	329.2
TFR[g]	12,697.8	10,465.0	12,740.2	9,929.5	11,458.1[c]	11,581.4	11,334.8
GRR[h]	6,196.5	5,106.9	6,217.2	4,845.6	4,192.7[c]	5,651.7	5,531.4

[a]September 1, 1971 to December 31, 1971, inclusively.

[b]January 1, 1972 to June 30, 1972, inclusively.

[c]July 1, 1972 to December 31, 1972, inclusively; estimates based upon 50 percent subsample of sample areas.

[d]January 1, 1973 to June 30, 1973, inclusively; estimates based upon 75 percent subsample of sample areas.

[e]Each period given equal weight. Rounding may make GFR, TFR, GRR period averages (e.g. 1-4) slightly different from sum of same period averages.

[f]GFR: General fertility rate.

[g]TFR: Total fertility rate.

[h]GRR: Gross reproduction rate (.488 TFR)

married women in rural Philippines. Had rates of this population been expressed as the rates of its ever-married women, they would not have been exceptional. Deriving fertility rates of currently married women has the advantage over that of ever-married women because these rates reveal the fertility of those actively engaged in child-bearing without variations occasioned by including the widowed and the separated. The fertility rate of the currently married therefore make an excellent contrast with the fertility rates of all women, which not only includes the widowed and separated but also the unmarried.

Rural rates

Table 4 presents age-specific birth rates for all women and for currently married women of the MCPS rural areas. The rates shown offer clear evidence of a fertility rate higher than the urban rates. Most of the age-specific rates for the single periods as well as the general fertility, total fertility, and gross reproduction rates are at higher levels than their urban counterparts. General fertility, total fertility, and gross reproduction rates of all women did not decline over the four periods. No fall in level of fertility is apparent when the average rate for periods 1

Table 5

Annualized age-specific urban death rates per thousand persons, by sex, Mindanao Center for Population Studies sample areas, periods 1 to 4 of study

Ages	Periods													
	1[a]	2[b]	3[c]	4[d]	1-4[e]	1-2[e]	3-4[e]	1[a]	2[b]	3[c]	4[d]	1-4[e]	1-2[e]	3-4[e]
	Males							Females						
0	130.6	103.7	37.9	83.3	88.9	117.2	60.6	23.8	79.0	42.7	67.4	53.2	51.4	55.0
1-4	2.9	11.3	10.8	15.1	10.0	7.1	13.0	8.6	14.9	5.8	10.2	9.9	11.8	8.0
5-9	2.7	1.6	2.8	1.9	2.2	2.2	2.4	0.0	1.6	8.2	3.8	3.4	0.8	6.0
10-14	0.0	5.6	3.2	2.2	2.8	2.8	2.7	0.0	3.4	0.0	2.0	1.4	1.7	1.0
15-19	0.0	3.0	3.0	1.9	2.0	1.5	2.4	1.6	3.0	0.0	1.2	1.4	2.3	0.6
20-24	0.0	1.6	2.8	7.4	3.0	0.8	5.1	0.0	1.3	2.3	0.0	0.9	0.6	1.2
25-29	0.0	4.5	8.1	2.7	3.8	2.2	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30-34	10.1	0.0	5.4	0.0	3.9	5.0	2.7	0.0	0.0	4.9	3.4	2.1	0.0	4.2
35-39	7.1	8.2	0.0	4.7	5.0	7.6	2.4	7.4	8.4	7.3	0.0	5.8	7.9	3.6
40-44	0.0	0.0	9.4	6.0	3.8	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45-49	37.1	21.3	12.4	0.0	17.7	29.2	6.2	13.0	0.0	0.0	0.0	3.2	6.5	0.0
50-54	27.2	0.0	14.4	20.1	15.4	13.6	17.2	16.1	18.0	28.5	10.1	18.2	17.0	19.3
55-59	19.8	11.3	39.5	25.9	24.1	16.6	32.7	20.0	12.1	22.4	15.0	17.4	16.0	18.7
60-64	25.6	15.4	25.8	37.5	26.1	20.5	31.6	50.6	28.7	26.4	0.0	21.4	39.6	13.2
65 & Above	41.9	48.1	38.7	92.3	55.2	45.0	65.5	21.5	60.5	20.6	47.6	37.6	41.0	34.1
All Ages	9.0	8.8	8.2	10.4	9.1	8.9	9.3	4.1	7.3	5.4	5.3	5.5	5.7	5.4

[a]September 1, 1971 to December 31, 1971, inclusively.

[b]January 1, 1972 to June 30, 1972, inclusively.

[c]July 1, 1972 to December 31, 1972, inclusively; estimates based upon 50 percent subsample of sample areas.

[d]January 1, 1973 to June 30, 1973, inclusively; estimates based upon 75 percent subsample of sample areas.

[e]Each period given equal weight. Rounding may make weighted averages of age columns slightly different from average for all ages computed directly.

Table 6

Annualized age-specific rural death rates per thousand persons, by sex, Mindanao Center for Population Studies sample areas periods 1 to 4 of study

Ages	Periods													
	1[a]	2[b]	3[c]	4[d]	1-4[e]	1-2[e]	3-4[e]	1[a]	2[b]	3[c]	4[d]	1-4[e]	1-2[e]	3-4[e]
	Males							Females						
0	76.3	61.2	74.9	75.6	72.0	68.8	75.2	22.0	70.8	97.4	65.9	64.0	46.4	81.6
1-4	8.0	9.8	7.0	7.9	8.2	8.9	7.4	12.4	7.8	14.7	1.7	9.2	10.1	8.2
5-9	3.1	2.0	0.0	1.3	1.6	2.6	0.6	1.6	2.1	2.0	0.0	1.4	1.8	1.0
10-14	0.0	3.6	0.0	0.0	0.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15-19	2.2	2.9	5.6	0.0	2.7	2.6	2.8	0.0	1.5	0.0	1.8	0.8	0.8	0.9
20-24	0.0	5.9	3.8	2.4	3.0	3.0	3.1	0.0	4.1	4.0	2.7	2.7	2.0	3.4
25-29	0.0	2.7	0.0	3.7	1.6	1.4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30-34	0.0	0.0	5.6	0.0	1.4	0.0	2.8	0.0	0.0	0.0	12.0	3.0	0.0	6.0
35-39	5.4	0.0	0.0	0.0	1.4	2.8	0.0	5.3	3.5	0.0	0.0	2.2	4.4	0.0
40-44	7.4	0.0	0.0	6.3	3.4	3.7	3.2	0.0	0.0	9.1	0.0	2.3	0.0	4.6
45-49	9.0	0.0	10.3	0.0	4.8	4.5	5.2	8.1	15.4	0.0	0.0	5.9	11.8	0.0
50-54	11.6	7.3	0.0	0.0	4.7	9.4	0.0	12.6	0.0	0.0	0.0	3.2	6.3	0.0
55-59	26.4	0.0	16.5	10.5	13.4	13.2	13.5	15.6	9.8	0.0	12.4	9.4	12.7	6.2
60-64	95.6	0.0	43.1	0.0	34.7	47.8	21.6	32.5	22.0	0.0	25.0	19.9	27.2	12.5
65 & Above	54.0	53.3	34.7	90.7	58.2	53.6	62.7	61.0	82.5	37.8	68.5	62.4	71.8	53.2
All Ages	9.3	7.0	7.4	7.4	7.8	8.2	7.4	5.8	8.0	7.4	6.1	6.8	6.9	6.8

[a]September 1, 1971 to December 31, 1971, inclusively.
[b]January 1, 1972 to June 30, 1972, inclusively.
[c]July 1, 1972 to December 31, 1972, inclusively; estimates based upon 50 percent subsample of sample areas.
[d]January 1, 1973 to June 30, 1973, inclusively; estimates based upon 75 percent subsample of sample areas.
[e]Each period given equal weight. Rounding may make weighted averages of age columns slightly different from average for all ages computed directly.

and 2 combined is compared with the average rate for periods 3 and 4.

The total fertility and gross reproduction rates of currently married women however were slightly lower in the average of the second pair of periods than in the average of the first, and in five of the seven age groups. It is possible that these somewhat contradictory indications signal the beginning of some fertility decline in the rural areas which for several years has experienced family planning inputs of modest proportions.

A substantial downward trend in urban Cagayan fertility in the future would be a hopeful development toward solving the Philippine population problem.

Specific Death Rates

Table 5 shows there is no clear evidence of a real decline in the mortality of urban males. Death rates were cumulatively higher during the fourth period rates than during the first. The variation of period rates within most age groups has been so large as to obscure any sign of a trend.

On the other hand female rates in Cagayan declined slightly if we compare the ratio of the rates of the first two periods with those of the last two periods. The phenomenon of greater male mortality for the same age groups is found in both urban and rural data.

A slight decline in male mortality appeared

in the rural data of Table 6. Female mortality remained constant.

The level of mortality reported seems lower than one would expect, both with regard to these age-specific rates and to the crude rates shown previously. This appears true even when one allows for a very young population (more than 50 percent under 20 years in the city and 60 percent under 20 in the rural areas), and for the favorable environment (absence of typhoons, earthquakes, epidemics, and a general abundance of food supply). The authors hope in a later paper to present some evidence indicating that the purposive concealment of death from interviewers and other inquirers is substantial in north Mindanao, and possibly in other parts of the Philippines.

Age patterns of mortality

Examination of patterns of mortality by age groups, period by period in Tables 5 and 6, will reveal a persistent dip in mortality below a smooth curve which one would expect to underlie the chance variations in actual rates. One would expect such a mortality curve to begin at a fairly high level to allow for higher mortality in the first year of life, then to sink rapidly to a low between ages 5-14, and then rise slowly and gradually to about age 34 at

Table 7

Graduated age-specific death rates per thousand persons, by sex and urban and rural location, Mindanao Center for Population Studies sample areas, periods 1 to 4 of study

Ages	Urban Area								Rural Area							
	Periods[b]															
	1	2	3	1-4[c]	1	2	3	1-4[c]	1	2	3	1-4[c]	1	2	3[a]	1-4[c]
	Males				Females				Males				Females			
0	130.6	103.7	37.9	88.9	23.8	79.0	42.7	53.2	76.3	61.2	74.9	72.0	22.0	70.8	97.4	64.0
1-4	2.9	11.3	10.8	10.0	8.6	14.9	5.8	9.9	8.0	9.8	7.0	8.2	12.4	7.8	14.7	9.2
5-9	0.0	1.6	2.8	2.1	0.5	1.6	8.2	2.4	1.5	2.0	0.0	0.9	0.6	2.1	2.0	0.2
10-14	0.1	2.3	1.3	2.4	0.4	0.3	0.1	1.4	1.2	1.2	1.3	1.5	0.4	0.4	0.0	0.4
15-19	1.0	2.3	2.2	2.5	0.3	0.7	0.4	1.4	1.9	1.9	1.3	2.4	0.8	0.7	0.0	1.1
20-24	2.4	2.9	3.1	2.8	0.5	0.9	1.0	1.0	3.3	2.2	1.3	2.6	1.3	1.1	4.0	1.9
25-29	4.3	3.5	4.2	3.2	0.8	1.3	1.8	1.0	4.0	2.4	1.3	1.9	1.9	1.7	0.0	1.1
30-34	7.0	4.3	5.7	3.7	1.2	2.1	3.2	1.8	4.7	2.6	1.7	1.5	2.2	2.6	0.0	2.3
35-39	10.3	5.4	7.8	5.0	1.9	3.5	5.1	2.7	5.1	3.1	2.9	1.7	2.5	3.8	0.0	2.3
40-44	14.1	6.7	10.9	7.9	3.0	5.5	7.9	3.0	7.8	4.1	5.1	2.7	4.0	5.4	9.1	2.8
45-49	18.2	8.2	14.9	13.2	5.1	8.4	11.6	6.7	10.7	5.8	8.7	3.7	5.5	7.2	0.0	4.4
50-54	21.7	9.6	19.6	17.6	7.8	12.3	16.3	13.4	16.3	8.4	13.7	6.2	10.6	9.4	0.0	4.5
55-59	24.8	11.2	24.7	22.5	12.1	16.8	21.1	18.0	21.4	11.5	20.2	15.7	16.2	11.7	0.0	9.8
60-64	27.7	13.0	29.6	26.7	19.4	21.6	25.9	21.9	29.7	15.0	27.6	32.5	21.7	14.1	0.0	19.3
65 & Over	41.9	48.1	38.7	55.2	21.5	60.5	20.6	37.6	54.0	53.3	34.7	58.2	61.0	82.5	37.8	62.4
All Ages	9.0	8.8	8.2	9.1	4.1	7.3	5.4	5.5	9.3	7.0	7.4	7.8	5.8	8.0	7.4	6.8

[a]Not graduated because of fewness of cases.

[b]The periods shown in this table have the same time coverage as indicated in Tables 13-4 to 13-7.

[c]The constant a was set in these graduations at values from a = 0.2 to a = 0.6 rather than at a = 2.0 as in graduations for the single periods.

which the rate of dying would increase more sharply through middle and older ages.

A persistent dip below this smooth curve appears however in the data for the late teens and/or for early adulthood. The dip remains in the average data for the four periods with the exception of urban males.

Graduation of the data for periods 1 to 3 (see Table 7) had removed these dips. However, when they continued to appear in the four-period averages of actual (ungraduated) rates, it is possible that mortality during the late teens and/or during early adulthood may be relatively more favorable in northern Mindanao (and possibly throughout the Philippines) than a smoothly rising curve of mortality would lead one to think.

For this reason the rates for the four-period averages shown in Table 7 have not been graduated with as much emphasis upon smoothness as in the graduations for periods 1 to 3 (with the constant *a* set to the value 2.0) but equal or even greater emphasis has been given to fit (*a* set to 0.2-0.6). Rates for ages 0-4 and 65 and above were not graduated. Whittaker-Henderson A-type difference equations were used for all these graduations.

The rates for the four-period averages, while obviously not as smooth as the rates for periods 1 through 3, show slight dips in mortality in three of the four sets of four-period data. The graduations suggest that the proper locus for the more favorable mortality is between ages 15 and 34, although ages 10-19 are to some extent also favored. Table 8 compares both ungraduated and graduated death rates with the Model West central death rates (m_x) based upon the Model West Life Tables (Coale-Demeny 1966; 17-23, 59-69, 106-117). Solid lines boxing ages 15-19 and 35-39 indicate the approximate locus of the observed mortality dips. Dotted lines indicate older ages affected in particular data sets.

Sex Ratios

In an earlier article (PSR 21:127), attention was called to the high level of the sex ratio at birth found in both Misamis Oriental samples, rural and urban. At that time, the phenomenon was judged to be probably due to sampling variation.

The data which have accumulated since that time raise some questions about this view, and it is appropriate to reconsider this question at this time.

Sex ratios observed at birth and without correction by the Chandrasekaran-Deming Formula were for each period:

	1	2	3	4	1-4a	1-4b
Urban	107.3	112.8	110.1	130.4	115.4	114.7
Rural	123.6	112.8	94.2	121.8	112.6	110.9

The two averages for periods 1-4 combined represent (a) only events reported for the areas studied both by recording and interviewing systems during periods 3 and 4, and (b) also the events reported by the recording system for the areas not covered in survey rounds 3 and 4 by the interviewers.

The combination of urban and rural births for periods 1-4a and 1-4b gave the sex ratios 113.9 and 113.8 respectively.

Seven of the eight sex ratios at birth for individual periods and areas exceed the commonly found level of 105-106 males per 100 females. If one hypothesizes that 106 males per 100 females represents the true Philippine sex ratio, and considers that an upward deviation from this mean has the same probability (.5) as a zero or a downward deviation, and sets the level of acceptance of the null hypothesis at .05, he finds he must reject the hypothesis of no significant difference between these sets of ratios and the level 106. The one-tailed probability of obtaining a sample in which seven of eight ratios are by chance greater than 106 would be less than four samples in every 200 samples randomly drawn.

Therefore these high sex ratios do not seem due to chance. No question exists here of greater care to register males in a governmental registration system, as we speak of a canvass of respondents by recorders and interviewers who

Table 8

Comparison of Mindanao Center for Population Studies four-period average death rates with mortality curves characteristic of Coale-Demeny Model West tables

Ages	Males				Females					
	Cagayan[a]		Coale-Demeny Model West Tables[a]		Cagayan[a]		Coale-Demeny Model West Tables[a]			
	Ungrad.[b]	Grad.[c]	17	18	Ungrad.[b]	Grad.[c]	17	18	19	20
0	88.9	88.9	91.83	78.65	53.2	53.2	74.5	63.0	52.0	41.7
1-4	10.0	10.0	8.94	7.06	9.9	9.9	8.5	6.6	4.8	3.2
5-9	2.2	2.1	2.37	1.99	3.4	2.4	2.2	1.8	1.4	1.0
10-14	2.8	2.4	1.77	1.50	1.4	1.4	1.7	1.4	1.1	0.8
15-19	2.0	2.5	2.78	2.40	1.4	1.4	2.5	2.1	1.6	1.3
20-24	3.0	2.8	3.94	3.40	0.9	1.0	3.3	2.8	2.2	1.7
25-29	3.8	3.2	4.22	3.61	0.0	1.0	3.8	3.2	2.6	2.1
30-34	3.9	3.7	4.81	4.11	2.1	1.8	4.4	3.7	3.1	2.4
35-39	5.0	5.0	5.86	5.05	5.8	2.7	5.2	4.4	3.7	3.0
40-44	3.8	7.9	7.64	6.68	0.0	3.0	6.1	5.4	4.6	3.9
45-49	17.7	13.2	10.28	9.23	3.2	6.7	7.7	6.9	6.2	5.4
50-54	15.4	17.6	14.60	13.34	18.2	13.4	10.8	9.8	8.8	7.8
55-59	24.1	22.5	20.91	19.51	17.4	18.0	15.1	13.9	12.7	11.5
60-64	26.1	26.7	31.08	29.28	21.4	21.9	23.1	21.4	19.7	18.1

Ages	Males					Females					
	Rural Areas[a]		Coale-Demeny Model West Tables			Rural Areas[a]		Coale-Demeny Model West Tables[a]			
	Ungrad.[b]	Grad.[c]	19	20	21	Ungrad.[b]	Grad.[c]	19	20	21	21
0	72.0	72.0	66.1	54.2	42.4	64.0	64.0	52.0	41.7	31.8	23.1
1-4	8.2	8.2	5.3	3.7	2.4	9.2	9.2	4.8	3.2	1.9	1.2
5-9	1.6	0.9	1.6	1.3	1.0	1.4	0.2	1.4	1.0	0.7	0.4
10-14	0.9	1.5	1.2	1.0	0.8	0.0	0.4	1.1	0.8	0.5	0.4
15-19	2.7	2.4	2.0	1.7	1.4	0.8	1.1	1.6	1.3	0.9	0.6
20-24	3.0	2.6	2.9	2.4	1.9	2.7	1.9	2.2	1.7	1.2	0.8
25-29	1.6	1.9	3.0	2.5	2.0	0.0	1.1	2.6	2.1	1.5	1.0
30-34	1.4	1.5	3.4	2.8	2.2	3.0	2.3	3.1	2.4	1.8	1.3
35-39	1.4	1.7	4.3	3.5	2.8	2.2	2.3	3.7	3.0	2.3	1.7
40-44	3.4	2.7	5.8	4.9	4.1	2.3	2.8	4.6	3.9	3.2	2.5
45-49	4.8	3.7	8.2	7.2	6.3	5.9	4.4	6.2	5.4	4.6	3.8
50-54	4.7	6.2	12.1	10.9	9.8	3.2	4.5	8.8	7.8	6.9	5.8
55-59	13.4	15.7	18.1	16.7	15.4	9.4	9.8	12.7	11.5	10.4	8.9
60-64	34.7	32.5	27.5	25.7	24.0	19.9	19.3	19.7	18.1	16.4	14.3

[a]Central death rates (m_x).

[b]Ungraduated average rates for four periods combined, each period given equal weight.

[c]Graduated rates based on the rates described in note (b) above. Graduation by Whittaker Henderson Type A difference equations with a = .5 and .6 for males and females, Cagayan, respectively, and with a = .3 and .2 for males and females, rural, respectively.

Source of Model West Tables: Ansley J. Coale, and Paul Demeny 1966.

visit the household to inquire about births. So far there is no evidence that the births of female children were concealed or that female children were deliberately registered as males. Malnutrition and/or undernutrition of mothers can affect the sex ratio at birth by increasing the number of fetuses miscarried, but this should depress, not increase, the sex ratio by increasing the number of male per female fetuses which terminate as still-born children. The practice of doctors and midwives to report as female, regardless of actual sex, the sex of deceased neonatals to their mothers, because they believe that the death of a baby girl will awaken less grief than the death of a boy, would also tend to reduce, not increase, the sex ratio of reported births.

The sex ratios of children less than one year of age were examined further and the resulting ratios were consistent with the sex ratios at birth.

	Baseline	1	2	3	4	1-4	1-4
Urban	114.6	104.7	112.3	124.2	118.4	113.6	112.2
Rural	109.6	105.9	112.2	113.8	115.5	111.2	

In addition, the national registration data exhibit similar ratios. For example, in 1968 the number of registered male births per 100 measured female births was 110.6 (471,880 of 898,750 total registered births), and the number of registered male births per 100 measured births in 1969 was 109.6 (495,110 of 946,753 total births). Because of the large percentage of underregistered births, the registration sex ratios may reflect only a conviction of parents that registration of male children is more important than registration of females.

Whatever the reason, the assembled data calls for continued attention and investigation. It is hard to explain away the higher than average sex ratios at birth in a meticulously conducted investigation when they occur seven out of eight times, and are supported by the sex ratios of children under one year of age. Reports have been made in the literature of higher than common sex ratios caused by some biological factors in various racial and ethnic groups, but thus far none of these reports seems to have been substantiated. The authors of the present paper are not prepared at this stage to accept a biological explanation for the high sex ratios they have encountered in Misamis Oriental, but they do recognize the phenomenon as worthy of further attention and research not only in their own study areas, but elsewhere in the Philippines as well.

Notes

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1. Standard errors of crude rates per thousand persons annualized for use with the rates in Table 2, were by periods of study as follows:

	1	2	3	4
Urban	3.6	2.8	5.7	2.6
Rural	1.6	2.6	3.4	2.9

These measures were based upon formulas of Marks (Marks, Seltzer, and Krotki 1972: [VII] 29-33; [III] 118-119) and were based upon the relative variances of numbers of cases and the relation of these to the population bases, as follows:

$$(1)\quad v_{\hat{n}}^2 = \frac{s_{n_1}^2}{E(n_1)^2} + \frac{s_{n_2}^2}{E(n_2)^2} + \frac{s_m^2}{E(m)^2} + \frac{2s_{n_1n_2}}{E(n_1)E(n_2)} - \frac{2s_{n_1m}}{E(n_1)E(m)} - \frac{2s_{n_2m}}{E(n_2)E(m)}$$

where the component variances are of the form, e.g., of:

$$s^2_{n_1} = \frac{\sum_{i=1}^{ki} \frac{(n_{1i} - n_1)^2}{pi}}{k(k-1)}$$

$$(2)\quad s^2_{w_1} = \frac{1}{E(n_2)^2}\left[s^2_m + W_1{}^2 s^2_{n_2} - 2W_1 \overline{rho}(mn_2) s_m s_{n_2} \right]$$

(No. 2 derived by A. N. Herrin)

$$(3)\quad s^2_{r_1} = \frac{1}{B^2}\left[s^2_{n_1} + R_1^2\, s^2_b - 2R_1 \overline{rho}(n_1 b)\, s_{n_1} s_b \right], \text{ and}$$

$$(4)\quad s^2_r = \frac{1}{W_1{}^2}\left[s^2_{r_1} + R^2 s^2_{w_1} - 2R\overline{rho}(r_1 w_1) s_{r_1} s_{w_1} \right]$$

Where: E (n_1) is the expected value of n_1, etc.; where n_1 are the events reported by system 1, n_2 are the events reported by system 2, m are events reported by both systems; W_1 is the expected value of the estimated coverage rate, w_1, based upon the reporting of events from each sample area ($w_1 = m_i/n_{2i}$ x $pi/pi = m_i/n_{2i}$); $\overline{rho}$ (mn_2) is the Pearsonian coefficient of correlation between m_i/pi and n_{2i}/pi; B is the expected value of the population base, b, estimated from each of the k sample areas; R_1 is the expected value of r_1, the vital rates (birth, death) estimated on the basis of the births reported only by system 1 from each of the k sample areas and the population of the area, i.e., $n_{1i}/bi \div pi/pi = n_{1i}/bi$; $\overline{rho}$ ($n_1 b$) is the correlation coefficient of the estimates of n_1 and b obtained from n_{1i}/pi, and bi/pi; $s^2_{r_1}$ is the variance of the vital rate, r_1, estimated only from the vital events reported by system 1 and the population base, s^2_r is the variance of the dual system vital rate; and R is the expected value of r, the vital rate estimates based upon reports of both systems (including the joint probability or CD corrections) and the population base as estimated from each sample area.

2. Standard error per thousand persons, derived by means of the same formula previously described, and annualized for use with rates presented in Table 2 are by period of study:

	1	2	3	4
Urban	1.4	1.3	2.9	0.9
Rural	1.6	1.5	3.3	1.3

3. Infant mortality rates should be distinguished from the age-specific central death rates of children under one year of age (which have different definitions). Infant mortality rates tend to be smaller than the central death rates.

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