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Differences in the cancer burden among foreign-born and US-born Arab Americans living in metropolitan Detroit

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Abstract

Purpose—Migrant studies often provide clues for cancer etiology. We estimated the cancer burden among Arab Americans (ArA) by immigrant status in the metropolitan Detroit area, home to one of the highest concentrations of ArA in USA.

Methods—A validated name algorithm was used to identify ArA cancer cases diagnosed 1990–2009 in the Detroit SEER database. Recorded birthplace was supplemented with imputation of nativity using birthdate and social security number. Age-adjusted, gender-specific proportional incidence ratios and 95 % confidence intervals were calculated comparing all ArA, foreign-born ArA, and US-born ArA, to non-Hispanic Whites (NHW).

Results—Foreign-born ArA males had higher proportions of multiple myeloma, leukemia, kidney, liver, stomach, and bladder cancer than NHW, while bladder cancer and leukemia were higher among US-born ArA males. For ArA women, gall bladder and thyroid cancers were proportionally higher among both foreign- and US-born compared with NHW. Stomach cancer was proportionally higher only among foreign-born women.

Conclusions—Cancer proportional incidence patterns among ArA show some similarity to other migrant groups, with higher proportional incidences of stomach and liver cancers among foreign-born than US-born. Other patterns, such as tobacco-related cancers among ArA men and gall bladder and thyroid cancers among ArA women, will require more investigation of genetic, epigenetic, and environmental factors.

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Keywords

Arab Americans; Migrant groups; Cancer incidence; Proportional incidence ratios

Introduction

Arab Americans (ArA) are a distinct ethnic population that derives its origins from a group of 22 countries constituting the Arab League. Although geographically diverse and extending from Northwest Africa to Southwest Asia, these countries share a similar culture with little variation in norms and practices across the entire region [1].

Estimates of the number of people of Arab ancestry residing in the USA range from 1.2 to 3.7 million [2, 3]. Because ArA is not recognized as a population group separate from White by the US Office of Management and Budget, there are no ArA national health statistics. The metropolitan area of Detroit, Michigan, and the State of California have the largest concentration and number of ArA, respectively [2]. The populations in these two geographical areas have been the basis for much of the extant literature related to ArA health; however, many studies used convenience samples [4–7]. Both Detroit and California have population-based cancer registries; yet given the lack of recognition as a separate ethnic group, it has been historically difficult to assess the ArA cancer burden.

In general, cancer incidence in the Middle East is lower than the West [8]. Certain cancers, such as thyroid and liver, have a disproportionately higher incidence in Arab countries [9]. Studies from the USA [10–12], as well as Australia, the Netherlands, and Sweden confirm that this trend tends to persist in first generation Middle Eastern immigrants [13–18]. Previous studies in metropolitan Detroit and California demonstrate increased risk of lymphoma, leukemia, cancers of the thyroid, kidney, and liver and decreased risk of skin melanoma among ArA compared with Whites [10–12]. The purpose of this investigation is to compare cancer risk between ArA and non-Hispanic Whites (NHW) living in metropolitan Detroit by immigration status (foreign- and US-born).

Methods

Non-Hispanic Whites invasive cancer cases diagnosed from 1990 to 2009 were identified in the Metropolitan Detroit Cancer Surveillance System (MDCSS), a population-based cancer registry that collects data for all residents in Wayne, Oakland, and Macomb counties and is a founding member of the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute. A previously developed and validated Arab name algorithm was used to identify cases of probable Arab or Chaldean (Iraqi Christian) ancestry [12]. The name algorithm, which was enhanced and reviewed for quality control in 2012, has a positive predictive value of 91 % when compared with self-reported Arab ancestry (KS personal communication).

Immigrant status for ArA cases was first categorized as either US- or foreign-born using the birthplace listed in MDCSS. Only 53 % of Arab cases had birthplace documentation. For cases missing birthplace, immigrant status was imputed via the social security number

(SSN). The year a SSN is issued can be determined by the digit sequence [19]. For SSNs issued after 1951, Social Security Administration (SSA) Form 7, published by the Division of Enumeration and Employer Identification, lists the year of issue for each SSN. For SSNs issued before 1951, the year of issue was derived using methodology developed by Block et al. [19]. Imputation of nativity assumes that most immigrants apply for SSNs during early or middle adulthood when they enter the work force or when they enter the country, as opposed to US-born persons who usually acquire a SSN as children or adolescents. Using ArA cases with known birthplace information from MDCSS, the optimal age cut point to determine nativity status was 25 years based on receiver-operating curves. With an area under the curve value of 0.85, this method demonstrated 83 % sensitivity and 86 % specificity for identifying a foreign-born ArA.

Age-adjusted proportional incidence ratios (PIRs) and 95 % confidence intervals were calculated comparing ArA with NHW using the standard cancer site groupings routinely reported by MDCSS. Calculations were sex specific and adjusted for age using the indirect method with five age groups (<40, 40–49, 50–59, 60–69, 70+). PIRs>1 indicate that there are proportionally more cancers of a given site among ArA than among NHW, accounting for differences in the age distribution of the groups. PIRs were calculated for the ArA group overall and then by immigrant status. Cancer sites with <10 cases were suppressed. Analyses were completed using SAS statistical software, version 9.2 (SAS Institute Inc., Cary, NC, USA).

Results

A total of 8,138 ArA (4,437 male and 3,701 female) cancer cases were diagnosed between 1990 and 2009. After imputation, nativity was available for 7,967 (97.9 %) cases. For the remainder of cases, nativity status could not be determined due to unknown SSN and/or unknown birthplace. Forty-four percent (3,517) were foreign-born, and 56 % (4,450) were US-born. Foreign-born ArA were more likely to be male and older than US-born (Table 1).

Compared to NHW, all ArA males (Table 2) had significantly higher proportions of cancers of the kidney (PIR 1.25, 95 % CI 1.07–1.45) and liver (PIR 1.74, 95 % CI 1.37–2.18). Foreign-born ArA males demonstrated higher proportions for both solid tumors (kidney: PIR 1.32, 95 % CI 1.06–1.62; liver: PIR 2.43, 95 % CI 1.81–3.19), but US-born did not (kidney: PIR 1.17, 95 % CI 0.93–1.45; liver: PIR 1.14, 95 % CI 0.74–1.68).

Overall, ArA males had a higher proportion of multiple myeloma and leukemia. Both foreign- and US-born ArA males had significantly higher proportions of leukemia compared with NHW (foreign-born: PIR 1.30, 95 % CI 1.02–1.62; US-born: PIR 1.30, 95 % CI 1.04–1.62). The PIR for multiple myeloma was similar among foreign- and US-born ArA males but only statistically significant among foreign-born (foreign-born: PIR 1.48, 95 % CI 1.02–2.06; US-born: PIR 1.42, 95 % CI 0.98–1.99).

An inconsistent pattern was seen in the proportions of tobacco-associated malignancies among males. Foreign- and US-born ArA males had a significantly higher proportion of urinary bladder cancer (foreign-born: PIR 1.35, 95 % CI 1.17–1.54; US-born: PIR 1.24, 95

% CI 1.07–1.43). The proportion of oral cavity cancers was significantly lower than NHW for both nativity groups (foreign-born: PIR 0.50, 95 % CI 0.35–0.71; US-born: PIR 0.67, 95 % CI 0.49–0.90), whereas the proportion of lung cancer was lower for US-born but not the foreign-born ArA males (US-born: PIR 0.79, 95 % CI 0.70–0.89; foreign-born: PIR 1.03, 95 % CI 0.93–1.14).

We did not find significant differences in the proportion of gastrointestinal tract malignancies except for gastric carcinoma; a higher proportion was seen in foreign-born ArA males (PIR 1.39, 95 % CI 1.04–1.82) but not US-born (PIR 1.06, 95 % CI 0.76–1.44). The proportion of melanoma cases was lower for all ArA males. Foreign-born males had proportionately less prostate cancer (PIR 0.89, 95 % CI 0.87–0.96) than NHW while US-born males did not (PIR 1.03, 95 % CI 0.95–1.11).

In females, no difference was observed in the proportions of ovarian, uterine, cervical, or breast cancers (Table 3). For cancers of the gastrointestinal tract, all ArA females showed higher proportions of hepatobiliary tumors (liver: PIR 1.61, 95 % CI 1.06–2.34; gallbladder: PIR 2.14, 95 % CI 1.38–3.15). Both foreign- and US-born ArA females had higher proportions of gallbladder cancer (foreign-born: PIR 2.30, 95 % CI 1.10–4.24; US-born: PIR 1.95, 95 % CI 1.06–3.27). Liver cancer was proportionally higher in US-born females (PIR 1.75, 95 % CI 1.04–2.77) but could not be evaluated in foreign-born females due to insufficient numbers. The proportion of gastric cancer, like males, was higher than NHW among foreign-born but not US-born ArA females (foreign-born: PIR 2.30, 95 % CI 1.58–3.23; US-born: PIR 1.10, 95 % CI 0.73–1.60).

There were an insufficient number of esophageal and laryngeal cases to calculate PIR by nativity status. Of the other tobacco-associated malignancies, the proportion of lung cancer was significantly lower for foreign-born (PIR 0.48, 95 % CI 0.39–0.59), but not US-born females (PIR 0.95, 95 % CI 0.85–1.07). No difference was seen for oral cavity, kidney, and bladder cancers compared with NHW. ArA females had a higher proportion of thyroid cancer than NHW, and the increase was seen in both foreign-born (PIR 1.49, 95 %CI 1.13–1.92) and US-born (PIR 1.42, 95 % CI 1.18–1.71) ArA.

For cancers of the hematopoietic and lymphoid systems, there were no significant differences in the proportion of Hodgkin's disease, non-Hodgkin's lymphoma (NHL), and leukemia seen in ArA females compared with NHW. For leukemia, there was a non-significant trend toward a higher proportion in foreign-born ArA females (PIR 1.29, 95 % CI 0.92–1.75) that was not seen in US-born (PIR 0.92, 95 % CI 0.68–1.21). Similar to what was seen for males, all ArA females regardless of nativity had decreased proportion of melanoma compared with NHW (foreign-born: PIR 0.32, 95 % CI 0.19–0.53; US-born: PIR 0.54, 95 % CI 0.40–0.71).

Discussion

Migrant studies are an invaluable tool for examining the roles of environmental and genetic factors in carcinogenesis [20]. Malignancies for which the risk changes after migration may provide clues to environmental exposures, while malignancies that do not change to the

adoptive country's profile may indicate genetic factors play a larger role in etiology [21]. ArA are a rapidly growing minority in the USA; however, there are scant data regarding cancer incidence rates in this group due to lack of both numerator and denominator data. In California and Michigan, two states with sizeable populations of Arab ancestry, efforts have been made to characterize cancer occurrence patterns by constructing surname databases. Surnames are routinely used as a proxy for determining ethnicity in health research [21–23]. To our knowledge, this is the only study that examines the differences between first and subsequent generation ArA with regard to cancer burden.

We found a higher proportion of hepatobiliary cancers in ArA, a pattern seen in other studies of Arab migrants. Foreign-born ArA males had a significantly higher proportion of liver cancer; females (both US- and foreign-born) showed a trend toward higher proportions of liver and gallbladder cancers. McCredie et al. demonstrated a similar pattern in Middle Eastern migrants to South Wales [14]. A higher proportion of liver cancer in people of Arab origin also was seen in first generation migrants to the Netherlands [16]. Previous studies from metropolitan Detroit and California also confirm the finding of higher proportions of hepatobiliary cancers in ArA and Middle Easterners [10, 11]. The higher proportion of hepatocellular cancer could be related to chronic viral hepatitis infection, which contributes to approximately 80 % of the worldwide burden of disease [24]. High parity, an established risk factor for gallbladder cancer, has been cited as a potential etiologic agent for the higher proportion of gallbladder cancer seen in Arab women [10]. We saw higher proportions of gallbladder cancer in both foreign- and US-born ArA women, perhaps indicating that reproductive practices may be similar among the two groups. Numerous studies from Arab League countries have confirmed early *Helicobacter pylori* acquisition and high prevalence in this region [25]. Increased gastric cancer has been reported in Arab immigrants in Australia, metropolitan Detroit, and Sweden [10, 14, 26]. Studies of the prevalence of hepatitis and *H. pylori* among foreign- and US-born ArA would contribute to the knowledge about the association between cancer and these infectious agents.

We expected to see foreign-born ArA women with proportionally less breast cancer than NHW, consistent with numerous other immigrant studies [27]; however, the proportional incidences for both foreign- and US-born were similar to NHW. Nasseri reported that Middle Eastern women in California demonstrated significantly lower age-adjusted incidence rates for in situ and invasive breast cancer compared with NHW [28]. Arab countries also report age standardized rates that are substantially lower than those in Western countries [9]. Colon cancer also was expected to be lower for foreign-born ArA men and women compared with NHW because the rates are much lower in Arab countries [9]. Yet, the PIRs were again close to 1.0. Perhaps the uptake of cancer screening among ArA is enough to have proportionally raised the incidence of these cancers to be similar to NHW; indeed, 70 % of foreign-born ArA women in a Detroit area population-based survey reported ever having received a mammogram [29].

The higher proportion of kidney cancer for foreign-born ArA compared with NHW in our study was seen in a previous study of Detroit ArA [12], but inconsistent with documented low rates of kidney cancer in Arab countries [30], and a study of the Middle Eastern population in California (however, 70 % of first generation immigrants in this study were

from non-Arab countries) [11]. Kidney cancer tends to remain clinically silent until locally advanced or metastatic and under-diagnosis and undercounting of renal cell cancers is theoretically possible in countries with less developed health care systems. This may explain the disparately high proportion of kidney cancers seen among Detroit ArA compared with the countries of origin.

The high proportion of urinary bladder cancer that has been described in ArA [11] persisted in both US- and foreign-born ArA males. A previous study found over 90 % of bladder cancers in ArA from metropolitan Detroit was of transitional cell origin [8]. This histologic sub-type is not associated with *Schistosoma haematobium* infection, which is endemic in several parts of Africa, and is an established risk factor for squamous cell bladder cancer [31]. Cigarette smoking is the most well-established risk factor for transitional cell bladder cancer; smokers have at least three times greater risk of developing bladder cancer compared with nonsmokers [32]. Though no single genetic mutation is directly linked to transitional cell bladder cancer, epidemiologic studies have confirmed that a positive family history of this histologic sub-type confers a twofold increase in risk [33, 34]. It is possible that genetic polymorphisms in certain genes predispose sub-groups of ArAs to an increased risk of bladder cancer.

Given the high smoking prevalence in the ArA population of metropolitan Detroit [35], it is difficult to explain the proportionately fewer cases of oral cancer in our study group. This finding, however, is consistent with lower rates of oro-pharyngeal cancer observed in the Middle East [8, 36]. The avoidance of alcoholic beverages due to religious beliefs may be one explanation as alcohol and tobacco act synergistically in the development of oral cancer [37, 38]. Further, the Mediterranean diet may play a role due to the protective effect of dietary intake of fruits, vegetables, coffee, and folate [39].

A high risk of thyroid cancer among females is seen in the Middle East [8]. We found that US-born ArA females also have a higher proportion of thyroid cancer compared with NHW. Risk factors such as medical radiation exposure (used for treatment of *Tinea capitis* in some parts of Northern Africa) and iodine deficiency that have previously been identified in Arab women are less likely to contribute to carcinogenesis in second generation immigrants [40, 41]. Factors such as reproductive patterns and underlying benign thyroid disorders may play more of a role than previously thought and merit further investigation [42].

Some important limitations to this study should be considered when interpreting the results. Developing a comprehensive yet accurate database of Arab names poses several challenges. There is overlap of commonly used surnames between Arab and non-Arab countries. Names of Islamic origin, for example, are widely shared by Indians, Pakistanis, Iranians, and Muslims worldwide. Furthermore, surnames like Abraham and George that are common among NHW are also common in the Iraqi Christian (Chaldean) community. In an attempt to overcome this problem, both first and last names were used for identification of cases for names common in NHW and Chaldean populations.

The lack of population (denominator) data necessitated the use of proportional analysis. PIRs can only be used as a guide to evaluate patterns of cancer occurrence. A higher

proportion of one cancer may not necessarily indicate an excess in the absolute rate of that disease. It may, instead, be a reflection of a deficit in the absolute rate of some other malignancy [43]. The large percentage of cases with unknown birthplace necessitated imputation by SSN. The potential misclassification of nativity by this method is likely to be balanced between US- and foreign-born assignment given the similar sensitivity and specificity.

In summary, the countries that constitute the Arab League are spread over a vast geographical area. Overall, cancer incidence and mortality are lower in these countries compared with the Western world [9]. The results from this study were generally consistent with what has been reported from the USA as well as other countries with Arab immigrants, but our ability to examine incidence patterns by nativity provided some novel information. Foreign-born ArA males had a higher proportion of multiple myeloma, leukemia, kidney, liver, stomach, and bladder cancer compared with NHW. The proportion of bladder cancer and leukemia remained significantly higher in US-born ArAs but liver, stomach, and kidney cancer did not, indicating that environmental exposures, such as infectious organisms, may be less in the adopted country. The pattern among the tobacco-related cancers is more difficult to explain and warrants further investigation into genetic, epigenetic, and environmental risk factors in this population, as do the higher proportions of gallbladder and thyroid cancers among ArA women.

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Table 1

Demographic and clinical characteristics of Arab American cases identified from the MDCSS

	Total Arab *n* (%)	Foreign-born *n* (%)	US-born *n* (%)	*p* value
Year of diagnosis				<0.01
1990–1994	1,633 (0.20)	600 (0.17)	1,010 (0.23)	
1995–1999	1,880 (0.23)	787 (0.22)	1,052 (0.24)	
2000–2004	2,195 (0.27)	990 (0.28)	1,162 (0.26)	
2005–2009	2,430 (0.30)	1,140 (0.32)	1,226 (0.28)	
Sex				<0.01
Male	4,437 (0.55)	2,144 (0.61)	2,200 (0.49)	
Female	3,701 (0.45)	1,373 (0.39)	2,250 (0.51)	
Age at diagnosis				
Mean (SD)	63.5 (20.9)	64.2 (13.3)	62.9 (16.0)	<0.01
<40	643 (0.08)	171 (0.05)	443 (0.10)	<0.01
40–49	812 (0.10)	317 (0.09)	470 (0.11)	
50–59	1,445 (0.18)	647 (0.18)	761 (0.17)	
60–69	2,122 (0.26)	1,086 (0.31)	989 (0.22)	
70+	3,116 (0.38)	1,296 (0.37)	1,787 (0.40)	
Immigrant status				
US-born	4,450 (0.55)			
Foreign-born	3,517 (0.43)			
Unknown	171 (0.02)			

Table 2

Age-adjusted PIRs and 95 % confidence intervals comparing the proportion of cancer by primary site of ArA men to NHW men

	All ArA			Foreign-born ArA			US-born ArA		
	n	PIR	95 % CI	*n*	PIR	95 % CI	*n*	PIR	95 % CI
Brain	65	1.04	(0.80–1.32)	36	1.30	(0.91–1.80)	25	0.76	(0.49–1.12)
Colorectal	470	1.07	(0.98–1.18)	229	1.08	(0.94–1.23)	233	1.08	(0.94–1.23)
Esophagus	27	0.44	(0.29–0.64)	–	–	–	22	0.73	(0.46–1.11)
Hodgkin's disease	39	1.07	(0.76–1.46)	14	1.01	(0.55–1.69)	23	1.09	(0.69–1.63)
Kidney	179	1.25	(1.07–1.45)	91	1.32	(1.06–1.62)	83	1.17	(0.93–1.45)
Larynx	60	0.95	(0.73–1.23)	32	1.04	(0.71–1.47)	25	0.82	(0.53–1.20)
Leukemia	161	1.30	(1.10–1.51)	76	1.30	(1.02–1.62)	82	1.30	(1.04–1.62)
Liver	77	1.74	(1.37–2.18)	52	2.43	(1.81–3.19)	25	1.14	(0.74–1.68)
Lung/bronchus	625	0.9	(0.83–0.97)	354	1.03	(0.93–1.14)	267	0.79	(0.70–0.89)
Multiple myeloma	68	1.44	(1.12–1.83)	34	1.48	(1.02–2.06)	33	1.42	(0.98–1.99)
NHL	201	1.10	(0.95–1.26)	90	1.06	(0.85–1.30)	104	1.11	(0.91–1.35)
Oral cavity	81	0.59	(0.47–0.73)	33	0.50	(0.35–0.71)	46	0.67	(0.49–0.90)
Pancreas	110	1.11	(0.91–1.34)	60	1.24	(0.95–1.60)	49	1.00	(0.74–1.33)
Prostate	1,268	0.96	(0.91–1.02)	580	0.89	(0.81–0.96)	655	1.03	(0.95–1.11)
Skin, melanoma	71	0.38	(0.30–0.48)	–	–	–	60	0.62	(0.48–0.80)
Stomach	98	1.25	(1.02–1.52)	53	1.39	(1.04–1.82)	41	1.06	(0.76–1.44)
Testis	50	0.67	(0.50–0.89)	–	–	–	44	0.98	(0.71–1.32)
Thyroid	49	1.14	(0.84–1.50)	20	1.07	(0.65–1.65)	28	1.21	(0.81–1.75)
Urinary bladder	403	1.29	(1.16–1.42)	206	1.35	(1.17–1.54)	191	1.24	(1.07–1.43)

ArA Arab Americans, *PIR* proportional incidence ratio, 95 % CI 95 % confidence interval

Table 3

Age-adjusted PIRs and 95 % confidence intervals comparing the proportion of cancer by primary site of ArA women with NHW women

	All ArA			Foreign-born ArA			US-born ArA		
	n	PIR	95 % CI	*n*	PIR	95 % CI	*n*	PIR	95 % CI
Brain	37	0.84	(0.59–1.16)	21	1.37	(0.85–2.10)	16	0.58	(0.33–0.95)
Breast	1,181	1.05	(0.99–1.11)	448	1.05	(0.96–1.16)	709	1.06	(0.98–1.14)
Cervix uteri	73	0.92	(0.72–1.16)	28	1.11	(0.74–1.60)	43	0.84	(0.61–1.13)
Colorectal	337	0.94	(0.84–1.04)	133	1.00	(0.84–1.19)	199	0.90	(0.78–1.03)
Corpus uteri	237	1.04	(0.91–1.18)	88	0.98	(0.79–1.21)	144	1.08	(0.91–1.27)
Esophagus	10	0.62	(0.30–1.15)	–	–	–	–	–	–
Gallbladder	25	2.14	(1.38–3.15)	10	2.30	(1.10–4.24)	14	1.95	(1.06–3.27)
Hodgkin's disease	38	1.24	(0.88–1.70)	–	–	–	29	1.39	(0.93–1.99)
Kidney	69	0.86	(0.67–1.09)	24	0.79	(0.51–1.18)	42	0.87	(0.63–1.18)
Larynx	14	0.94	(0.51–1.58)	–	–	–	–	–	–
Leukemia	91	1.06	(0.85–1.30)	40	1.29	(0.92–1.75)	49	0.92	(0.68–1.21)
Liver	27	1.61	(1.06–2.34)	–	–	–	18	1.75	(1.04–2.77)
Lung/bronchus	382	0.76	(0.68–0.83)	95	0.48	(0.39–0.59)	287	0.95	(0.85–1.07)
Multiple myeloma	35	0.99	(0.69–1.37)	19	1.42	(0.86–2.23)	15	0.69	(0.39–1.14)
NHL	165	1.15	(0.98–1.33)	64	1.2	(0.93–1.54)	98	1.11	(0.90–1.36)
Oral cavity	63	1.09	(0.84–1.39)	23	1.06	(0.67–1.59)	39	1.12	(0.79–1.53)
Ovary	139	1.12	(0.94–1.32)	56	1.21	(0.91–1.57)	79	1.05	(0.83–1.31)
Pancreas	90	1.08	(0.87–1.33)	35	1.13	(0.79–1.57)	54	1.06	(0.80–1.38)
Skin, melanoma	73	0.49	(0.38–0.61)	16	0.32	(0.19–0.53)	52	0.54	(0.40–0.71)
Stomach	63	1.60	(1.23–2.04)	33	2.30	(1.58–3.23)	27	1.10	(0.73–1.60)
Thyroid	182	1.47	(1.26–1.70)	59	1.49	(1.13–1.92)	114	1.42	(1.18–1.71)
Urinary bladder	90	0.97	(0.78–1.20)	38	1.10	(0.78–1.50)	52	0.92	(0.69–1.21)

ArA Arab Americans, *PIR* proportional incidence ratio, 95 % CI 95 % confidence interval