Preventive Medicine Reports 24 (2021) 101516

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Social determinants of flu vaccine uptake among racial/ethnic minorities in the United States

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ARTICLE INFO

Keywords:
Social determinants of health
Vaccination
Structural inequality
NHIS

ABSTRACT

Research on the social determinants of vaccine uptake often occur between racial/ethnic groups and not within groups. Though minoritized individuals face inequalities across the board, these are also not evenly distributed amongst minoritized individuals within groups. Using the National Health Interview Survey data, we examined disparities in flu vaccine uptake across racial/ethnic groups in the United States (US). We examined (a) NH (non-Hispanic) White (n = 32,655), (b) NH Asian (n = 2335), (c) NH African American (n = 5137), and (d) Hispanic (n = 5718) respondents who lived in the United States using the combined 2017 and 2018. We used multivariable logistic regression to predict flu vaccination (yes/no) both in models comparing racial/ethnic groups and within groups. Less than 50% of any of the four major racial/ethnic groups in the US received a flu vaccination in 2017–18. Flu vaccine uptake varied within racial and ethnic groups. These results suggest that increasing vaccination may require a complex, multi-faceted perspective that considers subgroups more directly.

1. Introduction

We focused both on the Social Determinants of Health as important lenses to understand flu vaccination in the United States. Social Determinants of Health has been important approach to understanding discrepancies in health outcomes within the United States (US) as way to improve outcomes for minoritized groups (Spruce, 2019; Thornton et al., 2016). The Social Determinants of Health are, "the conditions that people are born into and live under that affect their health." (Spruce, 2019) These social determinants impact all types of access and health care decisions, including related to flu vaccination (Nagata et al., 2013). The Social Determinants of Health is often used to consider between group variation, but can also be used as lens to consider how multiple identities and therefore experiences impact individual outcomes. For example, a Black women who is also a sexual and gender minority and also existing in low-income conditions may have different experience than a heterosexual Black women who has access to more financial resources.

The demographics associated with flu vaccination uptake in the US adult general population are well established – studies have found that race/ethnicity, age, sex, socio-economic-status (SES), insurance, having a usual source of care, contact with physicians, health behaviors, health status, and receipt of other vaccinations, and beliefs are associated with flu vaccine uptake (Kamis et al., 2017; Lu et al., 2015; Schmid et al., 2017; Takayama et al., 2012; Williams et al., 2017). The majority of literature examining correlates of vaccine uptake compare racial ethnic groups to non-Hispanic (NH) whites (Budhwani and De, 2016; Hughes et al., 2019; Lu et al., 2017; Lu et al., 2015; Srivastav et al., 2018; Stafford et al., 2013; Tse et al., 2018). The existing studies which examine flu vaccine uptake within specific US racial/ethnic groups are of limited generalizability due to the fact that they focus on the population of individual states or localities (Bazargan et al., 2020; Cohen et al., 2012; Hughes et al., 2018; Mendiola et al., 2016; Moran et al., 2017), or specific adult subpopulations (Bazargan et al., 2020; Crouse Quinn et al., 2017; Moran et al., 2017). We found one study using a nationally representative population, and it examined flu vaccine uptake within the US African American population (Quinn et al., 2018) and a single study that looked at social determinants of health within this group (Quinn et al., 2018).

This study examines the association of flu vaccination uptake and

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https://doi.org/10.1016/j.pmedr.2021.101516
Received 12 July 2021; Received in revised form 6 August 2021; Accepted 8 August 2021
Available online 12 August 2021

demographic measures within major US racial/ethnic groups to identify low vaccine uptake subgroups within each racial/ethnic group. Vaccine hesitancy is often high within minoritized communities due to historical problems with access to the medical system, distrust due to historic inequities and the history of racist medical trials like Tuskeegee (Feagin and Bennefield, 2014; Gamble, 1997; Park, 2017). Though, in aggregate, individuals in minoritized and marginalized communities face greater structural inequalities, these inequalities are not necessarily evenly distributed within a community. For example, Black women may face difficulties accessing healthcare for two reasons 1) because they are women and 2) because they are Black (Chesser et al., 2016; Lee et al., 2021; Mayberry et al., 2000; Stepanikova and Oates, 2017; Wright, 2017). There is an increasing understanding that Black women, for example face particularly significant barriers to care (Newman and Kaljee, 2017; Okoro et al., 2020). This combination of identities may produce more complex outcomes for other groups as well. Therefore, it is important to understand the burden of not-being vaccinated, not only between but also within, these marginalized and minoritized communities to allow better targeting and tailoring of vaccination campaigns. Further, getting vaccinated for the flu may reduce burden on hospitals and avoid simultaneous infection (Belongia and Osterholm, 2020; Ferdinand et al., 2020; Jaklevic, 2020), particularly for those at high risk for complications. The medical burden may already be high in minoritized groups, putting them at risk for complications (Graham, 2015; Haw et al., 2021; Purnell et al., 2016). Therefore, we seek to understand the impact of social determinants of health within minoritized and marginalized communities on flu vaccination rate.

2. Methods

2.1. Data

We examined (a) NH (non-Hispanic) White (n = 32,655), (b) NH Asian (n = 2,335), (c) NH African American (n = 5,137), and (d) Hispanic (n = 5,718) respondents (sample adults) who lived in the United States using the combined 2017 and 2018 National Health Interview Survey public use data file available to the general public on the Center for Disease Control and Preventions' (CDC) website (National Center for Health Statistics, 2019). (National Center for Health Stations, 2019) The NHIS is a large-scale, cross-sectional complex sample design survey of households living in the United States (US) fielded by the US National Center for Health Statistics, and is an important source for health information regarding the US civilian population. (National Center for Health Statistics, 2018, National Center for Health Statistics, 2019) In each household a sample child and sample adult are interviewed. (National Center for Health Statistics, 2018, 2019) In 2018 the response rate for sample adults was 83.9% and in 2017 the response rate was 80.7% (National Center for Health Statistics & Center for Disease Control and Prevention; National Center for Health Statistics & Center for Disease Control and Prevention). The analysis of publicly available, de-identified data is not human subjects research under the 2018 Revised Common Rule requirements.

2.2. Measures

2.2.1. Dependent variable

Flu vaccination (self-reported) in the last 12 months (nasal spray or injection) was the outcome variable.

2.2.2. Independent variables

Predictor variables included demographic and other individual level variables and were chosen based on the understanding that Social Determinants of Health impact health choices. Demographic variables included age (18–24, 25–34, 35–44, 45–64, and 65 or older years of age), education (below high school, high school/GED, some college, bachelors or above), sex (male, female), married or living with a partner (yes, no), insurance status (insured, not insured), income to federal poverty level ratio (0–0.99, 1–1.99, 2–3.99, 4 or above), and nativity (U.S.-born, foreign born). Respondents were classified as having a chronic disease if reported being diagnosed with one or more of the following conditions – high cholesterol, asthma, COPD (COPD, emphysema, chronic bronchitis), diabetes, cancer, arthritis, hepatitis, a liver condition, weak or failing kidneys, hypertension, cardiovascular disease (myocardial infarction, angina, coronary artery disease), stroke, or other heart disease. Respondents' region (as classified by the CDC) were also classified as living in the Northeast, Midwest, South, or West region of the United States because region may impact health-related experiences, discrimination and other important outcomes.

2.3. Analysis

We used four multivariable logistic regressions to determined the association of flu vaccination (1) within non-Hispanic Whites, (2) non-Hispanic Blacks, (3) Hispanics, and (4) non-Hispanic Asian Americans (stratifying the sample by race/ethnicity). The National Center for Health Statistics provides sampling weights for the NHIS which will allow estimations to reflect the US population (National Center for Health Statistics & Center for Disease Control and Prevention). We entered these sample weights into our analyses according to the directions for weighting multiple years of the survey that fall within the same sample design in the surveys' documentation (National Center for Health Statistics & Center for Disease Control and Prevention). Analyses were done with Stata 15.

3. Results

Less than 50% of any of the four major racial/ethnic groups in the US received a flu vaccination in 2017–18 (see Tables 1a and 1b). Non-Hispanic (NH) Asians (48.29%, 95% CI:45.76, 50.83) and NH Whites (47.36%, 95% CI: 46.62, 48.1) had the highest percent of uptake, while NH Blacks (35.64%, 95% CI: 33.82, 37.50) and Latinx (35.36%, 95% CI: 33.83, 36.92)) individuals had the lowest. A small proportion of NH Whites (5.38%, 95% CI: 4.98, 5.82) and NH Blacks (14.54%, 95% CI: 12.74, 16.55) were foreign born, however, the majority of NH Asians (76.83%, 95% CI: 74.38, 79.11) and Latinos surveyed were foreign-born (54.49%, 95% CI: 52.21, 56.74)). Additionally, 41.99% (37.09, 47.05) of NH Asians, and 39.98% (35.69, 44.42) of Latinos lived in the western region of the US.

3.1. Factors associated with receiving a flu vaccination in the last 12 months

3.1.1. NH Whites

Among NH White respondents, foreign-born individuals had lower odds (OR = 0.75, 95% CI: 0.65–0.86) of receiving a flu vaccination than US-born individuals. All age groups (18–25, 25–34, 35–44, and 45–64, see Table 2) had lower odds of receiving a flu vaccination compared with the group 65 years or older, as did men (compared to women), individuals with less than a bachelors or higher degree, individuals falling into 1 of the 3 groups below 4.0 on the income-to federal poverty level ratio (0–0.99, 1–1.99, 2–3.99), individuals who were not insured (compared to those who are insured, OR = 0.29, 95% CI: 0.25, 0.35), or individuals who did not have a chronic disease (compared to those with a chronic disease, OR = 0.6, 95% CI: 0.56, 0.65). Individuals who lived in the Northeast (OR = 1.2, 95% CI: 1.08, 1.34), Midwest (OR = 1.16, 95% CI: 1.05, 1.27), or South (OR = 1.11, 95% CI: 1.01, 1.22), in the US had higher odds of receiving a flu vaccination than individuals who lived in the West. Survey year was significant in the model; individuals who were surveyed in 2018 (OR = 1.07, 95% CI = 1.01, 1.13) had higher odds of receiving a flu shot than those surveyed in 2017.

Table 1
Sample characteristics.

	NH White		NH African American		NH Asian		Latinx		p+
	n	%	N	%	n	%	N	%	
Flu vaccine* **									<0.001
no	18,099	52.64% (51.9, 53.380	3,572	64.36% (62.5, 66.18)	1,324	51.71% (49.17, 54.24)	3,920	64.64% (63.08, 66.17)	
yes	17,784	47.36% (46.62, 48.1)	2,242	35.64% (33.82, 37.50)	1,290	48.29% (45.76, 50.83)	2,405	35.36% (33.83, 36.92)	
Nativity* **									<0.001
US-born	34,673	94.62% (94.18, 95.02)	5,243	85.46% (83.45, 87.26)	691	23.17% (20.89, 25.62)	2,940	45.51% (43.26, 47.79)	
Foreign-born	1,722	5.38% (4.98, 5.82)	692	14.54% (12.74, 16.55)	1,983	76.83% (74.38, 79.11)	3,471	54.49% (52.21, 56.74)	
Age* **									<0.001
18–24	2,479	10.23% (9.73, 10.75)	531	13.86% (12.48, 15.37)	302	11.28% (9.64, 13.15)	804	16.55% (15.29, 17.91)	
25–34	5,061	15.73% (15.2, 16.28)	986	21.2% (19.74, 22.74)	526	19.62% (17.8, 21.59)	1,386	22.77% (21.39, 24.2)	
35–44	4,865	14.52% (14.04, 15.02)	950	16.86% (15.58, 18.21)	534	22.7% (20.82, 24.7)	1,337	21.15% (19.98, 22.37)	
45–64	12,575	35.17% (34.54, 35.8)	1,461	15.15% (14.14, 16.22)	761	30.92% (28.9, 33.02)	1,851	28.72% (27.38, 30.11)	
65 plus	11,441	24.35% (23.65, 25.06)			556	15.47% (13.81, 17.29)	1,045	10.81% (9.91, 11.77)	
Sex* **									<0.001
Female	19,612	51.37% (50.71, 52.03)	3,486	54.63% (52.9, 56.35)	1,396	53.42% (51.2, 55.63)	3,635	50.27% (48.66, 51.89)	
Male	16,798	48.63% (47.97, 49.29)	2,452	45.37% (43.65, 47.1)	1,283	46.58% (44.37, 48.8)	2,788	49.73% (48.11, 51.34)	
Education* **									<0.001
Below High School	2,708	7.42% (6.95, 7.92)	949	14.1% (12.78, 15.53)	224	7.97% (6.67, 9.49)	1,831	27.81% (25.97, 29.73)	
High School/GED	8,710	23.63% (22.89, 24.39)	1,654	28.82% (27.25, 30.45)	390	15.3% (13.48, 17.32)	1,615	26.65% (25.08, 28.27)	
Some College	11,509	31.35% (30.61, 32.1)	1,933	33% (31.28, 34.77)	558	20.87% (18.85, 23.04)	1,737	28.1% (26.53, 29.72)	
Bachelors or Above	13,386	37.59% (36.52, 38.68)	1,364	24.08% (22.21, 26.05)	1,495	55.86% (52.84, 58.84)	1,193	17.45% (16.02, 18.07)	
Income to Federal Poverty Level Ratio* **									<0.001
0–0.99	3,164	7.38% (6.94, 7.85)	1,358	21.1% (19.36, 22.96)	322	10.23% (8.74, 12.06)	1,313	17.71% (16.35, 19.15)	
1.00–1.99	5,261	13.32% (12.78, 13.89)	1,343	22.72% (21.15, 24.37)	373	15.09% (13.06, 17.36)	1,743	28.66% (27.04, 30.33)	
2.00–3.99	9,863	28.25% (27.5, 29.01)	1,527	29.44% (27.89, 31.05)	584	23.57% (21.22, 26.09)	1,680	30.36% (28.83, 31.93)	
4.00 or above	15,870	51.04% (49.94 52.14)	1,297	26.73% (24.68, 28.88)	1,222	51.06% (47.83, 54.29)	1,323	23.38% (21.65, 24.99)	
Is Married or Partnered* **									<0.001
Married or Partnered	19,269	63.89% (63.22, 64.57)	1,814	39.86% (38.24, 41.5)	1,611	67.92% (65.48, 70.27)	3,323	58.37% (56.69, 60.04)	
Single	17,071	36.11% (35.43, 36.78)	4,109	60.14% (58.5, 61.76)	1,062	32.08% (29.73, 34.52)	3,091	41.63% (39.96, 43.31)	
Insurance Status* **									<0.001
Insured	34,050	93.46% (93.07, 93.82)	5,263	87.92% (86.48, 89.22)	2,506	93.71% (92.44, 94.77)	4,937	75.97% (74.05, 77.79)	
Not Insured	2,270	6.54% (6.18, 6.93)	639	12.08% (10.78, 13.52)	165	6.29% (5.23, 7.56)	1,454	24.03% (22.21, 25.95)	
Has a Chronic Disease* **									<0.001
Yes	22,775	59.78% (59.00, 60.56)	3,484	52.56% (50.74, 54.37)	1,153	43.64% (41.48, 45.84)	2,899	41.99% (40.31, 43.69)	
No	12,690	40.22% (39.44, 41.00)	2,235	47.44% (45.63, 49.26)	1,420	56.36% (54.16, 58.52)	3,322	58.01% (56.31, 59.69)	
US Region* **									<0.001
West	7,822	20.4% (18.95, 21.94(	499	8.42% (7.17, 9.87)	1,160	41.99% (37.09, 47.05)	2,380	39.98% (35.69, 44.42)	
Northeast	6,431	80.8% (79.43, 82.1)	741	15.96% (13.59, 18.66)	500	20.88% (17.01, 25.35)	789	13.49% (11.28, 16.04)	
Midwest	10,273	27.42% (26.23, 28.65)	924	15.2% (13.04, 17.65)	300	11.82% (9.57, 14.53)	640	9.39% (7.62, 11.52)	
South	11,884	32.98% (31.43, 34.57)	3,774	60.41% (56.8, 63.92)	689	25.31% (21.51, 29.52)	2,614	37.14% (32.82, 41.68)	
Year*									0.017
2017	18,841	50.03% (49.17, 50.89)	2,960	49.57% (47.49, 51.64)	1,353	48.93 (45.89, 51.97)	3,244	49.17% (48.24, 51.1)	
2018	17,569	49.97% (49.11, 50.83)	2,978	50.43% (48.36, 52.51)	1,326	51.07% (48.03, 54.11)	3,179	50.83% (48.9, 52.76)	
	36,410		5,938		2,679		6,423		

[+] Chi-squared test.

Table 2
Correlates of receiving a flu vaccination among NH Whites, NH Asians, NH African Americans, and Hispanics in the United States, NHIS 2017–18.

	2017–18 NH White OR (95% CI)	2017–18 NH Black OR (95% CI)	2017–18 NH Asian OR (95% CI)	2017–18 Hispanic OR (95% CI)
Nativity				
US-born	1	1	1	1
Foreign-born	**0.75 (0.65, 0.86)**	**0.73 (0.56, 0.97)**	**1.45 (1.15, 1.83)**	0.91 (0.78, 1.07)
Age				
18–25	**0.33 (0.29, 0.38)**	**0.41 (0.25, 0.67)**	**0.4 (0.29, 0.54)**	**0.42 (0.31, 0.58)**
25–34	**0.31 (0.28, 0.34)**	**0.26 (0.18, 0.39)**	**0.35 (0.27, 0.46)**	**0.42 (0.32, 0.54)**
35–44	**0.32 (0.29, 0.36)**	**0.39 (0.28, 0.55)**	**0.29 (0.22, 0.37)**	**0.37 (0.28, 0.47)**
45–64	**0.4 (0.37, 0.42)**	**0.41 (0.3, 0.56)**	**0.49 (0.4, 0.6)**	**0.51 (0.41, 0.63)**
65 plus	1	1	1	1
Sex				
Female	1	1	1	1
Male	**0.75 (0.71, 0.8)**	**0.78 (0.63, 0.96)**	**0.73 (0.63, 0.86)**	**0.71 (0.62, 0.81)**
Education				
Below High School	**0.59 (0.52, 0.67)**	1.14 (0.76, 1.69)	0.77 (0.59, 1.02)	0.93 (0.74, 1.16)
High School/ GED	**0.55 (0.51, 0.6)**	0.79 (0.56, 1.11)	**0.68 (0.54, 0.85)**	0.84 (0.67, 1.06)
Some College	**0.69 (0.63, 0.74)**	**0.59 (0.45, 0.78)**	**0.72 (0.59, 0.87)**	**0.79 (0.64, 0.97)**
Bachelors or Above	1	1	1	1
Income to Federal Poverty Level Ratio				
0–0.99	**0.78 (0.68, 0.88)**	**0.63 (0.42, 0.95)**	1.06 (0.81, 1.38)	1.02 (0.8, 1.31)
1.00–1.99	**0.76 (0.69, 0.83)**	**0.65 (0.47, 0.9)**	1.04 (0.8, 1.34)	0.86 (0.69, 1.06)
2.00–3.99	**0.84 (0.79, 0.9)**	**0.58 (0.42, 0.8)**	1.03 (0.83, 1.28)	0.9 (0.74, 1.11)
4.00 or above	1	1	1	1
Married or Partnered				
Married or Partnered	1	1	1	1
Single	0.95 (0.89, 1)	**0.78 (0.6, 1)**	0.87 (0.73, 1.03)	0.96 (0.81, 1.13)
Insurance Status				
Insured	1	1	1	1
Not Insured	**0.29 (0.25, 0.35)**	**0.56 (0.35, 0.9)**	**0.43 (0.32, 0.57)**	**0.43 (0.34, 0.54)**
Has a Chronic Disease				
Yes	1	1	1	1
No	**0.6 (0.56, 0.65)**	**0.6 (0.47, 0.77)**	**0.72 (0.61, 0.85)**	**0.56 (0.48, 0.66)**
US Region				
West	1	1	1	1
Northeast	**1.2 (1.08, 1.34)**	**1.42 (1.06, 1.9)**	1.08 (0.78, 1.51)	1.07 (0.86, 1.35)
Midwest	**1.16 (1.05, 1.27)**	1.18 (0.83, 1.67)	0.99 (0.74, 1.33)	0.79 (0.61, 1.01)
South	**1.11 (1.01, 1.22)**	1.06 (0.82, 1.36)	0.85 (0.66, 1.11)	0.87 (0.74, 1.03)
Year				
2017	1	1	1	1
2018	**1.07 (1.01, 1.13)**	0.96 (0.77, 1.19)	1.04 (0.89, 1.21)	1.09 (0.95, 1.26)
Constant				
constant	**4.04 (3.62, 4.51)**	**6.32 (4.21, 9.5)**	**2.44 (1.71, 3.5)**	2.96 (2.24, 3.92)

Note: bolded items are significant.

3.1.2. NH Blacks

Among NH Black respondents, foreign-born individuals had lower odds (OR = 0.73, 95% CI: 0.56–0.97) of receiving a flu vaccination than US-born individuals. All age groups (18–25, 25–34, 35–44, and 45–64, see Table 2) had lower odds of receiving a flu vaccination compared to those 65+ years of age, as did men compared to women (OR = 0.78, 95% CI = 0.63, 0.96), and individuals with some college education (OR = 0.59, 95% CI = 0.45, 0.78) compared to individuals with a bachelors or higher degree. Individuals with an income to federal poverty level ratio below 4.0, who were not married or partnered (compared to those who are married or partnered, OR = 0.78, 95% CI = 0.6, 1.0), did not have insurance (OR = 0.29, 95% CI-0.25, 0.35), or who did not have a chronic disease (OR = 0.6, 95% CI = 0.47, 0.77), also had lower odds of receiving the flu vaccine. Individuals who lived in the Northeast had higher odds (OR = 1.42, 95% CI = 1.06, 1.9) of receiving a flu vaccination than individuals living in the West. Survey year was not significant in this model.

3.1.3. NH Asians

Among NH Asians, foreign-born individuals had higher odds (OR = 1.45, 95% CI: 1.15–1.83) of receiving a flu vaccination than US-born individuals. All age groups (18–25, 25–34, 35–44, and 45–64, see table 2) had lower odds of receiving a flu vaccination compared those ages 65+, as did men compared to women. Additionally, individuals with a high school/GED (OR = 0.68, 95% CI = 0.54, 0.85) or individuals with some college education (OR = 0.72, 95% CI = 0.59, 0.87) had higher odds of receiving a flu vaccine compared to those with a Bachelor's degree or higher, individuals who were not insured (OR = 0.4, 95% CI: 0.32, 0.57), or individuals who did not have a chronic disease (OR = 0.72, 95% CI: 0.61, 0.85) also had lower odds of receiving a flu vaccine. Survey year was not significant in this model.

3.1.4. Hispanics

Among US Hispanics, foreign-born individuals (OR = 0.91, 95% CI: 0.78, 1.07) had the same odds of receiving a flu vaccination as US-born individuals. All age groups had lower odds of receiving a flu vaccination compared to those ages 65+, as did men (OR = 0.71, 95% CI = 0.64, 0.97) compared to women. Additionally, individuals with some college education (OR = 0.79, 95% CI = 0.64, 0.97) had lower odds of reciving a flu vaccine compared to those with a Bachelor's degree or more, individuals who were not insured (OR = 0.43, 95% CI = 0.34, 0.54), and individuals who did not have a chronic disease (OR = 0.56, 95% CI = 0.48, 0.66). Survey year was not significant in this model.

4. Discussion

Overall, our findings suggest that there is a great deal of improvement to be made in flu vaccine uptake among racial/ethnic groups in the United States. All ethnic groups surveyed had rates of vaccination below 50% which is lower than the CDC's stated goal of 70% of adults immunized annually. However, there was significant variation within racial/ethnic groups in who got vaccinated and who did not.

Our findings suggest that nativity should be included as a social determinant of flu vaccination as nativity was correlated with vaccination in 3 of the 4 major US racial/ethnic subgroups. Foreign-born NH Whites and foreign-born NH African Americans received flu vaccinations less often than US-born individuals, indicating that foreign-born individuals should be the target of flu vaccination interventions. Previous studies looking at within-group differences of NH African Americans and NH Whites did not include nativity in their models (Crouse Quinn et al., 2017; Quinn et al., 2018). A possible epidemiological-paradox was observed between US-and foreign-born Asians, as US-born Asians were less likely to uptake the flu vaccination than foreign-born Asians,

indicating that US-born individuals in this group should be a population of concern.

At the state-level, in California, flu vaccine uptake among Mexican-identified persons is correlated with generationality (Mendiola et al., 2016), and local level studies have found acculturation is associated with vaccine uptake among Mexican-identified persons and Hispanics in general (Hughes et al., 2018; Mendiola et al., 2016; Moran et al., 2017), however, we found no relationship between nativity and vaccine uptake among Hispanics at the national level. This suggests that when examining flu vaccine uptake (and vaccine uptake in general), the relationship of nativity or acculturation to vaccine uptake within the Hispanic population of the US may vary by state or locality.

Factors associated with flu vaccine uptake were largely consistent across racial and ethnic categories, suggesting that some trends in racial/ethnic subgroup vaccine uptake mirror that of the general public – men had lower odds of receiving a vaccination than women, younger individuals had lower odds of receiving a vaccination than older individuals, individuals with a chronic disease received the vaccine more often than those without a chronic disease, and individuals who were not insured had lower uptake of the seasonal flu vaccination (Kamis et al., 2017; Lu et al., 2015; Schmid et al., 2017; Takayama et al., 2012; Williams et al., 2017). Among NH Whites and NH Blacks, individuals with lower income received vaccinations less often, which may indicate a lack of access healthcare. Similar to findings in California (Mendiola et al., 2016), education and income were not associated with vaccine uptake among Hispanics in our national study (though a local level study has found an association (Cohen et al., 2012)). Only individuals with some college education had lower rates of vaccine uptake than individuals with a college degree or higher in our sample. NH Whites not living in the western region of the US had higher rates of vaccination than those living in the western region. Region was not a significant predictor of vaccine uptake for NH Asians and Latinos, despite the fact that a significant proportion of these populations live in the Western US region, which has the lowest rate of flu vaccination among the 4 regions of the US in 2020 (Rouw et al., 2020).

While some of the social determinants of flu vaccination within each racial/ethnic group mirrors the US general population, other factors, such as SES varies by group, so targeting solely low-SES individuals may not result in higher rates of vaccine uptake. Additionally, while flu vaccine rates varies among US region, our analysis suggests that all regions should be equal targets of education efforts.

5. Limitations

We do not have a large enough sample to disaggregate Hispanic subgroups but there are likely differences in terms of country of origin, nativity and flu vaccination. Our data come from 2017 to 2018. The questions about chronic conditions changed in 2019, making it difficult to use this year of data. Therefore, it is not incorporated into this paper. This analysis is a secondary analysis of NHIS data, which does not contain measures of attitudes or beliefs regarding flu vaccination in our sample. Additionally, few acculturation measures are available in the NHIS dataset, and those that were (speaking limited English and living in the US less than 1 year to 5 years) are correlated (a tetrachoric correlation was used) with being foreign born in the Latino and NH Asian population. As a result, these variables were not included in the analyses. Despite these limitations, this information will be important in working through vaccine hesitancy in the at-risk populations identified here. Additionally, this data is subject to the limitations of self-reported data and there may have been changes since 2018 in flu vaccination uptake, particularly in the context of Covid-19.

6. Conclusion

Our analysis shows that correlates flu vaccine uptake varies between racial/ethnic groups at the US national level, and that nativity should be considered a significant predictor of flu vaccine uptake. While there are general trends in the US population regarding the correlates of flu vaccine uptake, our analyses shows that these trends vary within major racial/ethnic subpopulations of the US. As a result, any vaccine education campaign needs to consider this variation in order to more effectively disseminate information.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

ASJ and MG conceptualized the project and designed the formal analysis. MG conducted the first formal analysis which was examined and updated by ASJ, RBA, and NR. MG, ASJ, and RBA wrote the original draft, which was reviewed and edited by MG, ASJ, RBA, and NR.

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.

References

Bazargan, M., Wisseh, C., Adinkrah, E., Ameli, H., Santana, D., Cobb, S., Assari, S., Heffernan, D., 2020. Influenza vaccination among underserved African-American older adults. Biomed Res. Int. 2020, 2160894. https://doi.org/10.1155/2020/2160894.

Belongia, E.A., Osterholm, M.T. 2020. COVID-19 and flu, a perfect storm. Science, 368 (6496), 1163. doi:10.1126/science.abd2220.

Budhwani, H., De, P., 2016. Disparities in influenza vaccination across the United States: variability by minority group, Asian sub-populations, socio-economic status, and health insurance coverage. Public Health 138, 146–153. https://doi.org/10.1016/j.puhe.2016.04.003.

Chesser, A., Burke, A., Reyes, J., Rohrberg, T., 2016. Navigating the digital divide: A systematic review of eHealth literacy in underserved populations in the United States. Inform. Health Soc. Care 41 (1), 1–19. https://doi.org/10.3109/17538157.2014.948171.

Cohen, B., Ferng, Y.H., Wong-McLoughlin, J., Jia, H., Morse, S.S., Larson, E.L., 2012. Predictors of flu vaccination among urban Hispanic children and adults. J. Epidemiol. Community Health 66 (3), 204–209. https://doi.org/10.1136/jech.2009.099879.

Crouse Quinn, S., Jamison, A.M., Freimuth, V.S., An, J., Hancock, G.R., 2017. Determinants of influenza vaccination among high-risk Black and White adults. Vaccine 35 (51), 7154–7159. https://doi.org/10.1016/j.vaccine.2017.10.083.

Feagin, J., Bennefield, Z., 2014. Systemic racism and U.S. health care. Soc. Sci. Med. 103, 7–14. https://doi.org/10.1016/j.socscimed.2013.09.006.

Ferdinand, K.C., Nedunchezhian, S., Reddy, T.K., 2020. The COVID-19 and Influenza "Twindemic": barriers to influenza vaccination and potential acceptance of SARS-CoV2 Vaccination in African Americans. J. Natl Med. Assoc. 112 (6), 681–687. https://doi.org/10.1016/j.jnma.2020.11.001.

Gamble, V.N., 1997. Under the shadow of Tuskegee: African Americans and health care. Am. J. Public Health 87 (11), 1773–1778. https://doi.org/10.2105/ajph.87.11.1773.

Graham, G., 2015. Disparities in cardiovascular disease risk in the United States. Curr. Cardiol. Rev. 11 (3), 238–245. https://doi.org/10.2174/1573403x11666141122220003.

Haw, J.S., Shah, M., Turbow, S., Egeolu, M., Umpierrez, G., 2021. Diabetes complications in racial and ethnic minority populations in the USA. Curr. Diab. Rep. 21 (1), 2. https://doi.org/10.1007/s11892-020-01369-x.

Hughes, M.C., Baker, T.A., Kim, H., Valdes, E.G., 2019. Health behaviors and related disparities of insured adults with a health care provider in the United States, 2015–2016. Prev. Med. 120, 42–49. https://doi.org/10.1016/j.ypmed.2019.01.004.

Hughes, M.M., Saiyed, N.S., Chen, T.S., 2018. Local-level adult influenza and pneumococcal vaccination disparities: Chicago, Illinois, 2015–2016. Am. J. Public Health 108 (4), 517–523. https://doi.org/10.2105/AJPH.2017.304257.

Jaklevic, M.C., 2020. Flu vaccination urged during COVID-19 pandemic. JAMA 324 (10), 926–927. https://doi.org/10.1001/jama.2020.15444.

Kamis, A., Zhang, Y., Kamis, T., 2017. A multiyear model of influenza vaccination in the United States. Int. J. Environ. Res. Public Health 14 (8), 849. https://doi.org/10.3390/ijerph14080849.

Lee, Y.S., Behn, M., Rexrode, K.M., 2021. Women's health in times of emergency: we must take action. J. Womens Health (Larchmt) 30 (3), 289–292. https://doi.org/10.1089/jwh.2020.8600.

Lu, D., Qiao, Y., Brown, N.E., Wang, J., Cowling, B.J., 2017. Racial and ethnic disparities in influenza vaccination among adults with chronic medical conditions vary by age in the United States. PLoS ONE 12 (1), e0169679. https://doi.org/10.1371/journal.pone.0169679.

Lu, P.J., O'Halloran, A., Williams, W.W., Lindley, M.C., Farrall, S., Bridges, C.B., 2015. Racial and ethnic disparities in vaccination coverage among adult populations in the U.S. Am. J. Prev. Med. 49 (6 Suppl 4), S412–425. https://doi.org/10.1016/j.amepre.2015.03.005.

Mayberry, R.M., Mili, F., Ofili, E., 2000. Racial and ethnic differences in access to medical care. Med. Care Res. Rev. 57 (Suppl. 1), 108–145. https://doi.org/10.1177/1077558700057001S06.

Mendiola, J., Do-Reynoso, V., Gonzalez, M., 2016. Generation status as a determinant of influenza vaccination among Mexican-identified adults in California, 2011–12. Prev. Med. Rep. 3, 25–29. https://doi.org/10.1016/j.pmedr.2015.11.006.

Moran, M.B., Chatterjee, J.S., Frank, L.B., Murphy, S.T., Zhao, N., Chen, N., Ball-Rokeach, S., 2017. Individual, cultural and structural predictors of vaccine safety confidence and influenza vaccination among Hispanic female subgroups. J. Immigr. Minor. Health 19 (4), 790–800. https://doi.org/10.1007/s10903-016-0428-9.

Nagata, J.M., Hernandez-Ramos, I., Kurup, A.S., Albrecht, D., Vivas-Torrealba, C., Franco-Paredes, C., 2013. Social determinants of health and seasonal influenza vaccination in adults >/=65 years: a systematic review of qualitative and quantitative data. BMC Public Health 13, 388. https://doi.org/10.1186/1471-2458-13-388.

National Center for Health Statistics, & Center for Disease Control and Prevention. Survey Description, National Health Interview Survey, 2018. Hyattsville, Maryland. 2019.

National Center for Health Statistics. National Health Interview Survey, 2017-18. Public-use data file and documentation. https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm. 2019.

Newman, L.A., Kaljee, L.M., 2017. Health disparities and triple-negative breast cancer in African American women: a review. JAMA Surg. 152 (5), 485–493. https://doi.org/10.1001/jamasurg.2017.0005.

Okoro, O.N., Cernasev, A., Hillman, L.A., Kamau, N.M., 2020. Access to health care for low-income African American women: lived experiences and expectations. J. Health Care Poor Underserved 31 (2), 939–957. https://doi.org/10.1353/hpu.2020.0070.

Park, J., 2017. Historical origins of the Tuskegee experiment: the dilemma of public health in the United States. Uisahak 26 (3), 545–578. https://doi.org/10.13081/kjmh.2017.26.545.

Purnell, T.S., Calhoun, E.A., Golden, S.H., Halladay, J.R., Krok-Schoen, J.L., Appelhans, B.M., Cooper, L.A., 2016. Achieving health equity: closing the gaps in health care disparities, interventions, and research. *Health Aff. (Millwood)* 35 (8), 1410–1415. https://doi.org/10.1377/hlthaff.2016.0158.

Quinn, S.C., Jamison, A., An, J., Freimuth, V.S., Hancock, G.R., Musa, D., 2018. Breaking down the monolith: Understanding flu vaccine uptake among African Americans. SSM Popul. Health 4, 25–36. https://doi.org/10.1016/j.ssmph.2017.11.003.

Rouw, A., Wexler, A., Dawson, L., Kates, J., Artiga, S. (2020). State variation in seasonal flu vaccination: implications for a COVID-19 vaccine. Retrieved from https://www.kff.org/coronavirus-covid-19/issue-brief/state-variation-in-seasonal-flu-vaccination-implications-for-a-covid-19-vaccine/.

Schmid, P., Rauber, D., Betsch, C., Lidolt, G., Denker, M.-L., Cowling, B.J., 2017. Barriers of influenza vaccination intention and behavior - A systematic review of influenza vaccine hesitancy, 2005–2016. PLoS ONE 12 (1), e0170550. https://doi.org/10.1371/journal.pone.0170550.

Spruce, L., 2019. Back to basics: social determinants of health. AORN J. 110 (1), 60–69. https://doi.org/10.1002/aorn.12722.

Srivastav, A., O'Halloran, A., Lu, P.J., Williams, W.W., 2018. Influenza vaccination coverage among english-Speaking Asian Americans. Am. J. Prev. Med. 55 (5), e123–e137. https://doi.org/10.1016/j.amepre.2018.06.018.

Stafford, K.A., Sorkin, J.D., Steinberger, E.K., 2013. Influenza vaccination among cancer survivors: disparities in prevalence between blacks and whites. J. Cancer Surviv. 7 (2), 183–190. https://doi.org/10.1007/s11764-012-0257-3.

Stepanikova, I., Oates, G.R., 2017. Perceived discrimination and privilege in health care: the role of socioeconomic status and race. Am. J. Prev. Med. 52 (1S1), S86–S94. https://doi.org/10.1016/j.amepre.2016.09.024.

Takayama, M., Wetmore, C.M., Mokdad, A.H., 2012. Characteristics associated with the uptake of influenza vaccination among adults in the United States. Prev. Med. 54 (5), 358–362. https://doi.org/10.1016/j.ypmed.2012.03.008.

Thornton, R.L., Glover, C.M., Cene, C.W., Glik, D.C., Henderson, J.A., Williams, D.R., 2016. Evaluating strategies for reducing health disparities by addressing the social determinants of health. Health Aff. (Millwood) 35 (8), 1416–1423. https://doi.org/10.1377/hlthaff.2015.1357.

Tse, S.C., Wyatt, L.C., Trinh-Shevrin, C., Kwon, S.C., 2018. Racial/ethnic differences in influenza and pneumococcal vaccination rates among older adults in New York City and Los Angeles and Orange Counties. Prev. Chronic Dis. 15, E159. https://doi.org/10.5888/pcd15.180101.

Williams, W.W., Lu, P.-J., O'Halloran, A., Kim, D.K., Grohskopf, L.A., Pilishvili, T., Skoff, T.H., Nelson, N.P., Harpaz, R., Markowitz, L.E., Rodriguez-Lainz, A., Fiebelkorn, A.P., 2017. Surveillance of vaccination coverage among adult populations - United States, 2015. MMWR Surveill. Summ. 66 (11), 1–28. https://doi.org/10.15585/mmwr.ss6611a1.

Wright, P.M., 2017. Reducing health disparities for women through use of the medical home model. Contemp. Nurse 53 (1), 126–131. https://doi.org/10.1080/10376178.2017.1281086.