COVID-19 Vaccine Breakthrough Infections in the United States by Race and Ethnicity

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INTRODUCTION

- COVID-19 has infected more than 81 million people and caused 991k deaths in United States as of May 1st, 2022.
- Vaccines have been proven to be highly effective at preventing infection, COVID-19 related hospitalization, and death; A total of 257 million people have received at least 1 dose of COVID-19 vaccines in U.S..
- Breakthrough infections (BIs) have been reported among fully vaccinated and varies between 0.02% and 1% in different studies; an estimated minimum 57,617 breakthrough COVID-19 deaths had occurred in the U.S as of March 2022.
- COVID-19 vaccination rates are different by racial and ethnic groups; Lower vaccination rates in African Americans and Hispanics have been reported in early 2021.
- Over the course of the vaccination rollout, differences between vaccination rates for African American, Hispanic and Caucasian people have narrowed.
- Increasing age and presence of anemia, diabetes, chronic lung diseases were proved to be related to higher rate of BIs.
- Evidence is limited about breakthrough infections by different racial/ethnic groups in the United States.

STUDY OBJECTIVE

- To estimate COVID-19 BIs among fully vaccinated individuals by race/ethnicity groups in the U.S.

METHODS

Data source and study design

- A retrospective cohort study was conducted using Optum Research Database.
- Evidence of COVID-19 vaccination status, breakthrough infections, and baseline patient demographics and clinical characteristics were identified.
- Individuals were followed 3 months after the index date (14 days post complete vaccination status) to identify BIs.

Patient selection criteria

- Age ≥16 years as of index year.
- Commercial and Medicare Advantage part D (MAPD) enrollees with complete vaccination status between December 1, 2020 and May 31, 2021.
  - One dose of Janssen vaccine.
  - Two doses Pfizer-BioNTech vaccine with at least 3 weeks apart.
  - Two doses Moderna vaccine with at least 4 weeks apart.
  - Index date defined on 14th day post complete vaccination.
- Continuous enrollment for 6 months prior and 3 months post index date.
- Patients were not included:
  - Received incomplete vaccination status (single dose of Moderna or Pfizer vaccine)
  - Received either mixed vaccines or >2 vaccinations
  - COVID-19 infection within 14 days of complete vaccination
  - Evidence of pregnancy
  - COVID-19 infection during the 6-month pre-index period

Study measures

- Outcome: COVID-19 BIs -- defined using International Classification of Diseases *(ICD)-10* diagnosis codes for COVID-19 infection diagnosed ≥14 days of complete vaccination status.
- Exposure: Patients categorized into the following racial/ethnic minorities groups: African-American, Asian, Caucasian, Hispanic.
- Study covariates: patient demographics, lifestyle factors, comorbid conditions.

Statistical analysis

- Descriptive analyses used to describe study population, including baseline characteristics and COVID-19 BIs by different demographic groups.
- Logistic regression models were used to estimate the odds of COVID-19 BIs in different racial/ethnic groups adjusting for patient demographics, lifestyle factors, and underlying comorbid conditions.

RESULTS

- A total of 1,949,301 individuals were fully vaccinated from 01 December 2020 through 31 May 2021; 1,286,085 individuals met the selection criteria and were included in the study.
- Mean age was 47.32 years (±14.88); and 51.08% were females.
- 76.41% were Caucasians, 9.97% of Hispanics, 7.44% of Asian and 6.18% of African American.
- 6,295 (0.48%) of study patients reported BIs within 3 months follow up period.
- A total of 4,483 (0.46%), 933 (0.73%), 509 (0.64%) and 370 (0.39%) patients of Caucasian, Hispanics, African American and Asians reported COVID-19 BIs respectively (Fig 1) .

Table 1: Demographics of Fully Vaccinated Patients

Demographics	Total (n=1,286,085)	COVID-19 Breakthrough infections		
		BIs - Yes (n=6,295)	BIs - No (n=1,279,790)	P-value
Age, mean ± SD	47.32 (14.88)	47.84 (14.9)	47.31 (14.88)	0.006
Age group		n	%	
16-29	181,527	867 (0.48%)	180,660 (99.52%)	0.435
30-49	488,289	2,328 (0.48%)	485,961 (99.52%)	0.106
50-64	485,439	2,457 (0.51%)	482,982 (99.49%)	0.035
65-79	114,742	526 (0.46%)	114,216 (99.54%)	0.114
80+	16,088	117 (0.73%)	15,971 (99.27%)	<0.001
Gender				
Female	656,901	3,474 (0.53%)	653,427 (99.47%)	<0.001
Male	629,184	2,821 (0.45%)	626,363 (99.55%)	<0.001
Race/Ethnicity				
African American	79,467	509 (0.64%)	78,958 (99.36%)	<0.001
Asian	95,669	370 (0.39%)	95,299 (99.61%)	<0.001
Caucasian	982,720	4,483 (0.46%)	978,237 (99.54%)	<0.001
Hispanic	128,229	933 (0.73%)	127,296 (99.27%)	<0.001
Region				
Northeast	150,655	1,007 (0.67%)	149,648 (99.33%)	<0.001
Midwest	438,404	1,606 (0.37%)	436,798 (99.63%)	<0.001
South	426,115	2,680 (0.63%)	423,435 (99.37%)	<0.001
West	270,338	991 (0.37%)	269,347 (99.51%)	<0.001
Other	573	11 (1.92%)	562 (98.08%)	<0.001
Insurance type				
Commercial	1,224,079	5,987 (0.49%)	1,218,092 (99.51%)	0.791
Medicare	62,006	308 (0.50%)	61,698 (99.50%)	0.791

RESULTS

Figure 1: COVID-19 Breakthrough Infections by Race/Ethnicity

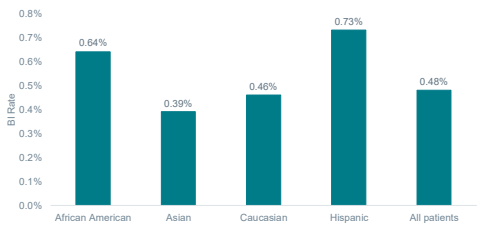


Figure 2: Breakthrough Infections Rate by Age and Race/Ethnicity

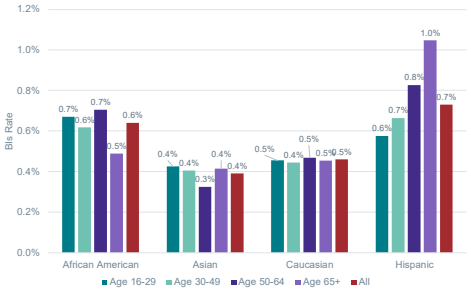
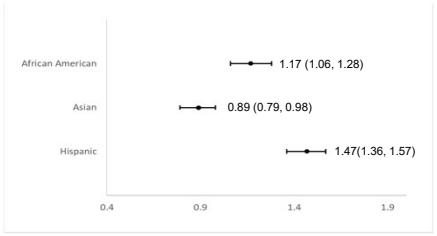


Figure 3: Odds Ratio of Breakthrough Infections Rate by Race/Ethnicity



*all odds ratios were calculated by having Caucasian group as the reference level

Other analysis results

- Within Hispanic group, older patients were more likely to have BIs comparing to younger patients, while the BIs rates between age groups were not different for other race/ethnicity groups.
- Compared to Caucasians:
  - Hispanics and African Americans had significantly higher odds of COVID-19 BIs: 1.47 times (adjusted odds ratio (aOR) = 1.47; 95% CI:1.36-1.57) and 1.17 times (aOR= 1.17; 95% CI: 1.06-1.28).
  - Asians had significantly lower odds of COVID-19 BIs (aOR= 0.89; 95% CI: 0.79-0.98).

LIMITATIONS

- Since administrative claims were used for this study, there is a possibility of data either being misreported or improperly coded.
- Possibility for unmeasured and residual confounding.

CONCLUSIONS

- The study findings present real-world evidence on the risk of COVID-19 BIs among fully vaccinated individuals in different racial/ethnic groups.
- Hispanics and African American population had significantly higher odds of COVID-19 BIs, and Asians had lower odds of BIs compared to Caucasian.
- Continuous investigations are important to identify other BIs risk factors and sustain high effectiveness of COVID-19 vaccinations.

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