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ORIGINAL RESEARCH

Chronic Obstructive Pulmonary Disease and Asthma–Patient Characteristics and Health Impairment

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Backgro nd/or asthma have gre nce data to estimate ndrome) on healt sk Factor Surv PD and asthma sthma, former a spondents. Associat al disability, use of sp ies (diabete) were assesse hma history.

were 5.6% and 7.6%, respectively; 2.4% reported both. In multivariable analyses, 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 Ce		
COPD C		
SOB Sh		

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than predicted (4). In addition to the impact of COPD on healthcare costs and mortality, it is a leading cause of disability (5–20).

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).

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the remainder of the sample to three regions of the state: the Western, Piedmont and Eastern regions.

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.

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syndrome was defined if the respondent answered affirmatively to both COPD and asthma questions. The age-adjusted prevalence (standardized to 2000 U.S. census population) of the five obstructive airway disease categories were similar between 2007 and 2009 (using pair-wise linear contrast t-test, $p > 0.05$); thus, data from the two survey years were combined.

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 ≥ 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.

Respondents were also asked a series of questions (Table 1) about whether they had ever been told by a health professional that they had diabetes, stroke, coronary heart disease (myocardial infarction, heart attack, coronary heart disease, or angina), high blood pressure, or arthritis (arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia). Women who reported high blood pressure or diabetes only during pregnancy and persons borderline diabetes itions.

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SUDAAN (version 10, Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design. The statistical significance level is denoted at 0.05.

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.

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blood pressure than in adults without those respective conditions, and was higher either in current smokers or former smokers compared to never smokers ($p < 0.05$).

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

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The age-adjusted prevalence of overlap syndrome was significantly higher in persons with obesity, coronary heart disease, stroke, diabetes, arthritis, or high blood pressure than persons without the respective co-morbid condition ($p < 0.05$); in current smokers and former smokers than never smokers ($p < 0.05$); and decreased with increasing educational level ($p < 0.05$). Health care coverage and time since last routine doctor visit were not associated with any of the obstructive airway disease categories.

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 = 46.2–57.3%), current asthma only (45.7%; 95% CI = 41. .9%). The prevaler p syndrome (41.4%; %) compare 4–21.4%), but was 1.8%; 95% CI = 18. 0.3%).

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Figure 2. Age-adjusted percent (%) of adults aged ≥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 ≥18 years, by obstructive airway disease categories: North Carolina, 2007 and 2009

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In multivariable analyses, persons with either overlap syndrome or COPD only had twice th disability, and a re y disease (p < 0.05). o have frequent re special equipme analyses. Compare ory of asthma

We e y obstructive airway rome had the high arisons with all four c < 0.05) only for diabe y higher age-adju er obstruct d to persons

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 ≥18 years reporting co-morbidities, by selected obstructive airway disease categories, North Carolina, 2007 and 2009.

Figure 3. Age-adjusted percent (%) of adults aged ≥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 higher among those with overlap syndrome (75.9%; 95% CI = 67.8–84.1%) than those with COPD only (56.6%; 95% CI = 49.3–63.9) ($p < 0.05$). The prevalence of having a breathing test was not statistically different in persons with overlap syndrome (79.8%; 95% CI = 70.5–89.1%) compared to those with COPD only (65.7%; 95% CI = 58.0–73.4%).

Discus

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The BRF conducted by each c diseases in the US i ne following:

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 (range 3.1–9.9%) and 6.9% in North Carolina (39). Changes in respondent selection, expansion of sample selection to cellular telephone respondents, and changes in statistical weighting in 2011 likely explain the higher prevalence of COPD in 2011 than that reported in 2007 and 2009, particularly with regards to the prevalence of COPD in females.

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COPDGene study reported that persons with concurrent asthma and COPD were predominantly Black females (30). Thus, it appears that a significant portion of females in the COPD population may have overlap syndrome, especially among those that have a smoking history; this may be a contributing factor to the rising prevalence and impact of COPD in women. The overlap syndrome was associated with obesity, consistent with others that have reported associations of asthma with obesity (12, 42). The relationship between obesity, airway obstruction and restriction, as well as obstructive sleep apnea is complex and requires further investigation (43).

As seen in other studies (44–48), our state-based epidemiological data demonstrates that co-morbidities are common in COPD, in particular cardiovascular disease, diabetes, stroke and arthritis. This difference was more evident in those with overlap syndrome. Patients with overlap syndrome in the COPDGene study were more likely to be frequent healthcare utilizers and had a greater degree of air trapping than those with COPD alone (30). A recent study in Spain reported that multiple co-morbidities, based on a higher Charlson co-morbidity index, were more frequent in those with overlap syndrome versus those with COPD alone (47). In that study, when considering individual co-morbidities, only diabetes mellitus was more common in the overlap syndrome group.

Socioeconomics appeared to play an important role in the likelihood of tobacco use and thus dev tudy, 21.4%, 4 nd overlap syndrom or quality of life. Bas ation had 3 times hi Consistent with our ociated with higher C

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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 poor health-related quality of life than Global Initiative for Chronic Obstructive Lung Disease stage (14), thus our question regarding SOB appears to be a reasonable measure of health impairment in COPD. However, with regards to SOB, we were unable to compare persons with asthma alone to those with COPD or overlap syndrome, as this question was only asked of respondents who had any history of COPD.

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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

The authors report the following: RAP: Speaker for Astra Zeneca, Boehringer Ingelheim, Novartis, Pfizer: JOA: Advisory Board for Astra Zeneca and Glaxo Smith Kline; JBC: No conflicts of interest; YL: No conflicts of interest; MK: Research Grants: National Institutes of Health, Genentech, GlaxoSmithKline, Merck, Asthmatx (Boston Scientific), Eumedics, and Novartis. Stipend from American thoracic Society for leadership role; IFD: Consulta is, Mylan, and Sun

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