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Comparison of Exposures Among Arab American and Non-Hispanic White Female Thyroid Cancer Cases in Metropolitan Detroit

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Abstract

Arab American (ArA) women may be at greater risk for thyroid cancer (TC) than White women. This case-case comparison explored differences in known and proposed risk factors of TC among ArA and non-Hispanic White (NHW) female TC cases in metropolitan Detroit. Cases of invasive TC identified from a population-based registry responded to a telephone survey regarding potential TC risk factors. Thirty ArA women (response rate 52%) and 70 NHW women (67%) participated. NHW women reported significantly more prior thyroid disease (TD), family history of TD, hormone use, cumulative years of hormone use, cigarette and alcohol consumption. In adjusted logistic regression analysis, ArA women had significantly higher odds of exposure to dental x-rays (OR = 3.48, CI 1.01–12.00) and medical radiation (OR = 13.58, CI 1.49–124.04) than NHW women. Risk factors for TC may differ among ArA women and their NHW counterparts.

Keywords

Thyroid cancer; Risk factors; SEER; Ethnicity; Medical radiation

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Introduction

Studies conducted in Michigan and California indicate Arab American (ArA) women living in the United States have a higher risk of thyroid cancer (TC) than White women [1, 2]. Arab/Chaldean women in metropolitan Detroit have 57% greater proportional incidence of TC as compared to white women [1]. Middle Eastern women living in California have a significantly higher incidence of TC than non-Hispanic White (NHW) women living in California (14.3 per 100,000 for Middle Eastern women and 9.4 per 100,000 for NHW non-Middle Eastern women) [2]. Among Middle Eastern and Northern African countries with cancer registries there is variation of incidence of female TC. Countries with higher incidence are Cyprus, Kuwait, Israel (Arabs), and Saudi Arabia (range 8.6–5.3 per 100,000) [3–5] while countries with lower incidence are Jordan, Oman, and Egypt (range 4.5–2.7 per 100,000) [3, 6].

Established TC risk factors are ionizing radiation [7] and iodine deficiency [8]. Other possible risk factors of TC include personal or family history of thyroid disease (TD) or TC [9, 10], hormonal factors such as age at menarche, pregnancy(ies), or hormone use [11], smoking history, alcohol consumption, ancestry, and consumption of iodine in diet [8]. We have been unable to find literature on how these risk factors for TC vary among different ethnicities.

The ArA population in the United States has been steadily increasing for the last few decades [12]. The metropolitan Detroit area has one of the highest concentrations of ArAs in the United States. The 2000 US Census estimated 125,000 Arabs live in the tri-county area (Macomb, Oakland, Wayne) [13] while other sources estimate the count as high as 490,000 throughout the state of Michigan [12]. About 80% of Arabs and Chaldeans in Michigan live in the tri-county area [12]. The actual population number is most likely between the two estimates, yet it is difficult to determine because Arabs and Chaldeans are not federally recognized minority groups. Arab refers to an ethnicity that shares identity, values, traditions, and language from the 22 member countries of the League of Arab States in the Middle East and North Africa [14]. Chaldean is a separate ethnic distinction from Arab. Chaldean refers to Christian minorities, specifically Iraqi Christians, who sometimes do not identify with the Arab ethnicity but are indigenous to the Middle East [15]. Detroit is an ideal area to study risk factors among different ethnicities because it has large Arab and Chaldean subpopulations and it is home to the Metropolitan Detroit Cancer Surveillance System (MDCSS), a founding member of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program.

Using a validated Arab/Chaldean name database [1] and the Detroit SEER registry, we sought to explore differences in known and proposed TC risk factors between ArA and NHW female cases living in metropolitan Detroit. A secondary goal was to determine potential barriers to research participation among ArA women.

Methods

Study Design

Given the limited number of ArA cases, a case-case study design was chosen because it allows for hypothesis generation in a cost-effective manner. We recruited all ArA cases and randomly selected NHW women to achieve a 2:1 case-case ratio, resulting in 30 ArA to compare with 70 NHW women. In this 2:1 case-case ratio, the larger number of NHW allows for more power to determine differences in ArA RF (risk factors) as compared to NHW.

Participants

Cases were identified from the MDCSS program located in Detroit, Michigan. Eligible participants were diagnosed with TC (ICD-O3 C73.9) and were residents of Macomb, Oakland, or Wayne counties between 2001 and 2007. Based on 2000 Census data, we know the majority of ArA women living in the metropolitan Detroit area immigrated from Lebanon or Iraq and are Christians and Muslims [13]. To capture eligible Arab American participants, we used an Arab/Chaldean surname list that was previously developed and validated to identify women of probable Arabic or Chaldean ancestry from a list of NHW TC cases [1, 16]. We attempted to contact all ArA cases identified by the surname database.

Data Collection

The participants were mailed an introduction letter about the study. Potential ArA women were mailed the information in both English and Arabic. One week after mailing, a female interviewer telephoned participants to conduct the interview. The participants gave oral consent before starting the survey. An Arabic-speaking female contacted the ArA women. For ArA women we did not successfully reach by telephone, we attempted a second recruitment strategy to increase the participation rate. Two months after the first call, a second call was placed by a second female Arabic interviewer from a local community organization, Arab Community Center for Economic and Social Services (ACCESS), to schedule an in-person interview rather than a telephone interview. Eligible participants had to be healthy enough to participate in a telephone or in-person interview.

Data Collection Instruments

The survey contained 120 questions and averaged 30 min to complete. Information on ancestry, workplace, diet, physical activity, personal and family TD history, tobacco exposure, and alcohol exposure was collected. The topic areas were based on a literature review of TC risk factors. In addition, ArA women were asked the Arabic Speaking Patient Acculturation Scale (8 questions), which assesses language preferences and ethnic group identity. ArA women were asked when exactly they started to wear Hijab (a headscarf worn by Muslim women that sometimes covers the face but not the eyes) and the number of years they have been wearing it prior to TC diagnosis. Upon completing the survey, participants were compensated $10 for their time.

Variables

High school graduate is defined as completing 12 years of education. Participants were asked about diagnosis with TD prior to their TC diagnosis, including diagnosis of postpartum thyroiditis, thyroid nodule, thyroiditis, hypothyroidism, Hashimoto disease, hyperthyroidism, Graves disease, or goiter. Participants reported family history of TD. Mediterranean diet prior to TC diagnosis was described as a diet high in fruits, vegetables, rice, bread, and olive oil, and low in red meat and processed foods. Cigarette use before cancer diagnosis assessed if the participant smoked at least one cigarette per day for 6 months prior to TC diagnosis. The age at which smoking was started and the age at which they gave up smoking were collected independent of TC diagnosis. Dental X-ray frequency was categorized as dental x-rays less frequent than annually (occasional or every other year), once a year, or greater than once a year prior to TC diagnosis. Exposure to medical radiation was asked as “ever exposed to radiation for medical purposes” prior to TC diagnosis, and specific reasons for the radiation were requested.

Data Analysis Plan

Potential risk factors were compared between the two ethnic groups using chi-squared analysis for categorical data, and a t-test of means for continuous data. A multivariable logistic regression model was performed using only those variables significant in the univariate analyses. In the adjusted multivariable model, frequency of dental x-rays was dichotomized as less frequent than annually and all others. Age at first pregnancy and hormone use length were categorized above and below the mean. Odds ratios were obtained from building a descending logistic regression model. All analyses were completed using SAS 9.2 software. Wayne State University and University of Michigan Institutional Review Boards approved this study.

Results

Participation

Of the 58 possible ArA participants eligible for the study, 30 ArA women completed the survey, yielding a 52% participation rate. There were 14 refusals (24%) and 14 women we were unable to contact (24%). Twelve ArA women who initially did not participate did participate after being approached by the interviewer from ACCESS. 105 NHW women were eligible for the study and 70 NHW women completed the survey, yielding a 67% participation rate. There were 26 refusals (25%) and 9 women we were unable to contact (8%). There were two ArA participants and two NHW participants who did not fully complete the survey. Additionally, some women did not know the answer to particular questions or refused to answer a question. Therefore, the sample size is inconsistent for the different variables and is indicated in small print next to the variable’s name in each table.

Data Analysis

The two ethnic groups had similar ages at diagnosis, health insurance status, histology, and stage at diagnosis (Table 1). ArA women were more likely to be immigrant, have less

education, lower incomes, and large households. The age at diagnosis, histology, and stage were similar between participants (n = 100) and non-participants (n = 63).

Several potential risk factors differed significantly between ArA and NHW women (Table 2). ArA women more frequently reported Mediterranean diet, increased dental x-ray frequency and exposure to medical radiation. NHW women reported more prior TD, family history of TD, ever hormone use, cumulative years of hormones use, lifetime cigarette consumption, and alcohol consumption. The most commonly reported TD among ArA and NHW women was thyroid nodules. For ArA women diagnosed with thyroid nodules (n = 4), the ages at diagnosis were 20–70 with a mean age of 41.75 ± 22.77 years. For NHW women diagnosed with thyroid nodules (n = 28), the ages of diagnosis were 19–77 with a mean age of 44.5 ± 16.17 years. NHW women also reported diagnoses of hypothyroidism (34.45 ± 15.42 years) and Hashimoto disease (43.54 ± 16.72 years). Few ArA women reported a family history of TD (10%). NHW women reported a diagnosis of hypothyroidisim in 15 family members (25%), thyroid nodule in 9 family members (15%), and Hashimoto disease in 5 family members (8%).

In the final adjusted logistic regression model ArA women had significantly higher odds of frequent dental x-rays (OR = 3.48, CI 1.01–12.00) and exposure to medical radiation (OR = 13.58, CI 1.49–124.04) prior to TC diagnosis compared to NHW women (Table 3). They had significantly lower odds of ever using hormones (OR = 0.21, CI 0.46–0.99) or drinking alcoholic beverages (OR = 0.15, CI 0.03–0.88).

Arab American Population Characteristics

The majority of ArA participants (78%) were born outside of the United States; 30% of participants were Lebanese and 26% were Iraqi, which reflects the Arab community in the metropolitan Detroit area. Women also reported immigration from Yemen (15%), Palestine (7%), and Kuwait (4%). Three quarters of women (76%) reported currently wearing a hijab. Of the women who currently wear a hijab, the majority wore a hijab, including the time at which cancer was diagnosed (73%). Women started wearing Hijab between ages 6–41 years with a mean age of 14.5 ± 11.8 years. The women wore Hijab on average 25.2 ± 17.44 years. When asked about their acculturation (n = 21), 52% reported speaking only or mostly Arabic at home and 57% reported speaking only Arabic or mostly Arabic with friends. A total of 71% reported reading and writing Arabic better than English. 80% identify only or mostly with Arabs as their ethnic group and 95% identified honoring Arabic traditions as very or somewhat important to them.

Discussion

This study was designed to explore differences in known and potential risk factors for TC among ArA and NHW female TC cases. We found that ArA women reported more dental x-rays and medical radiation exposure. This is consistent with previous studies that showed ionizing radiation as a risk factor for TC in women [8]. The thyroid contains iodine. When iodine is subjected to ionizing radiation, it blocks photons. This leaves an energy deposit in the thyroid which can break DNA bonds and lead to mutations [17]. In the past, radiation was used as therapy for fungal scalp infections such as *Tinea capitis* or acne treatments in

parts of the Middle East [18]. Ron et al. [7] reported that young adults exposed to ionizing radiation in these treatments are vulnerable to an increased risk of TC. The majority of ArA women (78%) in this study lived outside of the United States in the early part of their lives; it is possible they may have received radiation therapy for a common condition. We did not collect detailed information on medical radiation; this is an area which should be studied in greater detail in future studies.

Our results also indicate ArA cases report observing a Mediterranean diet more often than NHW cases. Mediterranean diet was significant in the unadjusted multivariable model but was not a significant risk factor when adjusted for other variables. Diet may be linked with the association between low iodine intake and TC development. Little iodine is available in a Mediterranean diet. Iodine is necessary for the production and regulation of thyroid hormones. When there is an iodine deficiency, certain thyroid hormones are overproduced, such as thyroid stimulating hormone, and sustained over-production can lead to neoplastic transformation [19, 20]. This finding that exposure to Mediterranean diet differs between ArA and NHW, may be related to TC development or simply represent cultural differences between the 2 study groups. Similarly, the observed difference in alcohol exposure may be solely related to cultural differences.

For ArA women, wearing a hijab is a possible RF for TC. A previous study hypothesized that lack of exposure to sunlight reaching the head causes a vitamin D deficiency, possibly having implications on TC development [21]. A second study opposed the association of dress and vitamin D deficiency [22]. The majority of ArA women (76%) reported wearing a hijab, including at the time of cancer diagnosis.

Saudi Arabia, Kuwait, Oman, and Jordan are the only countries in the Middle East with established cancer registries [23]. These registries, and countries with incidence data in the Persian Gulf area, show that TC incidence is high [23]. A Kuwaiti case–control study found reproductive factors such as age at menarche, pregnancy, menopausal status and age at menopause were not associated with TC [24]. Other studies have shown an increased risk of TC with a family history of benign TD [25]. Our case-case study found that hormone use and personal and family history of TD was greater for NHW than ArA women.

To our knowledge, there are no other studies comparing TC risk factors between the two ethnicities. Although the sample size is small, the women who participated appear to be representative of possible participants, as the age of diagnosis, histology and stage at diagnosis are similar between participants and non-participants. The sample size limits some statistical tests from being completed. For example, there is a significant difference in cigarette exposure between ArA and NHW women; however, the pack years of cigarette exposure cannot be fully statistically examined because only one ArA woman provided pack years.

All interviews were conducted anonymously, leading to little possible interviewer bias. The use of self reported information could result in bias if participants felt obligated to report answers in a certain way. Participant responses that could be verified by the cancer registry, such as age at TC diagnosis, indicated participants accurately reported their information.

Participants had the option to refuse questions that made them feel uncomfortable and some participants did refuse to answer questions. Therefore, we believe this demonstrates participants accurately reported their exposures for more sensitive questions.

A study limitation is the case-case comparison design. Because we are comparing potential known risk or protective factors among two case groups, the differences found may be simply due to cultural differences and have little to do with TC risk. This exploratory analysis indicates that exposures are different for the ArA and NHW groups but a non-disease group is needed to look at exposure differences to determine differences between cases and their non-cancer ethnically matched peers.

Challenges encountered during this study included self-identification of ArA participants and difficulty locating potentially eligible women. After identifying possible ArA participants using the name lists, several of these women self-identified their race/ethnicity as White or European. Previous Detroit-based studies have revealed that people of Lebanese and Syrian descent, especially those with a Christian religious affiliation, often identify as “white” rather than Arab American [26]. A small proportion of both the ArA and NHW study groups had moved out of the state, and we did not contact these women. There was a higher proportion of ArA women (27%) than NHW women (11%) of the study sample who were ineligible and a higher proportion of ArA women (22%) than NHW women (12%) whom we were unable to contact or locate.

ArA cases were, in general, more difficult to recruit to participate in the study. If we made contact with an ArA woman, she often refused to complete the interview. We recognized that a minority population may not be comfortable revealing personal medical information over the telephone to an unfamiliar interviewer; therefore, we recruited an Arab health care worker from a trusted well known local community organization (ACCESS) for assistance with recruitment. Twelve ArA women who did not initially participate did participate after being approached by the ACCESS interviewer. This study provided an important lesson about the recruitment of ArA women into health studies. The success of this study was based on the support of trusted community members, as might have been predicted given the results of the acculturation scale: 95% of the ArA women reported honoring Arabic traditions as important to them. Other researchers have had a similar recruitment experience in other areas of research, such as diabetes studies [27]. Our study provides another example of the importance of working with community organizations to ensure successful participation rates among minorities. Community organizations recognize the importance of these partnerships for both groups and are interested in assisting in academic research [28].

In conclusion, this study examined the differences in risk factors for TC among ArA and NHW female TC patients and indicates that dental x-rays and medical radiation may be risk factors among ArA women while personal and family history of TD may be more important for NHW women. Additional areas of future research should be exploration of diet and wearing hijab among ArA women as TC risk factors. To determine significant differences between these two ethnic groups, these studies would require a study design that includes a larger sample size of ArA women and non-cancer controls.

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Table 1

Diagnosis, demographic, hormonal exposure, and clinical factors of Arab American and Non-Hispanic White women diagnosed with thyroid cancer

	ArA N = 30	**NHW N = 70**	***P*-value**
Diagnosis			
Age at diagnosis	42.73 ± 15.14	45.94 ± 13.53	0.3495
Demographics			
Birth country			0.0001
US	5 (19)	66 (97)	
Outside US	22 (78)	2 (3)	
Years lived in US among immigrants	21.50 ± 11.10	22.33 ± 25.10	0.9176
Marital status			0.1234
Married	19 (70)	52 (76)	
Widowed	4 (15)	5 (7)	
Other	4 (15)	11 (17)	
Education			0.0069
Less than high school	7 (27)	4 (6)	
High school graduate	9 (34)	17 (26)	
Some college	8 (31)	21 (31)	
College graduate	2 (8)	25 (37)	
Household income			0.0003
$0–30,000	6 (22)	13 (19)	
$30,000–45,000	5 (19)	4 (6)	
$45,000–60,000	2 (7)	3 (4)	
>$60,000	2 (7)	32 (47)	
Refused	12 (44)	16 (24)	
Household size			0.0088
1 person	1 (4)	9 (13)	
2 people	4 (15)	21 (31)	
3 people	5 (19)	11 (16)	
4 people	6 (22)	20 (29)	
>4 people	11 (41)	6 (9)	
Health insurance	25 (93)	65 (96)	0.5553
Religion			0.0001
Christianity	12 (44)	62 (91)	
Islam	15 (56)	1 (2)	
Other	0	5 (7)	
County at diagnosis			0.1113
Macomb	5 (17)	22 (32)	
Oakland	7 (24)	22 (32)	
Wayne	17 (59)	25 (36)	
Clinical factors			

	ArA N = 30	**NHW N = 70**	***P*-value**
Histology group			0.5528
Papillary	29 (97)	64 (92)	
Follicular	1 (3)	4 (6)	
Medullary	0	2 (3)	
Stage			0.8033
Local	25 (83)	55 (79)	
Regional	5 (17)	13 (18)	
Distant/unknown	0	2 (3)	
BMI (26, 66)	26.46 ± 5.09	29.0 ± 7.68	0.0683

Total responses for categorical variables are indicated in small print for both ethnic groups next to variable headings. Numbers in parentheses are percentages. Level of significance is $P < 0.05$ for two-tailed test

Table 2

Risk factors of thyroid cancer prior to disease onset comparing Arab American women and non-hispanic white women residing in metropolitan Detroit, MI

Risk factor	ArA N = 30	NHW N = 70	*P*-value
Medical history			
Prior thyroid disease (TD) (28, 68)	14 (50)	50 (74)	0.0165
Thyroid nodule	4	28	
Thyroiditis	0	1	
Hypothyroidism	1	11	
Hashimoto disease	1	11	
Hyperthyroidism	2	6	
Graves disease	0	2	
Goiter	3	15	
Family history of TD (30, 70)	3 (10)	32 (46)	0.0018
Family history of cancer (28, 68)	13 (46)	34 (50)	0.7864
Diet			
Iodized salt intake (27, 68)	23 (85)	53 (78)	0.4003
Mediterranean diet (28, 68)	24 (85)	25 (36)	0.0001
Xray/radiation history			
Received dental x-rays (22, 67)			0.0164
Less frequent than annually	3 (14)	11 (16)	
Once a year	11 (27)	51 (76)	
Twice a year	6 (27)	4 (6)	
Other	2 (9)	1 (2)	
Radiation exposure at work (8, 44)	1 (12.5)	8 (18)	0.6960
CT scans (27, 68)	15 (56)	38 (56)	0.7887
Medical radiation (27, 68)	8 (30)	8 (12)	0.0359
Frequency of radiation (8, 7)	3.12 ± 3.35	49.71 ± 67.37	0.1172
Age at radiation (7, 8)	33.85 ± 15.14	31.12 ± 19.37	0.7645
Reasons for radiation			
Medical testing	0	3	
Cancer treatment	0	2	
Medical treatment	2	2	
Unknown	6	0	
Hormonal exposure			
Age at menarche (20, 66)	12.6 ± 1.23	12.37 ± 1.67	0.5233
Age at first pregnancy (23, 62)	21.26 ± 3.85	24.08 ± 5.32	0.0096
Ever used hormones (27, 68)	8 (30)	50 (74)	0.0001
Reasons for hormone use: (7, 50)			0.1270
Contraception	5	36	
Menopause	2	15	
Infertility/other	0	4	

Risk factor	ArA N = 30	NHW N = 70	*P*-value
Age when first started using hormones (7, 50)	34.87 ± 12.12	27.36 ± 11.92	0.1361
Cumulative years used hormones (8, 48)	3.62 ± 4.50	10.16 ± 8.44	0.0047
Pregnancy (27, 68)	23 (85)	62 (91)	0.3908
Miscarriage (25, 65)	9 (39)	20 (31)	0.4635
Experienced menopause (27, 68)	16 (59)	42 (62)	0.0749
Cigarette exposure			
Smoked 100 cigarettes in lifetime (27, 68)	4 (15)	27 (40)	0.0196
Smoked cigarettes before diagnosis (4, 27)	4	24	0.1599
Age started smoking (4, 27)	20.25 ± 3.40	16.85 ± 2.01	0.1378
Age when last smoked (2, 23)	22.5 ± 7.77	33.22 ± 11.60	0.2632
Average cigarettes per day smoked (3, 25)	15.33 ± 12.66	14.26 ± 11.29	0.8997
Alcohol exposure			
Drank alcoholic beverages (27, 68)	5 (19)	50 (74)	0.0001
0 drinks per week	3 (60)	25 (50)	
1–3 drinks per week	1 (20)	18 (36)	
3–6 drinks per week	1 (20)	5 (10)	
7 or more drinks per week	0	2 (4)	

Total responses for categorical variables are indicated in small print for both ethnic groups next to variable headings. Numbers in *parentheses* are percentages. Level of significance is $P < 0.05$ for two-tailed test

Table 3

Unadjusted and adjusted odds ratios and confidence intervals for risk factors of thyroid cancer comparing Arab American women to non-hispanic white women residing in metropolitan Detroit, MI

	Unadjusted odds ratio	Unadjusted 95% CI	Adjusted odds ratio[a]	Adjusted 95% CI
Prior thyroid disease (TD) (28, 68)	0.69	0.28–1.66	0.58	0.13–2.64
Family history of TD (30, 70)	0.38	0.15–0.97	0.68	0.19–2.40
Mediterranean diet (28, 68)	10.32	3.21–33.17	2.52	0.43–14.63
Frequency of dental x-rays (22, 67)	2.34	1.01–5.43	3.48	1.01–12.00
Medical radiation (28, 68)	3.15	1.04–9.55	13.58	1.49–124.04
Age at first pregnancy (27, 66)	0.87	0.77–0.98	0.52	0.11–2.41
Hormone use (28, 68)	0.15	0.05–0.40	0.21	0.05–0.99
Hormone use length (8, 48)	0.79	0.63–0.99	0.43	0.03–6.74
Smoked cigarettes (28, 68)	0.26	0.08–0.84	0.25	0.04–1.53
Drank alcoholic beverages (28, 68)	0.08	0.02–0.24	0.15	0.03–0.88

[a] Adjusted for all the other variables in the model