



HPV vaccination initiation among white, black and Middle East North African (MENA) males

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ABSTRACT

Objectives: US males initiate HPV vaccination at older ages than females and currently have low population coverage. We aim to describe the prevalence and predictors of HPV vaccination initiation among males of White, Black, and Middle-Eastern/North-African (MENA) descent in southeast Michigan.

Methods: We conducted three community-based surveys in 2019 that provided primary data via self report. Using population weights and multivariate modeling, we measured the prevalence and predictors of HPV vaccine initiation in each race/ethnicity of men (age 18–34 years) analyzed.

Results: The vaccine initiation rates were 44.5 % (95 % CI: 44.4, 44.6) for White men, 46.2 % (46.0, 46.4) for Black men, and 23.2 % (22.8, 23.6) for MENA men, ($p < 0.001$). Being a student, compared to unemployed or disabled, was significantly associated with HPV vaccine initiation across all three races/ethnicities. Married men of any race/ethnicity were unlikely to be vaccinated. MENA men born in the US and having some college education were also more likely to initiate HPV vaccination.

Conclusions: White, Black, and MENA men are not vaccinated in accord with Healthy (Healthy People 2030, 2022) goals. Each race/ethnicity has different predictors of vaccination.

1. Introduction

The US Advisory Committee on Immunization Practices (ACIP) recommended human papillomavirus (HPV) vaccines for males 11–12 years through 21 years old in June 2011, with routine catch-up vaccinations of some special groups through 26 years (Centers for Disease C, Prevention, 2011). Five years later, they changed the vaccine schedule from three doses to two doses for those 9–14 years old; (Meites et al., 2016) and in 2019, they expanded recommendations for routine catch-up vaccination of males through age 26 years; males aged 27–45 years may be vaccinated through shared clinical decision making with a

provider, but routine catch-up vaccination is not recommended for males in this age group (Meites et al., 2019).

Among those 18–26 years old, overall, in 2019, 47.0 % of adults aged 18–26 years had ever received an HPV vaccination. Non-Hispanic White (49.7 %) were more likely than Hispanic adults (40.6 %) to have ever received an HPV vaccination; differences between Black adults (45.8 %) and the other two groups were not statistically significant. Overall, women were more likely than men to have been vaccinated (56.6 % versus 37.2 %), and this pattern was seen for White women and men (60.6 % versus 38.6 %) and Hispanic women and men (50.2 % versus 30.8 %). However, the difference between non-Hispanic Black women

Abbreviations: ACIP, Advisory Committee on Immunization Practices; HPV, Human Papillomavirus; MENA, Middle Eastern North African; ACCESS, Arab Community Center for Economic and Social Services; NCHAI, National College Health Assessment; NHANES, National Health and Nutrition Examination Survey; BRFSS, Behavioral Risk Factor Surveillance System; NHIS, National Health Interview Survey.

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and men (48.9 % versus 43.0 %) was not statistically significant (QuickStats, 2021).

The recommendations for males have traditionally lagged behind the female vaccine recommendations, resulting in lower adolescent and young adult male initiation rates; (Adjei Boakye et al., 2018) yet, of late, coverage has increased dramatically among males and is now relatively comparable to females (Boersma and Black, 2020; Chido-Amajuoyi et al., 2021; Pingali et al., 2021). Of all HPV-associated cancers estimated in the US between 2012 and 2016, male cancers (penile, anal, rectal, and oropharyngeal) were 44 % of the cancer burden (Senkomago et al., 2019), indicating the importance that HPV vaccination could have on male HPV-associated cancer prevention (Liao et al., 2022). The most recent national surveillance report for adolescents shows that 73.1 % of 13–17-year-old males had at least one dose (Pingali et al., 2021). Among young adults, 26.3 % of 19–26-year-old males, had at least one dose (Lu et al., 2021). More importantly, 15 % of males 19–26 years old initiated after 18 years of age, indicating an adult acceptance of vaccination.

To facilitate further vaccine coverage, the Office of the Assistant Secretary for Health and the Office on Women's Health have launched the HPV VAX NOW program to increase HPV vaccination among young adults of both genders aged 18–26 years old in the US (US Department of Health & Human Services, 2022). While the current two phases of the campaign target healthcare providers and young adults in three states (Mississippi, South Carolina, and Texas), the campaign resources are available nationwide (US Department of Health & Human Services, 2022).

This study's primary aim is to describe the prevalence of HPV vaccination initiation (at least one dose) in southeast Michigan among adult males of 1) White race, 2) Black race and 3) Middle East-North African (MENA) descent, as a baseline before the effects of the HPV VAX NOW program. We also aim to describe the predictors of HPV vaccine initiation for each of the three racial/ethnic populations to increase understanding of vaccination behaviors within these three male populations.

2. Methods

2.1. Survey measures

We developed a community-based survey conducted between May 1–October 28, 2019, among White, Black, and MENA populations in southeast Michigan who were 18 years or older, as described elsewhere (Harper et al., 2021; Harper et al., 2021; Resnicow et al., 2021). The primary aim of this survey was to systematically assess the cancer prevention and screening behaviors of these major racial/ethnic subpopulations who reside in the Rogel Cancer Center catchment area.

Three approaches were used to recruit and administer the survey: (1) a landline or cell phone random dial phone interview conducted by Harris Interactive Inc and Dynata (<https://www.dynata.com>); and (2) an online questionnaire to a panel of respondents for the populations described by US Census categories (White/Black). The third method was targeted to the 12 MENA communities of southeast Michigan: (3) an in-person/phone/mail/online survey (via paper and pen, electronic online forms with a provided tablet device, in-home or phone interview) (Harper et al., 2021; Harper et al., 2021; Resnicow et al., 2021). The community sample was recruited from community supermarkets frequented by the MENA community, health clinics attended by Arab Americans, a state university with a high number of Arab American students, a recreation center, and places of worship, as well as community health events. The survey was available in both Arabic and English.

The telephone and online samples were built to match the demographic representation of the University of Michigan Rogel Cancer Center catchment area. Black participants were oversampled in both phone surveys. Dynata had a fixed pool of registrants. All data were self-reported.

2.2. Survey respondents.

We limited the analysis to those indicating male sex ages 18–34 years, representing the group of men who could have had access to the HPV vaccine as early as 2011. We did not ask the age at which men received their first dose or the number and timing of doses received.

2.3. Survey items

We included predictors of age, body mass index (BMI), living situation, education, marital status, employment, and type of health insurance, as well as health behaviors such as the timing of the last routine checkup, place of health care delivery and ranking of personal health (1–5: 1 = excellent 5 = poor). In addition, we included whether transportation was a barrier and the respondent's religious affiliation. Specifically for the MENA population, we included nativity, length of time in the US, parent's country of origin, whether their primary care physician (PCP) was of Arab ancestry, and how important the MENA identity was to him on a scale from 0 to 10 (0 = not at all important; 10 = very important).

2.3.1. Survey outcome

The self-reported outcome question measured HPV vaccine initiation, "Now we would like to ask you about the Human Papillomavirus (Pap-uhloh-muh virus), also called HPV. A vaccine to prevent HPV infection is available and is called the HPV shot, cervical cancer vaccine, Gardasil®, or Cervarix®." "Have you ever had an HPV vaccine?" was recorded with answers of yes/no.

2.4. Statistical analysis

We performed the statistical analysis in 2021. We used a 3-dimensional raking approach for age, gender, and race/ethnicity demographic variables. The MENA sample was weighted using one-dimensional post-stratification on the mother and father's country of origin; the population totals came from estimates created by the Arab-American Institute for the geographic area (Institute et al., 2022). In the presence of missing data on variables used for post-stratification, we imputed using the probability distributions of non-missing values. We assessed the final weights by comparing the weighted sums of demographic variables to the original population totals in each post-stratification cell (Harper et al., 2021). The univariate logistic regression predicting HPV vaccination initiation was done for each race of men. We carried forward the significant univariate variables for each of the three multivariate race/ethnic models. The prevalence of receiving at least one dose of HPV vaccine was reported as a proportion with 95 % Confidence intervals and compared across races/ethnicities by weighted Kruskal-Wallis analysis of variance (ANOVA) by ranks. We used Statistica v 13.0 for the statistical analysis (TIBCO Software Inc., 2018). The University of Michigan IRB approved this study (HUM00159558) on March 10, 2019.

3. Results

Of the 507 adult men who responded to the HPV vaccine question, 192 were 18–34 years of age, 66 were White, 52 were Black, and 74 were MENA. The population-weighted HPV vaccine initiation rates reported in 2019 were 44.5 % for White men, 46.2 % for Black men, and 23.2 % for MENA men (Tables 1a–1c). These rates are significantly different from each other for each race (44.5 % (White) vs 46.2 % (Black) vs 23.2 % (MENA), $p < 0.001$, with post hoc significant differences among all three pairs ($p < 0.001$)).

Among the white male population (Table 1a, Total column), more than one-half were overweight/obese (54 %); the majority were insured by private (39 %) and public (34 %) entities. The majority were single (65 %) and employed (55 %), having a routine health checkup within

Table 1a
HPV vaccine initiation among White men by demographic descriptors.

N = 548989 weighted population N = 66 study	White men				
	Yes HPV Vaccine (N, %)		Weighted %, 95 % CI		
	N	row %	%	L95	U95
Ages					
18-34 years of age (mean = 25.6, SD = 5.3)	30	40 %	44.50 %	44.40 %	44.60 %
BMI					
Underweight	0	0 %			
Normal	13	43 %	50.00 %	49.80 %	50.20 %
Overweight	6	27 %	37.00 %	36.80 %	37.30 %
Obese	9	47 %	42.40 %	42.10 %	42.70 %
Educational level					
HS or less	9	39 %	45.50 %	45.30 %	45.70 %
Some college	12	55 %	61.50 %	61.30 %	61.70 %
College	7	30 %	26.30 %	26.10 %	26.50 %
Post-college	2	33 %	47.80 %	47.20 %	48.50 %
Living situation					
In apt/house/room without government subsidy	14	34 %	45.10 %	44.90 %	45.30 %
In apt/house/room with government subsidy	6	86 %	62.30 %	61.70 %	62.90 %
Friend/Family	9	39 %	42.50 %	42.30 %	42.80 %
Health Insurance					
Private	11	41 %	45.40 %	45.20 %	45.60 %
Public	12	46 %	44.80 %	44.60 %	45.10 %
None	7	35 %	43.20 %	43.00 %	43.50 %
Marital Status					
Married	6	24 %	23.00 %	22.80 %	23.20 %
Single	24	49 %	54.60 %	54.50 %	54.80 %
Employment status					
Employed	14	33 %	36.90 %	36.70 %	37.00 %
Student	12	75 %	89.60 %	89.40 %	89.80 %
Other	4	24 %	28.20 %	28.00 %	28.50 %
Routine Checkup					
Within past year	17	47 %	56.20 %	56.00 %	56.40 %
1-2 years ago	8	40 %	46.50 %	46.20 %	46.70 %
3 or more years ago	4	25 %	26.70 %	26.50 %	26.90 %
Never	1	33 %	33.30 %	32.80 %	33.90 %

Table 1a (continued)

N = 548989 weighted population N = 66 study	White men				
	Yes HPV Vaccine (N, %)		Weighted %, 95 % CI		
	N	row %	%	L95	U95
Where do you seek health care?					
Clinic or health center	6	33 %	41.60 %	41.30 %	41.90 %
Doctor's office or HMO	20	57 %	60.50 %	60.30 %	60.70 %
Other	4	18 %	22.40 %	22.20 %	22.60 %
Ranking your general health					
Excellent	12	60 %	58.60 %	58.30 %	58.80 %
Very good	9	33 %	40.30 %	40.10 %	40.50 %
Good	6	29 %	33.20 %	33.00 %	33.40 %
Fair	2	40 %	63.10 %	62.60 %	63.70 %
Poor	1	50 %	50.00 %	49.30 %	50.70 %
Transportation is barrier					
Never or rarely	10	50 %	48.90 %	48.70 %	49.20 %
Always, usually, or sometimes	20	36 %	43.30 %	43.20 %	43.50 %
Religious Denomination					
Muslim	6	40 %	69.30 %	68.60 %	69.90 %
Christian	8	35 %	42.90 %	42.60 %	43.10 %
Jewish	1	33 %	19.30 %	18.80 %	19.70 %
None/God but no religion	12	46 %	46.90 %	46.70 %	47.10 %

BMI indicates body mass index as kg/m².

HS means high school through grade 12.

Apt means apartment.

Public health insurance means Medicare, Medicaid, or another state program (Health Michigan), TRICARE, Alaska Native, Indian Health Service, Tribal Health service.

Other employment means unemployed, homemaker, retired, or disabled.

Other places for getting health care mean Hospital emergency room, hospital outpatient department, some other place.

the last year (47 %), most often at a doctor's office or health maintenance organization (HMO; 44 %); less often, they received this checkup at a clinic (26 %), or another healthcare site (such as the emergency department, 30 %). Nearly all (90 %) ranked their health as good or better, but 45 % always, usually, or sometimes had transportation barriers to getting health care. Very few were post-college educated (5 %) men, and very few lived in subsidized housing (6 %). Religious denominations were 14 % Muslim, 40 % Christian, 5 % Jewish, and 41 % with either no religion or a belief in a god but no religion.

Among the Black male population (Table 1b, Total column), nearly one-half (48 %) were underweight or normal in body mass index. Seventy-six percent of this group finished high school or some college. They were insured by private (34 %) and public health (36 %) insurance, with 30 % having no insurance. The majority were single (85 %) and employed (65 %), and 53 % had had a routine health checkup within the last year, most often in other places (47 %) than a clinic (27 %) or physician's office/HMO (25 %), such as the emergency department.

Table 1b
HPV vaccine initiation among Black men by demographic descriptors.

N = 238550 weighted population N = 52 study	Black men				
	Yes HPV Vaccine (N, %)		Weighted %, 95 % CI		
	N	row %	%	L95	U95
Ages					
18–34 years of age (mean = 24.6, SD = 5.1)	23	44 %	46.20 %	46.00 %	46.40 %
BMI					
Underweight	4	44 %	53.70 %	53.30 %	54.20 %
Normal	7	41 %	45.10 %	44.70 %	45.60 %
Overweight	5	55 %	58.20 %	57.80 %	58.70 %
Obese	7	50 %	52.00 %	51.60 %	52.40 %
Educational level					
HS or less	5	26 %	18.30 %	18.00 %	18.50 %
Some college	11	52 %	61.50 %	61.20 %	61.90 %
College	6	60 %	69.90 %	69.50 %	70.30 %
Post-college	1	50 %	61.10 %	60.10 %	62.20 %
Living situation					
In apt/house/room without government subsidy	16	50 %	55.50 %	55.30 %	55.80 %
In apt/house/room with government subsidy	2	33 %	28.00 %	27.40 %	28.60 %
Friend/Family	4	36 %	34.00 %	33.60 %	34.30 %
Health Insurance					
Private	10	53 %	67.00 %	66.60 %	67.30 %
Public	10	53 %	56.30 %	56.00 %	56.60 %
None	3	20 %	15.00 %	14.70 %	15.30 %
Marital Status					
Married	4	50 %	63.30 %	62.80 %	63.90 %
Single	19	43 %	43.60 %	43.40 %	43.80 %
Employment					
Employed	15	44 %	49.10 %	48.90 %	49.30 %
Student	5	71 %	77.10 %	76.60 %	77.60 %
Other	3	27 %	23.10 %	22.80 %	23.50 %
Routine Checkup					
Within past year	12	44 %	48.80 %	48.50 %	49.10 %
1–2 years ago	6	55 %	65.60 %	65.10 %	66.00 %
3 or more years ago	5	42 %	36.30 %	36.00 %	36.70 %
Never	0	0 %	0.00 %	0.00 %	0.00 %

Table 1b (continued)

N = 238550 weighted population N = 52 study	Black men				
	Yes HPV Vaccine (N, %)		Weighted %, 95 % CI		
	N	row %	%	L95	U95
Where do you seek health care?					
Clinic or health center	7	47 %	53.70 %	53.40 %	54.10 %
Doctor's office or HMO	6	46 %	55.20 %	54.80 %	55.60 %
Other	10	42 %	35.90 %	35.60 %	36.20 %
Ranking your general health					
Excellent	7	47 %	59.50 %	59.10 %	59.90 %
Very good	10	50 %	52.00 %	51.70 %	52.30 %
Good	4	33 %	24.90 %	24.60 %	25.30 %
Fair	2	40 %	38.30 %	37.60 %	39.00 %
Poor	0	0 %	0.00 %	0.00 %	0.00 %
Transportation is barrier					
Never or rarely	9	60 %	60.80 %	60.40 %	61.10 %
Always, usually or sometimes	14	38 %	40.90 %	40.60 %	41.10 %
Religious Denomination					
Muslim	1	50 %	94.20 %	93.80 %	94.70 %
Christian	13	50 %	56.60 %	56.30 %	56.90 %
Jewish	1	50 %	25.60 %	24.90 %	26.40 %
None/God but no religion	7	33 %	28.50 %	28.20 %	28.80 %

BMI indicates body mass index as kg/m².

HS means high school through grade 12.

Apt means apartment.

Public health insurance means Medicare, Medicaid, or another state program (Health Michigan), TRICARE, Alaska Native, Indian Health Service, Tribal Health service.

Other employment means unemployed, homemaker, retired, or disabled.

Other places for getting health care mean Hospital emergency room, hospital outpatient department, some other place.

Most (91 %) ranked their health as good or better, and 55 % always, usually, or sometimes had transportation problems getting to health care. They were insured by private (34 %) and public health (36 %) insurance, with 30 % having no insurance. Very few lived in subsidized housing (12 %). The majority were Christian (52 %), followed by 40 % having either no religion or a belief in a god but no religion.

Within the MENA male population (Table 1c, Total column), more than three-quarters (76 %) were overweight or obese. Their health insurance was private (32 %) and public (39 %), with 20 % having no insurance. The majority were single (77 %) and employed (51 %); 62 % had had a routine health checkup in the last year, most often (58 %) at the physician's office or HMO, less often at other healthcare sites, 19 %). Nearly all (96 %) ranked their health as good or better, and 73 % never/rarely had transportation issues getting to health care visits. Very few were educated post-college (16 %); 4 % lived in subsidized housing. The majority religion was Muslim (73 %), followed by 26 % Christian. Most MENA men (62 %) ranked the importance of being MENA as very high; 47 % were born outside the US, 44 % were in the US for less than ten

Table 1c
HPV vaccine initiation among MENA men by demographic descriptors.

N = 45746 weighted population N = 74 study	MENA men				
	Yes HPV Vaccine (N, %)		Weighted %, 95 % CI		
	N	row %	%	L95	U95
Ages					
18–34 years of age (mean = 24.5, SD = 4.9)	13	19 %	23.20 %	22.80 %	23.60 %
BMI					
Underweight	0	0 %			
Normal	3	17 %	15.30 %	14.60 %	15.90 %
Overweight	6	20 %	23.60 %	23.00 %	24.20 %
Obese	4	21 %	25.30 %	24.70 %	26.00 %
Educational level					
HS or less	1	6 %	5.10 %	4.60 %	5.50 %
Some college	7	32 %	23.90 %	23.10 %	24.60 %
College	4	22 %	36.00 %	35.20 %	36.70 %
Post-college	1	11 %	12.80 %	12.10 %	13.50 %
Living situation					
In apt/house/room without government subsidy	9	19 %	19.40 %	19.00 %	19.90 %
In apt/house/room with government subsidy	0	0 %	100.00 %	100.00 %	100.00 %
Friend/Family	4	21 %	23.30 %	22.60 %	24.00 %
Health Insurance					
Private	2	9 %	12.40 %	11.90 %	12.90 %
Public	7	25 %	33.00 %	32.30 %	33.60 %
None	2	15 %	7.90 %	7.30 %	8.60 %
Marital Status					
Married	2	14 %	20.20 %	19.50 %	20.90 %
Single	11	21 %	24.30 %	23.80 %	24.70 %
Employment					
Employed	5	15 %	24.60 %	24.10 %	25.20 %
Student	7	32 %	27.10 %	26.40 %	27.80 %
Other	1	9 %	8.40 %	7.70 %	9.10 %
Routine Checkup					
Within past year	9	21 %	30.80 %	30.30 %	31.40 %
1–2 years ago	1	10 %	6.40 %	5.80 %	6.90 %
3 or more years ago	2	22 %	11.70 %	10.80 %	12.60 %
Never	1	17 %	17.10 %	15.80 %	18.40 %
Where do you seek health care?					
Clinic or health center	3	19 %	20.00 %	19.20 %	20.80 %
Doctor's office or HMO	9	24 %	30.90 %	30.40 %	31.50 %
Other	1	7 %	5.60 %	5.10 %	6.00 %
Ranking your general health					
Excellent	2	17 %	24.10 %	23.20 %	25.00 %
Very good	8	28 %	31.10 %	30.50 %	31.80 %
Good	3	14 %	14.90 %	14.30 %	15.50 %
Fair	0	0 %	0.00 %	0.00 %	0.00 %
Poor	0	0 %	0.00 %	0.00 %	0.00 %
Transportation is barrier					
Never or rarely	1	10 %	24.70 %	23.80 %	25.60 %
Always, usually or sometimes	12	21 %	23.20 %	22.80 %	23.60 %

Table 1c (continued)

N = 45746 weighted population N = 74 study	MENA men				
	Yes HPV Vaccine (N, %)		Weighted %, 95 % CI		
	N	row %	%	L95	U95
Religious Denomination					
Muslim	11	23 %	26.90 %	26.50 %	27.40 %
Christian	2	11 %	12.40 %	11.70 %	13.10 %
Jewish	0	0 %	0.00 %	0.00 %	0.00 %
None/God but no religion	0	0 %	0.00 %	0.00 %	0.00 %
Specifics to MENA population					
Importance of being MENA					
None to moderate 0–7	3	11 %	6.80 %	6.40 %	7.20 %
Very 8–10	13	29 %	32.70 %	32.20 %	33.20 %
PCP MENA					
Yes	16	27 %	29.40 %	28.90 %	29.80 %
No	0	0 %	0.00 %	0.00 %	0.00 %
Born in the US					
Yes	12	31 %	35.10 %	34.50 %	35.60 %
No	4	12 %	8.80 %	8.40 %	9.20 %
Length in the US, if not native					
10 or fewer years	1	7 %	0.00 %	0.00 %	0.00 %
11–20 years	3	20 %	17.30 %	16.60 %	18.10 %
More than 20 years	0	0 %	0.00 %	0.00 %	0.00 %
Parent's country of origin					
Lebanon	10	23 %	22.70 %	22.20 %	23.30 %
Syria	1	100 %	100.00 %	100.00 %	100.00 %
Palestine	0	0 %	0.00 %	0.00 %	0.00 %
Iraq	3	14 %	11.60 %	11.00 %	12.30 %
Yemen	1	20 %	20.00 %	19.00 %	21.00 %
Discordant parental countries of origin	1	50 %	54.10 %	52.20 %	56.10 %

MENA means Middle Eastern North African.

BMI indicates body mass index as kg/m².

HS means high school through grade 12.

Apt means apartment.

Public health insurance means Medicare, Medicaid, or another state program (Health Michigan), TRICARE, Alaska Native, Indian Health Service, Tribal Health service.

Other employment means unemployed, homemaker, retired, or disabled.

Other places for getting health care mean Hospital emergency room, hospital outpatient department, some other place PCP means primary care physician.

years, and most were of Lebanese heritage (59 %). 81 % had a primary care physician of MENA ethnicity.

Table 2a presents the unweighted unadjusted odds ratios of receiving at least one HPV vaccine for these three sets of adult men independently. Covariates differed by race. For instance, White and MENA men were more likely to report vaccination initiation at a younger age than older age. White men were more likely to initiate HPV vaccination if they lived in a government-sponsored facility than at home or with friends. They were more likely to initiate HPV vaccination if they were single rather than married, if they were a student rather than unemployed or disabled, and if they sought health care in a doctor's office than other health sites such as the hospital emergency room.

On the other hand, Black men were more likely to initiate HPV vaccination if they had private insurance than none and were a student rather than unemployed. MENA men were more likely to initiate HPV

Table 2a
Unadjusted unweighted predictors of HPV vaccination initiation among males by race.

	White				Black				MENA			
	OR	L95	U95	p-value	OR	L95	U95	p-value	OR	L95	U95	p-value
Age, yr												
18–34	0.89	0.81	0.98	0.02	1.00	0.90	1.11	0.98	0.84	0.72	1.00	0.04
BMI kg/m²												
Underweight	excluded				excluded				excluded			
Normal	referent				referent				referent			
Overweight	0.49	0.15	1.60	0.13	1.43	0.27	7.52	0.71	1.25	0.27	5.77	0.90
Obese	1.31	0.42	4.07	0.25	1.14	0.27	4.91	0.95	1.33	0.25	7.01	0.80
Education level												
HS or less	referent				referent				referent			
Some college	1.43	0.22	9.38	0.84	0.36	0.02	6.85	0.11	7.93	0.87	72.13	0.06
College	2.40	0.36	15.94	0.15	1.10	0.06	20.01	0.66	4.86	0.49	48.57	0.40
Post-College	0.88	0.13	5.94	0.34	1.50	0.07	31.57	0.39	2.12	0.12	38.48	0.68
Living Situation												
In apt/house/room without govt subsidy	0.86	0.30	2.47	0.06	1.75	0.43	7.17	0.33	0.89	0.24	3.33	0.86
In apt/house/room with govt subsidy	9.33	0.96	90.94	0.04	0.88	0.11	7.11	0.66	excluded			
Friend/Family	referent				referent				referent			
Health Insurance												
Private	1.28	0.39	4.23	0.95	5.71	1.16	28.07	0.11	0.55	0.07	4.46	0.30
Public	1.72	0.53	5.66	0.39	4.44	0.94	21.00	0.31	1.83	0.32	10.37	0.19
None	referent				referent				referent			
Marital Status												
Married	0.38	0.14	1.08	0.07	1.32	0.29	5.95	0.72	0.64	0.12	3.27	0.59
Single	referent				referent				referent			
Employment												
Employed	1.30	0.39	4.38	0.13	2.11	0.47	9.34	0.75	1.72	0.18	16.59	0.76
Student	7.80	1.69	36.06	<0.01	6.67	0.81	54.96	0.10	4.67	0.50	43.96	0.09
Other	referent				referent				referent			
Routine Checkup												
Within the past year	1.89	0.16	22.75	0.24	1.12	0.28	4.43	0.80	1.36	0.14	13.20	0.57
1–2 years ago	1.33	0.10	17.28	0.75	1.68	0.32	8.76	0.51	0.56	0.03	10.93	0.48
Three or more years ago	0.67	0.05	9.47	0.33	referent				1.43	0.10	20.44	0.64
never	referent				excluded				referent			
Where do you seek health care?												
Clinic or health center	2.25	0.52	9.70	0.85	1.22	0.33	4.49	0.86	3.00	0.27	32.75	0.65
Doctor's office or HMO	6.30	1.77	22.43	<0.001	1.20	0.31	4.67	0.90	4.18	0.48	36.53	0.22
Other	referent				referent				referent			
Ranking your general health												
Excellent	1.50	0.08	27.61	0.17	1.31	0.17	10.26	0.72	1.27	0.18	8.87	0.81
Very good	0.50	0.03	8.95	0.41	1.50	0.20	11.00	0.50	2.41	0.56	10.44	0.24
Good	0.47	0.03	8.60	0.36	0.75	0.09	6.47	0.48	referent			
Fair	0.67	0.02	18.06	0.89	referent				excluded			
Poor	referent				excluded				excluded			
Transportation is a barrier												
Never or rarely	1.67	0.59	4.67	0.33	2.46	0.72	8.42	0.15	0.41	0.05	3.54	0.42
Always, usually, or sometimes	referent				referent				referent			
Religious Denomination												
Muslim	0.78	0.21	2.82	0.95	1.71	0.09	31.92	0.89	2.60	0.52	13.04	0.25
Christian	0.70	0.23	2.17	0.88	1.59	0.48	5.28	0.89	referent			
Jewish	0.58	0.05	7.26	0.79	1.71	0.09	31.92	0.89	excluded			
None/God but no religion	referent				referent				excluded			

Significant if the 95 % confidence interval does not cross one (red) or p-value ≤ 0.10 (blue).

Other employment means unemployed, homemaker, retired, or disabled.

Other places for getting health care mean Hospital emergency room, hospital outpatient department, some other place.

vaccination if they had some college compared to only high school and were a student compared to unemployed. Likewise, Table 2b shows that MENA men were more likely to initiate HPV vaccination if they were born in the US than foreign-born.

Tables 3a–3c presents the multivariate modeling predicting HPV vaccine initiation for each race/ethnicity. Table 3a shows that White men are more likely to report initiating HPV vaccination at a younger age than an older age; are living separately from family or friends in apartments with government subsidy; are a student rather than unemployed, retired or disabled; and seek health care in a doctor’s office rather than a hospital emergency room.

From our analysis, Black men (Table 3b) do not have significant predictors of HPV vaccine initiation. Having private or public health insurance compared to no insurance may be significant in other databases.

Like Black men, MENA men (Table 3c) are also more likely to report younger vaccination, but this association does not reach statistical significance. No significant univariate predictors remained in the multivariate model.

4. Discussion

4.1. Prevalence of HPV vaccine initiation

Several current studies have reported that adult male HPV vaccination initiation ranges from 11 % to 43 %, depending on the age ranges included to define an adult, the comparison group (e.g., native- or US-born men), the survey type, and the survey year in which the data were analyzed (Lu et al., 2021; Adjei Boakye et al., 2019; Lewis and Markowitz, 2018; Thompson et al., 2019). Our work is the first to present the adult male MENA HPV vaccine initiation rate.

In this study, we found that the prevalence of HPV vaccination (at least one dose) among male adults 18–34 years old for White and Black males are similar to the HPV vaccination rates reported in 2013 by college men 18–26 years old, at 43.3 % for White men and 40.6 % for Black men (Thompson et al., 2016). Our rates were 44.5 % for White men and 46.2 % for Black men, where most had at least some college and few were still students.

An older cohort, 20–34 years old, in 2016 reported 37.8 % initiation among men, regardless of race (TIBCO Software Inc., 2018) while a younger cohort, 19–26 years old, reported a lower rate (26.3 %) in 2018 (Lu et al., 2021).

Table 2b
Unadjusted unweighted predictors of HPV vaccination initiation among MENA males.

	MENA			
	OR	L95	U95	p-value
Specifics to the MENA population				
Importance of being MENA				
None to moderate 0–7	referent			
Very 8–10	2.56	0.63	10.36	0.19
Born in the US				
Yes	3.73	0.92	15.12	0.06
No	referent			
Parent’s matching country of origin				
Lebanon	0.23	0.01	4.20	0.60
Syria	excluded			
Palestine	excluded			
Iraq	0.17	0.01	3.45	0.34
Yemen	0.25	0.01	8.56	0.81
Discordant parental countries of origin	referent			

Significant if the 95 % confidence interval does not cross one (red) or p-value ≤ 0.10 (blue).

Table 3a
Multivariate unweighted predictors of HPV vaccine initiation among White men.

	aOR	L95	U95	p-value
Ages				
18–34 years of age	0.88	0.76	1.01	0.07
Living situation				
In apt/house/room without government subsidy	1.09	0.27	4.43	0.12
In apt/house/room with government subsidy	15.99	0.85	299.46	0.05
Friend/Family	referent			
Marital Status				
Married	0.56	0.14	2.24	0.42
Single	referent			
Employment				
Employed	0.72	0.14	3.64	0.12
Student	4.66	0.63	34.31	0.05
Other	referent			
Where do you seek health care?				
Clinic or health center	1.73	0.29	10.32	0.44
Doctor’s office or HMO	10.21	2.07	50.36	<0.001
Other	referent			

Significant if confidence interval does not cross one (red) or p-value ≤ 0.10 (blue).

Apt means apartment.

Other employment means unemployed, homemaker, retired, or disabled.

Table 3b
Multivariate unweighted predictors of HPV vaccine initiation among Black men.

	aOR	L95	U95	p-value
Health Insurance				
Private	5.43	0.97	30.27	0.18
Public	4.80	0.93	24.79	0.26
None	referent			
Employment				
Employed	1.39	0.27	7.20	0.47
Student	5.43	0.56	52.78	0.12
Other	referent			

No predictors are significant.

Other employment means unemployed, homemaker, retired, or disabled.

In an exact age match to our study of 18–34-year-olds, the NHIS-2014–2017 survey shows that 11 % of US-born men initiated the HPV vaccine series, whereas 4.5 % of foreign-born men did (Adjei Boakye et al., 2019). Our adult MENA male HPV vaccination initiation was 35 % if US-born and 9 % if foreign-born, triple and double the rates for the general US population (Arab American Institute., 2022). Michigan is among the US states with the greatest MENA residents. The MENA-focused advocacy groups (e.g., Arab Community Center for Economic and Social Services) are increasingly active, with an active connection to online resources from the Michigan Department of Health and Human Services (Michigan.gov Health & Human Services, 2022; Michigan Department of Health & Human Services, 2022). This work will continue to encourage HPV vaccination in adolescents.

4.2. Predictors of adult male HPV vaccine initiation

Our work presents the predictors of HPV vaccine initiation for adult White men, Black men, and MENA men in southeast Michigan. Only White men had significant predictors when multiple covariates were modeled. Despite the lack of significance in the Black and MENA populations in multivariate analyses, the univariate analyses indicated

Table 3c
Multivariate unweighted predictors of HPV vaccine initiation among MENA men.

	aOR	L95	U95	p-value
Ages				
18–34 years of age	0.85	0.65	1.10	0.21
Education level				
HS or less	referent			
Some college	5.53	0.47	65.66	0.25
College	5.64	0.38	84.23	0.28
Post-College	1.78	0.06	52.04	0.65
Employment				
Employed	1.07	0.09	12.64	0.80
Student	1.74	0.13	23.94	0.57
Other	referent			
Born in the USA				
Yes	2.76	0.56	13.49	0.21
No	referent			

No predictions are significant.

Other employment means unemployed, homemaker, retired, or disabled.

different predictors for each race. White and MENA men were more likely to vaccinate at a **younger age** than older men. This age effect also appears in many prior studies of HPV vaccination in adult men (Adjei Boakye et al., 2019; Lewis and Markowitz, 2018; Chen et al., 2021).

One category of employment status is being a **student** compared to being unemployed or disabled. Our study is the first to show that student status as a form of employment is highly associated with HPV vaccination initiation across all three races/ethnicities. Student status reinforces the need for HPV vaccination offerings at vocational schools. Prior work shows that 53 % of collegiate men initiated HPV vaccination during college (American College Health Association, 2019).

While being a student would imply that the covariate of *educational level* might contribute as a predictor of HPV vaccine initiation, we only documented it in the univariate model for MENA men. MENA men with some college experience were most likely to have initiated HPV vaccination, hence pointing to the success of tailoring HPV vaccine messages at post-secondary schools for MENA males, particularly on campuses where they are growing in number (Rockenbach et al., 2020).

We interpret this result to mean that the actual attainment of a degree is not as important as being a student with access to student benefits or whose school requires HPV vaccination for admission. But we failed to show any association between where MENA men sought health care and HPV vaccination, making the *school health center* unlikely to change HPV vaccine initiation in this population.

Our work offers new insight into male HPV vaccination. The routine place of health care was essential for HPV vaccination. But only for White men, where the place of routine health care was a doctor's office and not a hospital emergency room or other urgent care. No one place of routine health care has not been associated with HPV vaccine uptake among young men to date, though.

Single marital status was only associated with HPV vaccination initiation among White men. In contrast, marital status is not a predictor for Black or MENA men. Nevertheless, in our study, 60 % of Black men and 80 % of MENA men were married but not vaccinated. We feel this is a strong indicator that HPV vaccination campaigns must target married men, as well, to be effective.

We showed that White men are more likely to initiate vaccination if they live independently from friends/family. We showed that 80 % of MENA men and 64 % of Black men who live at home are not vaccinated. The other work we could find examining living situations was among college students and did not show an effect of the living situation on HPV vaccine uptake (Fontenot et al., 2014). Like marriage, the characteristic

of adult independence may be of interest in future studies.

We are the first to report the predictors of HPV vaccine initiation among MENA men. We found influences specific to MENA men to be critical factors. The MENA men most likely to vaccinate are younger, US-born, a student, and have some college education. Prior work highlights similar cultural influences on health behaviors among Arab Americans (El-Sayed and Galea, 2009). We will need community input, support, and implementation to increase this community's male HPV vaccine uptake for future targeted interventions.

4.3. Strengths and limitations

This work is a survey study of a single cross-section of the population before COVID with self-reported health and vaccination history. We are the first to study this set of predictors among young men in a community setting. This study provides the first insights into community-based responses for MENA men.

A limitation of the survey is that the predictive factors were not collected simultaneously as the HPV vaccine initiation, as in a clinical study. Further, as this survey was designed to capture the race/ethnicities of residents living in our catchment area, only three subgroups were queried; further, sampling and recruitment strategies varied by race/ethnicity to ensure a large enough representation of each. While routine HPV vaccination is recommended among those aged 11–12, the aim of our study was to understand adult vaccination. Further, our survey was not designed to include provider recommendations for vaccination as we were limited in the number of questions the community of interest would complete. The community survey offers the strength of population-level data on the MENA subgroup for which no similar data exist.

This is a study using self-report; this bias pertains to all studies published for adult male HPV vaccination initiation, including NCHA II, NHANES, BRFSS, and NHIS. Recent studies of HPV vaccination self-report, using computer-assisted self-interviewing instruments (Oliveira et al., 2020), and community surveys (Thomas et al., 2018), by comparison to the electronic medical record³⁴ have reported reasonably accurate self-reported HPV vaccination rates, particularly among older HPV-eligible respondents. There were limited variations in sensitivity and specificity for self-reported vaccinations by race/ethnicity (Rolnick et al., 2013). There is no study comparing self-reported HPV vaccine initiation rates with verified registries for adult men; therefore, we cannot estimate the self-report bias. We can compare HPV to adult influenza vaccination self-report rates, which report high accuracy ($\kappa = 0.83$) (King et al., 2018).

This work represents responses from young adult males in southeast Michigan and is not generalizable to all US White/Black and MENA men. Our work is subject to the same non-response biases in all instruments of this type.

Finally, because of the disruptions in healthcare from the COVID pandemic, the predictors of future HPV vaccine initiation and completion among adult men may differ from what we reported pre-COVID.

5. Conclusions

In southeast Michigan, the predictors for HPV vaccination differ by race/ethnicity. Adult White, Black, and MENA men are well below the Healthy (Healthy People 2030, 2022) goal for HPV vaccination (Healthy People 2030, 2022). To increase the HPV vaccination initiation rate among adult men 18–34 years old, we must consider the unique needs specific to each race/ethnicity.

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CRediT authorship contribution statement

Diane M. Harper: Conceptualization, Formal analysis, Investigation, Writing – original draft. **Ryan Rego:** Writing – review & editing. **Madiha Tariq:** Resources, Writing – review & editing. **Minal R. Patel:** Investigation, Resources, Writing – review & editing. **Kenneth Resnicow:** Funding acquisition, Methodology, Conceptualization, Writing – review & editing. **Sherri Sheinfeld Gorin:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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