Effects of the 1918 Influenza Pandemic Mortality Experience on Subsequent Fertility of the Native Population of Guam

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Abstract—Between November 7 and December 9, 1918, 638 deaths were recorded within the native population of Guam, over twice the average annual total number of deaths for the preceding three years, or 68 per cent of the total number of deaths (944) recorded for the entire year of 1918. A sample of records for 321 individuals who died during this peak epidemic period and for whom complete linked family records have been compiled was analyzed to study the effects of this mortality on subsequent fertility and population growth patterns.

After the passage of the epidemic through Guam, levels of births prior to the epidemic were surpassed within two years, and previous levels of deaths were surpassed within four years. Total population size exceeded the 1915 level (12, 968) after 1920. Expected effects on fertility levels resulting from the deaths of 93 adults below the age of 50 in this sample were minimized by the subsequent fertility of 24 per cent of surviving spouses. The very low percentage of all influenza-related deaths occurring among infants may have served as a temporary constraint on completed reproductive performance levels of surviving adults. Given prevailing cultural and demographic patterns, consequences of the 1918 influenza epidemic were of minimal import to the microevolution of this native population.

An unusual feature of the 1918–19 influenza pandemic was its reported tendency "... to cause a fatal result in young adults..." (van Rooyen and Rhodes, 1948 : 563). This characteristic could be expected to have particular impact on the subsequent fertility history of small, relatively isolated populations, such as those of many Pacific islands. McArthur (1968) estimated some of these effects for the native and Indian populations of the Fiji Islands. Here I review the fertility consequences of the mortality experience of the native population of Guam resulting from the influenza epidemic beginning there in early November 1918. The vital statistics and other data for this study are derived from public records maintained at the Department of Public Health of the Government of Guam, the 1897 Spanish census, Guam News Letter, Guam Recorder, Annual Reports of the Governor of Guam, and from informants.

Background

In late October 1918, the military transport ship LOGAN arrived in Guam from Manila, carrying influenza-affected passengers. By November 7, the first cases of influenza-related deaths were recorded among native residents of the major center of Agana, and between that date and December 9, 1918, 638 deaths were reported for

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Table 1. Guam, 1902–1921. The total population size is from the Fifteenth Annual Census by the U. S. Census Bureau.

Year	Male deaths	Female deaths	Unknown deaths	Σ D	Sex ratio	Total population
1902	126	111		237	113.5	
1903	123	133		256	92.5	
1904	164	124		288	132.3	
1905	184	155		339	118.7	
1906	124	125		249	99.2	
1907	135	139		274	97.1	
1908	139	158		297	88.0	
1909	138	147		285	93.9	
1910	154	155		309	99.4	11,806
1911	141	138		279	102.2	
1912	139	155		294	89.7	
1913	175	164		339	106.7	
1914	139	118	3	260	117.8	
1915	163	152	4	319	107.2	
1916	119	123	1	243	96.7	
1917	125	118		243	105.9	
1918	443	501		944	88.4	
1919	101	74		175	136.5	
1920	95	121		216	78.5	13,275
1921	117	110		227	106.4	
Σ 1902–1917	2,288	2,215		4,511		
$\overline{X}$ (16y)	143	138		282		
Sex ratio					103.3	
Σ 1902–1921	3,044	3,021		6,073		
$\overline{X}$ (20y)	152	151		304		
Sex ratio					100.8	
Σ 1915–1917	407	393		805		
$\overline{X}$ (3y)	136	131		268		
Sex ratio					103.8	

natives residing in towns and villages throughout the island. The dramatic level of increased mortality can be seen from a comparison of the total number of deaths reported for 1918 and for the immediately preceding and subsequent years (Table 1).

According to Crosby (1976:232), over 800 Guamanians, or 4½ per cent of the entire population, died as a result of the influenza epidemic, implying the presence of a total native population of nearly 18,000 persons. However, the numerical figure is probably inaccurate; the total number of deaths recorded in 1918 was 944, but, based on a previous three-year average, an estimated 268 of the total deaths in 1918 may be attributed to causes other than the 1918 epidemic, leaving a remainder of 676 deaths ascribable to the direct effects or sequelae of the disease. This figure agrees closely with the figure of 638 deaths recorded during the peak period of effect, November 7 through December 9, 1918. Further, it is unlikely that a native population which had reportedly increased from 11, 624 in 1910 to 12, 968 in 1915 (Hainline, 1964) had

dramatically grown to nearly 18,000 individuals in 1918. I estimate that about 4½ per cent of a native population numbering less than 15,000, or a maximum of 675 persons, died in the 1918–19 influenza epidemic on Guam.

Table 2. Age-sex distribution of the native population of Guam, 1897 (Spanish census) and 1918 (estimated).

Age group	Males			Females			Total		
		Actual	Estimated		Actual	Estimated		Actual	Estimated
	%	N	N	%	N	N	%	N	N
0	3.29	136	235	2.50	114	197	2.87	250	420
0–4	15.59	645	1,112	14.03	640	1,104	14.77	1,285	2,216
5–9	14.16	586	1,010	11.51	525	905	12.77	1,111	1,916
10–14	10.61	439	757	10.04	458	790	10.31	897	1,548
15–19	9.79	405	699	10.11	461	795	9.96	866	1,494
20–24	10.30	426	735	11.23	512	883	10.79	938	1,618
25–29	9.23	382	659	9.98	455	785	9.62	837	1,443
30–34	7.42	307	529	7.78	355	612	7.61	662	1,141
35–39	5.17	214	369	4.65	212	366	4.90	426	735
40–44	3.24	134	231	3.49	159	275	3.37	293	506
45–49	3.05	126	218	4.01	183	315	3.55	309	532
50–54	2.88	119	205	4.34	198	341	3.65	317	547
55–59	2.54	105	181	3.40	155	267	2.99	260	448
60–64	2.83	117	202	2.72	124	214	2.77	241	416
65–69	1.67	69	119	1.45	66	114	1.55	135	232
70–74	0.92	38	66	0.77	35	61	0.84	73	126
75+	0.51	21	36	0.39	18	31	0.45	39	67
Unknown	0.09	4	6	0.10	5	8	0.10	9	15
Totals	47.56	4,137	7,134		4,561	7,866		8,698	15,000

Table 3. Births on Guam, 1903–1912 (total for both sexes).

Category	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Single births										
Legitimate	426	405	381	438	445	461	482	463	464	487
Illegitimate	93	78	65	76	71	83	61	67	55	56
Twin births										
Legitimate	4	2	8	14	2	10	6	4	6	16
Illegitimate	—	—	2	—	2	—	—	4	—	2
Other multiple briths										
Legitimate	4	—	—	—	—	—	—	—	—	—
Illegitimate	—	—	—	—	—	—	—	—	—	—
Totals	527	485	456	528	520	554	549	538	525	561

Mean = 5243/10 = 524.3.

As the age-sex distribution of the Guamanian population in 1918 is not available, age-specific mortality rates resulting from the epidemic cannot be calculated. Direct extrapolation from the 1897 Spanish census results (Table 2) underestimates the number of younger age groups in the growing population. A sample 10-year record of births and deaths, 1903 through 1912 (Tables 3 and 4), reveals a persistent excess of births over deaths, with a 10-year mean of +237.3. Only this

Table 4. Deaths by age group on Guam, 1903–1912 (total for both sexes).

Age group	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Stillborn	1	2	1	1	—	—	—	3	5	6
0	79	83	85	72	95	102	98	84	95	83
1–4	51	81	105	68	65	80	70	96	67	70
5–9	11	12	17	9	7	7	10	13	4	8
10–14	3	2	6	4	8	8	4	3	2	7
15–19	7	6	11	9	4	4	9	2	6	10
20–24	5	4	7	9	6	2	9	10	11	10
25–29	13	11	8	4	7	11	4	4	5	8
30–34	10	11	10	16	7	7	12	7	9	7
35–39	9	9	8	12	10	10	6	7	4	10
40–44	10	6	9	2	13	12	3	9	9	9
45–49	8	10	6	4	9	9	9	15	8	6
50–54	6	5	4	2	2	4	4	8	7	4
55–59	4	8	11	10	4	7	5	9	6	4
60–64	16	10	10	4	9	9	14	8	7	9
65–69	12	8	12	3	8	6	9	8	6	6
70–74	2	10	12	8	4	8	9	7	8	11
75–79	3	4	7	6	7	9	4	9	10	11
80–84	4	5	6	6	5	1	2	3	5	9
85–89	2	—	3	—	4	1	3	2	4	4
90–94	—	1	1	—	—	—	1	1	—	1
95+	—	—	—	—	—	—	—	1	1	1
Totals	256	288	339	249	274	297	285	309	279	294

Mean = 2870/10 = 287.0.

Table 5. Infant death rate and percent of all deaths due to early childhood deaths on Guam, 1903–1912.

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	Σ
Deaths (age <1)	79	83	85	72	95	102	98	84	95	83	876
Births	527	485	456	528	520	554	549	538	525	561	5,243
Infant death rate	15.0	17.1	18.6	13.6	18.3	18.4	17.9	15.6	18.1	14.8	16.7
Deaths (age 0–4)	129	130	164	190	140	160	182	168	180	162	1,605
Total deaths	256	288	339	249	274	297	285	309	279	294	2,870
Percent early childhood deaths	50.4	45.1	48.4	76.3	51.1	53.9	63.9	54.4	64.5	55.1	55.9

consistent excess of births ensured a slow rate of overall increase where the infant death rate averaged nearly 17, and the per cent of all deaths ascribable to deaths in early childhood (0–5) averaged more than 50 per year over this 10-year period (Table 5). Following Barclay (1958), this rate is calculated as the ratio of infant deaths to births for the same recording year.

Sample Materials and Results

A sample of 321 recorded death certificates was selected for analysis from the total death records for the period November 7 through December 9, 1918, based on the availability of complete and multiply-verified family records for each of the selected individuals. The age-sex distribution for the sample is shown in Table 6.

In comparison to average mortality patterns for 1903 through 1912, several notable differences can be summarized:

(1) infant deaths for the sample constituted a much smaller percentage (7.5 per cent) of total deaths as compared with an average 30.7 per cent for 1903–1912;

(2) 30.2 per cent of all epidemic period deaths in this sample occurred among persons aged 15–49 years, in contrast to an average 19.8 per cent among these age groups for 1903–1912;

(3) there was an increase in the percentage of all deaths among those aged 50 years and above (10.0 per cent in 1903–12 and 16.8 per cent in the 1918 sample).

There is no real difference between the sex ratio (96.9) for the 1918 sample and the average sex ratio (100.8) of all deaths for the period 1903 through 1912.

Among sample adults aged 20–49 at the time of death in 1918, 37, or 77.1 per cent of males, and 15, or 33.3 per cent of females were married. These figures probably understimate the number of adults in *de facto* marital unions, especially among younger cohorts. Among 30 unwed females, 6, or 20.0 per cent had previously delivered at least one child. A breakdown of marital status by 10-year age group is shown in Table 7.

Discussion

In all societies, the effects of epidemic mortality on subsequent fertility would expectably differ between and among cohorts or cohort groups. For example, there would be no expectable direct effects on subsequent fertility as a result of deaths among women after menopause. However, indirect effects could result if the disruption of existing sexual/marital unions were promptly followed by the re-marriage of surviving widowers to women in younger, reproductively-effective age groups. A summary of major expectable effects, specific to Guam, of 1918 epidemic mortality on subsequent fertility, by 10-year age groups, is shown in Table 8.

In earlier studies I found mean age at first marriage for males born in 1897 of

Table 6. Deaths by age and sex groupings on Guam, November 7–December 9, 1918.

Age group	Sample (N = 321)		
	Males	Females	Σ
<1 year N	10	14	24
%	6.3	8.6	7.5
1–4	34	41	75
	21.5	25.1	23.4
Σ0–4	(44)	(55)	(99)
	27.8	33.7	(30.8)
5–9	9	8	17
	5.7	4.9	5.3
10–14	3	4	7
	1.9	2.5	2.2
15–19	3	1	4
	1.9	0.6	1.2
20–24	7	5	12
	4.4	3.1	3.7
25–29	3	5	8
	1.9	3.1	2.5
30–34	4	7	11
	2.5	4.3	3.4
35–39	12	6	18
	7.6	3.7	5.6
40–44	7	10	17
	4.4	6.1	5.3
45–49	15	12	27
	9.5	7.4	8.4
50–54	7	8	15
	4.4	4.9	4.7
55–59	14	5	19
	8.9	3.1	5.9
60–64	7	6	13
	4.4	3.7	4.0
65+	23	31	54
	14.6	19.0	16.8
Σ	(158)	(163)	(321)
	99.9	100.1	99.9

Table 7. Current marital status at time of death in Guamanian sample, November–December 1918.

Age group (in years)	Males			Females			Σ		
	Σ	Single/ Widowed	Married	Σ	Single/ Widowed	Married	Σ	Single/ Widowed	Married
20–29	10	5	5	10	8	2	20	13	7
30–39	16	4	12	13	8	5	29	12	17
40–49	22	2	20	22	14	8	44	16	28
Totals	48	11	37	45	30	15	93	41	52

24.0 years, and 21.5 years for females born in the same year, with a mean age differential of 7.2 years between spouses. (These studies are recorded in a typed manuscript entitled "Population, history and the ethnodemography of Guam during the period of U. S. Navy administration, 1901–1941" on file at the University of Guam Micronesian Area Research Center.) Among 52 married individuals aged 20–49 at the time of death, 6, or 11.5 per cent were not survived by spouses, as these also succumbed to influenza. (These spouses are not part of the total sample of 321 deaths analyzed here.)

Of the remaining 46 surviving spouses, 8 widowers and one widow subsequently remarried, and all 8 widowers fathered children, while 3 widows gave birth to children out of wedlock. The mean time interval between spouse death and next birth for eight remarried widowers was 65.9 months and 49.7 months for three unwed widows. Since the earlier study had found an average birth interval of 31.2 months across all birth order ranks, influenza-related deaths resulted in an "equivalent offspring loss" of about one child for remarrying widowers, and slightly less than one-half child for the lesser number of surviving widows who subsequently produced liveborn offspring. Of remarrying widowers, only two were over 40 years of age in 1918, and each remarried women who were less than 7 years younger. No surviving widower aged 50+ in this sample subsequently remarried.

These findings suggest that the possible effects of influenza-related adult mortality on subsequent fertility in Guam were minimized by several factors, including prevailing demographic and cultural patterns, such as long-observed high rates of illegitimacy (Cox, 1910) continuing patterns of widower-remarriage, and the continuing presence of significant number of never-married females in this population. Among 46 marriages terminated by the death of one spouse, eleven survivors (24 per cent) subsequently produced offspring. Further, as a proportion of the influenza-related deaths may represent "premature deaths," as reflected in the decreased total number of deaths for the succeeding three years, perhaps only half of the deaths among sample adults represent losses specific to the 1918 influenza epidemic. In any case, the number of births reported for 1920 (661) had already

Table 8. Major expectable effects of epidemic mortality on subsequent fertility, by age-groups.

Age groups	Epidemic mortality	Expected fertility effects
0–4	Significantly lower mortality than in pre-epidemic period, especially among infants	(1) Fewer deaths to nursing infants, thus maintaining restraints of lactation on maternal fecundity. (2) Survivorship of larger cohort entering age of reproductive maturity in ca. 1934–38.
5–19	Minimal change in percentage contribution to total deaths	(1) No direct effects on subsequent fertility likely (2) Possible decrease in average age at first marriage by females as older widowed males seek mates from depleted older female cohorts.
20–29	Minimal increase (4.9%→6.2%) percentage contribution to total deaths	(1) Some pregnancies terminated by maternal deaths; some sexual/marital unions terminated by death of males and/or females, with consequent interruption or termination of further reproductive opportunity. (2) Increased opportunities for sexual/marital unions of surviving females with males of this and older cohorts, including widowers.
30–39	Significant increase (5.8%→9.0%) in percentage contribution to total deaths	(1) and (2) Same as above.
40–49	Significant increase (5.6%→13.7%) in percentage contribution to total deaths	(1) Premature termination of completed reproductive performance, particularly of males dying from influenza. (2) Extension of reproductive period for widowers who remarry younger women.
50+	Significant increase (10.0%→16.8%) in percentage contribution to total deaths	(1) No effects due to deaths among females. (2) Extension of reproductive period for widowers who remarry younger women.

exceeded the number of births, 612, reported in 1917. Similarly, McArthur (1968 : 35) recorded the rapid recovery of the Fijian and Indian groups by 1921.

Only in one other respect, beyond the scope of this paper, would fertility effects seem likely—the low percentage of total deaths among infants may have served as a constraint on reproductive performance. My earlier study noted a mean birth-spacing interval of 31.2 months for all birth orders, but 65 per cent of all births occurring within 24 months of a previous delivery followed the death of the older child. Thus, a decrease in infant mortality would act as a constraint on fertility.

The long-term genetic consequences of influenza-related mortality in adults were probably also slight. In eleven cases, at most, new sexual/marital unions allowed for

new genetic combinations in offspring born after 1918, while the interruption of existing unions which had already produced offspring by 1918 lessened the degree of genotypic variation in the population. This was, however, more than counterbalanced by the increased survival rate of infants in this growing population. Some slight advantage related to X-linked loci may have resulted from the slightly lower rate of fertility among widows after the epidemic. In summary, the microevolutionary consequences of the 1918 influenza epidemic in Guam were probably of little consequence in the history of this interesting island population.

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