

## ARTICLE

# Prevalence of influenza vaccination coverage amongst the first and third generation Asian adults in California, United States of America

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**Background:** The Asian population comprises the third largest ethnic minority in the state of California. However, influenza vaccination coverage amongst the overall Asian population, and the first and third-generation Asian's have not been widely studied. Previous literature exploring generational status as a correlate of influenza immunization amongst Mexican identified Latino adults confirms disparities in influenza vaccination coverage by generation. This study aims to report on the prevalence of influenza vaccination coverage amongst the overall, first and third-generation Asians in California, and examine the correlates of influenza vaccination coverage in the aforementioned population. **Methods:** Cross-sectional data from the California Health Interview Survey 2016 for Asian adults was analyzed using IBM SPSS 25.0 for Mac. Descriptive statistics were utilized for reporting the frequencies and percentages of the selected variables. Weighted multivariable binary logistic regression was used to obtain adjusted odds ratios (95% confidence interval) and determine independent association between socioeconomic determinants and influenza vaccination coverage amongst the first and third-generation Asians at  $P < 0.05$ . The analysis was adjusted for "visit to the doctor" and "insurance status". **Results:** Thirteen point one percent ( $n = 2,761$ ) of the survey respondents ( $N = 21,055$ ) identified as Asians. The first-generation ( $n = 1,857$ , 67%) comprised the highest proportion of the Asian ethnic group. Influenza vaccination coverage was reported as 61.2% amongst the overall, 61.1% amongst the first-generation and 70.9% amongst the third-generation respectively. All predictor variables were significant amongst the first-generation, however amongst the third-generation all variables except for location and living in a household of 3 and more, were significant predictors of influenza vaccination coverage. **Conclusion:** Compared to the other ethnic groups in California, the Asian respondents reported a higher percentage of influenza vaccination coverage. Influenza vaccination coverage was the highest amongst the third-generation Asians. Increased influenza vaccination coverage amongst the Asian ethnic group can be ascribed to higher educational attainment, a higher proportion choosing to visit a doctor as well as increased insurance coverage.

**Key words:** Influenza vaccination, Asian minority, Self-reported vaccination uptake, Determinants of influenza vaccination, Disparities in vaccination, Minority health

## Abbreviations:

IVC, influenza vaccination coverage; CHIS, California Health Interview Survey; AOR, adjusted odds ratio; CI, confidence interval.

## Competing interests:

The authors declare that they have no conflict of interest.

## Citation:

Khan RA, Brown J, Widiatmoko D. Prevalence of influenza vaccination coverage amongst the first and third generation Asian adults in California, United States of America. *Life Res.* 2021;4(2):12. doi: 10.12032/life2021-0401-0115.

**Executive Editor:** Yu-Ping Shi.

**Submitted:** 15 January 2021, **Accepted:** 13 April 2021, **Online:** 25 April 2021

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## Background

Influenza is a highly contagious acute respiratory infection, estimated to cause 3–5 million cases of severe illness worldwide [1] and is associated with lost productivity and economical costs [2]. Compared to other developed nations, influenza associated mortality is evidently much higher in the U.S as a result of the ageing baby boomers [3]. The 2017/18 winter season witnessed a record number of 80,000 influenza associated deaths in the U.S. [4,5].

Sub-optimal vaccination levels have been reported in the country despite long standing routine vaccine recommendations [6–8]. In 2016–17, only 43.3% of the U.S. adults reported as vaccinated for influenza [9]. In contrast with other developed countries, the citizens of the U.S. do not have access to universal health care insurance, however employer provided and privately purchased plans are majorly used to cover healthcare costs [10].

The “Healthy People” program, introduced in 2000 by the Office of Disease Prevention and Health Promotion aims to improve the overall health of the American population through various strategies including increased access to screening programs for at-risk groups and improving immunizations coverage for preventable diseases [11]. Since 2010, the Advisory Committee on Immunization Practices, CDC recommends annual influenza vaccination for everyone 6 months and above [12, 13]. Santibanez et al. (2017) [14] reported a low seasonal influenza vaccination coverage (IVC) amongst adults in the U.S. from 2009–2016. For 2015–16, the national average for influenza immunization uptake amongst adults was reported as 41.7% only [14]. These data indicated that the vaccination coverage over the last decade or so fell short of the Healthy People 2020 goals [15].

The Asian ethnic group is increasing at the same rate as the Hispanics and four times faster than the general population in the U.S. [12]. As of 2017, more than 22 million individuals of Asian descent resided in the country [16]. As of 2020, 15.5% of California’s population is comprised of individuals who identify as “Asian alone”. Only 2 studies were identified assessing influenza vaccination disparities amongst Asians in the U.S. [12, 17]. However, IVC amongst the Asian population of California is under researched and there is an absence of literature on exploring generational status as a predictor for IVC amongst the aforementioned group. Previous research confirms that correlates of health vary by generation [1, 18]. A recent study indicated generational status as an important determinant for IVC amongst Mexican identified Latino adults [18]. Mendiola, Do-Reynoso and Gonzalez (2016) [18] utilized the California Health Interview Survey (CHIS) 2011–12 survey data and reported a

lower IVC amongst the third and second-generation Mexicans compared to the first-generation Mexicans. Assessing IVC and exploring generational status as a potential determinant of IVC amongst the Asian population in California will provide valuable insight into the vaccination trends amongst the respective ethnic group. Furthermore, such findings can inform targeted vaccination initiatives aimed to achieve nationally recommended immunization levels as set by the Healthy People 2030 program.

This study aims to report IVC amongst the overall, first and third-generation Asian population in the state of California. We also assessed socio-demographic factors and generational status as independent predictors of IVC amongst the first and third-generation Asians.

## Methods

The CHIS is the largest state-wide population-based health survey conducted in the U.S. [19]. Since 2001, it has been collecting data on demographics and health care needs of the 58 counties of California [19]. The data is de-identified and assigned case number as per UCLA policies [19]. It utilizes a multi-stage sampling design and is a random-digit-dial telephone survey available in 6 languages i.e, English, Spanish, Chinese (Mandarin and Cantonese dialect), Tagalog, Vietnamese and Korean [20, 21].

The data for this study was drawn from the CHIS 2016 dataset for adults (individuals age 18 + years) conducted between January and December, 2016 [19]. We considered the CHIS 2016 dataset as the most relevant for our study’s aims because it is the most recent as well as the last year CHIS inquired about IVC [19]. The CHIS questionnaires are updated regularly with questions exploring issues of emerging concerns.

### Study population

The survey respondents included individuals aged 18 years and above, living in the state of California. Institutionalized individuals and undocumented migrants are excluded from participating in the CHIS [22]. Respondents were included based on the following criteria: selected “Yes” for “Received influenza vaccination in the past 12 months” and selected “Asian” for “OMB/Current DOF-Ethnicity” (note: OMB-Office of Management and Budget; DOF-Department of Finance).

### Outcome variable

To determine IVC, the survey question “Flu vaccine in past 12 months: Yes/No” was considered as the outcome variable with the selected response “Yes”.

Previously, Mangtani Shah and Roberts (2007) [23], Rolnick et al., (2013) [24] and Srivastav et al. (2018) [17] have verified self-reported IVC as a reliable and

highly sensitive measure of immunization uptake.

### Independent variables

The independent variables included gender, age, marital status, location of residence, household size, educational attainment, and the presence of hypertension, diabetes and asthma. These variables have been confirmed as either positive or negative correlates of IVC and have been previously studied amongst various populations in the U.S, Asia and Europe [1,12,25,26].

For generational status, two new variables “First generational status” and “Third generational status” were created by combining selected cases from the “citizenship” and “OMB/DOF-Ethnicity” variables of the CHIS 2016 survey.

### Definitions of generational status

Generational status was classified based on the U.S. Census Bureau’s definitions as adopted by Trevelyan et al. (2016) [27].

First-generation: individuals who are not U.S. citizens at birth. This includes naturalized citizens, legal permanent residents and temporary migrants such as foreign-born students.

Second-generation: U.S. born individuals with at least one foreign-born parent.

Third-generation: U.S. born individuals with both U.S. born parents.

### Ethical approval

Ethical approval was sought from the Health and Social Care Research Ethics Committee at the university. Given that CHIS is a public database with deidentified data, no ethical approval was required from UCLA for using the data as per the respective institution policies [21].

### Statistical methodology

In order to assess IVC, descriptive statistics were utilised, frequencies and percentages were obtained, and comparisons were drawn amongst the overall, first and third-generation Asian respondents.

To explore generational status as a determinant of IVC amongst the Asian ethnic group, weighted binary logistic regression analysis was utilized. Comparisons were made between the first and third-generation Asian groups using adjusted odds ratio (AOR). Data was controlled for “insurance status” and “visit to the doctor”.

Data analysis were conducted using IBM SPSS 25.0 for Mac. A 2 tailed *P* value < 0.05 was determined as statistically significant.

Note: second-generation Asians were excluded from the regression analysis owing to the limitations of the IBM SPSS 25.0 software. We were unable to select the second-generation Asians by filtering the first and third-

generation cases from the overall Asian sample.

## Results

Of the 21,055 total respondents, 13.1% (*n* = 2761) identified as Asians. The Asian respondents were classified into first, second and third-generation Asian’s as illustrated in Table 1. The highest percentage of the total Asian respondents comprised of the first-generation individuals (*n* = 1,857, 67.26%)

### Demographic distribution of the Asian sub-groups

Both the first and third-generation Asians comprised of a higher proportion of females than males (1<sup>st</sup> generation: *M* = 46.4%; *F* = 53.4% vs 3<sup>rd</sup> generation: *M* = 46.7%; *F* = 53.3%) (Table 1, 2). Adjusted logistic regression indicates females from the first-generation were more likely (AOR = 1.108, confidence interval (CI): 1.103, 1.114) while the third-generation females were less likely (AOR = 0.777, CI: 0.752, 0.802) to report IVC (Table 3). When comparing the various age groups, a larger proportion of the first-generation Asians comprised of the 18–39 year old (1<sup>st</sup> generation = 15.8% vs 3<sup>rd</sup> generation = 10.0%) while the third-generation majorly constituted of the 65 years and above age group (1<sup>st</sup> generation = 43.1% vs 3<sup>rd</sup> generation = 47.4%). The 65 + years age group was more likely to report IVC amongst the first and third generations (1<sup>st</sup> generation = AOR = 5.656, CI: 5.603, 5.710) (3<sup>rd</sup> generation = 2.821, CI: 2.691, 2.958) to report IVC.

A higher proportion of the respondents from the first-generation were married (62.6%) compared to the third-generation respondents (48.1%). Adjusted logistic regression indicates that amongst the first-generation, married respondents were 1.283 (CI: 1.276, 1.291) times likely to report IVC compared to 0.661 (CI: 0.635, 0.688) times amongst the third-generation Asians. Both the first and third-generation majorly lived in urban settings (1<sup>st</sup> generation = 97.3 vs 3<sup>rd</sup> generation = 94.8). Rural inhabitants were 2.824 (CI: 2.768, 2.882) times more likely to report IVC.

**Table 1 Asian respondents identified in CHIS 2016 stratified by generational status** (Source: California Health Interview Survey 2016)

Study Sample	Total number (n)	Percentage (%)
Overall Asian population	2,761	
First-generations Asians	1,857	67.26
Second-generation Asians	615	22.27
Third-generation Asians	289	10.46

CHIS, California Health Interview Survey.

**Table 2 Population characteristics of the total, first and third generation Asian respondents**

Variables	All Asians n = 2,761 (%)	First-generation Asians; n <sub>1</sub> = 1,857 (%)	Third-generation Asians; n <sub>3</sub> = 289
Received influenza vaccination	1,691 (61.2)	1,134 (61.1)	205 (70.9)
Gender			
Male	1,301 (47.1)	865 (46.6)	135 (46.7)
Female	1,460 (52.9)	992 (53.4)	154 (53.3)
Age			
18–39	568 (20.6)	293 (15.8)	29 (10.0)
40–64	1,042 (37.7)	764 (41.1)	123 (42.6)
65 or older	1151 (41.7)	800 (43.1)	137 (47.4)
Marital status			
Married	1,530 (55.4)	1,162 (62.6)	139 (48.1)
Living with partner	48 (1.7)	28 (1.5)	4 (1.4)
Widow/separated/divorced	574 (20.8)	384 (20.7)	66 (22.8)
Never married	609 (22.1)	283 (15.2)	80 (27.7)
Location			
Urban	2,677 (97.0)	1,807 (97.3)	274 (94.8)
Rural	84 (3.0)	50 (2.7)	15 (5.2)
Household size			
1	646 (23.4)	382 (20.6)	109 (37.7)
2	946 (34.3)	658 (35.4)	106 (36.7)
3 or more	1,169 (42.3)	817 (44.0)	74 (25.6)
Educational attainment			
No formal education/grade 1–8	131 (4.7)	127 (6.8)	1 (0.3)
Grade 9–11	95 (3.4)	86 (4.6)	3 (1.0)
High school diploma	493 (17.9)	352 (19.0)	26 (9.0)
Some college	241 (8.7)	141 (7.6)	32 (11.1)
Vocational school	54 (2.0)	30 (1.6)	5 (1.7)
AA or AS degree	160 (5.8)	97 (5.2)	23 (8.0)
Bachelor's degree	963 (34.9)	615 (33.1)	126 (43.6)
Master degree	447 (16.2)	285 (15.3)	58 (20.1)
Doctoral/equivalent	177 (6.4)	124 (6.7)	15 (5.2)
Currently insured			
No	100 (3.6)	79 (4.3)	4 (1.5)
Yes	2,661 (96.4)	1,778 (95.7)	285 (98.6)
Visited doctor in past 12 months			
No	457 (16.6)	331 (17.8)	33 (11.4)
Yes	2,304 (83.4)	1,526 (82.2)	256 (88.6)
Hypertension			
No	1,648 (59.7)	1,101 (59.3)	148 (51.2)
Yes	1,113 (40.3)	756 (40.7)	141 (48.8)
Diabetes			
No	2,283 (82.7)	1,518 (81.7)	230 (79.6)
Yes	478 (17.3)	339 (18.3)	59 (20.4)
Asthma			
No	2,464 (89.2)	1,704 (91.8)	238 (82.3)
Yes	297 (10.8)	153 (8.2)	51 (17.6)

Higher proportion of the first-generation Asians lived in households of size 3 and above (44.0%) while the highest proportion of the third generations lived in household of size 1 (37.7%) followed by households of size 2 (36.7%). AOR indicated that amongst the first-generation, respondents from household of size 3 were

the least likely to be immunized (AOR: 0.546, CI: 0.540, 0.553) while this appeared as an insignificant predictor amongst the third-generation. Though in both the groups, highest proportion of individuals had obtained a bachelor's degree (1<sup>st</sup> generation = 33.1 vs 3<sup>rd</sup> generation = 43.6), the third-generation consisted of

**Table 3 AOR for the first and third generation Asians (controlled for insurance status and visit to the doctor)**

Variables	AOR for 1 <sup>st</sup> generation Asians	AOR for 3 <sup>rd</sup> generation Asians
Gender		
Male	1	1
Female	1.108 (1.103,1.114)	0.777 (0.752, 0.802)
Age		
18–39	1	1
40–64	1.118 (1.111,1.125)	1.078 (1.040, 1.118)
65 or older	5.656 (5.603, 5.710)	2.821 (2.691, 2.958)
Marital status		
Unmarried/divorced/separated/living with partner	1	1
Married	1.283 (1.276,1.291)	0.661 (0.635, 0.688)
Location		
Urban	1	1
Rural	2.824 (2.768, 2.882)	Not significant
Household size		
1	1	1
2	0.627 (0.620, 0.634)	0.479 (0.458, 0.501)
3 or more	0.546 (0.540, 0.553)	Not significant
Educational attainment		
College/or less	1	1
University and Equivalent	1.573 (1.565, 1.582)	2.394 (2.302, 2.488)
Hypertension		
No	1	1
Yes	0.656 (0.651, 0.660)	0.357 (0.344, 0.371)
Diabetes		
No	1	1
Yes	2.120 (2.103, 2.138)	73.930 (66.138, 82.642)
Asthma		
No	1	1
Yes	1.377 (1.364, 1.389)	2.863 (2.760, 2.969)

Binary dependent variable (1 = respondent received influenza vaccine in the last 12 months, 0 = respondent did not receive influenza vaccine in the last 12 months). AOR, adjusted odds ratio.

almost 10% more respondents with a bachelor degree compared to the first-generation. Comparatively, the first-generation had a higher percentage of individuals with no formal education/grade 1–8 (1<sup>st</sup> generation = 6.8 % vs 3<sup>rd</sup> generation = 0.3%) and high school diploma (1<sup>st</sup> generation = 19.0% Vs. 3<sup>rd</sup> generation = 9.0%). AOR for the education variable indicate that first-generation Asians with a university qualification are 1.573 (CI:1.565, 1.582) times more likely, while the third-generation with a university qualification are 2.394 (CI 2.302, 2.488) times more likely to report IVC.

Majority of the first and third-generation Asians had insurance coverage (1<sup>st</sup> generation = 95.7% vs. 3<sup>rd</sup> generation = 98.6%). A higher proportion (88.6%) of the third-generation respondent confirmed visiting the doctor in the past twelve months compared to only 82.2 % of the first-generation respondents. Additionally, the third-generation also constituted a higher percentage of hypertensive (48.8% vs 40.7) and asthmatic (17.6% vs 8.2%) respondents. The difference in confirmed diabetes amongst the 2 population was not

as pronounced as hypertension and asthma with 18.3% of the first-generation and 20.4% of the third-generation reporting a diagnosis of diabetes. However, AOR indicates the third-generation Asian respondents with diabetes as 73.930 (CI: 66.138, 82.642) times likely to report IVC. The first-generation diabetic respondents were only 2.120 (CI: 2.103, 2.138) times likely to report vaccination but not as distinct as the third-generation. Having a diagnosis of hypertension was associated with a reduced likelihood of reporting IVC amongst both the generations (1<sup>st</sup> generation AOR: 0.656 vs 3<sup>rd</sup> generation AOR: 0.357), with significantly lower amongst the third-generation. Third-generation Asians with asthma were more likely to report IVC compared to first generation (AOR 3<sup>rd</sup> generation: 2.863 vs AOR 1<sup>st</sup> generation: 1.377).

When assessed via weighted binary logistic regression and controlled for “insurance status” and “visit to the doctor”, all predictors appeared statistically significant ( $P < 0.01$ ) amongst the first-generation, while location and household size were insignificantly

corelated amongst the third-generation Asians.

## Discussion

Our findings indicate that females are more likely to report IVC amongst the Asian ethnic group. This also accords with previous observations by Vaidya, Partha and Karmakar (2012) [28] and Almario et al. (2016) [6]. Green and Pope (1999) [29] had commented that compared to males, females were more sensitive to illness and focused more on preventive health. Females have also been reported to have a higher number of routine doctor visits [30] and studies have consistently reported visits to the doctor as positively correlated with an increased IVC [4, 31]. However, we confirm females as less likely to report IVC amongst the third generation Asians. This is incoherent with previous literature which reported females as more likely to report IVC amongst third-generation Hispanics [18] and owing to limited literature and qualitative studies we are unable to ascribe possible reasons to our findings.

Majority (61.1%) of the Asian's in California are foreign born. Previous studies have attributed the "Healthy Migrant Effect" which asserts that foreign born individuals are healthier and less risk averse compared to American born individuals, which may explain their high utilization of preventive care [12, 32]. Chung et al. (2018) [33] confirmed that compared to Whites, Asians had the highest odds of preventive healthcare visit (AOR: 0.853 (African-American), 0.886 (Hispanic), and 1.236 (Asian)).

However, when comparing AOR values amongst the first and third-generations we noticed interesting and surprising outcomes. Our data illustrates that the third-generation Asians are more likely (70.9%) than first-generation (61.1%) to report IVC. This is similar to the findings of Mendiola, Do-Reynoso and Gonzalez's (2016) [18] study exploring IVC in U.S. born and foreign-born Hispanics. Though they reported a similar trend, their IVC proportions were notably lower (1<sup>st</sup> generation = 26% vs 3<sup>rd</sup> generation = 33%) which could be reflective of the overall low IVC amongst Hispanics. The higher IVC evident in the third-generation Asians may be a result of the sample distribution since the group pre-dominantly consisted of individuals 65 + years, while the first-generation consisted of a higher proportion of 18–39 year old's. When comparing the AOR values for the predictors and IVC amongst the first and third generation, our results for gender and marital status considerably varied from Mendiola, Do-Reynoso and Gonzalez's (2016) [18] study. As indicated, the trends are similar (both decreasing from the first to third generation), but the reduction of the AOR values is significantly different. This indicates that Hispanics and Asians have unique behaviors and hence require health promotion strategies unique to their respective ethnic groups.

Majority of the Asian population reported educational attainment of a bachelor's degree or higher. This eventually translates into better employment opportunities and increased monthly income. These factors together could possibly attribute to the increased IVC evident from this group. Jain et al. (2017) [34] confirmed that in countries where payment of vaccination is necessary, individuals with higher education had a 67% increased odds of vaccination uptake.

## Limitations

Though offered in 6 languages, the CHIS is not available in any of the South-Asian languages, a subgroup confirmed to be rapidly growing in the U.S. Hence South-Asians preferring to speak in languages other than English, may be underrepresented. Also, the sample only included respondents from California, a state majorly inhabited by ethnic minorities and hence our findings may not be generalizable to states with dissimilar demographics.

Additionally, since Asians comprise of diverse ethnic groups, aggregating them together may mask the differences prevalent amongst each group respectively. Hence a generalized classification is conceptually problematic, and interventions developed based on these findings may not yield maximum results. In order to improve the outcomes of public health vaccination programs, nuanced targeted health policies are required as opposed to broad-based interventions.

## Conclusion

The Asian minority reported a higher IVC compared to the overall population of California and the U.S.A. One of the more significant findings to emerge from this study is the high rate of vaccination reported by the third-generation Asians. This is a new finding and supplements current literature which has till date only explored generational status amongst Mexican identified Latino adults only. The predictors for the first and third-generation Asians were quite distinct, with females more likely to report IVC amongst the first generation while males were more likely to report IVC amongst the third-generation. Likewise, being married was associated with an increased vaccination uptake amongst the first-generation while being unmarried was positively associated with increased uptake amongst the third-generation. Hence, the striking diversity amongst the two generations raise important concerns over the current immunization programs which attend to Asians as a homogenous group rather than stratified by generation.

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**Reviewer information** *Life Research* thanks Pujitha Lakshmi Raja, HamidReza Jahantigh and the other anonymous reviewer(s) for the contribution to the peer review of this paper.