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# Chronic Obstructive Pulmonary Disease and Asthma—Patient Characteristics and Health Impairment

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## Abstract

Background: Persons with chronic obstructive pulmonary disease (COPD) and/or asthma have great risk for morbidity. There has been sparse state-specific surveillance data to estimate the impact of COPD or COPD with concomitant asthma (overlap syndrome) on health-related impairment. Methods: The North Carolina (NC) Behavioral Risk Factor

Surveillance System (BRFSS) collected data on COPD and asthma among adults aged 18 years and older in 2011. Former and current smokers were asked if they had ever been diagnosed with COPD, asthma, or both. Respondents were also asked if they had ever been diagnosed with a disability, such as difficulty walking, climbing stairs, or doing physical work. The prevalence of COPD, asthma, and overlap syndrome was 10.1%, 10.1%, and 1.8%, respectively. The prevalence of a disability was 10.1%. The prevalence of COPD and asthma history was 1.8%.

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adults with overlap syndrome, current asthma only, and COPD only were twice as likely as those with neither disease to report health impairments ( $p < 0.05$ ). Compared to those with neither disease, adults with overlap syndrome and COPD were more likely to have co-morbidities ( $p < 0.05$ ). The prevalence of the five co-morbid conditions was highest in overlap syndrome; comparisons with the other groups were significant ( $p < 0.05$ ) only for diabetes, stroke, and arthritis. Conclusions: The BRFSS demonstrates different levels of health impairment among persons with COPD, asthma, overlap syndrome, and those with neither disease. Persons reporting overlap syndrome had the most impairment and highest prevalence of co-morbidities.


Keywords : chronic obstructive pulmonary disease asthma overlap syndrome Behavioral Risk factor Surveillance System health impairment

Abbreviations		
BMI Body mass index	=	
BRFSS Behavioral Risk Factor Surveillance System	=	
CDC Centers for Disease Control and Prevention	=	
COPD Chronic obstructive pulmonary disease	=	
SOB Shortness of breath.	=	

Introduction

Due to the increasing prevalence of asthma, defining the burden of asthma-related health goals and reporting on progress to surpass these goals is more important than pre

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Co-morbidities are common in COPD secondary to the advanced age of the typical patient, adverse health effects of tobacco, and because COPD is a systemic disease affecting multiple organ systems ([21-23](#)). Asthma has been reported to be present in 20-40% of COPD patients ([24-27](#)), and along with cardiovascular disease ([28, 29](#)) are some of the most important co-morbidities in COPD as evidenced by more adverse clinical outcomes than COPD alone ([24-30](#)).

The CDC ([31](#)) and the Institute of Medicine ([32](#)) recently published recommendations to expand COPD surveillance in the United States. The Behavioral Risk Factor Surveillance System (BRFSS) is a general population health survey used to define health behaviors and chronic diseases in U.S. adults and has been used for many years to define the epidemiology of asthma in the United States. As the BRFSS addresses many issues from the patient's perspective, it could provide substantial insight into COPD and relevant co-morbidities. In 2007 and 2009, the North Carolina (NC) COPD Taskforce and the State Center for Health Statistics of NC used the BRFSS to define the burden of COPD and has been reported elsewhere ([33](#)). In this report, data from the NC BRFSS was used to examine characteristics and health-related impairment of persons with COPD, asthma, and concomitant COPD and asthma (overlap syndrome).

## Methods

### Survey

The 2007 and 2009 NC BRFSS questionnaires contained > 90 core health-related questions (including asthma prevalence) as well as the addition of COPD prevalence and impact questions ([Table 1](#)). Using a scripted BRFSS, trained interviewers collected data using an independent random-digit dialed probability sample of households



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Table 1. Questions related to obstructive airways disease: Behavioral Risk Factor Surveillance System (BRFSS): North Carolina, 2007 and 2009

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The BRFSS protocol includes up to 15 phone call attempts to individual respondent's telephone numbers. Response rates are calculated from those who are contacted and complete the survey; cooperation rates are calculated from those who are contacted and agree to do the survey. A detailed description of the survey's design and random sampling procedures is available elsewhere ([34](#)). The response and cooperation rates from eligible households for NC in 2007 and 2009 were 55% and 62%, respectively and 75% and 80%, respectively ([35,36](#)) A cooperation rate less than 65% indicates a problem with interviewing techniques. The BRFSS has been approved as exempt research by the CDC's institutional review board.

### Analysis

Of the 28,054 respondents in the combined surveys, there were 24,073 who had complete information for COPD, asthma history, current asthma, socio-demographic characteristics, cigarette smoking, body mass index, co-morbid conditions, and health-related impairment. Five obstructive airway disease categories were defined by responses to COPD and asthma prevalence questions ([Table 2](#)).

Table 2. Distribution of selected characteristics of the adult study population, aged  $\geq 18$  years: North Carolina, 2007 and 2009



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For respondents reporting having COPD, we also compared between those with and without concomitant asthma, the percentage who agreed that shortness of breath (SOB) affected their quality of life and the percentage who reported having their condition diagnosed with a breathing test. Impaired health for each indicator was defined if the respondent reported  $\geq 14$  days in last 30 days for mental, physical, emotional impairment or use of special medical equipment. Disability was defined if the respondent reported being limited in any way in any activities because of physical, mental, or emotional problems. Body mass index (BMI) was calculated based on self-reported weight and height.

For the statistical analyses, we first examined the distribution of selected characteristics in our study population. The comparison of the age-adjusted prevalence of obstructive airway disease categories among subgroups of the selected characteristics was also assessed. In addition, we also compared the age-adjusted percentage of each health impairment indicator, co-morbid conditions, and cigarette smoking between groups defined by obstructive airway disease category. Finally, we assessed the association of the various obstructive airway disease categories with each health impairment indicator, co-morbid conditions, and cigarette smoking.

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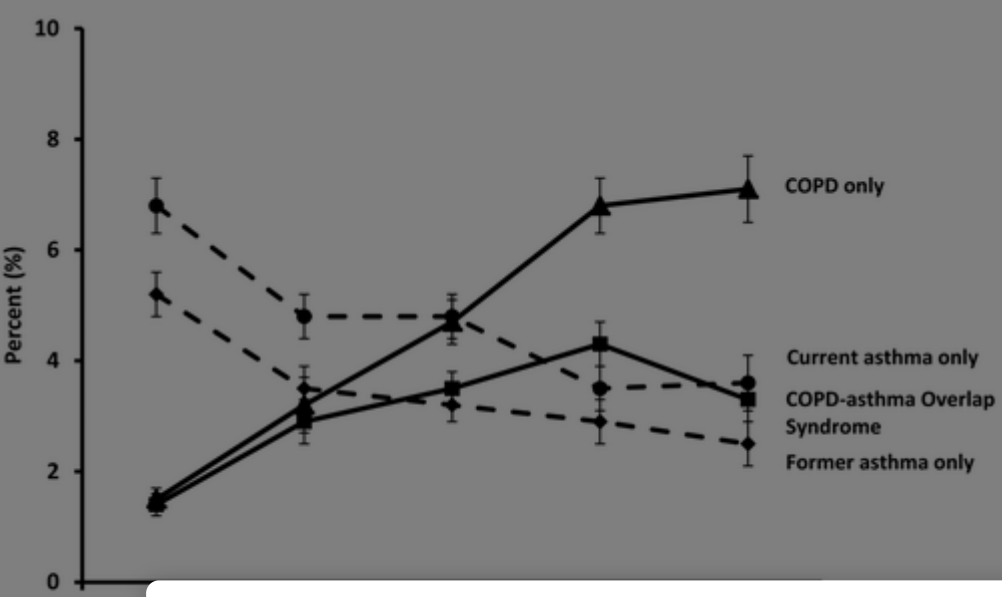
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# Results

Distributions of respondent demographics, healthcare access, health-related impairment indicators, smoking status, BMI, co-morbid conditions, and obstructive airway disease categories are shown in [Table 2](#). Based on 2010 U.S. census data in NC ([37](#)), the 2007 and 2009 NC BRFSS represented an appropriate cross-section of NC adults based on a similar proportion of gender, age, race, and education levels. The overall prevalence of self-reported COPD, current asthma, and ever asthma were 5.6%, 7.6%, and 12.1%, respectively. Notably, among the 1,948 respondents with self-reported COPD, 41.4% reported COPD-asthma overlap syndrome. [Figure 1](#) shows the prevalence of each obstructive airways disease category by age. Those reporting either former asthma or current asthma without concomitant COPD decreased between ages 18–44 and ages 45–54 years ( $p < 0.05$ ), whereas the prevalence of those with COPD only and those with overlap syndrome increased among successive age groups up until ages 65–74 years ( $p < 0.05$ ) where the prevalence appeared to decrease.

Figure 1. Prevalence (%) of selected obstructive airway disease categories among adults aged  $\geq 18$  years, by age groups: North Carolina, 2007 and 2009.



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Table 3. Age-adjusted prevalence of obstructive airway disease categories among adults aged  $\geq 18$  years, by selected characteristics: North Carolina, 2007 and 2009

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Notably, a significantly greater percentage ( $p < 0.05$ ) of a history of cigarette smoking was reported by respondents with COPD only (77.1%; 95% CI = 72.7–81.5%) and with overlap syndrome (71.5%; 95% CI = 65.1–77.9%) compared to those with a former asthma history only (51.8%; 95% CI = 46.3–57.3%), current asthma only (45.7%; 95% CI = 41.1–50.3%), or neither respiratory disease (45.7%; 95% CI = 44.6–46.9%). The prevalence of current smoking was significantly higher ( $p < 0.05$ ) for overlap syndrome (41.4%; 95% CI = 32.7–50.0%) and COPD only (48.9%; 95% CI = 41.1–56.7%)



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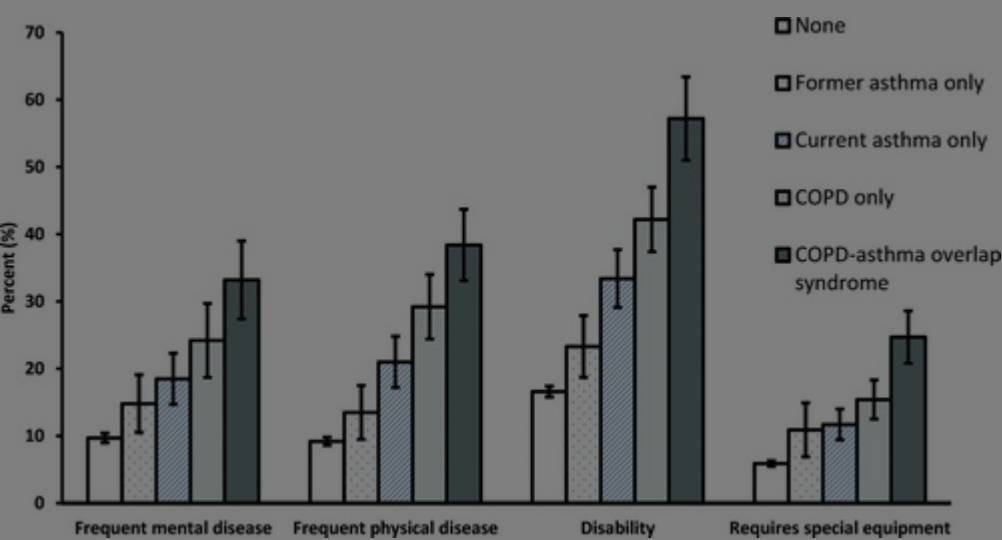
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COPD only also did not differ significantly from those with current asthma only in terms of the four health impairment variables but both of these groups had higher age-adjusted levels of disability than persons with neither obstructive airway disease compared to persons with former asthma or no obstructive airway disease (  $p < 0.05$ ).

Figure 2. Age-adjusted percent (%) of adults aged  $\geq 18$  years reporting frequent mental distress, frequent physical distress, disability, and/or limitations requiring special equipment, by selected obstructive airway disease categories, North Carolina, 2007 and 2009.



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Table 4. Age-adjusted prevalence and adjusted prevalence ratio of selected health impairments and co-morbid conditions among adults aged  $\geq 18$  years, by obstructive airway disease categories: North Carolina, 2007 and 2009

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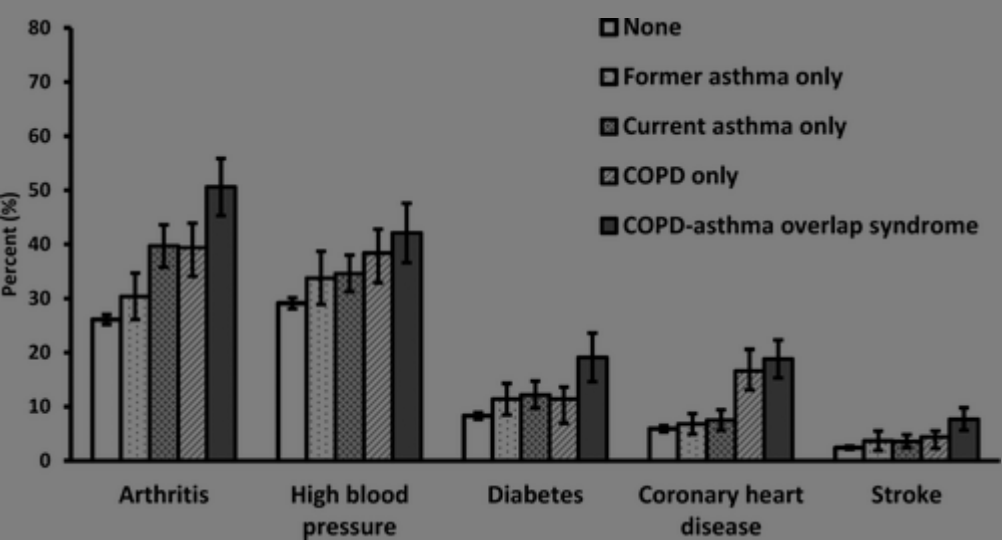
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We examined the age-adjusted prevalence of other co-morbid conditions by obstructive airway disease categories (Table 4 and Figure 3). Persons with overlap syndrome had the highest age-adjusted prevalence of each co-morbid condition but comparisons with all four other obstructive airway groups reached statistical significance ( $p < 0.05$ ) only for diabetes, stroke, and arthritis. Persons with COPD only had a significantly higher age-adjusted prevalence of coronary heart disease than persons with neither obstructive disease or persons in both asthma groups ( $p < 0.05$ ). Compared to persons with neither obstructive disease, those with overlap syndrome and those with COPD were more likely to have coronary heart disease, stroke, arthritis, and high blood pressure after adjustment for other covariates ( $p < 0.05$ ). Compared to persons with no obstructive airway disease, adults with current asthma only were more likely to have diabetes, coronary heart disease, and arthritis ( $p < 0.05$ ).

Figure 3. Age-adjusted percent (%) of adults aged  $\geq 18$  years reporting co-morbidities, by selected obstructive airway disease categories, North Carolina, 2007 and 2009.



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The age-adjusted prevalence of answering affirmatively that SOB affected their quality of life was 79.8% (95% CI = 71.8-84.1%)

than those with neither obstructive airway disease (79.8% vs. 71.8-84.1%)

having a co-morbid condition (79.8% vs. 71.8-84.1%)

(79.8% vs. 71.8-84.1%)

58.0% (95% CI = 51.8-64.1%)

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Using the NC BRFSS, we found that approximately 1 in 7 adults reported having COPD, asthma, or both. Tobacco use was frequent as approximately half of all adults and three-fourths of those with COPD and overlap syndrome reported a history of cigarette use. The prevalence of COPD only and overlap syndrome increased with advancing age, declined with educational attainment, were higher among persons who currently smoked, and were higher among those with coronary heart disease, arthritis, and high blood pressure. The age-adjusted prevalence of overlap syndrome was also significantly higher among persons with stroke, obesity, and/or diabetes. We found that disability, health impairment, and co-morbid conditions were common in adults with COPD or current asthma and were most pronounced in persons with overlap syndrome.

The BRFSS, an annual telephone health survey coordinated by the CDC and conducted by each state, has been used to help define the epidemiology of key chronic diseases in the US including asthma. It is a unique COPD surveillance tool because of the following: (1) a large number of adults are surveyed (nationally ~ 450,000); (2) it includes a wide range of demographic and health-related questions; (3) survey results are from the patient's perspective, and (4) the survey is state-based. We incorporated a COPD prevalence question and impact module into the 2007 and 2009 NC BRFSS to help define the burden of COPD in NC. The overall age-adjusted prevalence of self-reported COPD (5.6%) and ever asthma (12.1%) are consistent with most other studies in the general US adult population (1, 5, 38). These prevalence rates principally reflect persons with diagnosed COPD and/or asthma because of the survey questions' wording ("Have you ever been told by a doctor...?") and the high proportion of persons reporting diagnostic breathing tests (66% with COPD only and 80% with overlap syndrome), thus underestimates the true prevalence of disease.

In 2011, the prevalence question and COPD module was adopted into all states' BRFSS, and the overall prevalence of COPD was reported to be 6.1% in the United States

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21.4%, 48.9%, 41.4% of persons with current asthma alone, COPD alone, and overlap syndrome, respectively, continued to smoke cigarettes despite relatively poor quality of life. Based on the 2009 NC BRFSS, adults with less than a high school education had 3 times higher rates of tobacco use than those with a college education ([49](#)). Consistent with our study, others have reported that lower socioeconomic status is associated with higher COPD prevalence ([50-52](#)).

A previous BRFSS study reported current smoking history was an important risk factor for poorly controlled asthma ([53](#)). Tobacco use in asthma patients is known to lead to the development of chronic airflow obstruction but asthma has been found to be a significant risk factor for the subsequent development of COPD, even after adjusting for smoking history ([54](#)). Tobacco cessation and other targeted strategies are imperative, especially in high-risk groups.

Few studies have compared health impairment between persons with and without COPD in population-based samples ([15](#), [47](#)). In a population based study, strong inverse associations were found between physical and mental quality of life and the number of respiratory symptoms as well as with presence of COPD or impaired lung function ([15](#)). A population based study in Spain reported that 17.4% of COPD patients had concomitant asthma, and these patients had worse respiratory-specific quality of life than COPD alone ([47](#)).

Our study shows general measures of impaired health were worse in persons with COPD alone compared to persons with neither COPD nor asthma; and was most evident in overlap syndrome. Specific to obstructive lung disease, the measure of SOB was significantly worse in overlap syndrome than COPD alone. In the North Carolina BRFSS, half of persons with COPD and three-fourths of those with overlap syndrome reported that SOB affected their quality of life. One study suggested that respiratory symptoms were a better predictor of functional health status than quality of life in the Chronic Lung Initiative for

Chronic SOB appears to be a risk factor for COPD or overlap syndrome. Regarding to COPD or overlap syndrome, any history of COPD or overlap syndrome and COPD

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utilization than those with COPD only ([30](#), [55](#), [56](#)). In the COPDGene study, COPD + asthma patients had greater health impairment than COPD alone based on the St George's Respiratory Questionnaire ([30](#)). We previously reported that persons from the 2007 survey with concomitant asthma and COPD were more frequent utilizers of healthcare based on emergency department/hospital visits or prednisone use ([57](#)).

The label of concomitant disease could occur for a variety of the following reasons including: 1) asthmatics who are long-term smokers, 2) patients who have both diseases as defined by clinical and other information, exclusive of tobacco use, such as severe long-term asthma, 3) patients who are frequent healthcare utilizers may be more likely to get multiple diagnoses by multiple providers, and/or 4) persons with both diseases who may reflect a COPD or asthma phenotype and who has wheezing and/or chronic productive cough.

In conclusion, BRFSS data provides significant insight into COPD, asthma, and the overlap syndrome. There were clear differences among these conditions with regards to age, gender, race, education level, and tobacco history. Compared to persons with no COPD nor asthma, persons with asthma or COPD had a greater prevalence of co-morbid conditions and more adverse health impairment as defined by mental distress, physical distress, disability, and use of special equipment. Persons with overlap syndrome were also more likely to report that SOB affected their quality of life, as compared to COPD alone. Clearly, clinical studies of obstructive lung diseases in adults should include patients with overlap syndrome. With the incorporation of the COPD prevalence question into every state's BRFSS (2011-2013), significant insight can be gained into patient characteristics and the burden of these diseases at national and state levels.

## Declaration of Interests Statement

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No funding was associated with the conduct of this survey/study. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

All authors were involved in the development, conduct, and interpretation of study methods and manuscript development. The authors alone are responsible for the content and writing of the paper.

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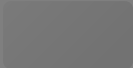

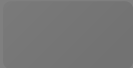

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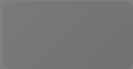

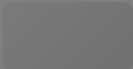
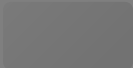
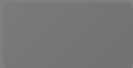
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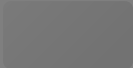

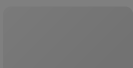
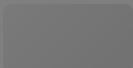

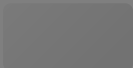


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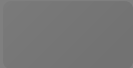




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