

# Trends and Prevalence of Obesity in the Arab-American Population of Southeast Michigan and Comparison with their Counterparts

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## Research article

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## Abstract

**Background** Arab-Americans constitute ~ 5% of Michigan's population. Estimates of obesity in Arab-Americans are not up-to-date. Here we describe the distribution of, and factors associated with obesity in an Arab-American population.

**Methods** Arab-American patients, ages 18–98 years, from Arab Community Center for Economic and Social Services (ACCESS) clinic located in Dearborn, Michigan were identified from medical records. Retrospective chart review abstracted age, sex, marital status, employment, body mass index (BMI), hypertension (HTN), diabetes mellitus (DM), hyperlipidemia (HLD), employment status, tobacco use and alcohol consumption. This cohort was compared to Michigan's Behavioral Risk Factor Surveillance System (BRFSS) data from 2018 and to a cohort seeking care between 2013–2019 from a free clinic in Ferndale, Michigan.

**Results** Of the 2,363 Arab-American patients from the ACCESS clinic, 67% (n = 1591) were female and 33% (n = 772) were male. Among Arab-Americans, patients who were older or with HTN, DM or HLD had a higher prevalence of obesity than patients who were younger or without these comorbidities (all p-value < 0.001). Patients with HTN were 3 times as likely to be obese than those without HTN (95% CI: 2.41–3.93; p < 0.001). Similarly, the odds of being obese were 2.5 times higher if the patient was diabetic (95% CI: 1.92–3.16; p < 0.001) and 2.2 times higher if the patient had HLD (95% CI: 1.75–2.83; p < 0.001). 9,589 individuals from Michigan's BRFSS data were included in the study and no significant difference in obesity rates between Arab-Americans (31%) and the BRFSS population (32.6%) was noted. Compared to Arab-Americans, patients seen at the free clinic (n = 1,033) had a higher obesity rate (52.6%; p < 0.001) as well as significantly higher rates of HTN, DM and HLD (all p < 0.001). In Arab-Americans, a trend was observed in which obesity increased with age up to 44 years and declined thereafter. This was not the case in BRFSS and FCFC patients, where consistent increase in obesity was seen with increasing age.

**Conclusion** Obesity rates in Arab-Americans were comparable to their BRFSS counterparts, and lower than their FCFC counterparts. Further studies are required to understand the impact of obesity and the association of comorbidities in Arab-Americans residing in the US.

## Background:

Obesity rates in the United States (US) are rising at an alarming rate with adult age-adjusted prevalence of 42.4% in 2018 compared to 30.5% in the year 2000 (1). The state of California has the highest Arab-American population followed by Michigan (MI), with Arab-Americans residing in 82 of the 83 counties (2) (3). Dearborn, located in Southeast MI, has the largest percentage of Arab-Americans (30%) among places of similar population size in Michigan (4).

In the US, non-Hispanic African Americans have the highest prevalence of obesity at 49.6% compared to other ethnicities [Hispanics (44.8%), non-Hispanic whites (42.2%) and non-Hispanic Asians (17.4%)] as reported by Centers for Disease Control and Prevention (CDC) based on data from the National Health and Nutrition Examination Survey (5). Arab-Americans experience similar environmental and behavioral conditions as the general US public; however, they present different customs and cultural norms that may be contributing to adult and childhood obesity in their communities. Since Arab-Americans are not considered a distinct racial or ethnic group as defined by the United States Census, estimates of obesity in this population are not current or readily available. The rising prevalence of obesity among genetically stable populations indicates that environmental and behavioral factors underlie the obesity epidemic (6) (7, 8).

Our aim was to study the distribution and characteristics of obesity in Southeast Michigan's Arab-American population. Furthermore, we compared these data to the 2018 Michigan's Behavioral Risk Factor Surveillance System (BRFSS) population (9) and to FernCare Free Clinic's (FCFC) patients in Ferndale, Michigan; a clinic that provides medical care to the medically uninsured at no cost.

## Materials And Methods:

IRB approval from Wayne State University was obtained. A retrospective analysis of Arab-American patients ages 18–98 years who received primary care at the Arab Community Center for Economic and Social Services (ACCESS) clinic in Southeast MI from 2010–2019 was performed. Patients below 18 years and pregnant women were excluded from the study. Several variables including age, sex, marital status, employment, body mass index (BMI), hypertension (HTN), diabetes mellitus (DM), hyperlipidemia (HLD), tobacco use, and alcohol consumption were abstracted from medical records. Body Mass Index (BMI) ranges of < 18.5, 18.5 to 24.9, 25.0 to 29.9 and were used to categorize patients into underweight, normal weight, overweight and obese, respectively.

To further explore the distribution and characteristics of obesity in the Southeast MI population, we compared our cohort of Arab-American patients to two other cohorts: (i) Michigan Behavioral Risk Factor Surveillance System's (BRFSS) published data from 2018 (9); and (ii) a cohort from FernCare Free Clinic (FCFC), a center that caters to uninsured individuals aged 19 to 64 years, from 2013–2019. Data were abstracted from FCFC in the same manner as were the ACCESS data.

Baseline characteristics were summarized using count and percentage for categorical variables (employment, marital status, HTN, DM, HLD, tobacco use and alcohol consumption) and median and range for continuous variables (age, height, weight and BMI). Baseline characteristics were further compared by Fisher's exact test for categorical variables and Wilcoxon rank-sum test for continuous variables between two groups defined by obesity (BMI  $\geq$  30 vs. <30). Distributional comparisons of BMI and age between two cohorts of patients were performed using Chi-squared tests. Spearman's correlation-based test was used for trend analysis. Univariable and multivariable logistic regression models were fit to assess associations between covariates of interest and obesity (non-obese served as the reference). For the multivariable logistic analysis, the covariates were selected based on the univariable logistic and interaction analyses at a p-value of 0.05. The subgroup logistic analyses were carried out to assess the interactions between sex and other variables and between employment and other variables on obesity. The interaction p-values in the subgroup analyses were adjusted for multiple comparisons using the Holm's

procedure. Statistical software packages, IBM SPSS Statistics (Version 19.0) and R (Version 3.6.2) were used for all data analyses. The statistical significance was determined at a 5% level.

## **Results:**

The 2,363 Arab-American patients from the ACCESS clinic had a median age of 37 years (range: 18–98), with 67.3% females (n = 1591) and 32.7% males (n = 772). The majority (30%) of Arab-Americans were in the 25–35 year age group. Based on the international BMI classification, 30% (n = 707) were of normal weight, 2% (n = 47) were underweight, 37% (n = 876) were overweight and 31% (n = 733) were obese. The age and BMI distributions of Southeast MI's Arab-American population are summarized in Table 1.

Table 1  
Baseline characteristics by obesity in ACCESS/Arab American patients

	All	Obesity		p
	(N = 2363)	No (N = 1630)	Yes (N = 733)	
<b>Age, year – median (range)</b>	37 (18,98)	34 (18,98)	44 (19,93)	< 0.001
<b>Age, year – no. (%)</b>				< 0.001
18–24	319 (13)	269 (17)	50 (7)	
25–35	714 (30)	562 (34)	152 (21)	
35–44	447 (19)	277 (17)	170 (23)	
45–54	391 (17)	230 (14)	161 (22)	
55–64	289 (12)	171 (10)	118 (16)	
65+	203 (9)	121 (7)	82 (11)	
<b>Sex – no. (%)</b>				0.421
Female	1591 (67)	1106 (68)	485 (66)	
Male	772 (33)	524 (32)	248 (34)	
<b>Height, in – median (range)</b>	64 (51,79)	65 (52,79)	64 (51,78)	< 0.001
<b>Weight, lbs – median (range)</b>	163 (79,346)	150 (79,248)	198 (117,346)	< 0.001
<b>BMI, lbs/in2 – median (range)</b>	27.43 (12.34,58.51)	25.39 (12.34,29.99)	33.47 (30.02,58.51)	< 0.001
<b>BMI, lbs/in2 – no. (%)</b>				-
Underweight	47 (2)	47 (3)	-	
Normal	707 (30)	707 (43)	-	
Overweight	876 (37)	876 (54)	-	
Obese	733 (31)	-	733 (100)	
<b>Employment – no. (%)</b>				0.739
No	387 (16)	275 (17)	112 (15)	
Yes	312 (13)	218 (13)	94 (13)	
missing	1664 (70)	1137 (70)	527 (72)	
<b>Marital status – no. (%)</b>				0.266
No	119 (5)	88 (5)	31 (4)	
Yes	472 (20)	323 (20)	149 (20)	
missing	1772 (75)	1219 (75)	553 (75)	
<b>Hypertension – no. (%)</b>				< 0.001
No	985 (42)	734 (45)	251 (34)	
Yes	392 (17)	191 (12)	201 (27)	
missing	986 (42)	705 (43)	281 (38)	
<b>Diabetes Mellitus – no. (%)</b>				< 0.001
No	956 (40)	701 (43)	255 (35)	
Yes	370 (16)	195 (12)	175 (24)	
missing	1037 (44)	734 (45)	303 (41)	
<b>Hyperlipidemia – no. (%)</b>				< 0.001
No	875 (37)	646 (40)	229 (31)	
Yes	455 (19)	254 (16)	201 (27)	
missing	1033 (44)	730 (45)	303 (41)	

	All (N = 2363)	Obesity		p
		No (N = 1630)	Yes (N = 733)	
<b>Alcohol use – no. (%)</b>				0.737
No	1048 (44)	713 (44)	335 (46)	
Yes	42 (2)	30 (2)	12 (2)	
missing	1273 (54)	887 (54)	386 (53)	
<b>Smoking status – no. (%)</b>				0.497
No	1560 (66)	1073 (66)	487 (66)	
Yes	377 (16)	252 (15)	125 (17)	
missing	426 (18)	305 (19)	121 (17)	
<b>Hookah use – no. (%)</b>				> 0.99
No	1230 (52)	837 (51)	393 (54)	
Yes	174 (7)	118 (7)	56 (8)	
missing	959 (41)	675 (41)	284 (39)	

Interestingly, the prevalence of obesity in Arab-Americans was not statistically different between males and females, 32.1% and 30.5%, respectively ( $p = 0.421$ ). Among Arab-Americans, patients with HTN, DM and HLD had a higher prevalence of obesity, 51.3%, 47.3% and 44.2%, respectively, than patients without these comorbidities, 25.4%, 26.7% and 26.2%, respectively, (all  $p$ -value  $< 0.001$ ) as illustrated in Table 1. Furthermore, in a univariable analysis, patients with HTN were 3 times more likely to be obese than those without HTN (95% CI: 2.4–3.9;  $p < 0.001$ ). Similarly, the odds of being obese were 2.5 times higher if the patient was diabetic (95% CI: 1.92–3.16;  $p < 0.001$ ) and 2.2 times higher if the patient had HLD (95% CI: 1.75–2.83;  $p < 0.001$ ), as summarized in Table 2.

Table 2

## Univariable and multivariable logistic regression analyses of factors associated with obesity (Yes vs. No, No as reference) in Arab-American patients

	Univariable			Multivariable		
	E/N	OR (95% 95% CI)	p	E/N	OR (95% 95% CI)	p
<b>Age</b>	733/2363	1.028 (1.022,1.033)	< 0.001	339/1130	1.016 (1.006,1.027)	0.002
<b>Sex</b>						
Female	485/1591	Reference				
Male	248/772	1.079 (0.896,1.298)	0.419			
<b>Employment</b>						
No	112/387	Reference				
Yes	94/312	1.059 (0.763,1.467)	0.732			
<b>Marital status</b>						
No	31/119	Reference				
Yes	149/472	1.309 (0.84,2.085)	0.243			
<b>Hypertension</b>						
No	251/985	Reference		219/899	Reference	
Yes	201/392	3.077 (2.411,3.933)	< 0.001	120/231	2.263 (1.533,3.348)	< 0.001
<b>Diabetes Mellitus</b>						
No	255/956	Reference		231/895	Reference	
Yes	175/370	2.467 (1.923,3.167)	< 0.001	108/235	1.048 (0.685,1.593)	0.828
<b>Hyperlipidemia</b>						
No	229/875	Reference		224/861	Reference	
Yes	201/455	2.232 (1.759,2.835)	< 0.001	115/269	1.129 (0.778,1.628)	0.518
<b>Alcohol use</b>						
No	335/1048	Reference				
Yes	12/42	0.851 (0.415,1.642)	0.644			
<b>Smoking status</b>						
No	487/1560	Reference				
Yes	125/377	1.093 (0.858,1.386)	0.468			
<b>Hookah use</b>						
No	393/1230	Reference				
Yes	56/174	1.011 (0.715,1.413)	0.951			
Univariable, Univariable logistic regression analysis; Multivariable, Multivariable logistic regression analysis; E/N, the number of events (i.e., obesity) and patients; OR, odds ratio; 95% CI, Confidence interval.						

Subgroup analysis of obesity in Arab-Americans by sex and employment status are illustrated in Figs. 1 and 2, respectively. It appears that there is no interaction by either sex or employment. Based on the outcomes of univariable and subgroup logistic analyses, age, HTN, DM and HLD were further selected for the multivariable logistic analyses. The multivariable analysis showed that age and hypertension are independent risk factors associated with obesity (Table 2).

Of the 9,589 individuals from the Michigan BRFSS population data, 51% were female (n = 4,922) and 49% were male (n = 4,667). 33% (n = 3,128) were obese and the prevalence of obesity was higher in females (53%; n = 1,635) compared to males (47%; n = 1,493), but not statistically significant (p = 0.206). Non-Hispanic African Americans had the highest prevalence of obesity with 40% followed by 32.5% in non-Hispanic Americans. Comparing BMI distribution between Arab-Americans and MI's BRFSS population showed that there was no difference in the rates of obesity between Arab-Americans (31%) and the BRFSS population (33%) (p = 0.141).

Moreover, in Arab-Americans, a trend was observed in which obesity increased with age up to 44 years and declined thereafter, as shown in Table 3. Descriptively, the prevalence of obesity was 7% in the 18–24 year age-group, 21% in the 25–34 year age-group, 24% in the 35–44 year age-group and showed a decline to 17% and 9% in the 55–64 and > 65 year age-groups, respectively. This was not the case in the BRFSS patients, where a consistent increase in

obesity was observed with increasing age with 5%, 10%, 13%, 17%, 24% and 31% in the 18–24, 25–34, 35–44, 45–54, 55–64 and > 65 year age-groups, respectively (test for trend,  $p = 0.003$ ).

Table 3  
Comparison of BMI distribution and age-wise prevalence of obesity among Arab-American/ACCESS, MI-BRFSS and FernCare Free Clinic data

	Arab-Americans/ACCESS	MI-BRFSS	FCFC patients	p*	
				vs. MI-BRFSS	vs. FCFC
<b>BMI – no. (%)</b>				0.278	< 0.001
Underweight	47 (2)	157 (2)	5 (1)		
Normal	707 (30)	2879 (30)	201 (19)		
Overweight	876 (37)	3425 (35)	284 (27)		
Obese	733 (31)	3128 (33)	543 (53)		
Total	2363 (100)	9589 (100)	1033 (100)		
<b>Age among obese patients – no. (%)</b>				< 0.001	< 0.001
18–24	50 (7)	145 (5)	29 (6)		
25–34	152 (21)	327 (10)	80 (15)		
35–44	170 (23)	404 (13)	98 (18)		
45–54	161 (22)	546 (17)	152 (28)		
55–64	118 (16)	741 (24)	178 (33)		
65+	82 (11)	965 (31)	0**		
Total	733 (100)	3128 (100)	543 (100)		
*, Pair-wise Chi-squared p-values between ACCESS and BRFSS and between ACCESS and FernCare.					
**, FCFC does not serve patients aged > 65 who are eligible for Medicare					

Of the 1,033 patients from the FCFC cohort, the male:female gender breakdown was 46% ( $n = 471$ ):54% ( $n = 562$ ) and the prevalence of obesity was higher in females (60%;  $n = 327$ ) compared to males (40%;  $n = 216$ ) ( $p < 0.001$ ). Analysis of BMI categories between ACCESS Arab-Americans and FCFC patients indicated a higher obesity rate in FCFC patients (53% vs 31%;  $p < 0.001$ ) and followed a trend that increased with age, as illustrated in Table 3 (test for trend,  $p = 0.017$ ). Furthermore, the results also show significantly higher rates of HTN, DM and HLD (80.5%, 85.7% and 69.6% respectively) in the FCFC patient population compared to the ACCESS Arab-American population (51.7%, 47.9% and 44.9% respectively; all  $p$ -values = 0.001).

## Discussion:

Obesity is a serious global health issue, with a disease burden that is increasing worldwide. The prevalence of obesity has increased ceaselessly across the globe and doubled in more than 70 countries since 1980 (10). It ranks third among the social burdens, after smoking and armed violence/terrorism(11). If the trends in obesity continue to increase at the current pace, it is estimated that nearly half of the world's adult population would be overweight or obese by 2030 (11). Furthermore, at the current trajectory, obesity-related comorbidities are estimated to increase healthcare costs to \$48–66 billion per year by 2030 (12). In the US, obesity is the principal cause of comorbidities that contribute to death and disability increased in ranking from 4th in 1990 to 2nd in 2016 with a 28.9% increase in obesity-related early deaths and disability (13). In this study, we primarily described the distribution and characteristics of obesity in three different groups: Arab-Americans of Southeast MI, MI's BRFSS and FCFC clinic. Our results demonstrate the following: (i) the prevalence of obesity in Arab-Americans did not differ by gender, (ii) Arab-American patients with HTN, DM and HLD had a higher prevalence of obesity than those without these comorbidities, (iii) there is no significant difference in obesity rates between Arab-Americans and MI's BRFSS population, (iv) Arab-Americans obesity rates increase steadily until 44 years of age and decline thereafter; whereas the MI BRFSS population showed a steady increase in obesity rates with increasing age, (v) FCFC patient obesity rates increased with increasing age. The patients from the free clinic also showed significantly higher rates of HTN, DM and HLD compared to the Arab-American population. To our knowledge, this is one of the first and largest collections of data ever reported about obesity in the Arab-American population in the US.

The importance of a healthy diet in maintaining an individual's BMI has been elaborated in the literature (14–16). Approaches to prevent and/or treat obesity by maintaining healthy dietary habits with the inclusion of fruits, vegetables, adequate fiber intake and lean protein were well explained in a study by Pace et al (17). A narrative summary by Hruby et al., on female nurses concluded that poor quality diet, lack of physical activity, short sleep duration as risk factors for obesity (18). In a study by McClelland et al., acuties of health, nutrition, and obesity between Arab-Americans and African Americans living in the same county were compared. Their results showed that Arab-Americans did not report difficulties in adopting healthy dietary habits and therefore exhibited a lower prevalence of obesity and chronic diseases compared to their African-American counterparts (19). In accordance with existing literature, we hypothesized that Arab-Americans will have a lower obesity prevalence compared to their counterparts. Our hypothesis is based on the notion that most Arab-Americans' diet contains a larger proportion of the healthier, low-fat, high-fiber Mediterranean diet. However, we were intrigued when our results showed that the prevalence of

obesity in Southeast MI's Arab-American population was nearly equivalent to that of the state of MI. This may be attributed to the transition of dietary preferences and social habits from one generation to the next as reported by a study performed on Arab-Americans in California. They reported that third-generation Arab-Americans were 2.59 times and 3.22 times more likely to be overweight or obese compared to first and second generation Arab-Americans, respectively. Furthermore, their results also revealed a higher likelihood of binge drinking in second generation California-based Arab-Americans compared to first-generation Arab-Americans (adjusted odds ratio [AOR] = 3.26; 95% CI = 1.53–6.94) (20)

Based on our results, the association of obesity in our study population and several comorbidities including hypertension, diabetes mellitus, hyperlipidemia and cardiovascular disease are in accordance with previous studies (21) (22) (23). Baik et al., reported the association of obesity with overall and cause-specific mortality in 39,756 US men aged 40–75 years. Their results showed that the risk of cardiovascular disease mortality among men aged < 65 years increased linearly with higher BMI. Moreover, men with a BMI of  $\geq 30$  had a relative risk of 1.97 for overall mortality compared to 1.21 for a BMI of 23–24.9, 1.19 for a BMI of 25–26.9, 1.39 for a BMI of 27–29.9 (test for trend:  $p < 0.001$ ) (24). In 2016, an extensive review was conducted by Hruby et al. regarding the risk factors and consequences of obesity. Data from the Nurses' Health Study showed that overweight and obesity are important risk factors for diabetes mellitus, cardiovascular diseases, cancers and early death (18).

The prevalence of obesity in the free clinic patient cohort was higher than that of Arab-Americans and MI-BRFSS population, which is may be due to their lower socioeconomic status. The impact of socioeconomic factors such as employment on obesity was well explained by Levine et al. who reinforced that individuals living in deprived regions have diminished access to fresh food and were more susceptible to a sedentary lifestyle (25). In an elaborate systematic literature review of longitudinal studies from 1996–2011 on sedentary behaviors and subsequent health outcomes in adults by Thorp et al., a consistent association of self-reported sedentary behavior with obesity from childhood to the adulthood was reported (26). Żukiewicz-Sobczak W et al., described the association between obesity and low socioeconomic status in developed countries such as the United States and United Kingdom. They described higher levels of unemployment, lower education, irregular meal patterns and reduced physical activity among the lower socioeconomic sector as the main reasons for obesity in underprivileged individuals (27).

The large Arab-American sample size ( $n = 2,363$ ), the ability to report the association of obesity with several cardiovascular and socioeconomic factors and compare ACCESS' Arab-American population with MI-BRFSS' and FCFC's population are the major strengths of our study. On the other hand, the retrospective nature of the study and incomplete data in ACCESS patient's paper charts were serious limitations.

## Conclusion:

In summary, we describe the characteristics and distribution of obesity in Arab-Americans of Southeast MI. We also compare these trends with Michigan's BRFSS results and Ferndale's FCFC un-insured patients, and summarize the association between obesity and several comorbidities in the Arab-American population. However, the obesity distribution does not appear to apply only to Arab-Americans in Southeast MI. Further prospective clinical studies are required to understand the distribution of obesity and its association with several comorbidities in Arab-Americans across the US.

## Abbreviations

MI  
Michigan  
BRFSS  
Behavioral Risk Factor Surveillance System  
FCFC  
FernCare Free Clinic  
ACCESS  
Arab Community Center for Economic and Social Services  
BMI  
Body Mass Index  
HTN  
Hypertension  
DM  
Diabetes Mellitus  
HLD  
Hyperlipidemia  
US  
United States  
CDC  
Centers for Disease Control and Prevention

## Declarations

Ethics approval and consent to participate was obtained.

Consent for publication: Not applicable

**Availability of data and materials:** All data generated or analysed during this study are included in this published article [and its supplementary information files. Data for the population of Michigan was acquired from BRFSS published data 2018.

[https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?](https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?rdReport=DPH_BRFSS.ExploreByLocation&rdProcessAction=&SaveFileGenerated=1&irbLocationType=States&isLocation=26&isState=&isCounty=&isClass=&icIndicators=_BMI5CAT&icIndicators_rdExpandedCollapsedHistory=&icIndicators=_BMI5CAT&hidPreviouslySelectedIndicators=&DashboardColumnCount=26)

[rdReport=DPH\\_BRFSS.ExploreByLocation&rdProcessAction=&SaveFileGenerated=1&irbLocationType=States&isLocation=26&isState=&isCounty=&isClass=&icIndicators=\\_BMI5CAT&icIndicators\\_rdExpandedCollapsedHistory=&icIndicators=\\_BMI5CAT&hidPreviouslySelectedIndicators=&DashboardColumnCount=26](https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?rdReport=DPH_BRFSS.ExploreByLocation&rdProcessAction=&SaveFileGenerated=1&irbLocationType=States&isLocation=26&isState=&isCounty=&isClass=&icIndicators=_BMI5CAT&icIndicators_rdExpandedCollapsedHistory=&icIndicators=_BMI5CAT&hidPreviouslySelectedIndicators=&DashboardColumnCount=26)

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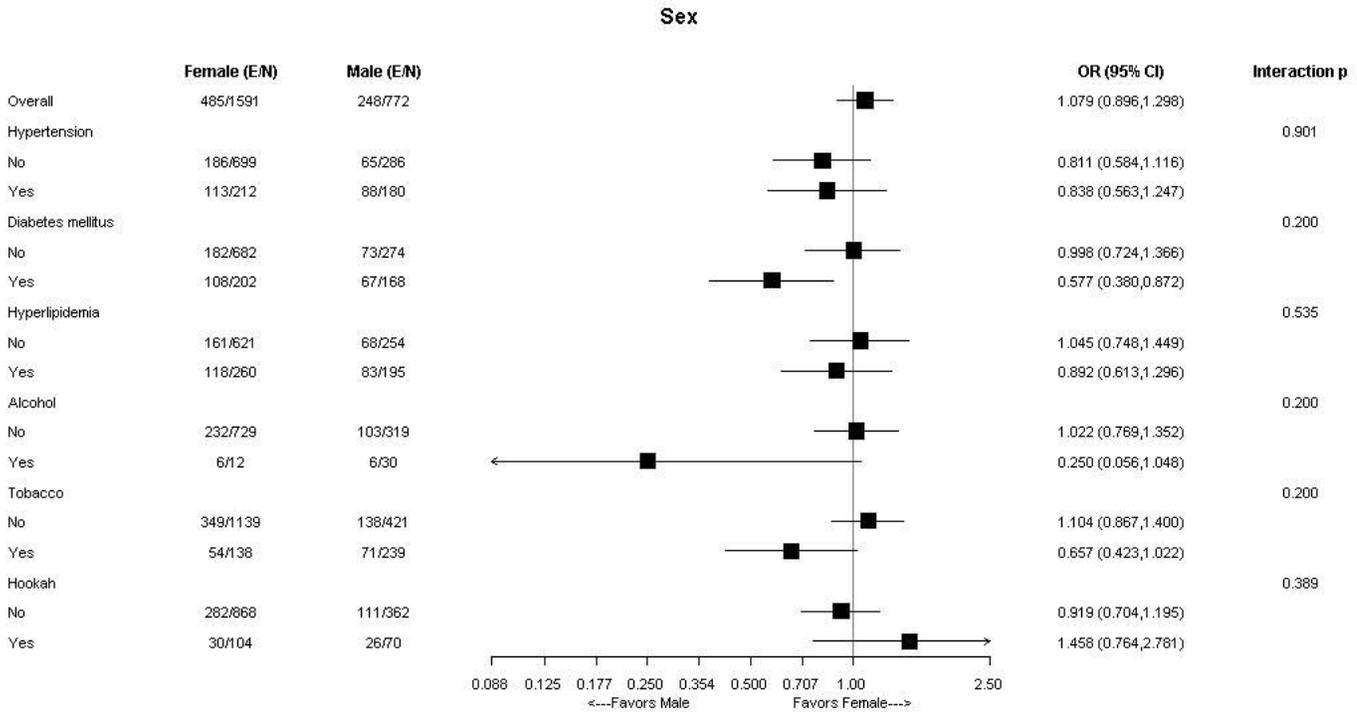
**Authors' contributions:** RAF conceptualized the manuscript. JT, NR, SA, ZF, NR, NS, ZK, OF, HR, DE, DU, HE, JN, FA, MS, IF reviewed patient charts and abstracted data. SK performed statistical analyses. SK drafted the manuscript. RAF, JT, OF, OL and MC revised the manuscript.

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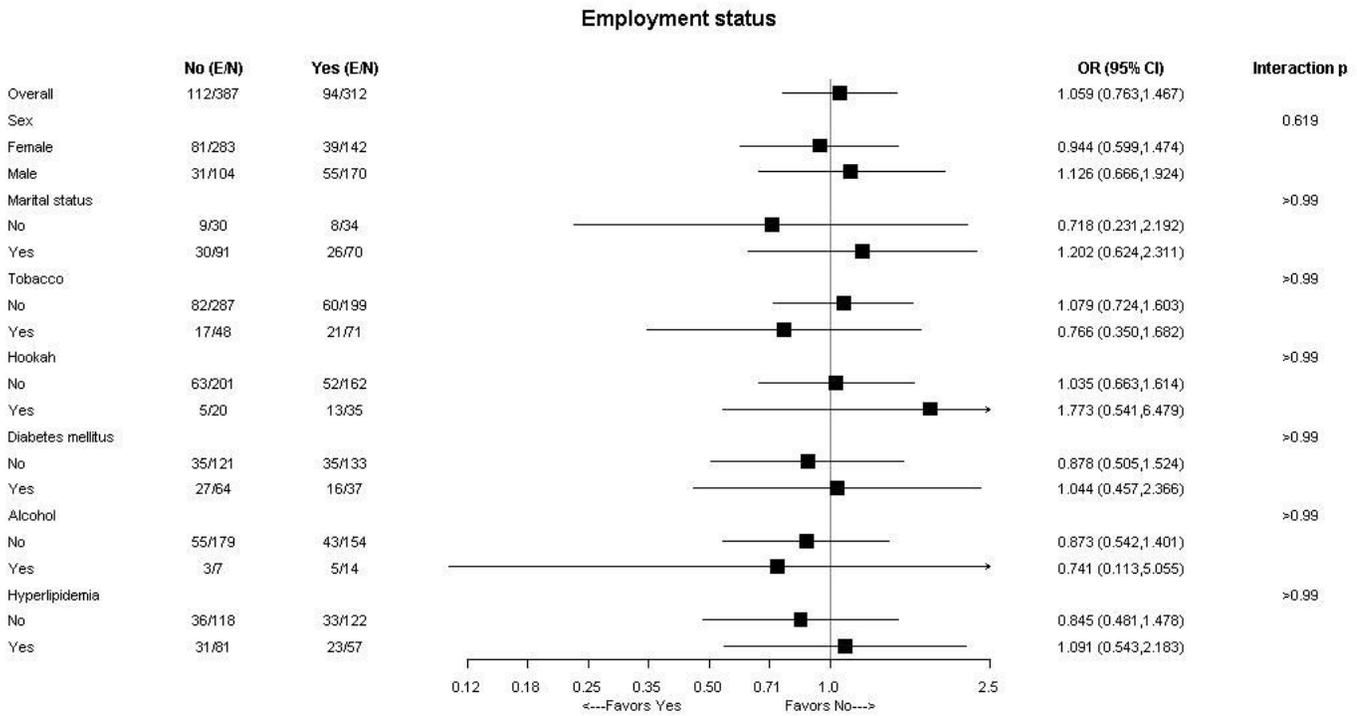
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# Figures



**Figure 1**  
Subgroup analysis of obesity by sex in Arab-American patients (Female vs. Male). The interaction p-values were corrected for multiple comparisons by the Holm's procedure.



**Figure 2**  
Subgroup analysis of obesity by employment status in Arab-American patients (Yes vs. No). The interaction p-values were corrected for multiple comparisons by the Holm's procedure.