

Cancer in Guam: a review of death certificates from 1971 – 1995

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Abstract

A review of data collected from the death certificates in Guam over a 25-year period suggests that cancer incidence rates on Guam have, in general, increased during this period. Cancers of the buccal cavity, liver, gallbladder, and pancreas appear to be particularly frequent on Guam among both sexes while among males cancers of the esophagus and respiratory system are common. Incidence rates for melanoma, uterine cancer and prostate cancer appear to be relatively low on Guam.

Introduction

Guam is an island territory of the United States of America located in the Western Pacific. Prior to the American liberation of Japanese-occupied Guam in 1944, the island's economy was largely agriculture based and island residents led an independent and self-sufficient existence. After World War II, most Guamanians abandoned farming for salaried jobs with the Federal or local government and a fledgling private enterprise sector.

Guam is today populated by Chamorro, the original inhabitants of the island, as well migrants from neighboring Micronesian islands, many countries of South-East Asia, the United States, and virtually every other corner of the world. Many families are also proud descendants of Spanish colonizers, fugitive sailors from passing ships, Japanese traders, or Filipino convicts and laborers. With no group consti-

tuting more than 40% of the population, today Guam is truly a multi-ethnic community.

In 1961 the basis for far-reaching changes occurred when the requirement that visitors to Guam obtain a military security clearance was suspended. Since then tourist-oriented industries have thrived, with visitor arrivals increasing from 1,975 in 1964¹ to 1,361,830 in 1995². Today not only do most of Guam's villages bear more resemblance to an American suburb than to their pre-war antecedents but island residents have adopted an American life-style.

All deaths occurring on the island of Guam are required to be registered with the Office of Vital Statistics, Guam Department of Public Health and Social Services. Physician certification of the cause of death is required if the decedent received medical treatment within seventy-two hours prior to death, otherwise the death automatically becomes a coroner's case and the cause of death must be certified by

Guam's Chief Medical Examiner³. A 1992 report by the South Pacific Commission based on hospital pathology reports calculated Guam crude and age-adjusted cancer incidence rates by sex for an 11-year period⁴. The present study is the first to compare changes in cancer incidence over time and to include analysis of incidence rates by residence and eth-

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nicity.

Methods

All death certificates filed with the Office of Vital Statistics, Guam Department of Public Health and Social Services, from 1971 through 1995 were reviewed (11,120 certificates). All cases of cancer mentioned on certificates were counted regardless of whether or not they were coded as the cause of death (approximately 8% of the cancer cases included in this study had not been coded as the official cause of death). Data in this study therefore represents cancer-associated deaths rather than only those deaths that were officially attributed to cancer. Information collected from death certificates included the sex, date of birth and date of death of decedent,

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Table 1. Total cases and mean annual crude incidence rates for cancer-associated deaths, by site and sex, Guam, 1971-1995

Site	Male		Female	
	Total cases	Incidence rate*	Total cases	Incidence rate*
1. ALL SITES	985	65.72	596	44.05
2. BUCCAL CAVITY & PHARYNX	60	4.00	38	2.82
3. Lip	0	0.00	1	0.07
4. Tongue	10	0.67	4	0.30
5. Salivary gland	0	0.00	2	0.15
6. Floor of mouth	0	0.00	0	0.00
7. Gum and other mouth	9	0.60	16	1.18
8. Oropharynx	5	0.33	3	0.22
9. Nasopharynx	34	2.27	9	0.67
10. Hypopharynx	2	0.13	1	0.07
11. DIGESTIVE SYSTEM	261	17.40	126	9.31
12. Esophagus	29	1.93	5	0.37
13. Stomach	32	2.13	24	1.77
14. Small intestine	4	0.27	2	0.15
15. Colon	49	3.27	30	2.22
16. Rectum & anus	31	2.07	9	0.67
17. Liver	69	4.60	26	1.92
18. Gallbladder	7	0.47	14	1.03
19. Pancreas	37	2.47	15	1.11
20. RESPIRATORY SYSTEM	367	24.46	107	7.91
21. Larynx	20	1.33	1	0.07
22. Lung & bronchus	342	22.80	103	7.61
23. BONES AND JOINTS	2	0.13	3	0.22
24. SOFT TISSUE (INCL HEART)	8	0.53	3	0.22
25. SKIN (EX. BASAL & SQUA.)	8	0.53	5	0.37
26. Melanomas of the skin	6	0.40	5	0.37
27. BREAST	2	0.13	99	7.32
28. FEMALE GENITAL SYSTEM	-	-	93	6.87
29. Cervix uteri	-	-	41	3.03
30. Corpus uteri	-	-	10	0.74
31. Uterus, NOS	-	-	9	0.67
32. Ovary	-	-	31	2.29
33. MALE GENITAL SYSTEM	88	5.87	-	-
34. Prostate	83	5.53	-	-
35. Testis	2	0.13	-	-
36. Penis	3	0.20	-	-
37. URINARY SYSTEM	35	2.33	10	0.74
38. Bladder	23	1.53	5	0.37
39. Kidney & ureter	12	0.80	5	0.37
40. EYE	0	0.00	0	0.00
41. NERVOUS SYSTEM	20	1.33	12	0.89
42. Brain	20	1.33	12	0.89
43. ENDOCRINE SYSTEM	4	0.27	7	0.52
44. Thyroid gland	4	0.27	7	0.52
45. LYMPHOMAS	20	1.33	13	0.96
46. Hodgkin's disease	2	0.13	0	0.00
47. Non-Hodgkin's	14	0.93	9	0.67
48. MULTIPLE MYELOMA	14	0.93	9	0.67
49. LEUKEMIAS	39	2.60	22	1.63
50. Lymphoid leukemia	5	0.33	6	0.44
51. Myeloid leukemia	20	1.33	12	0.89
52. Other leukemia	14	0.93	4	0.30
53. ILL-DEFINED OR UNKNOWN	51	3.40	47	3.47
54. CANCER IN SITU	0	0.00	2	0.15

* Mean annual cases per 100,000 population, not age-adjusted.

**Table 2. Age-adjusted incidence rates for cancer-associated deaths,
by site and sex, Guam, 1971-1995**

Site	Males		Females		
	U.S. Adj. (1)	W.H.O. Adj. (2)	Site	U.S. Adj. (1)	W.H.O. Adj. (2)
1. ALL SITES	180.21	133.49			
2. BUCCAL CAVITY & PHARYNX	8.98	7.18		7.12	5.15
3. Lip	0.00	0.00		0.25	0.13
4. Tongue	1.60	1.21		1.17	0.84
5. Salivary gland	0.00	0.00		0.18	0.16
6. Floor of mouth	0.00	0.00		0.00	0.00
7. Gum and other mouth	1.52	1.21		3.38	2.30
8. Oropharynx	0.91	0.70		0.60	0.47
9. Nasopharynx	4.56	3.75		1.25	1.13
10. Hypopharynx	0.39	0.31		0.30	0.13
11. DIGESTIVE SYSTEM	52.52	37.36		23.14	16.46
12. Esophagus	6.15	4.13		0.86	0.70
13. Stomach	8.31	5.73		3.68	2.94
14. Small intestine	0.45	0.50		0.40	0.29
15. Colon	9.91	6.81		5.78	3.84
16. Rectum & anus	6.88	4.61		1.43	1.09
17. Liver	11.48	8.65		4.86	3.52
18. Gallbladder	1.88	1.36		2.91	1.99
19. Pancreas	6.85	5.16		2.93	1.98
20. RESPIRATORY SYSTEM	59.73	47.10		17.36	14.09
21. Larynx	3.01	2.38		0.21	0.16
22. Lung & bronchus	56.10	44.17		16.61	13.53
23. BONES AND JOINTS	0.28	0.22		0.45	0.31
24. SOFT TISSUE (INCL HEART)	1.02	0.80		0.37	0.37
25. SKIN (EX. BASAL & SQUA.)	2.26	1.48		0.75	0.58
26. Melanomas of the skin	0.98	0.70		0.75	0.58
27. BREAST	0.83	0.59		15.57	12.17
33. GENITAL SYSTEM	24.38	15.66	28. GENITAL SYSTEM	14.11	11.23
34. Prostate	23.74	15.88	29. Cervix uteri	5.93	4.83
35. Testis	0.14	0.13	30. Corpus uteri	1.39	1.18
36. Penis	0.50	0.34	31. Uterus, NOS	1.38	1.09
			32. Ovary	4.98	3.81
37. URINARY SYSTEM	7.15	5.11		1.72	1.28
38. Bladder	4.52	3.15		0.86	0.61
39. Kidney & ureter	2.63	1.97		0.85	0.67
40. EYE	0.00	0.00		0.00	0.00
41. NERVOUS SYSTEM	2.45	1.96		1.09	0.97
42. Brain	2.45	1.96		0.85	0.72
43. ENDOCRINE SYSTEM	0.38	0.34		1.36	0.98
44. Thyroid gland	0.21	0.19		1.36	0.98
45. LYMPHOMAS	2.71	2.18		1.99	1.46
46. Hodgkin's disease	0.09	0.10		0.00	0.00
47. Non-Hodgkin's	1.82	1.56		1.54	1.07
48. MULTIPLE MYELOMA	2.70	1.94		1.96	1.41
49. LEUKEMIAS	5.42	4.27		3.16	2.46
50. Lymphoid leukemia	0.48	0.45		0.70	0.64
51. Myeloid leukemia	2.72	2.21		1.60	1.17
52. Other leukemia	2.22	1.61		0.86	0.64
53. ILL-DEFINED OR UNKNOWN	8.43	6.60		7.53	5.72
54. CANCER IN SITU	0.00	0.00		0.51	0.29

1. Mean annual incidence rate age-adjusted to the 1970 U.S. population. Ref. 8.

2. Mean annual incidence rate age-adjusted to the W.H.O. standard population. Ref 9.

Table 3. Cancer-associated deaths and crude incidence rates by site and 5-year periods, Males, Guam, 1971-1995

Site	Year-Groups				
	1971 - 75	1976 - 80	1981 - 85	1986 - 90	1991 - 95
1. ALL SITES	222.07	256.93	317.85	350.32	388.28
2. BUCCAL CAVITY	7.86	19.36	8.36	29.44	26.06
3. Lip	0.00	0.00	0.00	0.00	0.00
4. Tongue	1.97	3.52	0.00	5.89	3.91
5. Sal. gland	0.00	0.00	0.00	0.00	0.00
6. Floor of mouth	0.00	0.00	0.00	0.00	0.00
7. Gum, oth. mouth	0.00	5.28	1.67	5.89	1.30
8. Oropharynx	1.97	1.76	0.00	1.47	2.61
9. Nasopharynx	3.93	8.80	5.02	16.19	16.94
10. Hypopharynx	0.00	0.00	1.67	0.00	1.30
11. DIGESTIVE SYS.	53.06	72.15	90.34	82.43	108.14
12. Esophagus	7.86	8.80	10.04	10.30	9.12
13. Stomach	3.93	7.04	18.40	7.36	13.03
14. Small Intest.	1.97	1.76	0.00	1.47	1.30
15. Colon	7.86	7.04	10.04	22.08	26.06
16. Rectum, anus	5.90	10.56	10.04	8.83	13.03
17. Liver	13.76	24.64	26.77	19.14	24.76
18. Gallbladder	1.97	1.76	1.67	1.47	3.91
19. Pancreas	7.86	8.80	13.38	11.78	15.64
20. RESPIRATORY SYS.	76.64	87.99	132.16	136.89	138.11
21. Larynx	9.83	12.32	5.02	2.94	3.91
22. Lung & bronchus	62.89	75.67	125.47	133.95	131.60
23. BONES, JOINTS	0.00	0.00	0.00	0.00	2.61
24. SOFT TISSUE	0.00	3.52	1.67	2.94	3.91
25. SKIN	7.86	5.28	0.00	8.83	1.30
26. Melanomas	5.90	0.00	0.00	4.42	0.00
27. BREAST	0.00	0.00	1.67	0.00	1.30
33. MALE GENITALS	21.62	17.60	26.77	32.38	37.79
34. Prostate	21.62	15.84	25.09	29.44	36.48
35. Testis	0.00	1.76	0.00	0.00	1.30
36. Penis	0.00	0.00	1.67	2.94	0.00
37. URINARY SYSTEM	5.90	14.08	10.04	13.25	11.73
38. Bladder	5.90	7.04	8.36	10.30	5.21
39. Kidney, ureter	0.00	7.04	1.67	2.94	6.51
40. EYE	0.00	0.00	0.00	0.00	0.00
41. NERVOUS SYS	3.93	7.04	6.69	5.89	7.82
42. Brain	3.93	7.04	6.69	5.89	7.82
43. ENDOCRINE SYS	0.00	1.76	1.67	1.47	1.30
44. Thyroid gland	0.00	1.76	0.00	1.47	0.00
45. LYMPHOMAS	5.90	0.00	6.69	4.42	13.03
46. Hodgkin's	3.93	0.00	0.00	0.00	0.00
47. Non-Hodgkin's	0.00	0.00	6.69	2.94	10.42
48. MULTIPLE MYELOMA	9.83	1.76	1.67	4.42	5.21
49. LEUKEMIAS	17.69	12.32	13.38	8.83	11.73
50. Lymphoid	1.97	1.76	1.67	2.94	0.00
51. Myeloid	9.83	5.28	8.36	5.89	3.91
52. Other	5.90	5.28	3.35	0.00	7.82
53. ILL-DEFINED, UNKNOWN	11.79	14.08	16.73	19.14	18.24
54. CANCER IN SITU	0.00	0.00	0.00	0.00	0.00

Table 4. Cancer-associated deaths and crude incidence rates by site and 5-year periods, Females, Guam, 1971-1995

Site	Year-Groups				
	1971 - 75	1976 - 80	1981 - 85	1986 - 90	1991 - 95
1. ALL SITES	217.64	166.10	223.95	238.24	249.42
2. BUCCAL CAVITY	24.73	8.86	11.10	13.33	14.76
3. Lip	0.00	0.00	0.00	1.67	0.00
4. Tongue	2.47	2.21	1.85	1.67	2.95
5. Sal. gland	0.00	0.00	1.85	0.00	1.48
6. Floor of mouth	0.00	0.00	0.00	0.00	0.00
7. Gum, oth. mouth	17.31	4.43	5.55	6.66	0.00
8. Oropharynx	0.00	0.00	1.85	0.00	2.95
9. Nasopharynx	4.95	2.21	0.00	3.33	5.90
10. Hypopharynx	0.00	0.00	0.00	0.00	1.48
11. DIGESTIVE SYS.	46.99	31.01	51.82	44.98	56.08
12. Esophagus	0.00	0.00	1.85	1.67	4.43
13. Stomach	13.33	13.28	4.95	2.21	7.40
14. Small intest.	2.47	2.21	0.00	0.00	0.00
15. Colon	12.37	8.86	14.81	8.33	11.81
16. Rectum, anus	0.00	6.64	1.85	1.67	5.90
17. Liver	14.84	4.43	12.96	8.33	8.86
18. Gallbladder	7.42	6.64	1.85	5.00	5.90
19. Pancreas	4.95	0.00	9.25	6.66	5.90
20. RESP. SYS.	32.15	17.72	46.27	58.31	38.37
21. Larynx	2.47	0.00	0.00	0.00	0.00
22. Lung & bron.	24.73	17.72	44.42	58.31	38.37
23. BONES, JOINTS	7.42	0.00	0.00	0.00	0.00
24. SOFT TISSUE	0.00	0.00	0.00	1.67	2.95
25. SKIN	0.00	2.21	3.70	1.67	1.48
26. Melanomas	0.00	2.21	3.70	1.67	1.48
27. BREAST	32.15	31.01	33.31	41.65	42.80
28. FEMALE GENITALS	17.31	33.22	37.02	39.98	39.85
29. Cervix uteri	4.95	13.29	12.96	19.99	20.66
30. Corpus uteri	2.47	4.43	5.55	3.33	2.95
31. Uterus, NOS	0.00	4.43	1.85	0.00	8.86
32. Ovary	9.89	11.07	16.66	14.99	5.90
37. URINARY SYSTEM	4.95	6.64	0.00	5.00	2.95
38. Bladder	4.95	2.21	0.00	1.67	1.48
39. Kidney, ureter	0.00	4.43	0.00	3.33	0.00
40. EYE	0.00	0.00	0.00	0.00	0.00
41. NERVOUS SYS	12.37	0.00	5.55	1.67	4.43
42. Brain	4.95	0.00	5.55	1.67	4.43
43. ENDOCRINE SYS	2.47	4.43	1.85	3.33	1.48
44. Thyroid gland	2.47	4.43	1.85	3.33	1.48
45. LYMPHOMAS	7.42	0.00	1.85	3.33	10.33
46. Hodgkin's	0.00	0.00	0.00	0.00	0.00
47. Non-Hodgkin's	0.00	0.00	1.85	3.33	8.86
48. MULTIPLE MYELOMA	2.47	0.00	3.70	6.66	2.95
49. LEUKEMIAS	12.37	4.43	9.25	5.00	8.86
50. Lymphoid	0.00	2.21	3.70	3.33	1.48
51. Myeloid	9.89	0.00	5.55	1.67	5.90
52. Other	2.47	4.43	0.00	0.00	1.48
53. ILL-DEFINED, UNKNOWN	12.37	24.36	18.51	10.00	22.14
54. CANCER IN SITU	2.47	0.00	0.00	1.67	0.00

Table 5. Mean annual crude and age-adjusted cancer-associated death incidence rates and incidence rankings, by sex and village, Guam 1971-1995

Village	MALES		FEMALES	
	Crude (Rank)	Adjusted (Rank)*	Crude (Rank)	Adjusted (Rank)*
Agana	122.95 (3)	126.40 (12)	108.33 (2)	110.64 (5)
Agana Heights	89.35 (7)	116.11 (15)	63.11 (8)	76.61 (12)
Agat	84.13 (8)	105.05 (19)	70.54 (6)	96.41 (6)
Asan-Maina	104.15 (5)	152.04 (6)	39.72 (14)	51.13 (18)
Barrigada	64.77 (12)	131.86 (11)	42.51 (13)	65.42 (15)
Chalan Pago-Ordot	78.26 (9)	139.63 (10)	60.82 (9)	95.83 (8)
Dededo	61.05 (14)	108.46 (17)	34.31 (16)	57.52 (17)
Inarajan	116.58 (4)	197.40 (5)	88.56 (3)	135.82 (3)
Mangilao	48.60 (15)	121.02 (14)	39.63 (15)	71.72 (14)
Merizo	145.88 (2)	231.97 (3)	86.02 (4)	118.01 (4)
Mongmong-Toto-Maite	76.50 (10)	146.54 (9)	48.73 (12)	80.22 (11)
Piti	47.88 (16)	148.02 (8)	64.76 (7)	84.43 (10)
Santa Rita	33.75 (19)	114.75 (16)	28.04 (18)	72.86 (13)
Sinajana	154.09 (1)	298.98 (1)	136.22 (1)	156.79 (2)
Talofoto	63.61 (13)	148.18 (7)	58.31 (10)	96.12 (7)
Tamuning	66.29 (11)	105.97 (18)	32.44 (17)	47.24 (19)
Umatac	40.61 (18)	208.24 (4)	82.69 (5)	217.13 (1)
Yigo	41.46 (17)	122.91 (13)	21.15 (19)	58.30 (16)
Yona	97.90 (6)	246.04 (2)	49.36 (11)	91.83 (9)

* see Ref. 9

Table 6. Total cases and crude incidence rates of cancer-associated death in males by site and ethnicity, Guam 1971-1995

SITE	MALES					
	Chamoru	Filipino	Micronesian	Caucasian	Asian	Other
1. ALL SITES	594 (94.50)	204 (63.68)	19 (60.75)	117 (63.17)	35 (34.64)	16 (7.04)
2. BUCCAL CAVITY & PHARYNX	38 (6.05)	8 (2.50)	1 (3.20)	10 (5.40)	1 (0.99)	2 (0.88)
9. Nasopharynx	24 (3.82)	6 (1.87)	1 (3.20)	1 (0.54)	1 (0.99)	1 (0.44)
11. DIGESTIVE SYSTEM	147 (23.39)	64 (19.98)	5 (15.99)	22 (11.88)	19 (18.80)	4 (1.76)
12. Esophagus	19 (3.02)	6 (1.87)	2 (6.39)	0 (0.00)	1 (0.99)	1 (0.44)
13. Stomach	18 (2.86)	6 (1.87)	0 (0.00)	1 (0.54)	6 (5.94)	1 (0.44)
15. Colon	25 (3.98)	15 (4.68)	0 (0.00)	5 (2.70)	3 (2.97)	1 (0.44)
16. Rectum-anus	14 (2.23)	7 (2.19)	1 (3.20)	6 (3.24)	2 (1.98)	1 (0.44)
17. Liver	42 (6.68)	18 (5.62)	2 (6.39)	2 (1.08)	5 (4.95)	0 (0.00)
19. Pancreas	23 (3.66)	7 (2.19)	0 (0.00)	6 (3.24)	1 (0.99)	0 (0.00)
22. LUNG AND BRONCHUS	219 (34.84)	66 (20.60)	6 (19.18)	37 (19.98)	8 (7.92)	6 (2.64)
34. PROSTATE	56 (8.91)	14 (4.37)	0 (0.00)	11 (5.94)	1 (0.99)	1 (0.44)
37. URINARY SYSTEM	22 (3.50)	7 (2.19)	1 (3.20)	3 (1.62)	1 (0.99)	1 (0.44)
38. Bladder	16 (2.55)	5 (1.56)	0 (0.00)	1 (0.54)	0 (0.00)	1 (0.44)
42. BRAIN	11 (1.75)	3 (0.94)	0 (0.00)	3 (1.62)	3 (2.97)	0 (0.00)
45. LYMPHOMAS	10 (1.59)	9 (2.81)	0 (0.00)	1 (0.54)	0 (0.00)	0 (0.00)
49. LEUKEMIAS	25 (3.98)	10 (3.12)	0 (0.00)	4 (2.16)	0 (0.00)	0 (0.00)
51. Myeloid leukemia	10 (1.59)	7 (2.19)	0 (0.00)	3 (1.62)	0 (0.00)	0 (0.00)
53. ILL-DEFINED OR UNKNOWN	27 (4.30)	10 (3.12)	2 (6.39)	10 (5.40)	1 (0.99)	1 (0.44)

Table 7. Total cases and crude incidence rates of cancer-associated death in females, by site and ethnicity, Guam, 1971-1995

Site	FEMALES					
	Chamoru	Filipino	Micronesian	Caucasian	Asian	Other
1. ALL SITES	436 (66.42)	83 (27.41)	11 (38.00)	37 (32.66)	27 (34.91)	2 (1.16)
2. BUCCAL CAVITY & PHARYNX	32 (4.88)	2 (0.66)	1 (3.45)	3 (2.65)	0 (0.00)	0 (0.00)
9. Nasopharynx	9 (1.37)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
11. DIGESTIVE SYS	92 (14.02)	15 (4.95)	3 (10.36)	5 (4.41)	11 (14.22)	0 (0.00)
12. Esophagus	2 (0.30)	1 (0.33)	1 (3.45)	0 (0.00)	1 (1.29)	0 (0.00)
13. Stomach	16 (2.44)	5 (1.65)	1 (3.45)	0 (0.00)	2 (2.59)	0 (0.00)
15. Colon	21 (3.20)	2 (0.66)	0 (0.00)	4 (3.53)	3 (3.88)	0 (0.00)
16. Rectum-anus	7 (1.07)	0 (0.00)	0 (0.00)	0 (0.00)	2 (2.59)	0 (0.00)
17. Liver	19 (2.89)	3 (0.99)	1 (3.45)	0 (0.00)	3 (3.88)	0 (0.00)
19. Pancreas	12 (1.83)	2 (0.66)	0 (0.00)	1 (0.88)	0 (0.00)	0 (0.00)
22. LUNG & BRONCHUS	83 (12.64)	9 (2.97)	2 (6.91)	6 (5.30)	2 (2.59)	1 (0.58)
27. BREAST	70 (10.66)	14 (4.62)	0 (0.00)	12 (10.59)	3 (3.88)	0 (0.00)
29. CERVIX UTERI	24 (3.66)	9 (2.97)	1 (3.45)	2 (1.77)	5 (6.46)	0 (0.00)
32. OVARY	20 (3.05)	5 (1.65)	0 (0.00)	3 (2.65)	3 (3.88)	0 (0.00)
37. URINARY SYSTEM	4 (0.61)	4 (1.32)	0 (0.00)	2 (1.77)	0 (0.00)	0 (0.00)
38. Bladder	2 (0.30)	1 (0.33)	0 (0.00)	2 (1.77)	0 (0.00)	0 (0.00)
42. BRAIN	6 (0.91)	2 (0.66)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
45. LYMPHOMAS	8 (1.22)	2 (0.66)	1 (3.45)	1 (0.88)	1 (1.29)	0 (0.00)
49. LEUKEMIAS	15 (2.29)	5 (1.65)	0 (0.00)	2 (1.77)	0 (0.00)	0 (0.00)
53. ILL-DEFINED OR UNKNOWN	36 (5.48)	6 (1.98)	2 (6.91)	1 (0.88)	2 (2.59)	0 (0.00)

where decedent was born and residence at time of death, and decedent's race, ethnicity and occupation.

Population figures used to calculate the incidence rates presented in this study were obtained by exponential projections based on data in 1980 and 1990 Guam census publications and annual reports of the Office of Vital Statistics, Guam Department of Public Health and Social Services⁵⁻⁷.

Results

Table 1 presents the mean annual crude cancer incidence rates for Guam residents by gender and site of cancer. Cancer rates were nearly 50% higher for males than females overall and were substantially higher for many specific sites. Cancer of the respiratory system, the most common site of cancer in both sexes on Guam, was more than 3 times more common in males than in females. The incidence of cancer of the larynx was 19 times greater in men than in women. Exceptions to the general trend of cancer being more common in males than in females include, of course, breast cancer as well as salivary gland cancer, cancer of "Gum and other mouth," gallbladder cancer and cancer of the thyroid gland. The incidence rate of cancers of the female genital system was also slightly higher than the rate for male genital system cancers.

Guam has a relatively young population. Because, with certain exceptions, cancers are most likely to affect older persons, areas with especially young populations can logically be expected to have low cancer incidence rates. To make valid comparisons of cancer incidence rates between countries whose populations may differ greatly with respect to their age composition, it is common to adjust local rates to what they would be if they occurred in a "standard" population. Two commonly used standard populations are the US 1970 population⁸ and the World Health Organization standard population⁹. When Guam cancer incidence rates are age-adjusted they increase substantially, particularly with reference to the more mature US population (Tables 2)⁸.

When trends in cancer incidence on Guam are compared by 5-year periods, it is clear that they are, in general, increasing among both males and females (Table 3 and 4). Among males, cancer of the nasopharynx and digestive system (especially colon) have increased over the period of the study while bladder cancer and myeloid leukemia have apparently decreased. After increasing during the period 1971-90, cancers of the lung and bronchus may have stabilized or started to decrease in both males and females.

Non-Hodgkin's lymphoma has apparently increased in incidence among both males and females over the last 25 years. Common cancer sites among women include the

Table 8. Comparison of age-adjusted cancer incidence rates in Guam, Hawaii, California, and the United States

SITE	MALES				SITE	FEMALES			
	Guam*	Hawaii**	California**	U.S.**		Guam*	Hawaii**	California*	U.S.*
1. ALL SITES	360.4	399.8	458.0	454.0		196.4	302.4	340.5	332.9
2. BUCCAL CAV.	17.7	15.1	15.4	14.9		14.2	5.7	6.4	5.9
3. Lip	0.0	0.9	2.1	1.9		0.5	0.3	0.3	0.3
4. Tongue	3.2	2.6	3.1	3.1		2.3	1.4	1.4	1.3
5. Sal. gland	0.0	1.0	1.3	1.2		0.4	0.7	0.7	0.7
6. Floor of mouth	0.0	1.4	1.4	1.5		0.0	0.6	0.7	0.6
7. Gum, other mouth	3.0	1.7	2.3	2.2		6.8	1	1.4	1.2
8. Oropharynx	1.8	0.6	0.5	0.5		1.2	0.2	0.2	0.2
9. Nasopharynx	9.1	2.5	1.1	0.8		2.5	0.7	0.4	0.4
10. Hypopharynx	0.8	2.2	1.5	1.6		0.6	0.5	0.4	0.4
11. DIGESTIVE SYS.	105.0	109.9	91.0	93.1		46.3	66.8	59.4	60.1
12. Esophagus	12.3	5.9	5.5	6.3		1.7	1.2	1.8	1.8
13. Stomach	16.6	20.4	11.5	10.5		7.4	11.7	5.2	4.6
14. Small intestine	0.9	1.3	1.4	1.4		0.8	0.8	0.9	1.0
15. Colon	19.8	40.7	36.5	40.2		11.6	28.3	27.0	29.8
16. Rectum, anus	13.8	20.4	17.4	18.3		2.9	10.3	11.3	11.2
17. Liver	23.0	8.8	5.3	4.0		9.7	3.1	2.1	1.6
18. Gallbladder	3.8	1.0	0.7	0.7		5.8	1.4	1.3	1.3
19. Pancreas	13.7	9.0	10.3	9.6		5.9	7.9	7.9	7.2
20. RESPIRATORY SYS.	119.5	69.3	87.2	91.9		34.7	31.2	46.4	43.1
21. Larynx	6.0	5.1	7.1	8.3		0.4	0.8	1.5	1.8
22. Lung, bronchus	112.2	61.8	77.3	80.9		33.2	29.0	44.1	40.5
23. BONES, JOINTS	0.6	1.0	1.0	1.0		0.9	0.6	0.8	0.8
24. SOFT TISSUE	2.0	3.0	2.7	2.7		0.7	1.9	1.9	1.9
25. SKIN	4.5	14.2	22.4	15.8		1.5	7.1	9.7	8.6
26. Melanomas	2.0	9.2	13.4	11.3		1.5	5.5	8.7	7.7
27. BREAST	1.7	0.7	0.8	0.9		31.1	96.4	107.4	105.6
33. GENITALS	48.8	110.5	133.0	129.7	28. GENITALS	28.2	42.7	48.3	47.5
34. Prostate	47.5	106.1	127.8	124.5	29. Cervix uteri	11.9	9.3	9.9	9.6
35. Testis	0.3	3.7	4.3	4.2	30. Corpus uteri	2.8	17.8	20.2	20.0
36. Penis	1.0	0.4	0.7	0.7	31. Uterus, NOS	2.8	0.3	0.3	0.5
					32. Ovary	10.0	13.1	15.0	14.4
37. URINARY SYSTEM	14.3	27.5	41.3	43.7		3.4	8.7	13.3	14.2
38. Bladder	9.0	17.1	28.9	30.6		1.7	4.9	7.3	7.7
39. Kidney, ureter	5.3	10.2	11.9	12.7		1.7	3.7	5.8	6.3
40. EYE	0.0	0.3	0.9	0.9		0.0	0.4	0.7	0.6
41. NERVOUS SYS.	4.9	5.0	7.1	7.0		2.2	2.8	5.1	5.1
42. Brain	4.9	4.3	6.7	6.6		1.7	2.6	4.7	4.7
43. ENDOCRINE SYS.	0.8	4.6	3.2	3.0		2.7	12.2	6.8	6.2
44. Thyroid gland	0.4	3.5	2.5	2.3		2.7	11.6	6.4	5.7
45. LYMPHOMAS	5.4	16.1	20.5	19.4		4.0	10.5	13.0	13.9
46. Hodgkin's	0.2	1.9	2.8	3.1		0.0	1.8	2.1	2.3
47. Non-Hodgkin's	3.6	14.2	17.7	16.3		3.1	8.7	10.9	11.0
48. MULTIPLE MYELOMA	5.4	3.9	5.1	4.8		3.9	2.1	3.3	3.3
49. LEUKEMIAS	10.4	10.0	12.8	11.9		6.3	5.6	7.6	7.2
50. Lymphoid	1.0	3.4	5.6	5.4		1.4	2.2	3.3	3.1
51. Myeloid	5.4	3.4	4.1	3.7		3.2	2.3	2.6	2.5
52. Other	4.4	3.1	3.0	2.9		1.7	1.0	1.6	1.6
53. ILL-DEFINED, UNK.	16.9	9.0	13.6	13.2		15.1	7.8	10.5	9.7
54. CANCER IN SITU	0.0	0.0	0.1	0.1		1.0	41.7	50.7	46.5

* Guam site-specific cancer-associated death rates age-adjusted to the 1970 U.S. population and multiplied by a factor of 2 (see text and Ref. 8).

esophagus, soft tissues, and the uterus and cervix, while most digestive system sites have been responsible for fewer cancers among women or have remained relatively stable.

Over the period studied the village of Sinajana has experienced the highest incidence of cancer among both males and females (Table 5). The lowest general incidence of cancer occurred in Santa Rita (males) and Yigo (females). Among males, cancers of the buccal cavity and the nasopharynx were highest for residents of the village of Talofofo while among females the same cancers occurred with the highest incidence in Umatac and Talofofo, respectively. For digestive system cancers, incidence rates for males were highest in Sinajana and highest for females in Agana.

For cancers of the lung and bronchus, unadjusted incidence rates were highest among male residents of Merizo and female residents of Sinajana. Males living in Umatac had the highest incidence of colon cancer as did females living in Asan-Maina. For males, the incidence of lymphomas and leukemias were highest in Asan-Maina and Merizo, respectively, while for females these cancers were highest in the villages of Umatac and Sinajana respectively.

Because of the differences in the age composition of Guam's villages the mean annual incidence rates were age-adjustment to the W.H.O. standard population was performed for each village for total cancers (Table 5). This resulted in considerable shuffling of the village rankings with respect to cancer incidence; notably, females of Sinajana village no longer had the highest incidence of cancer. In contrast, Yigo and Santa Rita, with high military populations, both had higher incidence rates after age-adjustment.

When total cancer incidence was analyzed by sex and ethnicity (Tables 6 and 7), it was noted that males of all ethnic groups except "Asian" had higher rates than females. Both male and female Chamorus appear to have significantly higher rates of cancer than other ethnic groups on Guam. Chamoru males have experienced particularly high rates of cancer of the buccal cavity, nasopharyngeal cancer and liver cancer. High liver cancer rates among Chamorus are shared with the island's Filipino, Micronesian and Asian populations, probably due to the high incidence of Hepatitis B in all of these groups. Micronesians of both sexes also appear to have a high incidence of esophageal cancer; Micronesian females may have a high incidence of stomach cancer and lymphoma as well. Asian females appear to have a high incidence of cervical cancer, Asian males apparently have high stomach cancer rates. Filipino males living on Guam experienced a high incidence of lymphoma and myeloid leukemia.

An earlier report estimated that death registration captures only 50% of the cancer actually being diagnosed on Guam;⁴ for this reason Guam age-adjusted cancer rates were multiplied by a factor of 2 for comparison with cancer rates reported by areas with established cancer registries (Table 8)⁸. Cancers with notably higher incidence on Guam than in Hawaii, California or the US using this method included cancers of the buccal cavity, liver, gallbladder, and pancreas (both sexes), and the esophagus and respiratory system (males only), while melanoma, uterine cancer and prostate cancer rates were lower.

Discussion

Because of Guam's relatively small population, any conclusions based on these statistics must be interpreted with caution as the effect of random variation on annual changes is likely to be substantial. Another serious shortcoming of the present report is that data from sources other than death registration were not included since they were not consistently available for the period studied. Future studies should

attempt to integrate Guam's death registration statistics with data from pathology laboratories, health care providers and service agencies to provide a more definitive estimate of the true incidence of cancer on Guam.

Diagnoses reported on death certificates may or may not have been confirmed by

pathologic studies. Although the physician treating patients during the terminal stages of an illness would presumably be best qualified to specify the cause of death as well as any concurrent conditions such as cancer, inclusion of laboratory results in the data base of future studies may improve accuracy as well as increase the number of study subjects.

Guam does not have a tertiary-level medical facility and island residents are frequently referred off-island for medical care not available locally. As a result some deaths that would otherwise be recorded on Guam are, instead, recorded in medical referral centers including Hawaii, California or the Philippines. While this factor tends to reduce Guam cancer rates, future inclusion of data from sources other than death certificates would help correct for this factor.

Another weakness of this study is that the residence data recorded at the time of death may not be indicative of the location where decedents were exposed to carcinogenic factors during their lifetime. Major dislocations of Guam's population occurred during and after World War II and today some persons may change their residence upon retirement or when it becomes difficult to live independently. These factors could be taken into account if more detailed informa-

“ Future studies should attempt to integrate Guam's death registration statistics with data from pathology laboratories, health care providers and service agencies... ”

tion is collected regarding residence history of all cancer cases.

The chewing of betel nut (fruit of the *Areca catechu* palm) has long been a practice of many Micronesian cultures, including the Chamorus. A previous study based on clinical examination of senior citizens on Guam for oral lesions suggested that this habit was associated with a risk of developing oral cancer comparable to that due to tobacco use¹⁰. In view of the continued high incidence of oral cancer on Guam, particularly among those ethnic groups that use betel nut, it seems reasonable to at least discourage the adoption of this habit by young people.

It has been estimated that hepatitis B virus infection may be responsible for up to 80% of liver cancer cases occurring worldwide¹¹. Not surprisingly, the incidence of Hepatitis B infection on Guam¹² is highest among those ethnic groups experiencing high rates of liver cancer. The practice of universal infant vaccination for Hepatitis B holds some promise for reducing the incidence of this type of cancer.

In general it appears that the incidence of cancer on Guam is high and that it may be increasing. It is hoped that this report will encourage further research in this area and help focus island cancer prevention efforts in those areas of special need for which preventive measures may be available.

“ In view of the continued high incidence of oral cancer on Guam, particularly among those ethnic groups that use betel nut, it seems reasonable to at least discourage the adoption of this habit by young people. ”

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“ If I had my way I'd make health catching instead of disease. ”

R. G. Ingersoll (1833 - 99)