Cancer Incidence Among Arab Americans in California, Detroit, and New Jersey SEER Registries

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Objectives. We calculated cancer incidence for Arab Americans in California; Detroit, Michigan; and New Jersey, and compared rates with non-Hispanic, non-Arab Whites (NHNAWs); Blacks; and Hispanics.

Methods. We conducted a study using population-based data. We linked new cancers diagnosed in 2000 from the Surveillance, Epidemiology, and End Results Program (SEER) to an Arab surname database. We used standard SEER definitions and methodology for calculating rates. Population estimates were extracted from the 2000 US Census. We calculated incidence and rate ratios.

Results. Arab American men and women had similar incidence rates across the 3 geographic regions, and the rates were comparable to NHNAWs. However, the thyroid cancer rate was elevated among Arab American women compared with NHNAWs, Hispanics, and Blacks. For all sites combined, for prostate and lung cancer, Arab American men had a lower incidence than Blacks and higher incidence than Hispanics in all 3 geographic regions. Arab American male bladder cancer incidence was higher than that in Hispanics and Blacks in these regions.

Conclusions. Our results suggested that further research would benefit from the federal recognition of Arab Americans as a specified ethnicity to estimate and address the cancer burden in this growing segment of the population. (*Am J Public Health.* 2014;104:e83–e91. doi:10.2105/AJPH.2014.301954)

Migration of Arabs to the United States has occurred in several waves, beginning in 1875, with a steady increase over the past 30 years.[1] One of the largest barriers to conducting research in this population is the fact that they are not recognized as a minority group by the US Office of Management and Budget, and consequently, are not listed as a separate ethnic group in demographic or health databases.[2,3]

Likewise, outside of the United States, there are limited data available on Arab immigrant health. Studies conducted in the Netherlands and France found that first-generation and foreign-born immigrants from Morocco had an overall lower cancer incidence compared with the native-born populations.[4–6] Using the Amsterdam cancer registry, researchers in the Netherlands also examined specific cancer sites.[4] Cancer of the nasopharynx, cervix uteri, liver, and thyroid gland were significantly higher in first-generation Moroccan immigrants; however, this population had lower rates of cancers of the pharynx, esophagus, colon or rectum, lung, melanoma, other skin cancers, mesothelioma, breast, corpus uteri, ovary, prostate, testes, kidney, urinary tract, and central nervous system cancer. In general, Netherland immigrants with a longer duration of residency, younger age at migration, and second-generation status tended to have higher rates of cancer incidence compared with other migrant groups, especially for lung and colorectal cancer.[5] In Australia, researchers compared cancer incidence rates in native born Australians to migrant populations born in Iraq, Egypt, Lebanon, and Syria, as well as other Middle Eastern countries.[7] Immigrants had lower rates of cancer incidence overall; however, this was not true for all sites. Cancer incidence of the nasopharynx, stomach (female), gallbladder (female), liver (male), bladder (male), and thyroid were higher among immigrants. For breast cancer, Lebanese women tended to have lower rates compared with those born in Australia, but Egyptian women had higher rates.

US Census Bureau data indicate that there is a significantly large Arab American population, and that it has been growing rapidly. In 2000, more than 1 million Americans reported Arab ancestry. This value has increased from 610 000 in the 1980s to 860 000 in the 1990s, a steady growth rate of approximately 40% per decade. Of those considered Arab, most were of Egyptian, Lebanese, and Syrian descent. The Egyptian population increased by more than 80% during the 1990s. Although there is a roughly equal distribution of people with Arab ancestry across the 4 regions of the United States, almost half (48%) reside in just 5 states: California, Michigan, New Jersey, Florida, and New York. Several states also saw their Arab American populations increase by more than 50% in the 1990s (North Carolina, Washington, Colorado, and Virginia); in Tennessee, the Arab American population doubled.[8] In the United States, race/ethnicity plays an important role in health-related outcomes,[9] and immigrants and minorities often experience poorer access to health care, lower screening rates, and different infectious, environmental, and socioeconomic exposures compared with non-Hispanic White populations.[10,11] Despite the relatively large presence of Arab Americans minorities across the United States, little has been done to determine or compare cancer incidence rates in this population.

Investigators in California and Michigan, the states with the highest concentrations of Arab American populations,[12] have developed name algorithms and denominator approximations that have been linked with National Cancer Institute Surveillance, Epidemiology and End Results (SEER) data, to estimate cancer incidence among those of Middle Eastern descent in California and Arab Americans in metropolitan Detroit.[13–15] They found a lower incidence of cancer in Arab American and Middle Eastern populations for most cancers compared with Non-Hispanic Whites, especially in California. However, a direct comparison between Arab Americans populations in the 2 states is not possible because the name list of California includes Middle Eastern populations (Arab Americans and other Middle Eastern ethnicities), whereas the Michigan database includes Arab Americans only. Using the Arab American name list that was created in Michigan,[15] our goal was to link it to metropolitan Detroit, California, and New Jersey SEER data to estimate and compare Arab American cancer incidence in the 3 geographic areas, which represented different mixtures of countries of origin.[12] We also compared cancer incidence among Arab Americans with other racial/ethnic minority groups.

METHODS

This was an observational study using population-based data. Data were obtained from 3 sources: SEER registry incidence files, SEER*Stat (version 7.1.0; National Cancer Institute, Bethesda, MD) frequency sessions, and Integrated Public-Use Microdata Samples (IPUMS).[2,3] California SEER data were obtained from the California Cancer Registry. Detroit SEER data were obtained from the Metropolitan Detroit Cancer Surveillance System, and New Jersey SEER data were from the New Jersey Cancer Epidemiology Services. Population data were obtained from US 2000 decennial census IPUMS for the states of California and New Jersey, and Wayne, Oakland, and Macomb counties in Michigan. Because the data did not come from a single source, we used different methodologies to identify Arab Americans for the numerator and denominator.

Cancer Case Identification (Numerator)

Newly incident cancers diagnosed in 2000 among Arab Americans were obtained for each of the 3 sites by linking the California, Detroit, and New Jersey SEER data with a validated Arab name algorithm.[14,15] We followed the SEER catchment areas for each region: for Detroit, it was the 3 counties of Macomb, Oakland, and Wayne, and for California and New Jersey, it was the entire state. Recent quality control efforts of the surname list indicated a positive predictive value of 91% (unpublished data). The name algorithm included both given and surnames; for surnames shared between both Arabs and Europeans (common among the Chaldean population), both surname and given name were required to be designated as a match. Maiden name was preferentially used for female cases. Numerator data for Black and Hispanic races/ethnicities were obtained using SEER*Stat frequency sessions.[3] Non-Hispanic, non-Arab White (NHNAW) numerator data were calculated by subtracting Arab American cases identified from the registry files from Non-Hispanic White (NHW) totals obtained from SEER*Stat frequencies for each age group. (Comparisons also were performed with NHW and NHNAW, and there was no difference in results because of the small number of Arab American cases [data not shown].) We calculated descriptive statistics for Arab American cancer cases for each region. We calculated case counts and percentages by age group, gender, and cancer site, and stratified by gender.

Arab Americans Population Data by Geographic Region (Denominator)

We created Arab American ancestry profiles for the populations of California, metropolitan Detroit, and New Jersey using 3 variables from IPUMS extractions: ancestry, country of origin, and language spoken at home. We used an identification scheme suggested by others; if any 1 of these variables was positive, the individual was considered Arab American.[16] Arab American ancestry included any of the following: Algerian, Egyptian, Libyan, Moroccan, Ifni, Tunisian, North African, Alhucemas, Berber, Rio de Oro, Bahraini, Iraqi, Jordanian, Transjordanian, Kuwaiti, Lebanese, Saudi Arabian, Syrian, Yemeni, Omani, Muscat, Trucial Oman, Qatar, Bedouin, Kurdish, Kuria Muria Islander, Palestinian, Gazan, West Bank, South Yemeni, Aden, United Arab Emirates, Assyrian, Syrian, Chaldean, Arab, Arabic, Other Arab, Djibouti, Mauritanian, Somalian, or Sudanese. Birthplace in an Arab League nation included Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, State of Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen. Language spoken at home was Arabic, Near East Arabic dialect, Syrian, Aramaic, or Chaldean. In addition, those reporting Armenian ancestry were excluded from Arab Americans population estimates because Armenian surnames were specifically removed from the Arab American surname algorithm used to identify cancer cases.

When comparing Arab demographic characteristics across regions, specific Arab ancestries were included if they made up at least 5% of the total Arab population in 1 or more of the 3 regions based on the IPUMS extraction. IPUMS extracts represented a 5% sample of the entire population; therefore, weighted frequencies and percentages were used in all calculations. In US Census forms, an individual can list up to 2 ancestries; hence, 2 ancestry variables are available in IPUMS. We combined these 2 ancestry variables using the following logic: (1) if cases listed Iraqi and Chaldean for the pair of ancestry variables, then these individuals were reclassified as Chaldean; (2) if cases listed Arab ancestries for both variables, then these cases were classified by the first ancestry listed in IPUMS; (3) if cases listed an Arab ancestry for 1 ancestry variable and a non-Arab ancestry for the other, then these individuals were classified by the Arab ancestry listed; and (4) if cases listed non-Arab ancestries for both of the ancestry variables or no ancestry was reported, then these individuals were classified as “other or not reported.”

Rate and Rate Ratio Calculations

We calculated age-adjusted rates following the SEER methodology using numerator data obtained from the SEER registries in the 3 geographic regions and denominator data through IPUMS. Age-adjusted rates and 95% confidence intervals (CIs) were gender-specific and limited to ages 20 to 74 years for all cancer sites combined and for any cancer site that had at least 10 Arab American cases in at least 2 of the 3 geographic regions. Standard SEER definitions were used for cancer site codes, including the addition of in situ cases for urinary bladder cancer.[17] We calculated 95% CIs using the Tiwari et al. method.[18] Rates were limited to ages 20 to 74 years because adult cancers were of primary interest. Cancer cases among those older than 74 years were excluded from analyses because IPUMS population estimates for this age group had a high variability, with SEs exceeding 20%.

We calculated rate ratios (RRs) and 95% CIs to compare Arab American rates within regions to other races and with Arab American populations across regions.[19] Within regions, NHNAWs, Blacks, and Hispanics were used as the reference group compared with Arab Americans. When comparing Arab American populations across regions, we used the larger of the 2 populations as the RR reference group (i.e., California was the reference comparing California and Detroit or California and New Jersey; and Detroit was the reference group comparing Detroit and New Jersey).

RESULTS

Table 1 presents Arab cancer case statistics for the California, Detroit, and New Jersey SEER registries. In 2000, 669 Arab American cancer cases were identified in California, 309 Arab American cases in Detroit, and 266 in New Jersey. In all 3 regions, men had a slightly higher frequency of cancer, and more than 50% of the cases were diagnosed between ages 50 and 69 years. Sample size became a limiting factor for the calculation of site-specific rates, especially for Detroit and New Jersey.

California had the largest Arab American population, totaling 164 171, whereas Detroit had the largest concentration of Arab Americans, at approximately 3% of the total population (Table 2). Men were a larger proportion of the Arab American population in all regions. Detroit had the most Arab Americans at or below poverty level (15.5%), followed by California (12.4%) and New Jersey (11.0%). There was a similar age distribution among the 3 regions.

Table 1—Characteristics of Arab Cancer Cases From the California; Detroit, MI; and New Jersey Surveillance, Epidemiology, and End Results Program Registries, 2000

Characteristic	California, No. (%)	Detroit, No. (%)	New Jersey, No. (%)
Total	665 (100.0)	309 (100.0)	266 (100.0)
Age, y			
20–24	22 (3.3)	10 (3.2)	8 (3.0)
30–39	42 (6.3)	32 (10.4)	10 (3.8)
40–49	110 (16.5)	26 (8.4)	42 (15.8)
50–59	162 (24.4)	72 (23.3)	62 (23.3)
60–69	216 (32.5)	107 (34.6)	96 (36.1)
70–74	113 (17.0)	62 (20.1)	48 (18.0)
Gender			
Male	344 (51.7)	160 (51.8)	137 (51.5)
Female	321 (48.3)	149 (48.2)	129 (48.5)
Male cancer site			
Prostate	96 (14.4)	41 (13.3)	47 (17.7)
Lung	40 (6.0)	20 (6.5)	13 (4.9)
CRC	44 (6.6)	20 (6.5)	11 (4.1)
Bladder	24 (3.6)	11 (3.6)	13 (4.9)
Kidney	11 (1.7)	12 (3.9)	8 (3.0)
NHL	18 (2.7)	12 (3.9)	5 (1.9)
Other	111 (16.7)	44 (14.2)	40 (15.0)
Female cancer site			
Breast	130 (19.5)	49 (15.9)	42 (15.8)
Lung	30 (4.5)	20 (6.5)	8 (4.1)
CRC	24 (3.6)	7 (2.3)	15 (4.9)
Thyroid	20 (3.0)	12 (3.9)	4 (1.5)
Other	117 (17.6)	61 (19.7)	60 (22.6)

Note. CRC = colorectal cancer; NHL = non-Hodgkin lymphoma.

As shown in Table 2, Lebanese was the most common ancestry in California (18.9%) and Detroit (28.9%), whereas Egyptian (28.2%) was the most common in New Jersey. Egyptian was also common in California (11.7%), but was reported by only 1.8% in Detroit. Assyrian or Chaldean was common in Detroit (22.7%), but was reported by 9.2% in California and only 0.8% in New Jersey. In all 3 geographic areas, the other/not reported ancestry group made up a substantial proportion of the total Arab Americans (24.4% in California, 15.6% in Detroit, and 24.3% in New Jersey),

Table 3 compares age-adjusted rates between male Arab Americans and NHNAWs. Arab American men in California had lower rates of cancer for all sites (475.9 per 100 000; 95% CI = 426.3, 530.0) compared with NHNAWs (566.3 per 100 000; 95% CI = 560.2, 572.5; RR = 0.84; 95% CI = 0.76, 0.93). Arab American age-adjusted rates were similar for specific cancer sites in California and for all sites in Detroit and New Jersey compared with NHNAWs. However, the RRs and CIs between Arab American and NHNAW populations indicated that California and Detroit Arab American men had significantly lower rates of prostate cancer (California: RR = 0.83; 95% CI = 0.69, 0.99, Detroit: RR = 0.74; 95% CI = 0.56, 0.96) than NHNAWs.

When comparing age-adjusted rates for common cancer sites among the 3 regions, California Arab Americans had lower rates for most cancer sites (Table 3). New Jersey Arab Americans had the highest rates of prostate cancer and bladder cancer, whereas Detroit Arab Americans had the highest rates of lung and colorectal cancer (CRC). RRs calculated for the comparison between Arab Americans across regions indicated that Detroit Arab American men had significantly higher rates of kidney cancer (RR = 2.92; 95% CI = 1.06, 8.08) compared with Arab Americans in California (data not shown). When comparing Arab Americans in New Jersey to California, New Jersey men had significantly higher rates of all sites combined (RR = 1.24; 95% CI = 1.00, 1.53). There were no noted differences between Arab American male rates in Detroit and New Jersey.

Arab American and NHNAW women had similar age-adjusted rates within each of the 3 regions (Table 3). In California, Arab Americans

Table 2—Arab American Population Demographics in California; Detroit, MI; and New Jersey Surveillance, Epidemiology, and End Results Program Registry Geographic Regions, 2000

Characteristics	California, No. (%)	Detroit, No. (%)	New Jersey, No. (%)
Population			
Total region population	21,981,141	2,644,694	5,598,458
Total Arab population/region percent Arab	164 171 (0.75)	79 360 (3.0)	55 508 (0.99)
Gender			
Male	89 467 (54.5)	41 859 (52.7)	30 825 (55.5)
Female	74 704 (45.5)	37 501 (47.3)	24 683 (44.5)
Age, y			
20–29	36 164 (22.0)	20 655 (26.0)	11 048 (19.9)
30–39	43 631 (26.6)	22 526 (28.4)	16 062 (28.9)
40–49	39 250 (23.9)	16 923 (21.3)	13 657 (24.6)
50–59	23 195 (14.1)	10 617 (13.4)	8145 (14.7)
60–69	15 527 (9.5)	6050 (7.6)	5061 (9.1)
70–74	6404 (3.9)	2589 (3.3)	1535 (2.8)
Poverty status			
Not applicable	955 (0.6)	235 (0.3)	1102 (2.0)
≤ poverty threshold	20 280 (12.4)	12 286 (15.5)	6113 (11.0)
> poverty threshold	142 936 (87.1)	66 839 (84.2)	48 293 (87.0)
Educational attainment			
< high school	11 848 (7.2)	12 531 (15.8)	2797 (5.0)
9th–12th grade	50 643 (30.8)	35 085 (44.2)	19 583 (35.3)
1–4 y of college	79 085 (48.2)	25 061 (31.6)	25 622 (46.2)
≥ 5 y of college	22 595 (13.8)	6683 (8.4)	7506 (13.5)
Self-reported Arab Ancestry			
Arab/Arabic	20 873 (12.7)	9087 (11.5)	5260 (9.5)
Assyrian/Chaldean	15 032 (9.2)	17 976 (22.7)	421 (0.8)
Egyptian	19 265 (11.7)	1402 (1.8)	15 677 (28.2)
Iraqi	4704 (2.9)	5643 (7.1)	491 (0.9)
Lebanese	31 090 (18.9)	22 967 (28.9)	7353 (13.2)
Palestinian	9893 (7.3)	2169 (2.7)	1466 (2.6)
Syrian	11 326 (6.9)	3891 (4.9)	8199 (14.8)
Other Arab	11 962 (7.3)	3811 (4.8)	3175 (5.7)
Other/not reported	40 026 (24.4)	12 414 (15.6)	13 466 (24.3)

Source. Data source: Integrated Public Use Microdata Series.

had a significantly lower rate of all sites combined compared with NHNAWs (RR = 0.88; 95% CI = 0.79, 0.98). In Detroit and New Jersey, there were no significant differences between Arab American and NHNAW women.

Similar to California Arab American men, California Arab American women showed an overall trend of lower age-adjusted incidence compared with Detroit and New Jersey (Table 3), except for breast cancer. However, Detroit Arab Americans had lower age-adjusted rates of breast cancer compared with California and New Jersey (Detroit: 159.5 per 100 000; California: 194.9 per 100 000; New Jersey: 194.3 per 100 000). There were no significant differences between Arab Americans in Detroit and California. However, New Jersey did have higher rates of all cancer sites combined compared with California (RR = 1.31; 95% CI = 1.05, 1.63) and Detroit (RR = 1.28; 95% CI = 1.00, 1.63) (data not shown). New Jersey Arab American women also had higher rates of CRC compared with those in California (RR = 2.31; 95% CI = 1.03, 5.16).

Arab American cancer incidence was significantly lower than Black men for all cancers combined in California (RR = 0.70; 95% CI = 0.63, 0.77), Detroit (RR = 0.65; 95% CI = 0.57, 0.75), and New Jersey (RR = 0.75; 95% CI = 0.65, 0.88; Table 4). Arab American prostate and lung cancer incidence were also lower compared with Black men in all 3 regions, with Arab Americans in all 3 geographic regions having approximately half the prostate incidence rate of Blacks, and 48%–63% of the lung cancer rate. In California and New Jersey, Arab American male bladder cancer incidence was higher compared with Blacks (California bladder cancer: RR = 2.07; 95% CI = 1.15, 3.72; New Jersey bladder cancer: RR = 2.83; 95% CI = 1.15, 7.00). Compared with Hispanic men (Table 4), Arab American men had significantly higher incidence of all cancer sites combined in California (RR = 1.18; 95% CI = 1.05, 1.33) and New Jersey (RR = 1.51; 95% CI = 1.21, 1.88). Arab American men in California also had higher lung cancer incidence (RR = 1.62; 95% CI = 1.09, 2.41) and bladder cancer incidence (RR = 2.24; 95% CI = 1.24, 4.06) than Hispanic men.

Compared with Black women, Arab American women in New Jersey had a significantly higher incidence of all cancer sites combined (RR = 1.35; 95% CI = 1.10, 1.67) (Table 4). In California, Arab American female breast cancer incidence was higher than the incidence in Blacks (RR = 1.25; 95% CI = 1.03, 1.53). Thyroid cancer incidence in Arab American women was higher compared with Black women for both California (RR = 3.53; 95% CI = 1.60, 7.79) and Detroit (RR = 3.22; 95% CI = 1.19, 8.70). Compared with Hispanic women (Table 4), Arab American women had a higher incidence of all cancer sites in California (RR = 1.22; 95% CI = 1.07, 1.40) and New Jersey (RR = 1.51; 95% CI = 1.21, 1.88). In California, Arab American breast cancer incidence (RR = 1.65; 95% CI = 1.32, 2.06) and lung cancer incidence (RR = 2.09; 95% CI = 1.25, 3.49) was also higher than the incidence in Hispanic women.

DISCUSSION

In general, the cancer burden for Arab Americans in this study was more similar to NHNAW than to Black and Hispanic groups in the United States. Similar to NHNAW men,

Table 3—Age-Adjusted Rates and Rate Ratios by Geographic Region and Cancer Site for Arab American and Non-Hispanic Non-Arab White (NHNAW), 2000

Characteristics	Arab Americans, Rate (95% CI)	NHNAW, Rate (95% CI)	Rate Ratio (95% CI)
Male cancer sites			
All sites			
California	475.9 (426.3, 530.0)	566.3 (560.2, 572.5)	0.84* (0.76, 0.93)
Detroit, MI	562.1 (476.1, 660.0)	646.9 (630.1, 664.1)	0.87 (0.75, 1.01)
New Jersey	589.4 (492.1, 701.8)	643.8 (632.6, 655.1)	0.92 (0.78, 1.08)
Prostate			
California	142.3 (115.1, 174.2)	172.4 (169.1, 175.9)	0.83* (0.69, 0.99)
Detroit, MI	155.7 (111.3, 212.6)	211.2 (201.6, 221.1)	0.74* (0.56, 0.96)
New Jersey	202.3 (147.6, 272.7)	210.9 (204.6, 217.4)	0.96 (0.72, 1.28)
Lung			
California	59.7 (42.6, 81.7)	76.5 (74.2, 78.8)	0.78 (0.59, 1.03)
Detroit, MI	76.9 (46.5, 120.2)	96.5 (90.1, 103.3)	0.80 (0.53, 1.19)
New Jersey	58.6 (30.6, 103.5)	87.1 (83.0, 91.3)	0.67 (0.43, 1.06)
Colorectal cancer			
California	57.5 (41.6, 77.9)	54.0 (52.1, 55.9)	1.02 (0.68, 1.54)
Detroit, MI	69.7 (42.1, 109.7)	55.9 (51.1, 61.1)	1.25 (0.75, 2.06)
New Jersey	44.4 (21.7, 83.6)	67.6 (64.1, 71.4)	0.66 (0.40, 1.07)
Bladder			
California	35.3 (22.5, 53.0)	33.3 (31.9, 34.9)	1.06 (0.70, 1.61)
Detroit, MI	39.2 (19.0, 72.6)	45.8 (41.4, 50.6)	0.86 (0.48, 1.52)
New Jersey	65.6 (34.3, 114.7)	45.0 (42.1, 48.1)	1.46 (0.75, 2.85)
Kidney			
California	14.0 (6.9, 25.9)	16.4 (15.4, 17.5)	0.85 (0.49, 1.48)
Detroit, MI	40.9 (20.4, 74.4)	21.4 (18.4, 24.7)	1.91 (0.85, 4.29)
New Jersey	. . .	. . .	. . .
Non-Hodgkin lymphoma			
California	23.5 (13.9, 37.9)	24.9 (23.6, 26.2)	0.95 (0.60, 1.49)
Detroit, MI	35.4 (17.6, 65.6)	28.2 (24.8, 32.0)	1.26 (0.64, 2.47)
New Jersey	. . .	. . .	. . .
Female cancer sites			
All sites			
California	472.0 (421.4, 527.3)	493.3 (487.8, 498.9)	0.88* (0.79, 0.98)
Detroit, MI	482.0 (406.9, 567.8)	506.7 (492.6, 521.1)	0.95 (0.81, 1.12)
New Jersey	616.5 (512.3, 737.9)	524.1 (514.5, 533.8)	1.18 (0.97, 1.42)
Breast			
California	194.9 (162.6, 231.9)	187.1 (183.7, 190.6)	1.04 (0.87, 1.24)
Detroit, MI	159.5 (117.6, 212.3)	173.6 (165.4, 182.2)	0.92 (0.70, 1.21)
New Jersey	194.3 (139.4, 266.5)	181.7 (176.0, 187.5)	1.07 (0.78, 1.47)
Lung			
California	44.6 (30.0, 64.1)	59.7 (57.8, 61.6)	0.75 (0.55, 1.02)
Detroit, MI	67.2 (41.0, 104.9)	71.3 (66.2, 76.8)	0.94 (0.61, 1.45)
New Jersey	. . .	. . .	. . .
Colorectal cancer			
California	36.3 (23.2, 54.4)	35.5 (34.0, 37.0)	1.02 (0.68, 1.54)
Detroit, MI	. . .	. . .	. . .
New Jersey	83.6 (46.0, 141.2)	44.6 (41.9, 47.5)	1.87 (0.93, 3.76)

Continued

Arab American men generally had a lower incidence of cancer compared with Black men and a higher incidence compared with Hispanic men. Both Arab American and NHNAW women demonstrated higher rates compared with Black and Hispanic women within the 3 regions.

Despite the similarities of Arab American cancer incidence to that of NHNAWs, the data revealed several interesting contrasts between these 2 populations, specifically for female thyroid cancer, female CRC, male bladder cancer, and prostate cancer. Although the 95% CI for thyroid cancer RRs between Arab American and NHNAW women were not statistically significant because of the sample size, the age-adjusted rates (per 100 000) were almost twice the magnitude in California. The female CRC age-adjusted rates (per 100 000) in New Jersey were also quite high compared with NHNAW women. Our results also indicated higher bladder cancer incidence rates (per 100 000) in Arab American men compared with NHNAW men in New Jersey, although the RR was not statistically significant. Furthermore, age-adjusted rates of prostate cancer were significantly lower in Arab American men compared with NHNAW men in California.

Higher age-adjusted rates of thyroid cancer in Arab American women compared with NHNAW women were supported by studies conducted in Detroit and California that observed greater incidence of thyroid cancer compared with NHW women. In Detroit, proportional incidence of thyroid cancer was 57% higher in Arab American women compared with NHW women.[14] In California, the Middle Eastern female to non-Hispanic, non-Middle Eastern White RR for incidence was 1.5. The study in California hypothesized that the higher incidence of thyroid cancer might be linked to radiation exposure for fungal diseases, higher rates of thyroid disease because of dietary iodine imbalance, or a genetic predisposition caused by Middle Eastern heritage.[20] A pilot survey study conducted in the metropolitan Detroit area to explore the prevalence of known and potential risk factors of thyroid cancer in Arab American and NHW women reported Arab American women received more dental x-rays and medical radiation exposure compared with NHW women, which

Table 3—*Continued*

Thyroid			
California	25.3 (15.3, 39.9)	14.7 (13.7, 15.7)	1.72 (0.97, 3.07)
Detroit, MI	31.2 (15.9, 57.4)	16.3 (13.8, 19.2)	1.91 (0.87, 4.22)
New Jersey	. . .	. . .	. . .

Note. CI= confidence interval; NHNAW = non-Hispanic, non-Arab Whites. Age-adjusted rates calculated per 100 000. NHNAW is reference population for rate ratios.
**P* < .05.

might be associated with an increased incidence of thyroid cancer.[21]

The higher rates of CRC in Arab Americans women compared with NHNAW women is particularly interesting, because in 2011, New Jersey CRC incidence was lowest in Bergen county,[22] which has the second highest number of Arab Americans of all New Jersey counties (17% of total Arab American population in 2003).[23] Typically, CRC incidence is higher in Western nations, accounting for approximately 13% of all cancer cases, whereas in Arab nations, CRC rates are generally lower, accounting for approximately 9% of all cancer cases in Jordan and 4.4% in Egypt.[24] CRC is considered preventable; screening, early diagnosis, and removal of malignant polyps can prevent the onset of CRC. However, migrant populations typically receive less medical screening services compared with the general population, often because of financial reasons.[25,26] A study conducted in the Detroit area on the knowledge, attitudes, and beliefs of Arab Americans toward cancer screening and early detection found several barriers, including the inability to speak English, lack of transportation to medical facilities, and a lack of knowledge of where and when to get recommended cancer screening.[27] It was possible that those in the New Jersey Arab community had limited access to or knowledge of recommended CRC screenings.

Rates of bladder cancer in Arab countries are higher compared with the United States, which might partially explain the higher incidence of bladder cancer among Arab American men in California and New Jersey compared with the NHNAW populations. Egypt has the highest proportional incidence among Arab countries, with 16.2% of male cases attributed to bladder cancer.[24] Interestingly, both California and New Jersey have relatively large proportions of Arab Americans with Egyptian ancestry (California: 11.7%; New Jersey: 28.2%). Bladder cancers in Egypt are often related to schistosomiasis, a fairly common parasitic disease in Egypt, but rare in the United States. Perhaps a portion of the increased bladder cancer incidence in California and New Jersey Arab Americans is caused by earlier exposure among first-generation immigrants.

Mechanisms underlying the development of prostate cancer are poorly understood. The proportional incidence of prostate cancer in Gulf Cooperation Council countries from 1998 to 2001 observed rates lower than the global average, accounting for 5.2% of newly diagnosed cases in Saudi Arabia to 8.7% of newly diagnosed cases in Oman.[28] The incidence in the United Arab Emirates and neighboring countries (Oman, Yemen, Syria, Jordan, and Egypt) is estimated to be 4.5 per 100 000[29] and is drastically lower than rates seen in Western countries, which is estimated to be 97.2 cases per 100 000 in Northern America and 111.6 cases per 100 000 in Australia/New Zealand.[30] The variance of prostate cancer rates across geographic regions might be caused by a low frequency of cancer screening in Arab League nations compared with Western nations like the United States.[31] Furthermore, American immigrants[32] and non-White ethnicities[33] are known to have lower prostate cancer screening rates, which might explain why Arab immigrants have lower rates of prostate cancer.

When comparing cancer incidence among Arab Americans across the 3 regions, those in California tended to have lower rates than New Jersey and Detroit, with a few exceptions. New Jersey Arab American women had a significantly higher incidence of all cancer sites combined and CRC compared with California, whereas New Jersey Arab American men had a higher incidence of all cancer sites combined compared with California. Detroit had significantly higher Arab American male kidney cancer rates compared with those in California.

Looking at the overall trends in cancer incidence across the United States, California had lower rates of cancer compared with other states, particularly among minority populations. Cancer incidence for Asian/Pacific Islanders, Blacks, Hispanics, and NHWs was 3% to 9% lower than the nation for 2004 to 2008.[34] These trends might reflect geographic differences in behavioral risk factors. For instance, smoking prevalence in California is approximately 9.1% to 12.1% compared with New Jersey and Michigan, where the prevalence is 13.0% to 15.9% and 16.0% to 18.9%, respectively.[35]

One of the difficulties of studying Arab American groups across the United States is the limited population data available.

Unlike other US minorities, such as Asian or Hispanic groups, Arab Americans are not recognized as a separate group from Whites in US governmental classifications. This challenges investigators to use unique methods to obtain knowledge concerning Arab Americans' health and social issues.[13–15] By combining a name algorithm with existing population data, we were able to estimate Arab Americans' cancer incidence in 3 geographic areas that together make up a large proportion of US Arab Americans. The algorithm was validated using several methods and was found to have a positive predictive value of 91% and a negative predictive value of 100%.[15]

Study Limitations

The cancer incidence rates presented in this article should be considered with the limitations of the data. The New Jersey Cancer Epidemiology Services registry did not join SEER until 2000[36]; therefore, calculating cancer incidence was limited to a single year instead of the alternative of using a 5-year average. The limited number of cancer cases from each region for a single year resulted in uncertainty around the age-adjusted rate estimates. Data on associated risk behaviors were necessary to effectively explain the observed differences in Arab American cancer incidence with other races and across the United States; however, little work was done to characterize

Table 4—Age-Adjusted Rates and Rate Ratios by Geographic Region and Cancer Site for Arab Americans, Blacks, and Hispanics

Characteristics	Arab Americans (95% CI)	Blacks (95% CI)	Hispanic (95% CI)	Black Rate Ratio (95% CI)	Hispanic Rate Ratio (95% CI)
Male cancer sites					
All sites					
California	475.9 (426.3, 530.0)	684.6 (662.8, 707.1)	401.8 (391.5, 412.4)	0.70* (0.63, 0.77)	1.18* (1.05, 1.33)
Detroit, MI	562.1 (476.1, 660.0)	861.0 (823.5, 899.8)	478.6 (382.4, 593.7)	0.65* (0.57, 0.75)	1.17 (0.91, 1.52)
New Jersey	589.4 (492.1, 701.8)	780.9 (747.6, 815.3)	535.6 (502.7, 570.4)	0.75* (0.65, 0.88)	1.51* (1.21, 1.88)
Prostate					
California	142.3 (115.1, 174.2)	295.0 (280.5, 310.0)	141.7 (135.3, 148.3)	0.48* (0.41, 0.56)	1.00 (0.82, 1.23)
Detroit, MI	155.7 (111.3, 212.6)	362.9 (338.3, 388.8)	171.5 (113.9, 249.6)	0.43* (0.34, 0.54)	0.91 (0.56, 1.47)
New Jersey	202.3 (147.6, 272.7)	329.7 (307.9, 352.7)	197.1 (176.8, 219.3)	0.61* (0.48, 0.78)	1.03 (0.75, 1.40)
Lung					
California	59.7 (42.6, 81.7)	105.4 (96.8, 114.5)	36.9 (33.7, 40.3)	0.57* (0.44, 0.73)	1.62* (1.09, 2.41)
Detroit, MI	76.9 (46.5, 120.2)	122.0 (108.1, 137.2)	61.6 (30.1, 114.0)	0.63* (0.43, 0.92)	1.25 (0.60, 2.60)
New Jersey	58.6 (30.6, 103.5)	121.7 (108.7, 136.0)	56.4 (45.9, 68.8)	0.48* (0.32, 0.72)	1.04 (0.57, 1.89)
Colorectal cancer					
California	57.5 (41.6, 77.9)	57.2 (51.0, 64.0)	43.5 (40.1, 47.1)	1.01 (0.73, 1.38)	1.32 (0.93, 1.88)
Detroit, MI	69.7 (42.1, 109.7)	77.6 (66.6, 89.9)	. . .	0.90 (0.57, 1.41)	. . .
New Jersey	44.4 (21.7, 83.6)	68.5 (58.9, 79.3)	58.6 (48.1, 71.1)	0.65 (0.39, 1.09)	0.76 (0.43, 1.34)
Bladder					
California	35.3 (22.5, 53.0)	17.0 (13.7, 21.0)	15.7 (13.7, 18.0)	2.07* (1.15, 3.72)	2.24* (1.24, 4.06)
Detroit, MI	39.2 (19.0, 72.6)	19.1 (13.8, 25.7)	. . .	2.06 (0.85, 4.96)	. . .
New Jersey	65.6 (34.3, 114.7)	23.2 (17.7, 29.9)	29.2 (21.6, 38.7)	2.83* (1.15, 7.00)	2.25 (0.98, 5.15)
Kidney					
California	14.0 (6.9, 25.9)	19.7 (16.2, 23.7)	16.6 (14.6, 18.8)	0.71 (0.41, 1.23)	0.84 (0.48, 1.48)
Detroit, MI	40.9 (20.4, 74.4)	24.1 (18.3, 31.3)	. . .	1.69 (0.77, 3.71)	. . .
New Jersey	. . .	. . .	. . .	. . .	. . .
Non-Hodgkin lymphoma					
California	23.5 (13.9, 37.9)	20.8 (17.3, 24.9)	20.3 (18.1, 22.6)	1.13 (0.67, 1.91)	1.16 (0.70, 1.94)
Detroit, MI	35.4 (17.6, 65.6)	25.1 (19.1, 32.3)	. . .	1.41 (0.68, 2.95)	. . .
New Jersey	. . .	. . .	. . .	. . .	. . .
Female cancer sites					
All sites					
California	472.0 (421.4, 527.3)	421.9 (406.6, 437.7)	354.4 (346.1, 362.8)	1.03 (0.91, 1.16)	1.22* (1.07, 1.40)
Detroit, MI	482.0 (406.9, 567.8)	486.4 (462.4, 511.3)	434.7 (355.6, 527.1)	0.99 (0.84, 1.17)	1.11 (0.87, 1.42)
New Jersey	616.5 (512.3, 737.9)	455.3 (433.9, 477.5)	409.0 (384.9, 434.5)	1.35* (1.10, 1.67)	1.51* (1.21, 1.88)
Breast					
California	194.9 (162.6, 231.9)	155.4 (146.3, 165.0)	118.0 (113.3, 122.8)	1.25* (1.03, 1.53)	1.65* (1.32, 2.06)
Detroit, MI	159.5 (117.6, 212.3)	152.8 (139.6, 167.1)	127.7 (87.1, 181.9)	1.04 (0.77,1.41)	1.25 (0.80, 1.94)
New Jersey	194.3 (139.4, 266.5)	155.6 (143.2, 168.8)	141.8 (127.9, 157.0)	1.25 (0.88, 1.77)	1.37 (0.95, 1.98)
Lung					
California	44.6 (30.0, 64.1)	57.1 (51.5, 63.3)	21.3 (19.2, 23.6)	0.78 (0.56, 1.09)	2.09* (1.25, 3.49)
Detroit, MI	67.2 (41.0, 104.9)	74.1 (64.8, 84.3)	. . .	0.91 (0.58, 1.41)	. . .
New Jersey	. . .	. . .	. . .	. . .	. . .
Colorectal cancer					
California	36.3 (23.2, 54.4)	47.9 (42.7, 53.5)	28.8 (26.4, 31.4)	0.76 (0.52, 1.10)	1.26 (0.80, 1.99)
Detroit, MI	. . .	. . .	. . .	. . .	. . .
New Jersey	83.6 (46.0, 141.2)	50.9 (43.9, 58.8)	42.6 (34.8, 51.7)	1.64 (0.84, 3.19)	0.76 (0.43, 1.34)

Continued

Table 4—*Continued*

Thyroid					
California	25.3 (15.3, 39.9)	7.2 (5.4, 9.4)	14.0 (12.6, 15.6)	3.53* (1.60, 7.79)	1.81 (1.00, 3.27)
Detroit, MI	31.2 (15.9, 57.4)	9.7 (6.6, 13.7)	...	3.22* (1.19, 8.70)	...
New Jersey	...	...	...	...	...

Note. CI= confidence interval; NHNAW = non-Hispanic, non-Arab Whites. Age-adjusted rates calculated per 100 000. Black and Hispanic are reference populations for rate ratios.
**P* < .05.

the prevalence of tobacco use, alcohol consumption, obesity, occupational exposures, and screening and diagnostic practices in a population-based sample of Arab Americans. Furthermore, nearly all Arab Americans health studies were limited to Michigan Arab American groups. Considering that US census data indicated that the Detroit Arab American population might differ in their socioeconomic profile from those in California and New Jersey, it was difficult to generalize conclusions about Arab American health for populations across the United States or to make comparisons of one Arab American population with another (Table 2). A potential weakness in estimating the Arab American population based on variables from the IPUMS database was that our numbers might be biased toward those of first-generation immigrant status and might undercount successive generations who no longer speak Arabic or Chaldean at home or self-identify as Arab ancestry or a country of origin other than United States. Furthermore, cancer registry data, such as SEER, are derived from medical records, which do not routinely contain patient country of origin, ancestry, year of immigration, or other variables that could be used to determine Arab American cases.

Calculating cancer incidence among Arab Americans is likely to continue to pose problems. The 5% US decennial census in 2000 was the last to include ancestry-identifying variables from the long form.[37] From 2000 onward, Arab American population estimates were based on data from the American Community Surveys, which are distributed annually to a much smaller percentage of the US population, approximately 3.5 million households, but still include the ancestry variables.[38] To date, no research has been done to determine Arab American population estimates from these sources, but these estimates might be expected to vary considerably based on the smaller sample sizes.

Conclusions

We were able to estimate Arab American cancer incidence in 3 geographic areas that together make up a substantial proportion of the US Arab American population. Although Arab American incidence rates in general were similar to NHNAW rates, we did find several interesting differences. A number of these differences were even more pronounced comparing Arab Americans with other ethnic/racial minorities. Our results indicated the importance of determining cancer incidence in Arab Americans. To better define cancer patterns and develop preventive strategies in this special population, more research is needed. Future work in this population would benefit from the recognition of Arab Americans as a specific ethnicity. ■

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Contributors

R. Bergmans participated in the study design, retrieved and collected data from the 3 registry sites, analyzed the data, wrote the draft article, and participated in the final write-up of the final version of the article and response to reviewers' comments. A. Soliman participated in the study design, monitored data retrieval, discussed different versions of data analysis and data presentation, participated in revisions of the article and response to reviewers' comments. K. Schwartz participated in the study design, provided the name algorithms, helped with data coding, monitored data retrieval, discussed different versions of data analysis and data presentation, and participated in revisions of the article and response to reviewers comments. J. Ruterbusch helped with data coding, monitored data retrieval, provided population statistics for data analysis and explanations for the discussion section, discussed different versions of data analysis and data presentation, and participated in revisions of the article and response to reviewers comments. R. Meza provided experience in determining the statistical approach for the analysis. J. Graff provided technical expertise for data analysis and coding of the New Jersey Cancer Registry and suggestions for different versions of the article. K. Hirko provided her experience in analysis of Arab American cancer registry data and participated in revisions of different versions of the article.

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