

Cancer Incidence Among Korean-American Immigrants in the United States and Native Koreans in South Korea

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Background: While previous studies demonstrated contrasting patterns of cancer risk among migrant populations from different ethnic groups in the United States, few studies have focused on the Korean-American population. This study compares cancer incidence rates between Korean-Americans, whites, and blacks in the United States and native Koreans.

Methods: Data from the Surveillance, Epidemiology, and End Results (SEER) program and International Association for Research on Cancer were used to calculate age-standardized incidence rates among whites, blacks, and Korean Americans in the United States and native Koreans.

Results: The risk of stomach, liver, gallbladder, larynx, and esophageal cancer has sharply declined in Korean-American men compared with their native counterparts while prostate, colon, and rectum cancer risk has increased. In women, stomach, liver, gallbladder, and cervical cancers have declined, and breast, lung, colon, rectum, and endometrial cancers have increased. Cancer rates for stomach, liver, gallbladder, and esophagus are higher in native Koreans compared to US whites. Recently, cancer rates for Korean-American immigrants have increased for prostate, breast, colon, and rectal cancers.

Conclusions: The study provides evidence that the risk of cancers common in Western countries is higher for Korean Americans than for their native counterparts. Recent trends among Korean Americans also revealed a stronger Western profile.

Introduction

The United States continues to attract millions of immigrants, especially from Asia. Korean Americans represent about 10.3% of the US Asian population and comprise the fifth largest Asian subgroup.¹ Few studies have focused on cancer incidence in Korean Americans. Previous investigations have concentrated on the Chinese, Japanese, and

Filipino populations in the United States and their respective native populations in Asia.²⁻¹⁷

Past epidemiologic studies have indicated possible genetic and environmental factors that contribute to the development of cancer.¹⁸⁻²¹ A study by Gomez et al²² was one of the first to compare cancer incidence between native Koreans and US Koreans. The authors used the 1988-1992 Surveillance, Epidemiology, and End Results (SEER) data for the United States and the 1986-1992 cancer registry data from Kangwha, South Korea. During 1986-1992, cancer incidence data for South Korea were reported from only one rural island county (Kangwha). This study²² showed a shifting pattern of cancer risk for Korean immigrants as they moved from their country of origin to the United States. Cancer incidence data for South Korea are now available from three major cities: Seoul, Busan, and Daegu. These cities cover approximately 34% of the South Korean population.

For this study, we compiled cancer incidence rates among Korean Americans and the native Korean population using more recent data and then compared these rates to the US white and black populations. Specifically, we calculated age-standardized cancer incidence rates for major anatomic sites among US Koreans,

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Abbreviations used in this paper: SEER = Surveillance, Epidemiology, and End Results, IC-O-2 = International Classification of Diseases for Oncology, 2nd edition, ICD-10 = International Classification of Diseases, 10th revision codes.

whites, and blacks. We also compared recent cancer incidence rates in Korean Americans to published rates from 10 years ago to examine temporal changes. The study findings provide more recent cancer incidence data for Korean-American immigrants in order to design cancer control strategies that target frequently occurring cancers in this population.

Methods

Our study used data from three sources: the SEER program for the period 1997–2002,²³ the 2000 Census,^{24,25} and Korean Cancer Registries²⁶ published by the International Agency for Research on Cancer (IARC) for the years 1993–1998. Slightly later years were selected for SEER data in order to capture more recent information for Korean Americans that is useful for cancer control purposes. The SEER program collects cancer data from 14 population-based cancer registries that cover about 26% of the US population. Participating states include Connecticut, Hawaii, Iowa, New Mexico, Utah, Alaska, California, Georgia, and metropolitan areas of Atlanta, Detroit, San Francisco-Oakland, Los Angeles, San Jose-Monterey, and Seattle. The SEER program maintains thorough quality controls to ensure accuracy of compiled data.²⁷ The population included in the SEER program is comparable to the general US population with respect to poverty, education, and social class.

Data fields obtained from SEER data sets include race, gender, age at diagnosis, year of diagnosis, histology type, and primary site of cancer. Age at diagnosis was used to calculate age-standardized incidence rates. Information on histology was utilized for converting International Classification of Diseases for Oncology, 2nd edition (ICD-O-2) to International Classification of Diseases, 10th revision codes (ICD-10). Cancer site frequencies by age, gender, and race were determined. The population at risk that was used to calculate cancer incidence rates was obtained from 2000 Census data^{24,25} for the geographical areas included in the SEER program. White (alone), black (alone) and Korean (alone) populations (regardless of Hispanic origin) were identified by gender and 5-year age groups.

The Korean cancer registries include the urban areas of Busan, Daegu, and Seoul and the agricultural area of Kangwha County in South Korea. Incidence data for these areas were assembled by the IARC, the World Health Organization, and the International Association of Cancer Registries and published in *Cancer Incidence in Five Continents*.²⁶ Kangwha County and Seoul collected data from 1993 to 1997, Busan from 1996 to 1997, and Daegu from 1997 to 1998. Varying time periods for Korean registries were used because data was available only for those specific years. Cancer data in South Korea were obtained from various hospi-

tals and cancer care facilities. Cancer reporting is completely voluntary in Korea. In addition, medical field officers visit private hospitals, clinics, and health centers to collect and review medical records and corresponding pathology reports to increase overall surveillance. All registries also collect death certificates from the National Statistics Office and use the Resident Registration Number to identify cancer cases that are not included in the registry. Cancer registries are required to maintain high standards in collecting data in order to be included in the IARC report.²⁶

The SEER program utilizes the ICD-O-2²⁸ while Korean cancer registries use ICD-10. In order to permit data comparability, ICD-O-2 codes were changed to ICD-10 codes using topography and/or morphology codes from the oncology classification system. Furthermore, only cancer sites in the SEER data set with behavior code listed as primary malignant neoplasm were included in order to match ICD-10 coding system used by Korean registries. Most categories have the same classification in ICD-O-2 and ICD-10 except for Kaposi's sarcoma, mesothelioma, lymphomas, and leukemias. The categories for these four cancer sites do not exist in ICD-O-2 and were identified using the appropriate ICD-O-2 morphology codes²⁹ and then converted to ICD-10 codes (C45, C46, C81-96). Also, melanoma of the skin is classified under neoplasms of the skin in ICD-O-2, but it is a separate category under ICD-10. Thus, melanoma of the skin was distinguished from other malignant skin neoplasms using the corresponding ICD-O-2 morphology codes and then changed to ICD-10 code.

Statistical Analysis

All primary cancer sites from the SEER data set and Korean cancer registry data in Korea were listed according to ICD-10 (Tables 1 and 2). Age-specific cancer incidence rates were calculated for whites, blacks, and Korean Americans from SEER data. The number of primary cancer cases by 5-year age intervals was divided by the person-years of observations, which is the population at risk (2000 Census population) multiplied by the number of observation years (1997–2002). Korean registries used a similar approach to calculate incidence rates as described in *Cancer Incidence in Five Continents*.²⁶ Age-standardized cancer incidence rates were calculated separately for Korean Americans, whites, and blacks using direct standardization method with the standard world population proposed by Doll.³⁰ The standard world population originated from a pooled population of 46 countries. Age-specific and age-standardized incidence rates for native Koreans were acquired from published sources and the age-standardized rates were calculated using the same standard

Table 1. — Age-Standardized Incidence Rates per 100,000 by Race for Males

ICD-10	Site	SEER Registries, 1997–2002 ²³⁻²⁵						Korean Registries, 1993–1998 ²⁶
		White		Black		Korean American		
		Rate	95% CI	Rate	95% CI	Rate	95% CI	
C01	Tongue	3.05	2.94–3.16	3.37	3.02–3.72	1.20	0.56–1.84	1.0–2.3
C03–C06	Mouth	2.33	2.23–2.43	3.66	3.29–4.02	1.08	0.45–1.71	1.0–1.5
C09	Tonsil	1.88	1.79–1.97	2.58	2.27–2.88	1.53	0.77–2.28	0.4–1.0
C15	Esophagus	5.29	5.15–5.44	7.56	7.03–8.10	2.63	1.66–3.61	7.3–10.0
C16	Stomach	7.07	6.90–7.23	11.74	11.09–12.40	30.24	26.92–33.55	66.5–72.5
C18	Colon	26.91	26.60–27.23	34.38	33.25–35.50	20.48	17.73–23.22	7.4–13.1
C19–C20	Rectum	12.83	12.61–13.06	12.08	11.41–12.75	14.12	11.85–16.39	6.8–12.6
C22	Liver	5.29	5.14–5.44	8.66	8.10–9.22	23.29	20.35–26.22	32.6–59.4
C23–C24	Gallbladder etc	1.60	1.52–1.68	1.49	1.26–1.73	4.57	3.28–5.85	7.8–9.7
C25	Pancreas	8.14	7.96–8.31	11.14	10.49–11.78	6.72	5.17–8.28	6.8–7.9
C32	Larynx	4.78	4.64–4.92	8.56	7.99–9.13	2.49	1.54–3.44	5.2–6.1
C33–C34	Trachea, bronchus, lung	50.83	50.39–51.28	78.08	76.37–79.80	34.72	31.16–38.27	44.8–51.3
C47, C49	Connective and soft tissue	2.99	2.87–3.11	2.83	2.52–3.14	1.46	0.65–2.26	0.1–0.9
C43	Melanoma of skin	19.08	18.80–19.36	0.91	0.73–1.10	0.96	0.38–1.54	0.0–0.2
C61	Prostate	117.54	116.85–118.23	190.05	187.34–192.76	29.46	26.12–32.79	5.4–8.5
C62	Testis	6.91	6.73–7.09	1.41	1.21–1.62	0.84	0.31–1.36	0.4–0.6
C64	Kidney	11.33	11.11–11.55	13.43	12.73–14.13	5.35	3.90–6.79	0.8–5.4
C67	Bladder	11.90	11.69–12.11	7.35	6.83–7.87	5.88	4.41–7.35	6.7–11.2
C70–C72	Brain, nervous system	7.78	7.59–7.98	4.14	3.76–4.52	2.93	1.79–4.07	2.3–3.9
C73	Thyroid	3.67	3.54–3.80	1.75	1.51–1.99	2.89	1.88–3.91	1.5–1.9
C81	Hodgkin's disease	3.34	3.21–3.47	2.72	2.43–3.02	0.49	0.09–0.90	0.2–1.2
C82–C85, C96	Non-Hodgkin's lymphoma	15.65	15.40–15.90	12.07	11.43–12.71	6.82	5.28–8.36	3.9–6.2
C90	Multiple myeloma	4.24	4.12–4.37	8.50	7.94–9.06	1.44	0.71–2.18	0.5–1.4
C91	Lymphoid leukemia	6.95	6.76–7.15	4.03	3.64–4.42	2.29	1.13–3.44	1.2–1.8
C92–C94	Myeloid leukemia	5.50	5.35–5.66	4.45	4.06–4.85	2.80	1.76–3.84	1.9–3.2
All	All sites	346.89	345.71–348.08	436.98	432.92–441.03	206.65	197.89–215.41	212.5–294.8

Table 2. — Age-Standardized Incidence Rates per 100,000 by Race for Females

ICD-10	Site	SEER Registries 1997–2002 ²³⁻²⁵						Korean Registries, 1993–1998 ²⁶
		White		Black		Korean American		
		Rate	95% CI	Rate	95% CI	Rate	95% CI	
C01	Tongue	1.23	1.17–1.30	1.10	0.92–1.28	0.84	0.37–1.30	0.0–0.4
C03–C06	Mouth	1.36	1.29–1.43	1.39	1.19–1.59	0.61	0.22–1.00	0.0–0.5
C15	Esophagus	1.23	1.16–1.29	2.67	2.39–2.95	0.26	0.03–0.50	0.8–1.2
C16	Stomach	3.37	3.26–3.48	5.95	5.56–6.34	15.25	13.31–17.19	19.5–30.4
C18	Colon	20.81	20.55–21.07	27.98	27.11–28.85	13.23	11.43–15.04	4.4–8.7
C19–C20	Rectum	7.85	7.68–8.02	8.23	7.75–8.71	8.41	6.94–9.88	4.5–8.2
C22	Liver	2.03	1.95–2.12	2.64	2.36–2.91	9.11	7.58–10.65	8.9–17.1
C23–C24	Gallbladder etc	1.78	1.71–1.86	1.60	1.39–1.81	3.40	2.51–4.29	4.6–7.4
C25	Pancreas	5.98	5.84–6.12	8.72	8.23–9.21	4.47	3.41–5.53	3.5–4.7
C32	Larynx	1.11	1.05–1.18	1.84	1.61–2.07	0.27	0.00–0.53	0.4–0.7
C33–C34	Trachea, bronchus, lung	35.95	35.59–36.31	38.00	36.96–39.05	16.18	14.15–18.21	6.7–13.3
C47, C49	Connective and soft tissue	2.29	2.18–2.39	2.09	1.84–2.34	0.87	0.38–1.35	0.0–0.1
C43	Melanoma of skin	14.55	14.30–14.79	0.59	0.46–0.72	1.05	0.42–1.68	0.0–0.0
C50	Breast	109.24	108.61–109.88	89.54	87.97–91.12	41.82	38.56–45.09	12.7–20.8
C53	Cervix uteri	7.86	7.68–8.04	8.80	8.31–9.28	8.56	7.11–10.02	15.2–22.3
C54	Corpus uteri	19.73	19.46–20.00	13.47	12.83–14.10	6.36	5.09–7.63	1.5–2.2
C56	Ovary	11.46	11.25–11.67	7.18	6.73–7.63	5.76	4.52–7.01	0.5–1.5
C64	Kidney	5.83	5.68–5.99	6.85	6.40–7.30	2.75	1.73–3.76	0.3–1.9
C67	Bladder	3.06	2.96–3.15	3.14	2.86–3.43	1.50	0.90–2.11	1.7–2.0
C70–C72	Brain, nervous system	5.71	5.54–5.88	3.16	2.84–3.48	2.55	1.49–3.60	1.4–3.1
C73	Thyroid	10.87	10.65–11.09	4.97	4.60–5.34	8.29	6.79–9.78	5.4–8.5
C81	Hodgkin's disease	2.86	2.74–2.99	2.04	1.80–2.28	0.25	0.00–0.5	0.1–0.5
C82–C85, C96	Non-Hodgkin's lymphoma	10.64	10.44–10.84	7.29	6.84–7.74	3.53	2.58–4.49	1.5–3.6
C90	Multiple myeloma	2.70	2.60–2.80	6.34	5.93–6.76	1.08	0.58–1.58	0.7
C91	Lymphoid leukemia	4.29	4.13–4.44	2.34	2.07–2.60	1.66	0.76–2.56	0.9–3.0
C92–C94	Myeloid leukemia	3.74	3.61–3.87	3.01	2.73–3.30	1.98	1.15–2.81	1.2–2.4
All	All sites	297.53	296.47–298.59	260.93	258.23–263.63	160.05	153.57–166.54	96.7–166.8

world population.²⁶ We also calculated 95% confidence intervals for the age-standardized rates. In comparing cancer incidence rates among whites, blacks, and Korean Americans, non-overlapping confidence intervals were considered to signify statistically significant difference in cancer incidence rates. For native Koreans, cancer incidence is reported as a range due to difference in case ascertainment of the various cancer registries from Seoul, Busan, Daegu, and Kangwha. All statistical analysis was performed using SAS version 9.1 (SAS Institute Inc, Cary, NC).

The study was approved by the University of Medicine and Dentistry of New Jersey (UMDNJ) Institutional Review Board.

Results

Comparison of Cancer Rates Among Korean Americans, Blacks, and Whites in the United States

For males, the cancer rate for all sites combined in Korean Americans was 40% lower than whites and 53% lower than blacks (Table 1). For cancers of the esophagus, colon, larynx, lung, prostate, kidney and multiple myeloma, black males had the highest rates, followed by whites and Korean Americans. While the rate of pancreas cancer was comparable in whites and Korean Americans, the rate was much higher in blacks. The rate of prostate cancer was 6.5 times higher in blacks and 4 times higher in whites than in Korean Americans. Rates for brain cancer, non-Hodgkin's lymphoma, lymphoid leukemia, and myeloid leukemia were highest in white males, intermediate in blacks, and lowest in Korean Americans. While the rates of melanoma of the skin and cancers of the testis, bladder, and brain were comparable in blacks and Korean Americans, the rates were much higher in whites. Stomach cancer for Korean-American males was 4.3 times higher than whites and 2.6 times higher than blacks. Gallbladder cancer for US Korean males was 2.9 times higher than whites and 3.1 times higher than blacks.

In females, the cancer incidence rate for all sites combined in Korean Americans was 46% lower than whites and 39% lower than blacks (Table 2). Excluding breast cancer, the Korean-American rates were 37% and 31% lower than white and black rates, respectively. For cancers of the esophagus, colon, pancreas, larynx, lung, kidney, and multiple myeloma, black females had the highest incidence rates followed by whites and then by Korean Americans. There were no meaningful differences in the rates of cervical cancer among blacks, whites and Korean Americans. The incidence rates for breast, corpus uteri, ovary, and non-Hodgkin's lymphoma were highest in white females, intermediate in blacks, and lowest in Korean Americans. Thyroid cancer was highest in white

females, followed by Korean Americans and lowest in blacks. Melanoma of the skin was much higher in white females compared to black or Korean-American females. The rates for melanoma of the skin were comparable between black and Korean-American females. Furthermore, the breast cancer rate in females was 2.6 times higher in whites and 2.1 times higher in blacks compared to Korean Americans. Stomach cancer for US Korean females was 4.5 times higher than whites and 2.6 times higher than blacks. Also, gallbladder cancer for Korean-American females was 1.9 times higher than whites and 2.1 times higher than blacks.

Comparison of Cancer Rates Among Korean Americans in the United States and Native Koreans in South Korea

Although Koreans in the United States and native Koreans in South Korea may differ in terms of socioeconomic status, their genetic homogeneity invites comparisons. Contrasts between these two populations might provide important clues to the roles of environmental and lifestyle factors in cancer causation.

For males, the cancer incidence rate for all sites combined was not meaningfully different between US Koreans and native Koreans as reported by Korean registries. Incidence rates for colon and prostate cancer in males were higher for Korean Americans than their native counterparts in Korea. Colon cancer was 56% higher (by taking the upper value of the range provided by Korean registries as a reference value) in US Korean males than in native Koreans. Prostate cancer was also 3.5 times higher in US Koreans compared with their native counterparts. However, cancers of the stomach, esophagus, liver, gallbladder, larynx, and lung were lower in US Korean males compared with native Koreans. Incidence rates for all other sites were close in both populations.

For females, cancer incidence rates for all sites combined were comparable between the two Korean populations. Among females, cancer incidence rates for colon, lung, breast, endometrium, ovary, melanoma of the skin, and connective/soft tissue were higher in US Koreans than native Koreans. On the other hand, cancer incidence rates for the esophagus, stomach, gallbladder, and cervix uteri were higher in native Koreans compared to US Koreans. Colon cancer was 1.5 times higher (by taking the upper value of the range provided by Korean registries as a reference value) in US Korean females compared to their native counterparts. Breast cancer was 2.0 times higher in US Koreans compared to native Koreans. Cancer of the corpus uteri was 2.9 times higher in Korean immigrants compared to natives. Also, ovarian cancer was 3.8 times higher in Korean Americans compared to native Koreans. Conversely, cervical cancer was 2.6 times higher for native Koreans compared to US Koreans.

Table 3. — Relative Rate Ratio of Cancer Sites Among Native Koreans and Korean Americans Compared to US Whites, Males²³⁻²⁵

Cancer Site*	Native Koreans	Korean Americans
Stomach	9.83	4.28
Liver	8.71	4.40
Gallbladder etc	5.44	2.86
Esophagus	1.53	0.50
Larynx	1.17	0.52
Trachea, bronchus, lung	0.94	0.68
Pancreas	0.90	0.83
Bladder	0.80	0.49
Rectum	0.78	1.10
Colon	0.40	0.76
Kidney	0.33	0.47
Non-Hodgkin's lymphoma	0.30	0.44
Prostate	0.06	0.25

* Data not shown for rates based on fewer than 30 cases.

The relative rate ratios of cancer rates for selected sites among native Koreans and Korean Americans relative to US white males is presented in Table 3. Male Korean immigrants have an intermediate level of risk in comparison to their country of origin and immigrant country. Native Korean males compared to US white males have a 9.8 times higher rate of stomach cancer, 8.7 times higher rate of liver cancer, and 5.4 times higher rate of gallbladder cancer. The relative rate ratio comparing US Korean males to whites was only 4.3 for stomach, 4.4 for liver, and 2.9 for gallbladder cancers. The marked decrease in the rate ratios for Korean Americans compared to native Koreans reflects a decrease in the incidence of stomach, liver, and gallbladder cancer as Koreans move from their native land to the United States. The change is more dramatic for cancers of the esophagus and larynx where the relative rate ratio decreases from 1.5 to 0.5 and 1.2 to 0.5, respectively, for native Korean males compared to Korean Americans. For cancers of the colon, rectum, kidney, prostate, and non-Hodgkin's lymphoma, the relative rate ratios show a protection in male Korean Americans and native Koreans. However, this protection appears to diminish for male Korean Americans. These findings suggest that the rates of colorectal, kidney, prostate, and non-Hodgkin's lymphoma have increased among Koreans who migrated to the United States.

Again, female Korean Americans have an intermediate level of relative risk compared to their native counterparts and US whites. Female native Koreans have higher relative rate ratios for stomach, liver, gallbladder, and cervical cancer vs female Korean Americans. The relative rate ratios comparing female native Koreans to US whites were 8.0 for stomach, 6.4 for liver, 3.5 for gallbladder, and 2.5 for cervical cancers. The relative rate ratios comparing female US Koreans to US whites were 4.5 for stomach and liver, 1.9 for gallbladder, and 1.1 for cervical cancers. Again, the significant decline in rate

ratios from female native Koreans to Korean Americans indicates decreased stomach, liver, gallbladder, and cervical cancer after relocation to the United States. For cancers of the colon, rectum, pancreas, thyroid, ovary, lung, non-Hodgkin's lymphoma, breast, and endometrium, the relative rate ratios show a protection in native and US Koreans compared to whites. However, this protection is less apparent in female Korean Americans than native Koreans (Table 4).

Comparison of Cancer Incidence Rates in Korean Americans, 1988–1992 and 1997–2002

Comparison of cancer incidence rates between the period 1988–1992 and 1997–2002 revealed important changes among Korean Americans. Cancer rates for prostate and female breast cancer increased by 71% and 67%, respectively. Similarly, colorectal cancer increased in both male and female Korean Americans. The increased incidence of colon cancer was higher for males (43%) than for females (24%). However, rectal cancer increased more in females (56%) than males. On the other hand, cervical and esophageal cancers decreased by 34% and 43% in males, respectively. While lung cancer decreased in males by 15%, it increased in females by 27%. Stomach cancer remained unchanged in females but decreased in males by 17% (Table 5).

Discussion

A comparison of cancer incidence rates for Korean Americans in the United States to native residents of South Korea has demonstrated a shifting pattern of cancer risk. Overall, cancer risk for Korean immigrants has changed to an intermediate level between their native country and their new country. Cancer rates for most sites were lowest among native Koreans compared to Korean Americans in the United States and were also lower than rates for whites and blacks in the United

Table 4. — Relative Rate Ratio of Cancer Sites Among Native Koreans and Korean Americans Compared to US Whites, Females²³⁻²⁵

Cancer Site*	Native Korean	Korean American
Stomach	8.04	4.52
Liver	6.37	4.48
Gallbladder etc	3.52	1.90
Cervix uteri	2.48	1.09
Rectum	0.86	1.07
Pancreas	0.73	0.75
Thyroid	0.59	0.76
Ovary	0.36	0.50
Colon	0.34	0.64
Trachea, bronchus, lung	0.31	0.45
Non-Hodgkin's lymphoma	0.26	0.33
Breast	0.16	0.38
Corpus uteri	0.10	0.32

* Data not shown for rates based on fewer than 30 cases.

Table 5. — Comparison of Cancer Incidence Rates for Korean Americans, 1988–1992 and 1997–2002

Cancer Site	1988–1992*			1997–2002 ^{23,25}			Percent Change 1997–2002 vs 1988–1992	
	N	Rate	95% CI	N	Rate	95% CI	% Change	95% CI
Prostate	93	17.2	13.8–20.9	308	29.46	26.12–32.79	71.28	56.89, 89.28
Breast (female)	261	25.1	22.1–28.4	648	41.82	38.56–45.09	66.61	58.77, 74.48
Cervix uteri	125	13.0	10.8–15.5	138	8.56	7.11–10.02	–34.15	–35.35, –34.00
Lung								
Male	232	40.8	35.6–46.4	379	34.72	31.16–38.27	–14.90	–17.52, –12.47
Female	113	12.7	10.5–15.2	259	16.18	14.15–18.21	27.40	19.80, 34.76
Colon								
Male	85	14.3	11.3–17.6	220	20.48	17.73–23.22	43.22	31.93, 56.90
Female	97	10.7	8.6–13.0	218	13.23	11.43–15.04	23.65	15.69, 32.91
Rectum								
Male	68	11.1	8.5–14.0	153	14.12	11.85–16.39	27.21	17.07, 39.41
Female	53	5.4	4.0–7.0	132	8.41	6.94–9.88	55.74	41.14, 73.50
Stomach								
Male	223	36.5	31.7–41.6	329	30.24	26.92–33.55	–17.15	–19.35, –15.08
Female	148	15.7	13.3–18.4	251	15.25	13.31–17.19	–2.87	–6.58, 0.08
Liver								
Male	150	23.6	19.9–27.6	250	23.29	20.35–26.22	–1.31	–5.00, 2.26
Female	77	8.6	6.8–10.7	142	9.11	7.58–10.65	5.93	–0.47, 11.47
Esophagus								
Male	26	4.6	3.0–6.6	29	2.63	1.66–3.61	–42.82	–45.30, 44.67
Female	<5	*	*	5	0.26	0.03–0.50	*	*

* Data not shown for rates based on fewer than 5 cases.

Modified from Gomez SL, Le GM, Clarke CA, et al. Cancer incidence patterns in Koreans in the United States and in Kangwha, South Korea. *Cancer Causes Control*. 2003;14:167-174. Reprinted with permission from Kluwer Academic Publishers.

States. The relative rate ratios comparing Koreans to US whites were much higher for native Koreans than Korean Americans for stomach, liver, gallbladder, esophagus, and cervical cancers. The relative rate ratios comparing Koreans to US whites for colon, prostate, breast, lung, ovary, and endometrial cancers show a protection in Koreans, and this protection appears to diminish for Korean Americans. During the past 10 years, cancers of the prostate, breast, colon, and rectum have increased among Korean Americans. In contrast, cancers of the stomach, esophagus, and cervix uteri have declined during the same period among Korean Americans. These patterns in cancer risk among Korean Americans and native Koreans in Korea reflect the expected changes that are consequent to migration. These changes are presumably caused by lifestyle and environmental factors that affect cancer etiology.

Previous studies have shown similar results of a shifting pattern of cancer incidence among other migrant Asian American populations such as the Japanese,^{11,12,15,31,32} Chinese,^{12,16,17,32,33} and Filipinos.^{12,14,31} Asian immigrants were shown to have intermediate level of risk compared to their native country and current host country.^{11,12,16,31} Prehn et al¹² found stomach, liver, and cervical cancer to be higher in Chinese, Japanese, and Filipinos in Asia compared to migrant Asians in the United States. Prostate, breast, colon, and corpus uteri had higher incidence rates in Asian Americans than in Asians residing in Asia.

This study was also consistent with the recent investigation by Gomez et al²² that compared age-standardized incidence rates between US Koreans and native Koreans in South Korea. While their study focused only on the most common cancer sites, similar patterns were seen. Also, their study was based on older data and included only one Korean cancer registry from an agricultural area. The present study utilized more recent US and Korean data and included more registries from both urban and agricultural areas.

The decreased incidence rates for prostate, breast, and colon cancer among Korean Americans in comparison to whites and blacks were consistent with an earlier study.²² Affluent nations with Westernized lifestyles tend to have higher cancer rates, especially for prostate, breast, and colorectal cancers compared to less developed nations.^{34,35} The Korean-American immigrant population can be expected to develop cancer rates that progressively approach the pattern seen in their new country. This pattern is seen in the comparison of cancer incidence rates from 1988–1992 to 1997–2002. Cancers of the breast, prostate, colon, and rectum have increased in Korean Americans over a 10-year period. Breast, prostate, and colorectal cancers are more strongly associated with Western lifestyle. In contrast, stomach and cervical cancer, which are more prevalent in Korea, have decreased in immigrants. Moreover, it is interesting to note that the rate of lung cancer has increased among female Korean Americans in the last 10 years.

Higher rates of stomach, rectum, liver, and gallbladder cancer in Korean Americans compared to whites and blacks likely reflect early life experience and persistent cultural habits that are causes of these cancers in Korea.³⁶ Native Koreans had higher rates for stomach and cervical cancer compared to US populations. Gomez et al²² found stomach, rectum, and liver cancer to be highest in native Koreans compared to US Koreans and whites. A study in Illinois also noted elevated incidence of stomach cancer in migrant Koreans compared to whites and blacks in the United States.³⁷ Stomach cancer ranks as the most common cancer in Korea. The Korean diet contains many high-sodium pickled food that likely contribute to gastric cancer.³⁸ Liver and cervical cancers are associated with viral infections that are more prevalent in Asia than in the United States.^{39,40}

The lower esophageal cancer rates in Korean Americans in the United States compared to whites and blacks and native Koreans could be related to changes in the diet of Korean Americans who migrated to the United States. Risk factors for esophageal cancer include pickled vegetables, nitrites, and nitrosamine foods, which are prevalent in Korean diet.¹²

Colon cancer increased significantly in Korean Americans compared to native Koreans. This trend follows a shifting pattern of cancer risk in a migrant population living in a more Westernized culture. Diets high in fat, protein, alcohol, and meat and low in fiber and calcium have been shown to increase the risk of colon cancer.⁴¹ These dietary risk factors are more prevalent in the United States and other Westernized countries compared to Asian countries. Even though colon cancer was higher in Korean Americans than in native Koreans, the incidence rate remained well below cancer rates for whites and blacks.

Higher rates of breast and prostate cancer among Korean Americans compared to native Koreans in Korea, as well as lower rates compared to whites and blacks, may reflect a shift in lifestyle as Korean Americans have migrated from their native country to the United States. The breast cancer rate is rising in Asian American women. Asian immigrants continue to adopt the Western lifestyle of marrying later, having fewer children, getting less physical activity, increasing fat intake, and decreasing consumption of soy products.⁴² Asian American men living in the United States may also acquire increased risk for prostate cancer with similar changes in diet and behaviors. Researchers have noted an increasing incidence of prostate cancer in Asia. They attributed this recent trend to dietary and environmental factors.⁴³

A small part of the difference in cancer rates in whites, blacks, and Korean Americans in the United States and native Koreans may have been the result of differences in cancer screening rates between the United States and South Korea. Other limitations in com-

paring US Korean migrant population to their native Korean population include the possibility that Korean cancer registries do not fully reflect population rates as well as the nonrepresentativeness of immigrants. Immigrants are more likely from a higher social class. Thus, variable cancer rates could be due to differences in social class. The elderly are more likely to defer further medical treatment after an initial diagnosis and thus are underrepresented in the Korean registry data. Less educated cancer patients tend to turn to traditional oriental clinics rather than Western medical care available in hospitals.²⁶ The lack of inclusion of lower-class individuals and the elderly would have exaggerated cancer rate differences for sites common in the West. However, the findings of large excesses of certain cancers known to be common in the Koreans argue against this being a major explanation for the international differences. While different time periods for both sources of cancer data can limit direct data comparability, examining the most recent SEER data highlights prevailing cancer rates among US Koreans that are useful for future cancer control strategies. Moreover, the difference in the time interval between the two registries is not large enough to cause substantial bias in comparison. Misclassification could have occurred in the conversion of ICD-O-2 classification codes to ICD-10. Nonetheless, the potential for misclassification is minimal since there are only four categories in ICD-10 with different coding from ICD-O-2.

There have been two waves of Korean immigration in the United States. The first began in the late 1800s and early 1900s as many Korean immigrants settled in Hawaii as plantation laborers.⁴⁴ The second wave began after the Immigration Act of 1965.⁴⁵ About 73% of US Koreans were foreign-born in 1990.⁴⁶ However, the number of foreign-born Korean immigrants included in this study is unknown due to unavailability of data. Moreover, the length of time contributed by each Korean American since their immigration to the United States is unknown.

Findings of this study have important clinical and public health implications. The risk of stomach, liver, gallbladder, larynx, and esophageal cancer have sharply declined in US Korean males compared to their native counterparts, while prostate, colon, and rectum cancer risk has increased. In females, stomach, liver, gallbladder and cervical cancers have declined while breast, lung, colon, rectum, and endometrial cancer have increased. Cancer rates for stomach, liver, gallbladder, and esophageal in males are much higher in native Koreans compared to US whites. Korean-American males should be targeted for prostate and colorectal screening. Colorectal screening has been shown to be effective in reducing mortality. However, the effectiveness of PSA screening for prostate cancer continues to be controversial.^{47,48}

Conclusions

Korean Americans have a distinct cancer profile. Our findings provide current data for a growing Korean migrant population that can be useful to monitor changes over time and to guide prevention programs. Comparison of cancer rates from 1988–1992 and 1997–2002 reveals a stronger Western profile with significant increases in prostate and breast cancer and sharp declines in stomach and cervical cancer.

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