

Disease Burden and Health-Related Quality of Life (HRQoL) of Chronic Obstructive Pulmonary Disease (COPD) in the US – Evidence from the Medical Expenditure Panel Survey (MEPS) from 2016-2019

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Purpose: Chronic obstructive pulmonary disease (COPD) is a progressive disease associated with reduced life expectancy, increased morbidity, mortality, and cost. This study characterized the US COPD burden, including socioeconomic and health-related quality of life (HRQoL) outcomes.

Study Design and Methods: In this retrospective, cross-sectional study using nationally representative estimates from Medical Expenditures Survey (MEPS) data (2016–2019), adults (≥ 18 years) living with and without COPD were identified. Adults living without COPD (control cohort) and with COPD were matched 5:1 on age, sex, geographic region, and entry year. Demographics, clinical characteristics, socioeconomic, and generic HRQoL measures were examined to include a race-stratified analysis of people living with COPD.

Results: A total of 4,135 people living with COPD were identified; the matched dataset represented a weighted non-institutionalized population of 11.3 million with and 54.2 million people without COPD. Among people living with COPD, 66.3% had ≥ 1 COPD-related condition; 62.7% had ≥ 1 cardiovascular condition, compared to 33.5% and 50.5% without COPD. More people living with COPD were unemployed (56.2% vs 45.3%), unable to work due to illness/disability (30.1% vs 12.1%), had problems paying bills (16.1% vs 8.8%), reported poorer perceived health (fair/poor: 36.2% vs 14.4%), missed more working days due to illness/injury per year (median, 2.5 days vs 0.0 days), and had limitations in physical functioning (40.1% vs 19.4%) (all $P < 0.0001$). In race-stratified analyses for people living with COPD, people self-reporting as Black had higher prevalence of cardiovascular-risk conditions, poorer socioeconomic and HRQoL outcomes, and higher healthcare expenses than White or Other races.

Conclusion: Adults living with COPD had higher clinical disease burden, lower socioeconomic status, and reduced HRQoL than those without, with greater disparities among Black people living with COPD compared to White and other races. Understanding the characteristics of patients helps address care disparities and access challenges.

Keywords: COPD, burden of illness, healthcare cost, race/ethnicity

Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive disease characterized by persistent respiratory symptoms¹ and occasional exacerbations leading to significant disease and economic burden on the US healthcare system.^{2,3} In 2019, direct medical expenditures attributable to COPD generated using Medical Expenditure Panel Survey

(MEPS) data were estimated at \$31.3 billion and projected to increase to \$60.5 billion in 2029.⁴ Direct cost estimates do not present a complete picture of the disease burden, as COPD has been shown to negatively impact socioeconomic outcomes, healthcare resource utilization (HCRU), and health-related quality of life (HRQoL).^{2,5}

Among adults reporting a diagnosis of COPD, in a 2011 Behavioral Risk Factor Surveillance System (BRFSS) survey assessing the impact of COPD and reduced lung function, 64.2% of respondents reported that shortness of breath negatively impacted their HRQoL.⁶

Based on the 2008 to 2012 MEPS data of people aged ≥ 40 years living with COPD, asthma, or both, compared to other concurrent medical conditions, COPD contributed the most to all-cause and respiratory hospitalizations and emergency department (ED) visits.⁷ Additionally, there is some evidence that the experiences individuals have living with COPD may differ across racial and socioeconomic groups. Data from 1980 to 2000 showed that Black people living with COPD experienced higher hospitalization rates and ED visits and reported fewer scheduled physician office visits than non-Hispanic White people.⁸ A study by Sarrazin et al⁹ reported that Black individuals are at a higher risk of severe COPD exacerbations and suggested that racial disparities in disease management services such as vaccination programs, smoking cessation education, and home oxygen prescriptions may contribute to the higher exacerbation severity. In the FLOW (Function, Living, Outcomes, and Work) study of Kaiser Permanente Medical Care Plan, members living with COPD, lower socioeconomic status, education, and income were consistently linked with poorer COPD outcomes, despite broad access to healthcare.¹⁰

Systemic consequences of COPD and higher occurrence of concurrent conditions negatively impact individuals living with COPD regardless of stage of disease.^{11,12} In particular, there is evidence of an elevated risk of a cardiovascular (CV) event during a COPD exacerbation,^{13,14} and several studies reported that cardiovascular disease (CVD) is a common cause of mortality in earlier stages of COPD severity.^{15–17} Our study includes an analysis of the prevalence of CVD among people living in the US.

Several studies^{10,18–21} have examined the burden of COPD and its exacerbations on productivity, HRQoL, and HCRU; however, updated estimates that use nationally representative data are lacking. There are also a number of studies examining differences in disease burden based on the race and socioeconomic profile of people living with COPD.^{10,22,23} These studies focus on state-level or local effects of racial disparities on disease burden. To our best knowledge, no studies use nationally representative, population-based data to characterize the interplay between race/ethnicity and COPD disease burden. Moreover, the present study aims to examine racial differences in key HRQoL and socioeconomic outcomes not considered in previous studies, such as employment status, health factors limiting the ability to work, self-reported mental health status, and HCRU.

In this study, we use the 2016–2019 MEPS data to estimate COPD disease burden by comparing socioeconomic and HRQoL outcomes, evidence of concurrent conditions (with a focus on the systemic manifestations of COPD), and HCRU in people living with and without COPD. Further, we analyzed these outcomes by stratifying the population living with COPD by race to provide a complete picture of the burden of COPD and the complexity of people living with COPD in the US.

Methods

Data Source

MEPS is a nationally representative survey of the US civilian noninstitutionalized population, conducted by the Agency for Healthcare Research and Quality (AHRQ) since 1996, that collects person- and household-level information on respondents' sociodemographic characteristics, health status, clinical diagnosis, and related charges and payments. This cross-sectional, retrospective study design used MEPS data from 2016 through 2019. MEPS was chosen to answer the research objectives because of its complex weighting strategy, which allows outcomes and disease cohorts to be weighted to the full US population. MEPS person-level weights, based on selection probabilities and adjusted for nonresponse, allow for generating nationally representative estimates.

Study Design

In the years 2016, 2017, 2018, and 2019, people living with COPD ≥ 18 years of age were identified from MEPS medical condition files based on International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes that represent COPD (J40-J44 and J47). Demographics, presence of concurrent diseases, socioeconomic, and HRQoL variables were based on respondent-reported information from the MEPS Full-Year Consolidated Data file, and respondent-reported clinical characteristics were transcribed by professional coders using 3-digit ICD-10-CM codes (J40-J44 and J47). A control cohort was drawn from the general MEPS population aged ≥ 18 years without COPD at any time from 2016 to 2019 and matched 5:1 to those living with COPD on age, sex, geographic region, and year of entry. People without valid weighting variable values were excluded.

This study used the MEPS de-identified data that is available for public download on its website. MEPS is reviewed annually by an Institutional Review Board (IRB) and has IRB approval by Westat IRB.²⁴ All patient records were de-identified and certified to be in full compliance with the confidentiality requirements outlined in the Health Insurance Portability and Accountability Act of 1996 in the United States (US). Further, per Title 45 of CFR, Part 46, the survey data used in our study were exempt from IRB review as it was a retrospective analysis of existing data (hence no patient intervention or interaction), and no patient-identifiable information was included in the dataset.²⁵

Demographics and Clinical Characteristics

The prevalence of COPD was calculated as the weighted number of people living with COPD over the total number of weighted US patients in each year of study and pooled across 2016–2019. Clinical characteristics, including the presence of 19 concurrent medical conditions of specific interest were examined. Conditions categorized as COPD-related included asthma, congestive heart failure, coronary heart disease, depression, other mental health and/or substance abuse problems, other heart diseases, pneumonia, and stroke.²⁶ Conditions categorized as not related to COPD included arthritis, back problems, cancer, diabetes, dyslipidemia, HIV/AIDS, hypertension, injuries, pregnancy, renal failure, and skin disorders.²⁶

Concurrent conditions in the MEPS Medical Conditions file were assessed as respondent-reported: a) “Has a physician ever diagnosed you with X condition?” and b) “Do you currently have X condition?” Medications in the MEPS Prescribed Medications files were coded as text names and National Drug Codes and rolled up into predefined Therapeutic Classes. Medications and classes of interest for this study were determined a priori based on clinician input. We also analyzed the presence of cardiovascular concurrent conditions (CHD, CHF, hypertension, dyslipidemia, and other heart diseases) stratified by the following categories (percentage of patients with any cardiovascular condition, percentage of patients with no cardiovascular condition of interest, percentage of patients with only 1, only 2, or ≥ 3 cardiovascular conditions of interest).

Socioeconomic and HRQoL Outcomes

All outcomes related to COPD burden were pooled and reported as average annual estimates across the 4 years (2016–2019). The assessment of COPD burden included socioeconomic variables such as household income, insurance status, employment status, food stamp enrollment, and poverty status and generic measures of HRQoL such as perceived health, perceived mental health, health limitation to activity, difficulty performing tasks, pain that limits work, feeling depressed, and annual disability days.

HCRU Outcomes

Healthcare cost data and HCRU are available in the MEPS Full-Year Consolidated Data file. This study focused on direct healthcare costs to address the perspective of the payer and policy stakeholders responsible for developing COPD management strategies and treatment budgets. Healthcare costs were reported as medical expenditures for healthcare services and total prescription expenditures provided during the year, including out-of-pocket costs and payments by private insurance, Medicaid, Medicare, and other sources.

All-cause direct medical utilization was calculated for the following categories of healthcare services: inpatient hospitalizations, hospital outpatient visits, ED visits, office-based physician visits, and prescription medications. The utilization was a count of the number of medical events reported for the category. All sources were analyzed from the societal perspective for this study, and cost variables were reported in 2021 US dollars, using the price index in accordance with AHRQ recommendations.²⁷

Sociodemographic characteristics, HRQoL outcomes, HCRU, and cost variables were also reported for people living with COPD stratified by race (Black, White, other [American Indian, Alaska Native, Asian or Pacific Islander, or other]).

Analytical Approach

Continuous measures were reported as means and standard deviations, and categorical measures were reported as counts and proportions. Continuous and categorical variables were compared using *t*-tests or Chi-square tests, respectively. *P*-values <0.05 were considered statistically significant.

Results

Clinical and Demographic Characteristics

In the years 2016 to 2019, 4,135 people living with COPD, representing a weighted population of 11.5 million non-institutionalized US civilians, were identified from the MEPS database. Matched populations included 11.3 million people living with COPD and 54.2 million people without COPD, with an overall mean age of approximately 60 years (median 61 years) and 62% female (Table 1).

Among the matched cohorts, people living with COPD were more likely to be White (87.0% vs 79.9%, *P*<0.0001) and covered by public insurance (Medicare and Medicaid; 62.2% vs 52.1%, *P*<0.0001) and a lower proportion were college-educated (4-year college education completed) (17.5% vs 22.3%, *P*<0.0001) compared to those without COPD (Table 1).

Among people living with COPD, a higher proportion was from the South (40.6%) as compared to the Northeast (16.4%), Midwest (24.9%), or West (18.0%). Among people living with COPD, 9,819,838 (87.0%) were White, 883,320 were Black (7.8%), and 585,705 (5.2%) were of other races. Black and other non-White patients were slightly younger than their White counterparts (mean age in years, 57.6 and 53.0 vs 60.0). While Medicare was the primary payer across

Table 1 Selected Characteristics by COPD Status Among Adults Aged ≥18 Years and in People Living with COPD Stratified by Race, 2016–2019 (MEPS)^a

| Characteristics | COPD | | | | | No COPD (N=54,159,701) | P-value (COPD vs no COPD) | |
|-----------------------------|---------------------------|------------------------|----------------------|----------------------|--------------------------|---------------------------|---------------------------------|------|
| | Overall (N=11,288,864) | White (N=9,819,838) | Black (N=883,320) | Other (N=585,705) | P-value (within COPD) | | | |
| Age in years, mean, (SD) | 59.3 (0.5) | 59.9 (0.5) | 57.6 (1.1) | 52.9 (1.6) | 0.0001 | 59.7 (0.2) | 0.35 | |
| Median | 61.0 | 61.6 | 58.4 | 55.4 | | 61.2 | | |
| Age category, in years, (%) | | | | | | 0.001 | | 0.40 |
| 18–34 | 10.7 | 10.1 | 12.3 | 19.8 | | 9.5 | | |
| 35–44 | 9.0 | 9.0 | 7.8 | 10.7 | | 8.8 | | |
| 45–54 | 12.8 | 12.3 | 15.8 | 16.6 | | 13.4 | | |
| 55–64 | 24.8 | 24.6 | 28.6 | 21.7 | | 25.8 | | |
| ≥65 | 42.7 | 44.0 | 35.4 | 31.2 | | 42.6 | | |
| Female (%) | 62.1 | 61.4 | 69.0 | 63.9 | 0.07 | 62.3 | 0.90 | |
| Geographic region (%) | | | | | | <0.0001 | | 0.32 |
| Northeast | 16.4 | 17.2 | 10.3 | 13.0 | | 17.2 | | |
| Midwest | 24.9 | 25.6 | 20.1 | 20.5 | | 26.6 | | |
| South | 40.6 | 39.0 | 60.0 | 38.8 | | 38.2 | | |
| West | 18.0 | 18.2 | 9.6 | 27.7 | | 18.0 | | |

(Continued)

Table 1 (Continued).

| Characteristics | COPD | | | | | No COPD (N=54,159,701) | P-value (COPD vs no COPD) |
|--|---------------------------|------------------------|----------------------|----------------------|--------------------------|---------------------------|---------------------------------|
| | Overall (N=11,288,864) | White (N=9,819,838) | Black (N=883,320) | Other (N=585,705) | P-value (within COPD) | | |
| Race/ethnicity (%) | | | | | | | <0.0001 |
| White – no other race reported | 87.0 | 100.0 | NA | NA | | 79.9 | |
| Black – no other race reported | 7.8 | NA | 100.0 | NA | | 11.9 | |
| Other race – only single race reported | 2.1 | NA | NA | 40.2 | | 6.0 | |
| Multiple races reported | 3.1 | NA | NA | 59.8 | | 2.1 | |
| Education completed (%) | | | | | | 0.007 | <0.0001 |
| 4-year college | 17.5 | 17.7 | 13.1 | 19.9 | | 22.3 | |
| Marital status | | | | | | <0.0001 | |
| Married | 49.2 | 51.3 | 32.0 | 38.6 | | 57.8 | |
| Widowed/Divorced | 34.5 | 34.4 | 37.0 | 32.9 | | 26.8 | |
| Sources of health insurance (%) | | | | | | <0.0001 | <0.0001 |
| Private | 34.8 | 35.4 | 26.7 | 36.6 | | 42.4 | |
| Medicare | 51.4 | 52.1 | 49.5 | 42.4 | | 45.1 | |
| Medicaid | 10.8 | 9.7 | 18.3 | 18.2 | | 7.0 | |
| Other | 0.6 | 0.5 | 1.6 | 0.7 | | 0.4 | |
| Uninsured | 2.5 | 2.3 | 3.9 | 2.1 | | 5.1 | |

Notes: ^aAnalyses were conducted on the weighted and matched population with matching performed using age, sex, geographic region, and year of entry.

Abbreviations: COPD, chronic obstructive pulmonary disease; MEPS, Medical Expenditure Panel Survey; SD, standard deviation.

racial groups, nearly twice as many non-Whites (Black and other races) received Medicaid (18.3% and 18.2% vs 9.7%), with only 26.7% of Black people living with COPD having private insurance coverage (Table 1).

People living with COPD had a higher prevalence of other diseases, with 66.3% having ≥ 1 COPD-related concurrent condition compared to 33.5% without COPD (Table 2) and 62.7% having ≥ 1 cardiovascular condition compared to 50.5% without COPD (Figure 1). Specifically, twice the number of people living with COPD reported having CHD (16.7% vs 7.6%), depression (21.1% vs 10.6%), and other mental health problems (29.0% vs 14.7%) compared to those without COPD. People living with COPD also had a significantly higher prevalence of CHF (4.1% vs 1.0%), other heart diseases (9.9 vs 5.9%), asthma (29.7% vs 5.7%), and pneumonia (9.8% vs 1.6%) compared to those without COPD. The differences in the prevalence of all COPD-related conditions (except stroke, $P=0.51$) in people with or without COPD were statistically significant ($P<0.0001$) (Table 2).

The prevalence of concurrent conditions (related or unrelated to COPD) varied among racial groups of people living with COPD; for 10 of the 19 conditions of interest, statistically significant differences were observed between the Black, White, and Other race groups. The most prominent differences were the higher prevalence of arthritis (39.8% vs 30.3% vs 29.1%, $P=0.01$), asthma (37.4% vs 28.5% vs 38.1%, $P=0.002$), CHF (7.5% vs 3.8% vs 2.8%, $P=0.01$), HIV (2.4% vs 0.1% vs 1.2%, $P<0.0001$), and hypertension (68.1% vs 48.3% vs 40.7%, $P<0.0001$) among Black people living with COPD compared to White and Other race individuals, respectively; while lower rates were observed for diagnosis for depression (13.9% vs 21.7% vs 21.4%, $P=0.02$) and other mental health or substance abuse problems (21.3% vs 29.8% vs 26.5%, $P=0.02$) (Table 2).

Table 2 Key Concurrent Conditions by COPD Status Among Adults Aged ≥18 Years and in People Living with COPD Stratified by Race, 2016–2019 (MEPS)^a

| Key concurrent conditions (%) | COPD | | | | | No COPD (N=54,159,701) | P-value (COPD vs no COPD) |
|--|---------------------------|------------------------|----------------------|----------------------|--------------------------|---------------------------|------------------------------|
| | Overall (N=11,288,864) | White (N=9,819,838) | Black (N=883,320) | Other (N=585,705) | P-value (within COPD) | | |
| No concurrent conditions | 10.1 | 9.9 | 11.0 | 12.3 | 0.56 | 26.8 | <0.0001 |
| At least 1 COPD-related concurrent condition ^b | 66.3 | 66.5 | 66.1 | 63.4 | 0.74 | 33.5 | <0.0001 |
| At least 1 concurrent condition not related to COPD ^c | 81.5 | 81.4 | 84.7 | 77.5 | 0.16 | 67.8 | <0.0001 |
| Arthritis | 31.0 | 30.3 | 39.8 | 29.1 | 0.01 | 17.4 | <0.0001 |
| Asthma | 29.7 | 28.5 | 37.4 | 38.1 | 0.002 | 5.7 | <0.0001 |
| Back problems | 23.6 | 23.4 | 23.9 | 25.7 | 0.82 | 14.4 | <0.0001 |
| Cancer | 11.1 | 11.4 | 9.2 | 9.3 | 0.50 | 8.5 | <0.0001 |
| Coronary heart disease | 16.7 | 16.6 | 18.1 | 14.7 | 0.70 | 7.6 | <0.0001 |
| Congestive heart failure | 4.1 | 3.8 | 7.5 | 2.8 | 0.01 | 1.0 | <0.0001 |
| Depression | 21.1 | 21.7 | 13.9 | 21.4 | 0.02 | 10.6 | <0.0001 |
| Diabetes | 20.5 | 20.2 | 26.0 | 17.0 | 0.05 | 15.2 | <0.0001 |
| Dyslipidemia | 40.0 | 39.9 | 40.7 | 40.4 | 0.97 | 31.2 | <0.0001 |
| HIV | 0.4 | 0.1 | 2.4 | 1.2 | <0.0001 | 0.2 | 0.02 |
| Hypertension | 49.5 | 48.3 | 68.1 | 40.7 | <0.0001 | 39.7 | <0.0001 |
| Injuries | 20.3 | 20.7 | 15.2 | 20.5 | 0.15 | 13.4 | <0.0001 |
| Mental health and/or substance abuse problems | 29.0 | 29.8 | 21.3 | 26.5 | 0.02 | 14.7 | <0.0001 |
| Other heart diseases | 9.9 | 10.3 | 7.7 | 6.8 | 0.16 | 5.9 | <0.0001 |
| Pneumonia | 9.8 | 10.3 | 7.7 | 3.9 | 0.007 | 1.6 | <0.0001 |
| Pregnancies | 0.8 | 0.8 | 1.0 | 0.0 | 0.17 | 1.1 | 0.29 |
| Renal failure | 1.1 | 1.0 | 1.6 | 2.0 | 0.25 | 0.8 | 0.22 |
| Skin disorders | 14.9 | 15.1 | 12.7 | 14.8 | 0.60 | 9.5 | <0.0001 |
| Stroke | 0.3 | 0.3 | 0.8 | 0.0 | 0.04 | 0.4 | 0.51 |

Notes: ^aAnalyses were conducted on the matched population with matching performed using age, sex, geographic region, and year of entry. ^bConcurrent conditions considered to be COPD-related include asthma, congestive heart failure, coronary heart disease, depression, other mental health and/or substance abuse problems, other heart diseases, pneumonia, and stroke. ^cConcurrent conditions not related to COPD include arthritis, back problems, cancer, diabetes, dyslipidemia, HIV/AIDS, hypertension, injuries, pregnancy, renal failure, and skin disorders.

Abbreviations: COPD, chronic obstructive pulmonary disease; MEPS, Medical Expenditure Panel Survey.

Socioeconomic Outcomes

With regard to socioeconomic status, people living with COPD were significantly more likely to be unemployed (56.2% vs 45.3%, $P<0.0001$), unable to work due to illness or disability (30.1% vs 12.1%, $P<0.0001$) (Figure 2), have a lower mean (SD) family income (\$66,227 (\$1,772) vs \$81,208 (\$1,070), $P<0.0001$) (e-Table 1) and have problems paying bills (16.1% vs 8.8%, $P<0.0001$) (Figure 2).

While overall there were no statistical differences across the 3 racial groups for unemployment status (White, 56.4%; Black, 57.4%; Other, 51.4%, $P=0.30$), a slightly higher number of unemployed Black and other race individuals living with COPD indicated that they were unable to work due to illness or disability compared to White individuals (47.5% and 40.0% vs 27.9%, respectively, $P<0.0001$) (Figure 3). Mean (SD) family income was approximately 35% lower for Black individuals

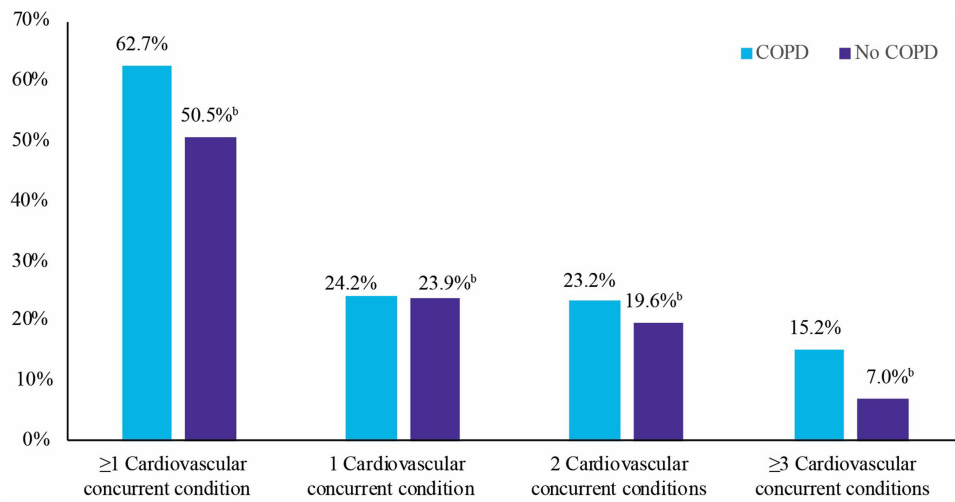


Figure 1 Key cardiovascular concurrent conditions^a by COPD status among adults aged ≥18 years.
Notes: ^a Cardiovascular conditions included coronary heart disease, congestive heart failure, hypertension, dyslipidemia, and other heart disease. ^bAll differences were statistically significant ($P<0.0001$).
Abbreviation: COPD, chronic obstructive pulmonary disease.

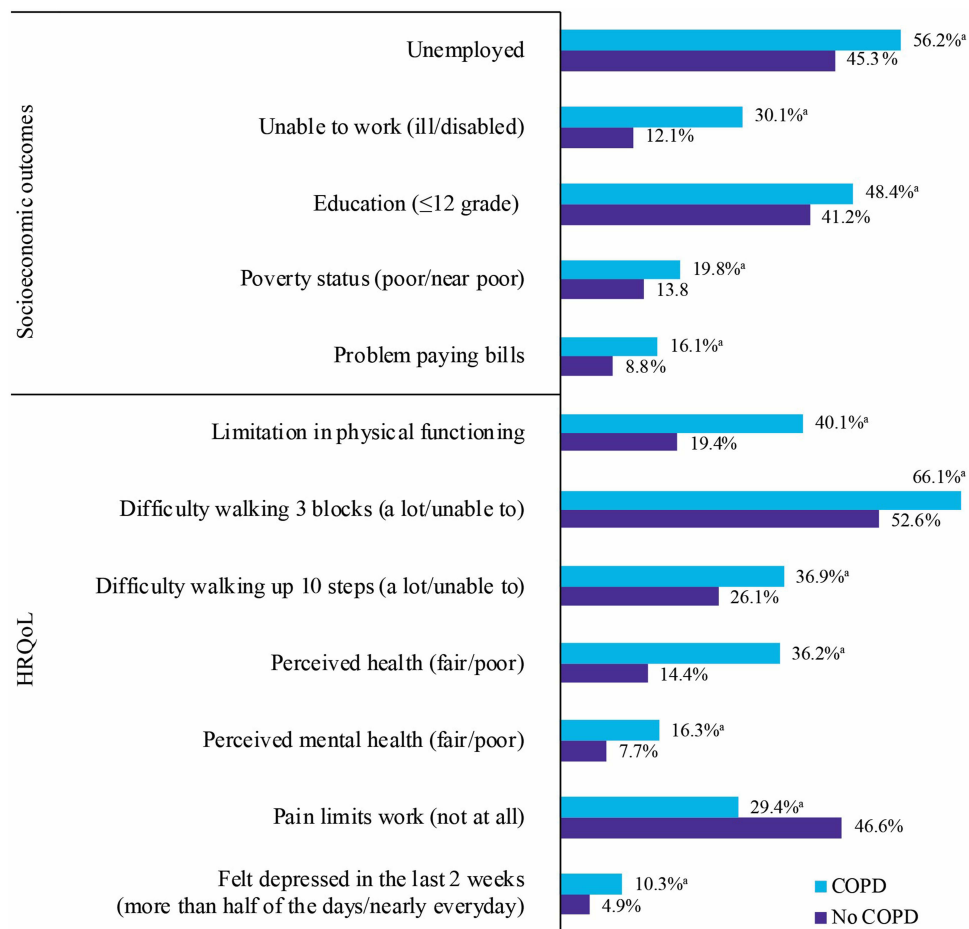


Figure 2 Socioeconomic and HRQoL outcomes in people living with COPD and without COPD, 2019 (MEPS).
Note: ^a All differences were statistically significant ($P<0.0001$).
Abbreviations: COPD, chronic obstructive pulmonary disease; MEPS, Medical Expenditures Survey; HRQoL, health-related quality of life.

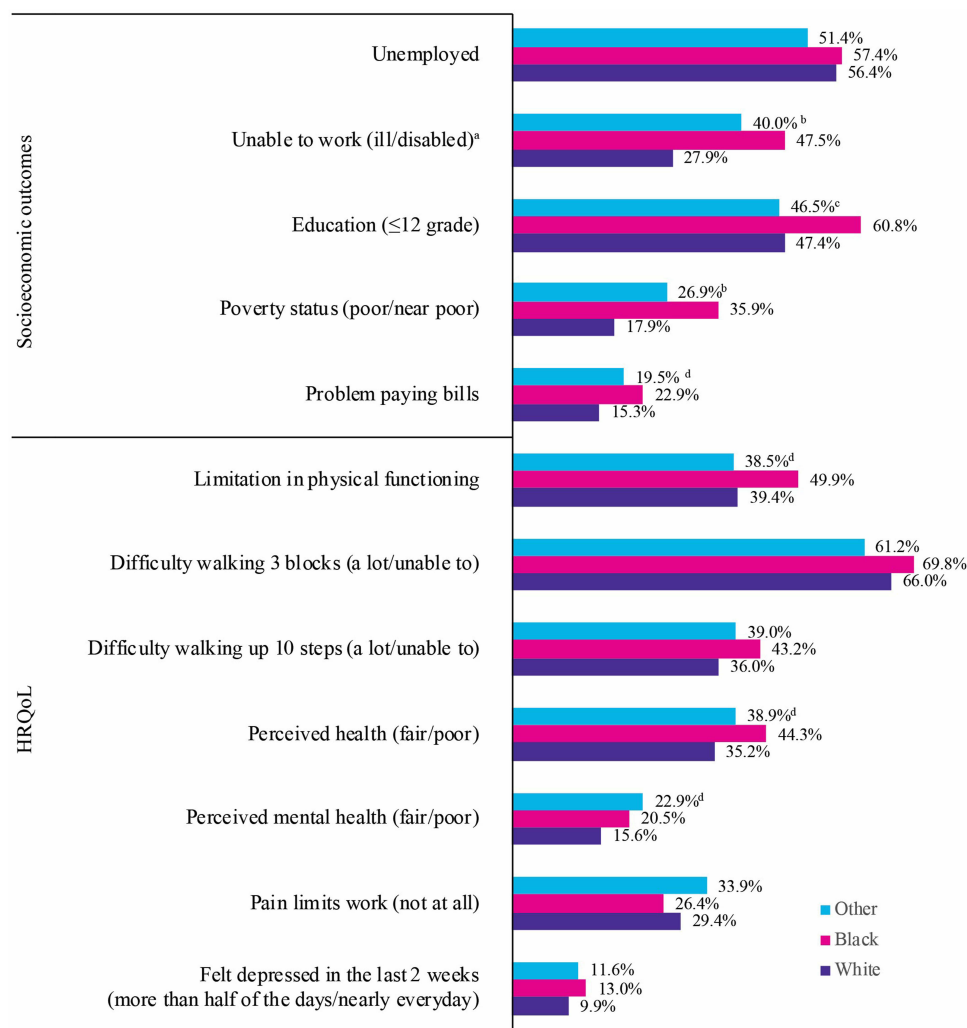


Figure 3 Socioeconomic and HRQoL outcomes in people living with COPD stratified by race, 2019 (MEPS).
Notes: ^aThis refers to those who were not employed/unemployed at the time of the MEPS interview. ^b $P < 0.0001$. ^c $P < 0.001$. ^d $P < 0.05$.
Abbreviations: COPD – chronic obstructive pulmonary disease; MEPS – Medical Expenditures Survey; HRQoL – health-related quality of life.

compared to White and Other races (\$43,714 [\$3,388] vs \$68,050 [\$1,830] and \$69,601 [\$10,147], respectively, $P < 0.001$), and 28.1% received food stamps compared to White (14.9%) and Other races (20.3%; $P < 0.0001$) (e-Table 3).

HRQoL Outcomes

Overall, measures of all HRQoL outcomes were worse in people living with COPD. The percentage of people living with COPD reporting fair or poor perceived health (36.2% vs 14.4%), feelings of depression in the last 2 weeks for more than half the days or nearly every day (10.3% vs 4.9%), and limitations in physical functioning (40.1% vs 19.4%) (all $P < 0.0001$) were higher as compared to people without COPD. Additionally, only 29.4% of people living with COPD did not experience pain that limited work compared to 46.6% of those without COPD (Figure 2). Among those who were employed in both cohorts, people living with COPD had more missed days at work due to illness/injury per year, (median days missed: 2.5 vs 0.0, respectively; $P < 0.0001$) as compared to people without COPD (e-Table 1).

Slight yet statistically significant differences were observed among Black, White, and other races with HRQoL outcomes such as fair/poor perceived health (44.3% vs 35.3% vs 38.9%, respectively, $P = 0.032$) and fair/poor perceived mental health (20.5% vs 15.6% vs 22.9%, respectively, $P = 0.009$). Limitations in physical functioning reported by people living with COPD differed significantly by race groups (Black 49.9% vs White 39.4% vs Other 38.5%, $P = 0.002$) (Figure 3). Among those

employed, Black people had more missed days at work due to illness/injury per year compared to White and other races (median days missed: 3.3 vs 2.4 vs 2.6, respectively; $P<0.0001$) ([e-Table 3](#)).

HCRU Outcomes

A greater percentage of people living with COPD had ≥ 1 office-based visit (95.9% vs 82.6%), $P<0.0001$) and ≥ 1 hospital outpatient visit (38.3% vs 26.1%, <0.0001) as compared to people without COPD. Among those with visits, the mean number of office-based provider visits was higher for people living with COPD compared to people without COPD (14 vs 10, $P<0.0001$). The mean number of hospital outpatient visits was the same for both groups (mean among those with visits, 4, $P=0.09$). Twice the percentage of people living with COPD had ≥ 1 ED visit (32.4% vs 16.6%, $P<0.0001$; mean among those with visits, 2 vs 1, $P<0.0001$) and ≥ 1 inpatient hospital stays (19.8% vs 9.8%, $P<0.0001$; mean among those visits, 1 for both groups, $P<0.0005$) as compared to people without COPD ([Figure 4](#) and [e-Table 2](#)). People living with COPD had twice as many prescription fills, on average (mean, 36 vs 17 prescriptions, $P<0.0001$), compared to people without COPD ([e-Table 2](#)). Average and median total healthcare (mean [SE], \$15,995 [\$527]; median \$7,930 vs \$8,739 [\$170]; \$2,861) and prescription expenses (\$4,859 [\$222]; \$1,834 vs \$2,206 [\$72]; \$283) for people living with COPD were higher than those reported for people without COPD ([Table 3](#)).

A higher proportion of Black people living with COPD had ≥ 1 ED visit, compared to White and other races (47.9% vs 30.9% vs 34.3%, $P<0.0001$) (mean among those visits, 1.8 vs 1.8 vs 2.0). Additionally, a greater proportion had ≥ 1 all-cause inpatient hospital stays (25.1% vs 19.5% vs 16.2%, $P=0.02$) (mean among those stays, 1.5 for all groups) as compared to White and Other races ([Figure 5](#) and [e-Table 4](#)). White people living with COPD had a lower mean number of prescription fills compared to Black and other races (35 vs 43 and 42, respectively) ([e-Table 4](#)). Among people living with COPD, the average total adjusted healthcare and prescription expenses were numerically higher for Black individuals compared to individuals who are White or other races but observed differences were not statistically significant.

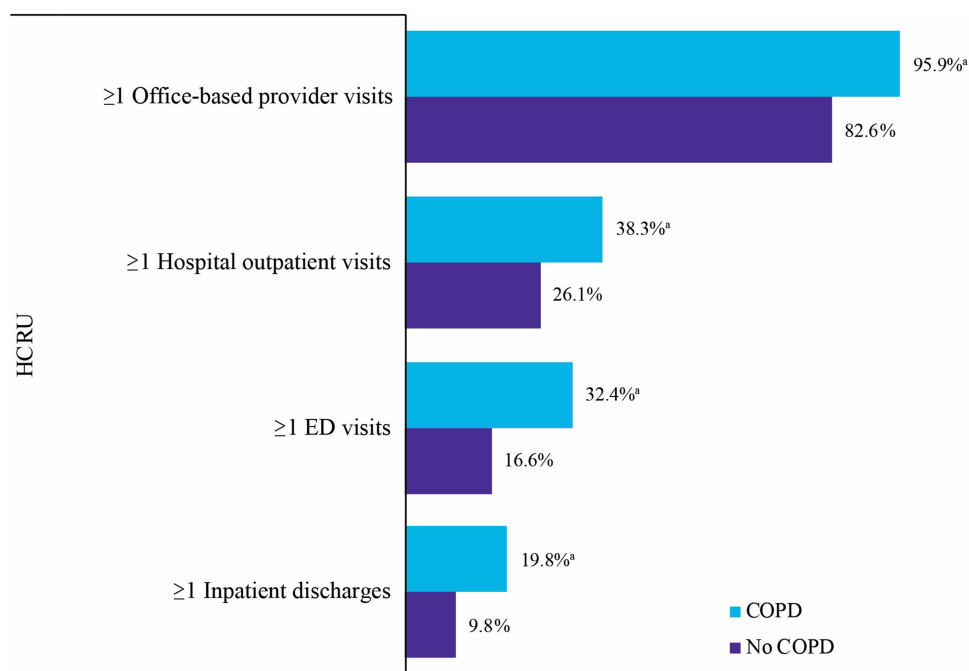


Figure 4 HCRU outcomes in people living with COPD and without COPD, 2019 (MEPS).

Note: ^a All differences were statistically significant ($P<0.0001$).

Abbreviations: COPD, chronic obstructive pulmonary disease; ED, emergency department; HCRU, healthcare resource utilization; MEPS, Medical Expenditures Survey.

Table 3 Healthcare and Prescription Expenses by COPD Status and in People Living with COPD Stratified by Race, 2016–2019 (MEPS)

| Cost variables | COPD (N=11,288,864) | | | | | No COPD (N=54,159,701) | P-value (COPD vs no COPD) |
|--|------------------------|---------------------|-------------------|-------------------|-----------------------|------------------------|---------------------------|
| | Overall (N=11,288,864) | White (N=9,819,838) | Black (N=883,320) | Other (N=585,705) | P-value (within COPD) | | |
| Total healthcare expenses, \$ ^a | | | | | | | <0.0001 |
| Mean (SE) | 15,995 (527) | 15,726 (545) | 18,008 (1661) | 17,461 (2627) | 0.35 | 8,739 (170) | |
| Median | 7,930 | 8,066 | 7,204 | 6,500 | | 2,861 | |
| Total prescription expenses, \$ ^a | | | | | | | <0.0001 |
| Mean (SE) | 4,859 (222) | 4,713 (241) | 5,773 (647) | 5,930 (1084) | 0.20 | 2,206 (72) | |
| Median | 1,834 | 1,828 | 1,941 | 1,709 | | 283 | |

Notes: ^aAdjusted to 2021 USD based on the Personal Health Care Price Index.³

Abbreviations: COPD, chronic obstructive pulmonary disease; MEPS, Medical Expenditure Panel Survey; SE, standard error; USD, United States dollar.

Discussion

Results from this nationally representative, MEPS database study, demonstrate that people living with COPD have a higher clinical disease burden, lower socioeconomic status, and worse HRQoL than those without COPD. Furthermore, among people living with COPD, Black people had comparatively poorer socioeconomic and HRQoL outcomes, higher healthcare expenses, and HCRU (higher ED visits and inpatient discharges) than White or other races. People living with COPD experience a high frequency of concurrent health conditions, including depression and cardiovascular conditions such as CHD and CHF, contributing to the significant disease burden and complexity of care for people with COPD. In addition, some of the comorbidities not categorized as COPD-related (eg, musculoskeletal impairment, diabetes, hypertension) in this study have been found to be more prevalent among individuals with COPD, and these comorbidities may be initiated and/or worsened by

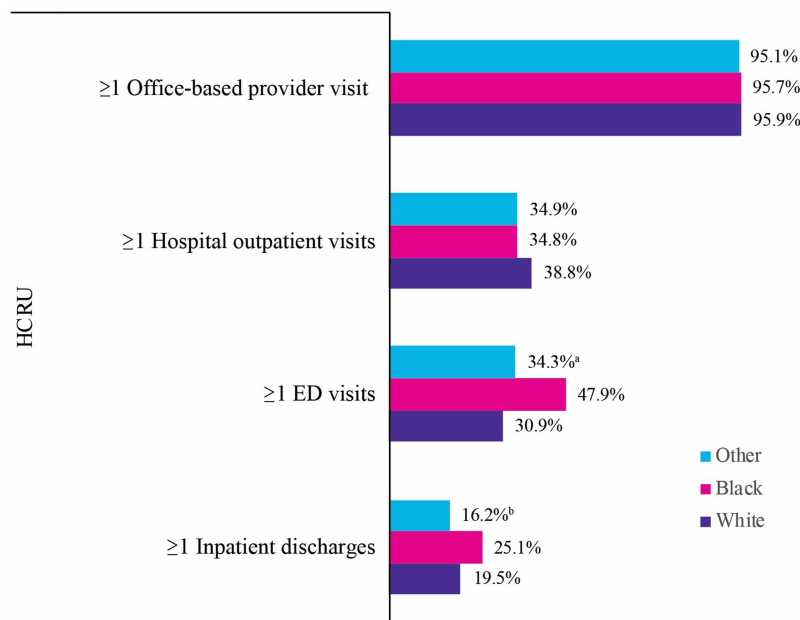


Figure 5 HCRU outcomes in people living with COPD stratified by race, 2019 (MEPS).

Notes: ^aP<0.0001. ^bP=0.0172.

Abbreviations: COPD, chronic obstructive pulmonary disease; ED, emergency department; HCRU, healthcare resource utilization; MEPS, Medical Expenditures Survey.

smoking and COPD.²⁸ While many concurrent conditions did not differ between races, percentages for reported diagnoses of arthritis, asthma, CHF, HIV, and hypertension were higher among Black people living with COPD compared to White or other races, while lower rates of diagnosis were reported for depression and other mental health or substance abuse problems.

The inability to work due to illness or disability was higher in people living with COPD compared to those without COPD. Our results also suggest that only 30% of people living with COPD do not report any work limitations due to pain, and a substantially higher percentage of people living with COPD report limitations in physical functioning. Other studies have also reported higher levels of pain intensity among people living with COPD, particularly those with moderate to severe COPD, compared to healthy controls,²⁹ as well as in comparison to people living with other chronic conditions.³⁰ Greater experience of pain is associated with increased dyspnea, fatigue, reduced physical activity, depression, and poorer HRQoL.³¹ Additionally, limitations in physical functioning may lead to reduced physical activity, muscle deconditioning, and higher rates of frailty in people living with COPD.^{32–34}

While COPD is primarily characterized by airflow obstruction due to chronic inflammation of the lungs, several studies provide evidence that the inflammatory mediators of COPD spill over into circulation and may lead to many systemic manifestations, including, among others, concurrent cardiovascular conditions, depression, lung cancer, and diabetes.^{11,35} Systemic inflammation, which is persistent in people living with COPD, increases during the exacerbation of the disease.³⁶ In our analysis, among people living with COPD, those with any cardiovascular condition of interest (CHD, CHF, hypertension, dyslipidemia, or other heart disease) included about 63% of the population, while only 37% reported no cardiovascular conditions. Our results are consistent with published research reporting a high prevalence of concurrent conditions in people living with COPD, particularly CVD.^{12,37} In a systematic review, assessing the risk of cardiovascular comorbidity in people living with COPD, Chen et al³⁷ reported that patients with COPD were more likely to be diagnosed with CVD (odds ratio [OR]: 2.46; 95% CI: 2.02–3.00; $P < 0.0001$) compared to the non-COPD population.³⁷ In a recent case–control study, Hu et al¹⁴ followed patients for 6 months post-discharge from hospitalization for a COPD exacerbation and reported that 6.05% had concomitant acute CV events. The CV event group was more prone to re-exacerbation within 3 months after hospitalization and had poorer clinical outcomes than the non-CV event group.¹⁴ Due to the growing evidence that previous COPD exacerbations may trigger acute CV events,³⁸ the COPD disease management strategy should include interventions beyond the lungs, including treatment of concurrent conditions, reduction of cardiovascular risks, and management of dyspnea and anxiety.

Stratified by race, our results report that among those living with COPD, Black people show a trend toward a higher prevalence of cardiovascular-risk conditions such as CHD, CHF, diabetes, and hypertension compared to White and other races. In a prospective cohort study by Eisner et al,¹⁰ Black race was associated with greater disease severity and a higher risk of acute exacerbations, which did not persist after accounting for differences in socioeconomic status and other covariates (comorbidities, smoking history, body mass index, and occupational exposures). Contrary to this, a study by Ejike et al²² showed that the association between Black race and respiratory outcomes, although improved after adjusting for individual-level and neighborhood socioeconomic status factors, was still significantly poorer.²² Also, Black people showed greater limitations in physical function and submaximal exercise performance, even after adjusting for socioeconomic and other covariates.¹⁰ Our research found an association between Black race and poorer COPD-related outcomes; however, further research is needed to fully elucidate potential underlying factors (eg, socioeconomic status, impact of CVD). Understanding the diversity of people with COPD can help address care disparities and access challenges by developing strategies to narrow the socioeconomic gap between races and improve HRQoL outcomes. Prioritizing the treatment of the underlying lung disease may help to stem the systemic inflammatory cascade and control the risk of exacerbations and systemic manifestations of COPD, leading to a reduction in HCRU.

The focus of this study was to examine racial stratifications within people living with COPD. As COPD patients are multi-dimensional and their care is complex; additional stratifications and comparisons of patients could be informative. Future research should consider describing characteristics and outcomes by gender and other important groups.

Several methodologies have been used to report the burden of COPD on socioeconomic, HRQoL, and HCRU parameters, such as disease-specific, patient-reported outcome (PRO) measures in clinical trials,³⁹ the association between exacerbation patterns and HCRU using data from a large US national health plan,⁴⁰ and the effect of COPD severity on work productivity, HRQoL and HCRU in employed adult respondents of the US National Health and Wellness Survey.¹⁹ Limited studies describe the disease burden of COPD in a nationally representative sample of the US

population using the MEPS database. In a prospective study, Vaz Fragoso et al⁴¹ used MEPS data to evaluate the impact on PROs and HCRU in people living with COPD or asthma and compared it to the asthma-COPD overlap syndrome. While providing useful comparative information, the study did not evaluate the difference in disease burden between people living with and without COPD.⁴¹ The results of our analysis corroborate some of the findings from other studies^{7,42} that use MEPS data; however, differences in methodology do not allow an accurate comparison.

Our study had several limitations. This study summarizes the US burden of COPD and may not be generalizable to COPD burden experienced in other countries. The study used cross-sectional data and was conducted to be descriptive in nature; therefore, causality could not be examined. Also, epidemiological resources such as MEPS survey noninstitutionalized adults and do not include adults who live in long-term care facilities, prisons, and other facilities; therefore, findings are not generalizable to those populations. Further, data files from the year 2020/2021 were unavailable during this analysis due to the lag in availability from the MEPS database, in addition to the uncertainty regarding the nature/quality of these files due to the COVID-19 pandemic. While the MEPS database is a robust source of nationwide population-based data and has been widely used by researchers since 1996, the presence of COPD and many other outcomes were based on self-reported physician diagnoses, not on medical records or diagnostic tests, and might be subject to recall and social desirability biases. Clinical information that could be used to provide more detailed information on the generalizability of the study to other COPD populations (eg, spirometry data, smoking history, respiratory symptoms, genetic factors) is not available in the MEPS dataset and should be considered in future evaluations of disease burden.

Conclusions

Using nationally representative estimates from the MEPS database, this study provides evidence that people living with COPD have a higher clinical disease burden, lower socioeconomic status, and worse HRQoL than those without COPD. People living with COPD also experience a high frequency of concurrent health conditions, including depression and cardiovascular conditions such as CHD and CHF, contributing to the significant disease burden and complexity of care for people with COPD. While our study reports a higher disease burden in non-White individuals living with COPD, further research is needed to explain the disparities in respiratory outcomes between racial subgroups and other subgroups based on gender, payer, and regional (rural/urban) parameters. Understanding the diversity of people with COPD can help to address care disparities and access challenges. Payers, providers, and policy developers need to recognize the challenges of these patients and ensure their COPD management is optimized for their condition.

Abbreviations

AHRQ, Agency for Healthcare Research and Quality; ATS, American Thoracic Society; BRFSS, Behavioral Risk Factor Surveillance System; CFR, Code of Federal Regulations; CHD, coronary heart disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; CV, cardiovascular; ED, emergency department; FLOW, Function, Living, Outcomes, and Work; HCRU, healthcare resource utilization; HRQoL, health-related quality of life; ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification; IRB, Institutional Review Board; MEPS, Medical Expenditure Panel Survey; OR, odds ratio; PRO, patient-reported outcome; SD, standard deviation.

Ethics Approval and Informed Consent

Given the robust deidentification and public-use policies of the data sources used in this study (ie, no use of restricted data files), investigators had no direct interaction with patients. The study conducted secondary analyses on data that were accessible to the public and not restricted to researchers. Therefore, no informed consent was required, and no subject and IRB approval was needed. Please note, MEPS is reviewed annually by an IRB and has IRB approval by Westat IRB. https://meps.ahrq.gov/communication/participants/faq_gen_mpc.shtml#FAQ10

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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MFP and NF are full-time employees and stockholders of AstraZeneca. MHR, DMM, and DWM are paid consultants of AstraZeneca. MHR reports consulting and/or research funding from AstraZeneca, GSK plc., and Sunovion Pharmaceuticals. DMM is a paid consultant to AstraZeneca, GSK plc, Regeneron, Genentech, Up-to-Date, and Schlesinger Law Firm. He is also an expert witness on behalf of people suing the tobacco and vaping industries. DWM reports research funding from AstraZeneca, GSK plc., and Sunovion Pharmaceuticals and is a paid consultant for Novartis and Theravance. EF, OL, and SA are or were employees of Cencora at the time research was conducted. The authors report no other conflicts of interest in this work.

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