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# Insights into Cigarette and Waterpipe Use among Houston-Based Arab Immigrants and Refugees

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## Abstract

Despite the decrease in tobacco use in the United States, it remains a public health concern among Arab Americans. Yet, limited studies have examined tobacco use among this population, especially among Arab refugees who experience significant stressors of displacement and resettlement that potentially influence the onset, maintenance, and addiction of tobacco. We conducted a cross-sectional survey to assess the prevalence of cigarette and waterpipe use (the most common forms of tobacco use among Arabs) in a sample of 250 Arab Americans, including refugees (76% female; 41.4 ± 12.4 years) residing in a large Houston metropolitan area. We observed that the prevalence of current cigarette smokers was significantly higher among males than females (45% and 3.2%, respectively; $p < 0.0001$). Similarly, the prevalence of current waterpipe smokers was significantly higher among males than females (16.7% and 13.2%, respectively; $p = 0.049$). Unexpectedly, the prevalence of current cigarette smokers and the prevalence of waterpipe smokers were comparable between Arab American immigrants and refugees. Multivariable logistic regression analysis demonstrated that males are more likely to smoke cigarettes than females (AOR: 35.29; 95% CI: 9.56, 130.31). And 40 years and older individuals are more likely to smoke cigarettes than the younger group (AOR: 12.65; 95% CI: 1.08, 147.80). The high prevalence of cigarette and waterpipe use among Arab American immigrants and refugees is a public health concern; hence, developing evidence-based and culturally sensitive smoking cessation interventions for this understudied population is warranted.

**Keywords**

Cigarette Smoking, Waterpipe Smoking, Arab Immigrants, Arab Refugees

## 1. Introduction

Although effective tobacco control policies and programs have been implemented to reduce global tobacco demand and dependence, tobacco use continues to be highly prevalent in the Arab world. For example, according to the World Health Organization (WHO) global report, the rate of current tobacco use among people aged 15 and older in the Eastern Mediterranean Region (EMR: which includes most of the Arab countries) was 18.6% (33.0% in males, 4.2% in females) (WHO, 2021). In addition, tobacco use continues to rise in six countries, of which four were Arab countries including Egypt, Jordan, Lebanon, and Oman (WHO, 2021). Recently, countries in the Arab region have experienced considerable and ongoing political and economic instability, which allow forces that promote tobacco use, such as the tobacco industry and the emerging trends in tobacco use, to coalesce around some shared cultural and socio-political features of this region which undermines tobacco control efforts (Maziak et al., 2014). Furthermore, evidence suggests that the high prevalence rates of smoking among Arabs seem to persist even following the migration and resettlement of Arabs in novel environments such as the United States (US) (Al-Omari & Scheibmeir, 2009; El Hajj et al., 2017).

An estimated 3.7 million individuals of Arab descent currently reside in the US, accounting for about 1.1 percent of the total US population (Batalova & Cumoletti, 2018). Arab Americans are considered a health disparities group with respect to tobacco use prevalence and associated health outcomes (Abuelezam et al., 2018; Awad et al., 2022). The prevalence rate of tobacco smoking among Arab Americans is high (39% to 69%) when compared with the average prevalence rate of 19% (Cornelius et al., 2022; Ghadban et al., 2019) for overall American population. Such high prevalence is likely due to the fact that smoking, particularly cigarette smoking, is considered a normative cultural behavior among Arab men, and this behavior continues after immigration and resettlement in the US (Al-Omari & Scheibmeir, 2009; El Hajj et al., 2017; Ghadban et al., 2019). While cigarette smoking by women is an unacceptable behavior in the Arab culture; waterpipe has become quite popular among Arab women in the last decade (Hecht, 2002; Khalil et al., 2013). The high smoking rate among Arab Americans is also associated with higher burden of smoking-related mortality and morbidity (Ghadban et al., 2019). However, national data on the prevalence of tobacco use among Arab immigrants in the US does not exist (Rice et al., 2010) which may be due to the classification of Arabs in the US census in the "White" category. This neglect is concerning, especially for Arab refugees who have migrated from places of war and political conflict, and experience significant stressors upon

resettlement, such as unemployment and social strain, factors that potentially influence tobacco use among this disadvantaged minority group (Lo et al., 2016). Only a few studies have examined tobacco use among Arab immigrants, and none of these studies included refugees from Arab countries (Alzyoud et al., 2014; Ghadban et al., 2016; Ghadban et al., 2019; Haddad et al., 2012; Rice & Kulwicki, 1992). Despite the documented high prevalence of tobacco use among Arab American communities, there is a scarcity of effective tobacco cessation programs that target this minority group (Al-Faouri et al., 2005; Ghadban et al., 2016; Haddad & Corcoran, 2013; Haddad et al., 2017). Therefore, there is a critical need to examine tobacco use patterns and factors related to tobacco use and cessation barriers in this population to inform the development and evaluation of smoking cessation interventions culturally adapted for this understudied population.

In this study, we have examined tobacco use prevalence and patterns in a sample of Arab American refugees and immigrants residing in the Greater Houston area. We have focused on waterpipe and cigarette smoking as these are the most common forms of tobacco use among Arabs (Ward et al., 2006). We also examined the prevalence of cigarette and waterpipe use among Arab refugees as compared to non-refugee Arab immigrants and its association with perceived stress. Our hypothesis was that refugees will report high perceived stress correlated with high prevalence of cigarettes and/or waterpipe use compared to Arab immigrants. This study is an initial investigation with the goal to gain insight into cigarette and waterpipe use behavior among this high risk understudied population.

## 2. Methods

We conducted a cross-sectional survey-based study among Arab immigrants and refugees residing in the Greater Houston area (September 2020-April 2022). Communication forms and survey questionnaires utilized in the study were approved by the Institutional Review Board (IRB) Committee for the Protection of Human Subjects (STUDY00002065, STUDY00003078), University of Houston (UH), Houston, TX, US.

### 2.1. Study Participants and Recruitment

Following approval by the UH-IRB committee, participants were recruited using convenient sampling and snowball recruitment methods through two community organizations. Inclusion criteria included; 1) Arab American adult (18 years and older), male or female, immigrant, or refugee, 2) residing in greater Houston area. We used convenient sampling methodology for recruitment through our community partners (Atrooz et al., 2022; Atrooz et al., 2023). Arab refugees were recruited through Houston-based 501(C)(3) non-profit organization IMPACTs, which facilitates re-settlement of refugees in the Houston area. Arab immigrants were recruited through Houston-based 501(C)(3) non-profit organization Multi Cultural Center (MCC), Webster, TX (https://www.multiculturalcenter.net/). Participants

who agreed to participate in the study were contacted via phone or through group visits/events. Response rates were 95% among refugee females, 70% among refugee males, 95% among immigrant Arab females, and 50% among immigrant Arab males. Recruitment and survey administration were explained in Arabic/English languages by a postdoctoral fellow who is an Arab American.

### 2.2. Survey

The survey consisted of four main sections: sociodemographic questions, general health questions, tobacco use specific questions, and Perceived Stress Scale (PSS) (Atrooz et al., 2022). The sociodemographic questions included information on gender, education level, age, marital status, immigration status, annual income, and health insurance status. General health information data included reporting presence of chronic diseases including diabetes, hypertension, hyperthyroidism, asthma, and irritable bowel syndrome. Tobacco use status was assessed from two self-reported items: "Have you ever used cigarettes?"; and "Have you ever used waterpipe?" Participants were given 4 options: 1) never, 2) I was, but I quit, 3) occasionally, 4) daily. Perceived stress scale (PSS) was used to assess perceived stress level among participants. The PSS questionnaire is designed to assess the level of perceived stress experienced over a period of one month (Cohen et al., 1983). The Arabic version of the PSS-14 has been previously validated (Atrooz et al., 2022). The total PSS score of 18 or less is considered low stress, scores between 19 - 37 are considered moderate stress, and scores between 38 - 56 are considered high perceived stress (Cohen et al., 1983). The survey was administered through UH-REDCap platform in English and Arabic languages, participants had the option to choose the language they prefer to complete the survey.

### 2.3. Statistical Analysis

Sample size was calculated using G*POWER 3.1 statistical software package (Faul et al., 2007). Considering a multiple logistic regression statistical test, the minimum sample size to yield a statistical power of at least 0.95 with an alpha of 0.05 and a medium effect size (d = 0.15) was estimated to be 239. Descriptive statistics were performed to summarize participants' sociodemographic characteristics, general health, cigarette and waterpipe use frequency and status, and PSS score categories. The frequencies for all variables were calculated and described as percentages. Group differences were assessed using chi-square tests for categorical variables and ANOVA test for the PSS scores. Although there was a difference in the sample size between males and females, other assumptions of the statistical tests including independence of observations and homogeneity of the variance were satisfied. Multivariable logistic regression models were used to determine predictors of tobacco use (cigarettes and waterpipe smoking). We included the following three models: 1) current cigarettes smokers vs. nonsmokers; 2) current waterpipe smokers vs. nonsmokers; and 3) current tobacco (waterpipe or cigarettes) smokers vs. nonsmokers. Independent variables included in the

model were: demographics, immigration status (immigrant, refugee), health insurance status (Yes/No); presence of chronic disease (Yes/No) in one variable: have any of the chronic diseases including diabetes, hypertension, hyperthyroidism, asthma, and irritable bowel syndrome), and perceived stress (low/ moderate to high). Quitting rate was calculated for cigarettes and waterpipe, separately, as the number of former smokers divided by the number of ever smokers (Maziak et al., 2005).

## 3. Results

A total of 250 individuals (n = 143 immigrants; n = 107 refugees; 76.0% females; age 41.4 ± 12.4 years; response rate = 77.5%) were included in this analysis. 52% of the participants completed the survey in Arabic language, 76.6% of refugees chose Arabic language, while 66.0% of immigrants chose English language to complete the survey.

### 3.1. Demographic Characteristics

As demonstrated in Table 1, a total of 60 males (24.1%) and 190 females (74.9%) participated in the study, among whom 107 (42.8%) of the participants were Syrian refugees, and 143 (57.2 %) were Middle Eastern Arab immigrants. The age of the participants ranged from 20 years to 82 years, with an average age of 41.4 (SD = 12.4 years), with 37% of the participants reported having limited education level (high school or less). Most participants were married (74.5%). More than half of the participants (53.0%) were under the poverty level with an annual income of less than $25,000. Approximately 60% of the participants reported being unemployed, although 84.8% reported having health insurance. Overall, 82 (32.8%) of the participants reported having at least one of the chronic diseases, and 71.8% reported having moderate or high stress.

### 3.2. Cigarette Smokers

Overall, 13.2% of participants were current cigarette smokers. Cigarette smoking was significantly higher among males than females (45%, and 3.2%; respectively; $p < 0.001$), Table 1. Cigarette smoking was significantly higher among participants with limited education level (high school or less) as compared to individuals with college or graduate degrees (20.9%, compared to 11.3%, and 2.5%, respectively; $p = 0.023$). Cigarette smoking was significantly higher among participants with annual income range between $25,001 - $5000 compared to participants with lower (less than $25,000) or higher (more than $50,001) annual income (27.6%, compared to 16.3% and 6.3%, respectively; $p = 0.040$). The prevalence of current cigarette smokers was comparable between Arab American refugees and Arab immigrants (non-refugees). The percentage of former cigarette smokers was 2.8% among all participants. Additionally, male former cigarette smokers were significantly higher than female former cigarette smokers (8.3%, and 1.1%, respectively; $p < 0.0001$). Unexpectedly, no difference was observed in

**Table 1.** Sociodemographic characteristics of the participants and cigarette/waterpipe smoking including former smokers.

| Variable | Cigarette smoking n = 250 | | | | | Waterpipe smoking n = 249 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Non-smokers n = 217 (86.8%) | Former smokers n = 7 (2.8%) | Current smokers n = 33 (13.2%) | Total | *p* values | Non-smokers n = 214 (85.9%) | Former smokers n = 4 (1.6%) | Current smokers n = 35 (14.1%) | Total | *p* values |
| | n (%) | n (%) | n (%) | n (%) | | n (%) | n (%) | n (%) | n (%) | |
| **Age** | | | | | | | | | | |
| 18 - 25 | 28 (90.3) | 1 (3.2) | 2 (6.5) | 31 (13.5) | | 27 (87.1) | 0 (0) | 4 (12.9) | 31 (13.6) | |
| 26 - 39 | 61 (89.7) | 1 (1.5) | 6 (8.8) | 68 (29.7) | 0.2696 | 55 (80.9) | 0 (0) | 13 (19.1) | 68 (29.8) | 0.5303 |
| 40+ | 103 (79.2) | 4 (3.1) | 23 (17.7) | 130 (56.8) | | 110 (85.3) | 3 (2.3) | 16 (12.4) | 129 (56.6) | |
| **Gender** | | | | | | | | | | |
| Male | **28 (46.7)** | **5 (8.3)** | **27 (45.0)** | 60 (24.0) | **<0.0001** | **47 (78.3)** | **3 (5.0)** | **10 (16.7)** | **60 (24.1)** | **0.0489** |
| Female | **182 (95.8)** | **2 (1.1)** | **6 (3.2)** | 190 (76.0) | | **163 (86.2)** | **1 (0.53)** | **25 (13.2)** | **189 (75.9)** | |
| **Education** | | | | | | | | | | |
| High school or less | **69 (75.8)** | **3 (3.3)** | **19 (20.9)** | 91 (37.0) | | 78 (85.7) | 1 (1.1) | 12 (13.2) | 91 (37.1) | |
| College | **98 (85.2)** | **4 (3.5)** | **13 (11.3)** | 115 (46.7) | **0.0234** | 94 (82.5) | 2 (1.8) | 18 (15.8) | 114 (46.5) | 0.8355 |
| Graduate study | **39 (97.5)** | **0 (0)** | **1 (2.5)** | 40 (16.3) | | 35 (87.5) | 1 (2.5) | 4 (10.0) | 40 (16.3) | |
| **Relationship status** | | | | | | | | | | |
| Single | 37 (86.1) | 1 (2.3) | 5 (11.6) | 43 (17.7) | | 34 (79.1) | 0 (0) | 9 (20.9) | 43 (17.8) | |
| Married | 149 (82.3) | 6 (3.3) | 26 (14.4) | 181 (74.5) | 0.9790 | 153 (85.0) | 4 (2.2) | 23 (12.8) | 180 (74.4) | 0.6067 |
| Separate/widow/ Divorce | 17 (89.5) | 0 (0) | 2 (10.5) | 19 (7.8) | | 16 (84.2) | 0 (0) | 3 (15.8) | 19 (7.9) | |
| **Income** | | | | | | | | | | |
| $25,000 or less | **99 (80.5)** | **4 (3.3)** | **20 (16.3)** | 123 (53.0) | | 109 (88.6) | 1 (0.8) | 13 (10.6) | 123 (53.2) | |
| $25,001 - 50,000 | **21 (72.4)** | **0 (0)** | **8 (27.6)** | 29 (12.5) | **0.0405** | 21 (72.4) | 1 (3.5) | 7 (24.1) | 29 (12.6) | 0.1349 |
| $50,001+ | **72 (90.0)** | **3 (3.8)** | **5 (6.3)** | 80 (34.5) | | 64 (81.0) | 2 (2.5) | 13 (16.5) | 79 (34.2) | |
| **Immigration status** | | | | | | | | | | |
| Refugee | 84 (78.5) | 4 (3.7) | 19 (17.8) | 107 (42.8) | 0.1139 | 92 (86.0) | 1 (0.9) | 14 (13.1) | 107 (43.0) | 0.7568 |
| Immigrant | 126 (88.1) | 3 (2.1) | 14 (9.8) | 143 (57.2) | | 118 (83.1) | 3 (2.1) | 21 (14.8) | 142 (57.0) | |
| **Employment** | | | | | | | | | | |
| No | 129 (87.8) | 2 (1.4) | 16 (10.9) | 147 (59.3) | 0.1657 | **122 (83.0)** | **0 (0)** | **25 (17.0)** | **147 (59.5)** | **0.0163** |
| Yes | 80 (79.2) | 4 (4.0) | 17 (16.8) | 101 (40.7) | | **86 (86.0)** | **4 (4.0)** | **10 (10.0)** | **100 (40.5)** | |
| **Health insurance** | | | | | | | | | | |
| No | 31 (83.8) | 0 (0) | 6 (16.2) | 37 (15.2) | 0.4769 | 35 (94.6) | 0 (0) | 2 (5.4) | 37 (15.3) | 0.2462 |
| Yes | 172 (83.5) | 7 (3.4) | 27 (13.1) | 206 (84.8) | | 170 (82.9) | 4 (2.0) | 31 (15.1) | 205 (84.7) | |
| **Health status** | | | | | | | | | | |
| No Chronic disease | 138 (82.1) | 6 (3.6) | 24 (14.3) | 168 (67.2) | 0.4156 | 140 (83.8) | 3 (1.8) | 24 (14.4) | 167 (67.1) | 0.7923 |
| Chronic disease | 72 (87.8) | 1 (1.2) | 9 (11.0) | 82 (32.8) | | 70 (85.4) | 1 (1.2) | 11 (13.4) | 82 (32.9) | |
| **Perceived stress** | | | | | | | | | | |
| Low | 56 (84.9) | 1 (1.5) | 9 (13.6) | 66 (28.2) | 0.8874 | 56 (84.9) | 2 (3.0) | 8 (12.2) | 66 (28.2) | 0.5354 |
| Moderate to high | 143 (85.1) | 5 (3.0) | 20 (11.9) | 168 (71.8) | | 142 (84.5) | 2 (1.2) | 24 (14.3) | 168 (71.8) | |

Bold-faced numbers indicate statistically different at $p < 0.05$.

cigarette use status between individuals who reported low stress when compared to individuals who reported moderate/high stress (Table 1).

### 3.3. Waterpipe Smokers

The prevalence of current waterpipe smokers among Arab Americans was comparable to cigarette smoking (14.1%). Waterpipe smoking among males was significantly higher than females (16.7%, and 13.2%, respectively; $p = 0.049$) (Table 1). Waterpipe smoking was significantly higher among unemployed participants than employed individuals (17.0%, and 10.0%, respectively; $p = 0.016$). The percentages of current waterpipe smokers among Arab American immigrants (non-refugees) and refugees were comparable (Table 1). The percentage of former waterpipe smokers was significantly higher among males as compared to females (5.0%, and 0.05%, respectively; $p = 0.049$). Unexpectedly, no difference was observed in waterpipe use status between individuals who reported low stress when compared to individuals who reported moderate/high stress (Table 1).

### 3.4. Multivariable Logistic Regression Analysis

As shown in Table 2, regression analysis indicated that Arab American males are more likely to smoke cigarettes as compared to females (AOR: 35.29; 95% CI: 9.56, 130.31), and older participants (40 years and above) are more likely to smoke cigarettes than younger participants (AOR: 12.65; 95% CI: 1.08, 60.95). Arab American males are more likely to use tobacco (cigarettes or waterpipe) as compared to females (AOR: 9.03; 95% CI: 3.76, 21.71). Individuals with an average annual income of more than $25,000 are more likely to use cigarette/waterpipe as compared to individuals with annual income less than $25,000 (AOR: 4.00; 95% CI: 1.00, 15.82) (Table 2).

## 4. Discussion

High tobacco use remains a public health concern among ArabAmericans, which are considered a health disparities group with respect to tobacco use prevalence and associated health outcomes (Abuelezam et al., 2018; Ghadban et al., 2016). The present cross-sectional survey study was conducted to assess the rate of tobacco use in a sample of 250 Arab Americans residing in a large metropolitan Houston area in the United States. We focused on two forms of tobacco, cigarettes and waterpipe because these are the most forms used by Arabs (Ward et al., 2006).

High prevalence of cigarette and waterpipe smoking: The present study found that tobacco use (cigarettes or waterpipe use) is highly prevalent among Arab American males. A significant number of Arab American females also reported current waterpipe use. Considering the short-term and the long-term negative health consequences of tobacco use, the high tobacco prevalence among this minority group is a public health concern. Given the fact that most Arabs live in an extended family household (Kulwicki, 2021), there is a pressing need for evidence-based tobacco intervention programming for this group.

Table 2. Multivariable logistic regression analysis of predicable variables for cigarette/waterpipe smoking.

| Variable | Cigarette smoking | Waterpipe smoking | Tobacco use (cigarette or waterpipe) |
|---|---|---|---|
| | AOR (95% CI) | AOR (95% CI) | AOR (95% CI) |
| **Age** | | | |
| 18 - 25 | 1 | 1 | 1 |
| 26 - 39 | 5.30 (0.46 - 60.98) | 3.50 (0.75 - 16.46) | 3.42 (0.72 - 16.20) |
| 40+ | **12.65 (1.08 - 147.80)** | 1.81 (0.36 - 9.09) | 3.05 (0.64 - 14.44) |
| **Gender** | | | |
| Female | 1 | 1 | 1 |
| Male | **35.29 (9.56 - 130.31)** | 2.26 (0.77 - 6.64) | **9.03 (3.76 - 21.71)** |
| **Education** | | | |
| High school or less | 1 | 1 | 1 |
| More than high school | 0.715 (0.14 - 3.75) | 0.92 (0.22 - 3.94) | 0.78 (0.22 - 2.71) |
| **Relationship status** | | | |
| Married | 1 | 1 | 1 |
| Separate/Divorce/widow/single | 2.57 (0.43 - 15.34) | 2.48 (0.80 - 7.71) | 1.48 (0.49 - 4.46) |
| **Income** | | | |
| $25,000 or less | 1 | 1 | 1 |
| More than $25,000 | 7.43 (0.91 - 60.50) | 2.91 (0.65 - 12.95) | **4.00 (1.00 - 15.82)** |
| **Immigration status** | | | |
| Refugee | 1 | 1 | 1 |
| Immigrant | 4.14 (0.62 - 27.89) | 1.29 (0.29 - 5.75) | 1.98 (0.53 - 7.31) |
| **Employment** | | | |
| No | 1 | 1 | 1 |
| Yes | 1.86 (0.57 - 6.12) | 0.34 (0.12 - 0.93) | 0.70 (0.31 - 1.59) |
| **Health Insurance** | | | |
| No | 1 | 1 | 1 |
| Yes | 0.52 (0.12 - 2.21) | 2.56 (0.47 - 13.95) | 1.53 (0.46 - 5.05) |
| **Health status** | | | |
| No Chronic disease | 1 | 1 | 1 |
| Chronic disease | 1.04 (0.19 - 5.64) | 0.44 (0.05 - 3.75) | 0.78 (0.21 - 2.90) |
| **Perceived stress** | | | |
| Low | 1 | 1 | 1 |
| Moderate/high | 0.78 (0.24 - 2.52) | 1.28 (0.46 - 3.59) | 1.19 (0.51 - 2.76) |

Bold-faced numbers indicate significantly different at $p < 0.05$.

The high rate of tobacco use found in our sample of Arab Americans, particularly men, aligns well with previous studies that have reported relatively high-rate (39% to 69%) as compared with the general US population (19%) (Abuelezam et al., 2021; Cornelius et al., 2022; Ghadban et al., 2019; Haddad et al., 2012). Cigarette smoking among Arab men is considered a normative cultural behavior, on the other hand, cigarette smoking by women is an unacceptable behavior in the Arab culture; therefore, under reporting of this socially unacceptable behavior by women cannot be ruled out in our sample. However, in the past few years, waterpipe smoking has become a more socially acceptable behavior (Alzyoud et al., 2014; Anjum et al., 2008). Interestingly, the prevalence of waterpipe smoking in our sample of Arab women was observed to be higher than cigarette smoking. This is not surprising considering that waterpipe smoking is more culturally acceptable than cigarette smoking among Arab women (Bashirian et al., 2021; Labib et al., 2007), and some women believe that waterpipe is less addictive than cigarettes and quitting is easily attainable (Akl et al., 2010).

Tobacco use prevalence among Arab immigrants and refugees: Immigrants often experience resettlement challenges such as unemployment, language barriers, and other acculturation-related processes; factors connected to the initiation and maintenance of tobacco use (Bird et al., 2018). These stressors are especially apparent for Arab refugees who have migrated from places of war and political conflict, having left their livelihoods, and loved ones behind in their distant native lands (Jamil et al., 2010; Kheirallah et al., 2020). Although we expected refugees to show higher rate of tobacco use compared to immigrants, the prevalence of cigarette use and the prevalence of waterpipe use in our sample were comparable between Arab immigrants and Arab refugees which suggest that other factors common between all Arab migrants have great influence on cigarette/waterpipe use. For example, past work has found that acculturation level was a factor related to tobacco dependence among Arab Americans (Al-Omari & Scheibmeir, 2009; Alzyoud et al., 2014; Haddad et al., 2012). There are mixed findings on whether tobacco smoking prevalence is higher among refugee than non-refugee populations (Lo et al., 2016). For example, some studies observed a significantly higher prevalence of tobacco use among refugee as compared to non-refugee populations, while other studies found this association to be non-significant (Jawad et al., 2016; Lo et al., 2016; Roberts et al., 2013). The variations in population demographic characteristics and geographic location may explain the differences observed in these studies.

Predictors of tobacco use: Two predictors of cigarette smoking were identified by the regression analysis: being male and older than 40 years. The fact that cigarette use by men is culturally accepted behavior and a symbol of muscularity is a unique predictive factor for cigarette use among Arab men (Al-Omari & Scheibmeir, 2009; El Hajj et al., 2017). Therefore, tobacco cessation interventions should target such culturally informed beliefs among Arab men. The finding that older participants were more likely to report cigarette and waterpipe smoking suggests

that younger people may use other emerging forms of tobacco such as smokeless tobacco or e-cigarettes, which were not explored in this study. Finally, individuals with an average annual income of over $25,000 were more likely to smoke cigarettes and waterpipe, perhaps because of greater financial resources that enable them to afford to pay for tobacco products.

Tobacco quitting rate: Previous studies have showed that Arab Americans have low tobacco quitting rates (cigarette use quitting rate: 10.2%, waterpipe quitting rate: 17.5%) when compared to average cessation rate of 23% in the US (Ghadban et al., 2019; Haddad et al., 2012; Jamil et al., 2009). In our sample, the reported average quitting rate for cigarette use was 17.5% and for waterpipe use was 10.5%, which were within the reported range of quitting rate among Arab Americans. Several effective population-based tobacco control educational campaigns and interventions have been launched in the US. For example, the CDC's Tips From Former Smokers campaign and the FDA's Every Try Counts campaign, combined with barrier-free access to evidence-based cessation treatments, led to significant linear increase in quit attempts, recent successful cessation, and quit ratio during 2009-2018 (Creamer et al., 2019). Despite the effectiveness of tobacco control interventions in the US, Arab Americans may not have benefitted from such interventions. The reason for poor uptake could be cultural barriers that potentially negatively impact the efficiency, acceptability and feasibility of tobacco cessation campaigns among Arab American tobacco users (Yosef, 2008). Therefore, we suggest that culturally competent and language tailored tobacco cessation interventions may offer an important step forward for better uptake and positive outcomes in this minority group.

## 5. Conclusion

Our study findings demonstrated a high prevalence of tobacco use among a sample of Houston-based Arab Americans. Both Arab immigrants and refugees showed high prevalence of cigarette and waterpipe use with comparable rates between the two groups. Given the health burden of tobacco use, there is a pressing need for evidence based and culturally relevant tobacco cessation interventions for the Arab American minority group, particularly for males who reported significantly higher rate of tobacco use as compared to females.

## 6. Limitations

Although our study has highlighted important findings, it has several limitations. *First*, all data were self-reported, and participants might have underreported cigarette use, particularly women, as cigarette use is considered an unacceptable behavior among women in the Arab culture. *Second*, a small sample size and limited number of men as compared to women which created bias in sample representation, therefore, our findings are not reflective of the entire Arab American population in the Houston area or the entire Arab population in the US. The lack of categorization of Arab Americans in the US Census as a sep-

arate category and the fact that the Arab Americans are categorized as part of the Caucasian population, results in a lack of targeted outreach in the Arab American community. *Third*, motivational factors of tobacco use, and quitting barriers are not explored in this study. *Fourth*, other types of tobacco use such as e-cigarettes and smokeless tobacco were not examined in this study (our focus has been on cigarette and waterpipe use considering these are the most common forms of tobacco used among Arabs). Consumption of other tobacco types and motivational factors of tobacco use and quitting barriers among Arab Americans will be included in future studies. *Finally*, this study was conducted during and after COVID-19 pandemic, therefore, the impact of the pandemic on smoking onset and maintenance in our sampling cannot be explicated.

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## Author Contributions

Conceptualization was made by F. Atrooz and S. Salim, who conducted the literature review, interacted with the participants, prepared the survey questionnaires, and collected the data. T. Asfar and O. J. Oluwole conducted statistical analysis and assisted with interpretation of results. F. Atrooz and S. Salim wrote the first draft of the manuscript. T. Asfar, M. J. Zvolensky and L. Garey finalized the draft after several layers of edits and iterations. All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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